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AND INDIAN STATES.

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Despatch-33-

[Despatch Abstract.]

TINNEVELLY. - QUILON RAILWAY SURVEY

Communicating to the Resident in Travancore and Cochin, for early action, Proceedings, Public Works Department, Railway Branch, forwarding, for the consideration of the Travancore Government, plans and estimates in connection with the -- .

FURTHER PAPERS				
No.	Department.	Date.	G.O.	No.

TINNEVELLY-QUILON RAILWAY.

REPORT

ON THE

PROJECT FOR ITS CONSTRUCTION.

SURVEY

OF

1895.

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TINNEVELLY-QUILON RAILWAY.

Survey of 1895.

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COOROOK,

September 1895.

E. I. SHADBOLT,

Engineer-in-Chief,

Tinnevely-Quilon Railway Survey.

TINNEVELLY-QUILON RAILWAY.

REPORT

ON THE

PROJECT FOR ITS CONSTRUCTION.

SURVEY OF 1895.

Preliminary.

The Tinnevely-Quilon Railway Survey is a project for a railway to connect Tinnevely, the terminus of the South Indian Railway and the most southerly railway station in India, with Quilon, a port on the west coast. Quilon is one of the principal towns in the State of Travancore and is also a Military Cantonment where a regiment of Madras Native Infantry is maintained. It is situated 44 miles north of Trivandram the seat of the Travancore Government.

Such a line would bring the State of Travancore into connection with the general railway system of India and would also form an essential part of any scheme for the development of the port of Quilon. At present there is only an open roadstead, and shipping operations cannot be carried on during the four or five months of the south-west monsoon, but the natural features at Quilon are more favourable than at any other spot in the Travancore coast for the development of a harbour. The construction of a breakwater would not be difficult and efficient protection for shipping might be secured at a moderate cost.

An estimate of the cost of making a detailed Survey for a line from Tinnevely to Quilon and of preparing the drawings and estimates in connection with it was called for in letter, No. 775, R. C., dated 18th August 1894, from the Government of India, P. W. D., to the Government of Madras, P. W. D., Railway Branch. The estimate having been furnished and approved, orders to carry out the Survey were issued by the Consulting Engineer for Railways, Madras, in his letter, No. 3503, dated 8th November 1895, addressed to the Engineer-in-Chief, Bezvada-Madras Railway Survey.

The question of introducing a railway into Travancore appears to have been first brought forward in 1873 when a communication on the subject was sent to the durbar by the Madras Government. In 1876 His Highness the Maharaja of Travancore made a visit to Calcutta and on his return he discussed the matter with Mr. Barton, the Chief Engineer of the State, who drew up a preliminary memorandum (No. 963, dated 3rd March 1876) afterwards corrected and amplified in his No. 4636, dated 26th October 1876. The conclusion he arrives at is that the junction with the South Indian Railway should be at Koilpati (40 miles north of Tinnevely), that the line should enter Travancore by the Ariankavu Pass and run thence to Trivandram, and that there should be a branch to Quilon. At this time proposals were already being put forward by the South Indian Railway for an extension of their line into Travancore, but it was not until 1881 that any definite steps were taken for making a systematic examination of the country. After this period the history of the case is fully recorded in the correspondence laid before the Government of Madras and the various General Orders issued on the subject from time to time.

Before giving a summary of these it is necessary to describe certain peculiarities of the locality which have given rise to considerable difference of opinion as to the best method of attaining the end in view.

Object of railway.

Orders of Government.

Previous reports and records.

Mr. Barton, 1876.

Travancore is long and narrow in shape, its length being in a north and south direction and its width varying from 20 to 60 miles. It may be looked upon as naturally divided lengthways into two portions of entirely different character the western half consisting of comparatively low land extending from 10 to 40 miles inland from the coast and the eastern portion comprising a chain of rocky mountains rising in some cases to an altitude of nearly 7,000 feet and offering a formidable barrier to communication with the level districts of Tinnevely and Madura which lie to the east. These mountains belong to the range of the Western Ghats which extend from the north of India to Cape Comorin. In the southern portion there are two practicable passes through which roads have been constructed to connect Travancore with the Tinnevely District, namely, the Aramboli Pass lying about 13 miles and the Ariankavu Pass about 70 miles north of Cape Comorin. A line joining these two passes would therefore be 57 miles long. The towns of Tinnevely and Trivandram are situated on opposite sides of this line in such a position that a line joining them would form the diagonal of a roughly square figure and a line joining the two passes would form the other diagonal. The towns would be at opposite corners of the square east and west and the passes at opposite corners north and south.

A railway connecting Tinnevely with Trivandram would therefore roughly speaking take the form of two sides of a square whichever of the two possible routes might be adopted. In the Northern route the Ariankavu Pass, and in the Southern route the Aramboli Pass, would form the apex. The port of Quilon is 41 miles north of Trivandram and lies nearly due west of the Ariankavu Pass.

It is necessary to have a clear idea of the relative positions of these five places, namely, the two passes and the towns of Tinnevely, Trivandram and Quilon, in order to understand the points that have been raised and the different views that have been urged in connection with the general question of introducing a railway into Travancore.

As stated above various papers and correspondence connected with the question have, since 1881, been submitted to Government and have been, from time to time, the subject of departmental General Orders. Without making any detailed extracts or quotations from these, a brief summary of their general purport will now be given.

The southern route from Tinnevely via Aramboli to Trivandram was advocated by Sir Mahdava Rao when Dewan of the State in his memorandum, dated 5th March 1881; and the northern route via Ariankavu to Trivandram and Quilon by his successor the Hon. V. Ramiengar. The balance of opinion appearing to be in favour of the northern route its survey alone was recommended by the South Indian Railway and a sum of Rs. 12,000 was sanctioned by the Government of India for the purpose. Towards the end of 1881 the Chief Engineer of the South Indian Railway began work and by the end of April 1882 a preliminary trial survey and section had been made from Tinnevely to the Ariankavu summit, about 56 miles, and from Quilon to Yarrur, about 30 miles, leaving an unsurveyed gap of about 20 miles in the middle. This gap occurs on the western slope of the mountains in a country covered with dense jungle where severe fever prevails from April to June. In the meantime Mr. Logan had travelled over the country to Trivandram and thence onward to Aramboli and Tinnevely and had become enamoured of the southern route. As the country west of Ariankavu was too unhealthy after April to allow of the continuance of work he decided to move his surveyors to the south and make a rapid traverse of the Aramboli route in order to get sufficient information to make a comparative estimate of the cost of the two lines.

In January 1883 Mr. Logan sent in his report together with estimates and measurements. Parts of the line were still unsurveyed, but estimates for these portions were based on the figures obtained in what were considered to be similar sections of country elsewhere. A summary comparing the length and cost of the two schemes gives the following result.

General
Orders of
Government.

G. O., 368, B.,
6th June 1882.

G. O., 163,
R., 23rd
February
1883.

Northern Route.

	Miles.	Cost.
Tinnevely to Quilon	103	Rs. 80,81,346
Yarur to Trivandram	35	25,69,627
	138	1,06,50,973

Southern Route.

Tinnevely to Trivandram	89	58,57,493
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Difference in favour of Southern Route.

	49	47,93,480
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The general conditions of the country are described and an estimate of probable traffic is given very much in favour of the Southern Route.

The Consulting Engineer for Railways, in reviewing the papers notes that wherever communication exists between Quilon and Trivandram and a fair comparison of the two schemes must therefore omit the Yarur-Trivandram branch and appear in the form below.

Northern Route.

	Miles.	Cost.
Tinnevely to Quilon...	103	Rs. 80,81,346

Southern Route.

Tinnevely to Trivandram	89	58,57,493
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Taking into consideration the character of the work, the gradients, and the traffic prospects, he considers that the southern route presents the greatest advantages. The Order of Government is that the papers be submitted to His Highness the Maharaja of Travancore for opinion.

The reply of the Travancore Government is to the following effect:—

- I. It is desired that the South Indian Railway shall be extended into Travancore.
- II. The Northern Route is preferred.
- III. It would be best that the line should be constructed by private enterprise.

In a memorandum, dated 13th August 1883, the Hon. V. Ramiengar, Dewan of Travancore, enters very minutely into the relative advantages of the two routes. He shows that the trade of South Travancore is of a local nature, that Trivandram is not important commercially but only as the seat of Government and that in fact all the principal commerce of the country is carried on in North Travancore and its development would be best served by a line to Quilon. He states that Quilon is undoubtedly the proper objective of a railway and not Trivandram and that this point has been lost sight of by the authorities of the South Indian Railway.

After a perusal of the papers the Order of Government is that the Northern Route is approved and that the Directors of the South Indian Railway will be asked whether they are prepared to take action with a view of constructing the proposed extension.

G. O., 1013,
22nd Sep-
tember 1883.

G. O. 1253.
R. 6th Dec-
ember 1883.

It having appeared that the authorities of the South Indian Railway were willing to take up the scheme an opinion was expressed by Government that work on the unsurveyed gap between Ariankavu and Yarrur should be completed and that an endeavour should be made to lay out a line through the hills with a ruling gradient not steeper than 1 in 70.

G. O. 734, R.
20th July
1884.

The field work was entrusted to Mr. Spalding assisted by Mr. Ellis and by July 1884 Mr. Logan and his staff had finished the hitherto unsurveyed portion, revised the previous surveys and sections, and recast the estimates for the whole length from Tinnevely to Quilon. It was found impracticable to avoid gradients of 1 in 60 in one or two places and the length and cost of the line were now found to work out as below.

	Miles.	Cost. Rs.
Tinnevely to Quilon...	106	99,55,313

The papers having been submitted to Government it was ordered that they should be forwarded to H. H. the Maharaja of Travancore.

G. O. 486, R.
17th June
1885.

When the Travancore Government received these papers they were handed over by the Dewan to Mr. Horsley, the Acting Chief Engineer of the State, who requested Mr. Valentine, the Executive Engineer of the Quilon Division, to thoroughly explore the country between Shenkotta and Quilon. This was done in the early part of 1885 and Mr. Valentine's local knowledge of the hills and jungles proved of great service. He found that by making the tunnel at the Ariankavu summit at a lower level than that proposed in the South Indian Railway project (and consequently increasing its length), he would be able to lay out a line through the hills with a ruling gradient of 1 in 100. With regard to the alignment down the western face of the hills it should be noted that Mr. Logan's line was laid out specially with a view of reaching Trivandram and consequently turned southward as soon as the nature of the country allowed of its doing so, the section from Ayur to Quilon being merely a branch in the best available position under the circumstances. Mr. Valentine's object, however, was to find the best direct line to Quilon on its own merits and without any reference to Trivandram. Up to Camp Gorge (about 10 miles west of the summit) only one valley is practicable and any difference would merely be in details of location. From this point outwards, however, Mr. Logan's line tends southward following the river, while Mr. Valentine's line continues in a westerly direction.

In working out his estimates on similar lines to those followed by the South Indian Railway he obtains the following result:—

Northern Route with Mr. Valentine's Revision.

	Miles.	Cost. Rs.
Tinnevely to Quilon...	106	94,38,921

Part of the saving in cost over the South Indian Railway estimate is however due to proposed economies which would apply equally to both lines.

In returning the papers to Government the Dewan goes into all points affecting the question and again emphasizes the opinion that as Trivandram is neither a port nor a

Quilon must certainly be the objective point of any railway extension into Travancore.

In December 1885 the papers referring to Mr. Valentine's route with his revised estimates were sent to the Agent, South Indian Railway, for remark. He replied in a paper of considerable length almost entirely devoted to a re-statement of the arguments in favour of the Southern Route. Even if it is admitted that Quilon must be the objective, he considers that the Southern Route to Trivandram and thence onward to Quilon would still have the

advantage both in first cost and in traffic prospects. He makes a slight further revision in the estimate as amended by Mr. Valentine and shows that the comparison would now stand as below:—

Northern Route.

	Miles.	Cost. Rs.
Tinnevely to Quilon ...	106	93,15,623

Southern Route.

Tinnevely to Trivandram ...	89	56,70,138
Trivandram to Quilon ...	44	31,58,578
	133	88,28,716

The Consulting Engineer for Railways, in submitting the papers to Government, remarks that the facts and figures appear to be in favour of Mr. Logan, but the whole weight of Travancore official opinion is against him.

The order of Government is that the route must be decided by the Travancore Government, and whichever route H. H. the Maharaja may select the Government of Madras will recommend to the Government of India that the portion in British territory shall be constructed concurrently with the portion lying in Travancore.

The whole case as brought up to date being now sent to the Travancore Government an exhaustive memorandum, dated 26th October 1886, was drawn up by the Hon. V. Ramiengar the Dewan. He considers the case under three aspects—

- (1) From an engineering point of view.
- (2) As to probable traffic.
- (3) As to first cost.

All these matters are very fully dealt with, and the arguments advanced by Mr. Logan are discussed point by point. The final opinion arrived at is that Quilon must be the terminus and that the route should be by the Tambraparni valley (in the Tinnevely District) and thence by Shenkotta and Ponalur. This is equivalent to Mr. Logan's location from Tinnevely to the summit of the Ariankavu Pass and Mr. Valentine's route thence to Quilon.

When matters had arrived at this stage the case was forwarded by the Government of India to the Secretary of State who, in communicating with the Directors of the South Indian Railway, expressed a preference for the Southern Route and a hope that the Travancore Government might yet be convinced of its superior advantages. After this the Managing Director writes that his board has taken steps to again lay the matter before the Travancore Government to ask for a definite decision as to the route and also how far that Government would assist in raising capital for the undertaking.

About this time the Government of Madras appears to have pointed out that hitherto only a rough preliminary survey had been made and that a detailed survey and final location would be necessary to allow of the preparation of accurate estimates of the probable cost of construction to serve as a basis for arranging definitely as to the amount of capital required.

In February 1887 the Agent of the South Indian Railway communicated with the Dewan asking to what extent his Government would assist in raising capital. He also (with a persistence worthy of Mr. Dick on the subject of the head of Charles the first) took the opportunity of re-iterating a few of the arguments in favour of the Southern Route.

A new Dewan (Mr. T. Rama Rao) having now arrived on the scene and having, before giving his reply, made certain enquiries from the Resident of Travancore that officer drew his attention to G. O., No. 486 of 17th June 1886, pointing out that "it is left to the Travancore Government to decide which route should be finally adopted" whereupon the Dewan repeated the opinion already expressed by his predecessor that the Travancore Government approved of the line via Ariankavu to Quilon.

The case now came up again for review and as all the points under discussion appear to have been practically settled the Government of Madras contented itself by announcing that "the financial exigencies of the State render it no longer doubtful that the portion of the projected line lying within British territory must be carried out, if at all, by private enterprise." It will be remembered that hopes were at first held out that this portion might be constructed directly by Government, while the Travancore State should undertake or at least assist in the construction of the portion within its boundaries. It was now clear that the whole scheme must depend on private enterprise with such assistance as the Travancore State might be willing to afford.

G.O. 1148, E.,
23rd October
1889.

It would appear that no definite scheme followed on the negotiations which had been so long pending with the South Indian Railway and the whole question remained in abeyance for some time. In 1889, a proposal was made on behalf of a private firm in London to finance, construct, and work the railway in return for certain concessions and guarantees to be made by the Travancore State. The matter was referred by the Government of Madras to the Secretary of State for enquiry into the position and standing of the applicants.

G.O. 1343, E.,
9th September
1890.

Enquiries having been made as to the wishes of the Travancore Government on the subject the Dewan replied in a letter, dated 22nd October 1889.

Considered with reference to previous correspondence the contents of this letter mark what may be described as a decidedly new departure. It is stated that the construction of the railway would in effect involve the provision of 7 or 8 lakhs of rupees from the revenues of the country for a period of from 20, to 25 years, thus reducing the grant for Public Works, and retarding improvements in the administration and the development of the country. On the other hand, the Government of H. H. the Maharaja have under consideration a scheme for the construction, at a cost of 10 lakhs, of a light railway from Trivandram to Aramboli. If this is found to pay the South Indian Railway might be disposed to extend their railway to meet it at the frontier at Aramboli. "Should this arrangement commend itself to His Excellency the Governor in Council His Highness' Government would wish to defer the consideration of the proposals made for the construction of the Ariankavu line."

On receipt of this document the Government of Madras appear to have pointed out that an isolated piece of tramway from Trivandram to nowhere in particular cannot be considered as an alternative to the project for a railway. "The question is whether or not the Travancore Government desire that the country shall be connected with the railway system of India and are prepared to incur sacrifices and liabilities to secure this object."

The correspondence relating to the concessions extended over about a year and, for reasons that do not appear, they were finally refused in September 1890. Not long after this it would seem that the desirability of constructing the line by the agency of their own officers again occupied the attention of Government. The question however slumbered for a year or two more until, at the end of 1894, the scheme was included in the list of Surveys to be taken in hand during the ensuing season.

Orders for carrying out this Survey were issued shortly before the completion of the office work of the Bezvada-Madras Railway Survey of 1894 the intention being that the same engineers should be employed on the work.

Present
Survey.

The length of the line being 103 miles and part of it being ghat work through the hills, it appeared that it would be suitable to form two Divisions. As explained above the mountainous portion is situated in the middle and the more open country on each side. It was, therefore, arranged that the centre portion should form one Division while the other should comprise the two separate sections on each side. It was known that on the Ghat Division there would be difficult work involving special methods of investigation and that operations might be impeded by sickness due to the unhealthiness of the jungles. It was therefore determined that the staff employed should be sufficiently strong to complete it in a single season if this could possibly be done. It was settled in the first instance that the Division should begin at Shenkotta (mile 45) and extend to Ponalur (mile 76) with the understanding that towards the end of the season it might be increased or diminished according to the progress made, the length of the other Division being correspondingly altered. The latter was called the "First Division" not a very appropriate name as matters turned out.

In the end the limits of the Divisions were arranged as follows:—

	Miles
<i>First Division, Eastern Section.</i> —	
Tinnevely (mile 0) to Shenkotta (mile 45)	45
<i>Ghat Division.</i> —	
Shenkotta (mile 45) Kotarakara (mile 88)	43
<i>First Division, Western Section.</i> —	
Kotarakara (mile 88) to Quilon (mile 103)	15
Total...	103

The following officers were employed on the Survey:—

Engineer-in-Chief.—

Mr. E. I. SHADBOLT.

Ghat Division.—

Mr. T. MICHELL, *Executive Engineer.*

Mr. C. H. BOND, *Temporary Assistant Engineer.*

Two permanent and one temporary subordinates.

First Division.—

Mr. H. J. ODDIE, *Executive Engineer.*

Mr. O. S. BARROW, *Temporary Assistant Engineer.*

One permanent and two temporary subordinates.

The tents and instruments used on the Bezvada-Madras Railway Survey were at once available and field-work was begun in December 1894 and finished in April 1895. The staff then moved to Coonoor to prepare drawings and estimates and to complete the project.

The country to be traversed by the railway may be divided, according to its natural features, into three distinct parts.

On the east is the plain of the Tinnevely District which is part of the great plain sloping gently from the mountains on the west to the sea on the east that extends over the whole of the peninsular portion of India.

The middle section comprises the mountains of the Western Ghats which, on their eastern side, rise abruptly from the plain. On the western face the hills are more broken and extended until they gradually die out in the comparatively low-lying lands of Travancore.

This, the western section, is a country that is nowhere level but consists of rolling hills and ridges attaining an elevation of one or two hundred feet running together and

Description of
country
traversed.

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interlacing in all directions and including between them narrow winding valleys of complex shapes. Near the coast they become reduced in size to mere undulations, but there is very little flat land even up to the water's edge.

Tinnevely is the most southerly railway station in India being only 45 miles north of Cape Comorin. The total width of the peninsula at this latitude is about 90 miles, the east coast being distant 30 miles and the west coast 60 miles. The ports of Tuticorin on the east and Quilon on the west both lie a little north of Tinnevely, the distance to the former by the South Indian Railway being 36 miles and to the latter by the route of the present survey 103 miles.

The important town of Shenkotta, just within the Travancore frontier, lies at the foot of the road leading up to the Ariankavu Pass and may be considered an obligatory point on the railway. A straight line joining Tinnevely with Shenkotta would have a north-westerly direction, would be 38 miles long, and at the 34th mile would pass through Tenkasi, a large Taluq town in British territory. This may also therefore be taken as an obligatory point.

The direct road from Tinnevely to Tenkasi practically coincides with this straight line but the country traversed by it is of inferior dry red soil with occasional outcrops of quartzite rock and there is not a village of any importance. Much of the land is barren waste and the crops produced on the rest are generally scanty and precarious.

The town of Tinnevely is situated on the Tambraparni River the different tributary streams of which emerge from the hills at various points south of Shenkotta and Tenkasi flowing in an easterly direction. Along the north side of this river and at no great distance from it is a second road leading out of Tinnevely which, after running nearly due west for 20 miles or so leaves the vicinity of the river and turns northward till it joins the first road just before it enters Tenkasi.

At the 10th mile from Tinnevely on this second road a branch turns due south, crosses the river near Shermadevi and then follows the south bank of the river to Kaladakurchi 19 miles from Tinnevely where it bends sharply to the north, recrosses the river and joins the second or north bank road 15 miles south of Tenkasi.

It will thus be seen that there are three routes from Tinnevely to Tenkasi; the direct road which is practically straight, the Tambraparni north bank road which is in the form of two sides of a triangle of which the first is the base, and the south bank road which forms a loop outside the triangle.

The Tambraparni runs in a well-defined channel, and in flood time forms a stream seven or eight hundred feet across and some twenty feet deep. On either side is a narrow belt of rich alluvial land, the whole being little more than a mile in average width, and the waters of the river are extensively utilized by means of a very complete system of irrigation. On taking a birdseye view of the locality from one of the high peaks of the mountains a narrow green winding ribbon, with a silver thread in its centre, represents the Tambraparni with its irrigated land. The river valley produces every year two rich harvests of the finest quality of rice and these crops are reckoned a certainty and never known to fail. Near to the south bank, at frequent intervals, are large populous villages with substantial tiled houses amidst which stand conspicuously out the picturesque forms of numerous temples and pagodas. The inhabitants along this line of country are a prosperous and enterprising population—cultivators, merchants, weavers; and the principal villages and towns contain a large number of wealthy Brahmin landholders to whose energy and intelligence their prosperity is mainly due.

The location selected for the railway follows generally the third or most southerly of the three roads described above. For a mile or two out of Tinnevely it runs through

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irrigated land and is then taken on to higher ground to the north up to the tenth mile. At this point it is desired to cross to the south side of the river and, as the land of the irrigated belt is of very high value, it is crossed nearly at right angles so as to take up as little of it as possible, a sharp turn being made both on entering and leaving it. From Shermadevi (mile 12) it runs generally parallel to the river and, as far as practicable, along the edge of the irrigated land. This is, however, somewhat irregular and broken up by isolated rocks and hillocks which occasionally necessitate minor deviations. In addition to this the villages where stations are required are often surrounded by rice fields, but the principle that has been adhered to in laying out this portion of the line has been to keep close to the strip of cultivation but to cut it up as little as possible as the cost of the land will in some cases amount to nearly two thousand rupees per acre.

At Kaladakurchi (mile 19) the railway bears northward and re-crosses the river running not many miles from the foot of the mountain range. From this point onwards the ground is undulating and broken, but a large proportion is under cultivation wet or dry, the water for the former being derived from tanks fed by the numerous streams that emerge from the hills. After passing Kadyam (mile 31) rocky mounds and hillocks become more frequent and the line has to wind about amongst them until it reaches Tenkasi (mile 42). From here to Shenkotta (mile 45) the country is more open and level, and there is good soil irrigated from a continuous series of tanks.

Shenkotta is a town within the Travancore boundary situated on the western edge of the plain. The mountains that overlook it are lofty, precipitous and rocky, bare in many places, but having a moderately thick covering of jungle on the lower slopes and in the ravines and valleys. There are many spurs that run out for a mile or two decreasing in size until they are succeeded by isolated hills and rocky masses which, in this locality may be said to die out near Shenkotta.

The average height of these mountains is not less than three or four thousand feet and at least one peak reaches seven thousand, but there are passes and saddles between them at a much lower level over which are practicable tracks and pathways. The summit of the Ariankavu Pass has an elevation of only 1,140 feet and through this gap a metalled road has been constructed. As already indicated the eastern face of the range is generally abrupt and precipitous, but the lower slopes and the spurs that project towards Shenkotta have a form and contour that allow of the location of a fairly good approach on a limiting gradient of 1 in 80. From the summit of the Pass a view is obtained of the plain with its prevailing tint of dull red stretching out as far as the eye can see till merged in the blue haze of the far distance.

Turning to the west the road begins to descend through a narrow valley flanked on either side by rocky hills the tops of which, sometimes precipitous and sometimes assuming the form of black rounded masses rise out of a thick covering of dense and luxuriant jungle, the growth and character of which indicate that totally different conditions of rainfall and climate prevail on the hills as compared with the plain on the east. At one period a good deal of clearing took place for the cultivation of coffee which does not seem to have been very successful. Some of these clearings have relapsed into jungle but many have been turned to account for growing plantains (uncommonly poor ones) and the bright green patches are conspicuous on the hill sides amidst the dark foliage of the jungle. Coffee seems to have failed not from unsuitable climatic conditions, but on account of the same pests and diseases which nearly ruined the plantations in Ceylon twenty years ago. On some estates Tea, Liberian Coffee and other products have been substituted and though the planting industry does not appear to be very vigorously flourishing, it is by no means dead and the blackened areas of recent clearings indicate that it is even extending.

The sides of the valley are broken by spurs and projections and a practicable line will involve alternate banks and cuttings of short length often 40 or 50 feet high while

in one or two cases tunnels have been found necessary. The rock is a hard granitoid gneiss and is generally at or near the surface so that the work in cuttings will be expensive. The banks will be largely formed of the material excavated from the cuttings, but softer material is sufficiently abundant to supplement this from side cuttings. The rock is almost invariably suitable for masonry work and excellent building stone may be said to occur everywhere.

After descending the valley for about ten miles from the summit the country opens out sufficiently to allow of leaving the vicinity of the river which bends southwards, and taking a more direct route towards Quilon. A short cut is taken across a projecting line of hills from the valley of the Kaltharuri stream into the main valley of the Kolatarpalli River. The hills and spurs gradually become smaller and less formidable, small patches of rice cultivation begin to appear in the hollows and there are occasional signs of habitation. A little before reaching Ponalur (mile 76) the regular ghat conditions may be said to end. Ponalur is a village of some size situated on both banks of Kolatarpalli River over which the road is carried on a handsome suspension bridge of 200 feet span. Although the locality, however, is clear of the main slopes of the mountains the country is by no means flat or open but consists of rolling, billowy hills and narrow ridges running into each other at all angles with small valleys and hollows between them. As these hills rise from one to two hundred feet the location of a practicable line involves gradients and curves nearly as severe as on the main ghat itself.

After reaching Kotarakara (mile 88) the country is more open though by no means level and gradually improves (from an engineering point of view) towards Quilon, the last mile or so being flat and sandy. One point in which the Travancore country west of the mountains differs entirely from the rest of India is that the inhabitants have little tendency to collect together in villages. Each cultivator lives on his own holding and has his house standing in an enclosure planted with mangoes, jack-fruit, areca, or other useful trees. Even in the villages themselves each house has a garden round it so that a village of small population extends over quite a large area.

The line will be on the metre gauge, that being the gauge of the South Indian Railway of which it is an extension.

The centre of the station building of the present terminus of the South Indian Railway at Tinnevely is taken as the zero point from which the mileage is reckoned.

The length of the line from the zero point at Tinnevely station to the centre of Quilon station is 103 miles and to the actual end of the line as marked out 103.33 miles.

Up to mile 44.85 it traverses the Tinnevely District of Madras. At this point it crosses the Travancore boundary near Shenkotta but the boundary is somewhat irregular and for the next few miles there are projecting portions of British territory as far as mile 47.7. From this onwards it lies wholly within the State of Travancore.

The following summary shows the lengths in British and Travancore territory respectively.

British Territory—

From	To	Length	Total
0.00	44.85	44.85	
45.96	46.69	0.73	
46.84	47.11	0.27	
47.15	47.77	0.62	

Travancore Territory—

44.85	45.96	1.11	
46.69	46.84	0.15	
47.11	47.15	0.04	
47.77	103.33	55.56	

Total length of line.

56.86

103.33

Location.

As stated above (p. 2) there are practically only two gaps in the mountain range through which a railway can be constructed and the Ariankavu Pass being the one selected this becomes an obligatory point. Shenkotta lies near the foot of the ascent to the Pass and Tenkasi a few miles from it in the Tinnevely direction. Both are important towns and as any possible line of approach must pass near them they too may be considered obligatory points. From Tinnevely to Tenkasi, however, several routes are available and these will be discussed under the head of "Alternative Routes" (p. 12). Between Ariankavu and Quilon there are no obligatory points in the ordinary sense of the term though, owing to the confined nature of the valley certain points become so from engineering considerations merely because they cannot be avoided. All that is required is to pick out the easiest and most economical line possible.

East of the town of Tinnevely at a distance of three or four miles is situated the Civil Station of Palamcotta, formerly a cantonment for troops. It is no longer used for that purpose, but its bungalows are now pervaded by the peaceful missionary. The railway station is situated midway between Tinnevely and Palamcotta in a position equally inconvenient for both. They are connected by a road and the existing railway approaches it at right angles and terminates at its edge. The proposed extension after crossing this road bends sharply to the west through valuable rice fields and skirts the town of Tinnevely on the south side. At mile 4 it reaches the village of Pettai where it is proposed to have a station. Here it is taken across a ridge of barren red soil with outcrops of rock and is continued parallel to the Tambraparni River and at a distance of about a mile from it keeping out of the strip of irrigated land that lies along the river bank.

At about the 10th mile it is necessary to cross the river in order to reach Shermadevi which lies on the opposite side. The river being practically parallel to the line, a right angled turn is made to the south and another on the other side in order to resume the general westerly direction which is continued as far as Kaladikurchi (mile 19). After leaving this village the line is turned northwards and, recrossing the river at a point where it has steep banks and a rocky bed, is taken in a direct line to Tenkasi (mile 42) passing Ambasamudram (mile 21) and Kadyam (mile 31). From Tenkasi it is carried on to Shenkotta (mile 45) where the regular ascent to the Pass commences.

From Shenkotta onwards advantage is taken of the contours of projecting spurs and of the lower and less steep slopes of the hills, and the line winds along them in a generally north-westerly direction for about five miles, when an abrupt turn is made towards the south, and in another mile the Ariankavu Pass is reached. Here there is a narrow saddle or ridge connecting two lofty hills, and the summit, which lies at an elevation of 1,140 feet above sea level, is a well-defined point with a rapid descent on either side. It is proposed to pass this ridge by means of a tunnel, and the question at once arises as to the elevation at which it is to be placed. It has been finally fixed at 850 feet or 290 feet below the summit, which gives it a length of 3,500 feet. The reasons for this decision will be discussed under "Gradients and Curves" (p. 13).

The valley beyond the Pass is narrow and confined, the hills on the southern side being, as a rule, more abrupt and precipitous than those on the opposite side. A stream rises at the head, which rapidly increases in size. The metalled road to Quilon has been taken along its right or northern bank, and the alignment of the railway is kept, generally speaking, in its vicinity, but rather above it, nearly as far as Camp Gorge (mile 61). At this place the hills approach each other, and there are bare and rocky cliffs on both sides of the river. The road takes a winding course along a gallery formed on the face of the rock, while the railway takes a direct line emerging a little below the Engineer's Rest House and involving three tunnels through the spurs.

The Kaltharūrti stream here bends to the south-west falling into the Kolatūrpalli River a few miles away, the branch valley, which has been followed so far, joining the main valley of the Kollatūrpalli. The line, after crossing some intermediate high ground but still steadily descending, comes into the vicinity of that river at Utakal (mile 65), and so continues as far as Edamanūr (mile 72). Here the river bends away southward, curving round the end of a long hill or ridge that lies at right angles to the direction of the line. In order to cross this ridge at what is known as the Edamanūr Saddle (mile 71), the continuous down grade now stops, and there is a short rise, but the steep falling grade again commences at the Saddle and continues to mile 74.

From about this point actual ghat work may be said to cease, and the country begins to assume a more open character. The line crosses the Kolatūrpalli River at Ponālūr (mile 76) at which place a fine sheet of water, stretching from bank to bank, is constantly maintained by means of a masonry dam situated a mile or so down-stream. It is proposed to bridge this river by means of 5 spans of 60 feet arches. As already described (p. 10), the whole area between the mountains and the sea consists of a mass of small hills and valleys running together in a manner sufficiently intricate to involve somewhat severe grading and heavy work. For the rest of the way the line keeps close to the road passing the large village of Kotarakara at mile 88. From this point Quilon lies in a south-westerly direction, and the line bends accordingly. There is not much change in the character of the country till after passing Elukonam (mile 92), when it becomes a little less broken and more undulating, and so continues nearly up to Quilon (mile 103), only the last mile or two being flat and sandy.

The site selected for the station is most convenient, being on the edge of the open ground of the cantonment, but close up to the town and in a position that allows of an easy extension to the sea should this be found desirable.

Alternative Routes.

The various proposals as to the route to be adopted when extending a railway to Travancore, have been referred to above in the summary given of the history of the case (pp. 2 to 6). The most direct line of communication would be from Kollipati on the South Indian Railway and via the Ariankavu Pass, but this would traverse an exceedingly poor and barren region, and though at first mentioned by Mr. Barton in 1876, it seems to have at once dropped out of sight, all authorities tacitly agreeing that the extension must start from Tinnevely. From here however two entirely distinct routes are available, the Northern by the Ariankavu Pass and the Southern by the Aramboli Pass, and each one has been vigorously advocated. But the whole weight of official opinion in Travancore has been in favour of the Northern route, partly for reasons set forth in the correspondence, and partly, perhaps, for others that do not appear, and as the decision rests with the Government of that State, the Northern route has now been adopted.

The Ariankavu Pass being an obligatory point, the sections of the line on either side of it may now be considered separately.

As already noted (p. 11) Tenkasi is also practically an obligatory point, and from Tinnevely to Tenkasi three routes are available:—

- A nearly straight line following the public road via Alankolam.
- A line nearer to the Tambraparni River following the public road via Papakadi and Kadyam.
- A line coinciding with line (b) for the first ten miles, then crossing the river to Shermadevi, following its southern bank to Kaladikurohi, re-crossing the river and again joining line (b) north of Ambasamudram.

Line (a) would traverse a poor and barren country with scarcely a single village. Line (b) would skirt the belt of land irrigated by the Tambraparni, but would be cut off from the series of large and flourishing villages which lie along its south bank. All authorities agree that the only line which would meet the requirements of the locality in a satisfactory way is line (c), although it is several miles longer than (a) or (b) and also involves bridging the river twice. This view was adopted by Mr. Logan when making his preliminary survey in 1881 and accepted by the Travancore Government in subsequent discussions, and is the view now held by the District authorities. It is therefore the route that has been adopted in the present survey.

On the western side of the Pass the line enters the narrow valley of the Kaltharūrti, and is necessarily confined to it at least as far as mile 66. Mr. Logan's line of 1881 follows the stream beyond this point to its junction with the Kolatūrpalli River, crosses the valley of that river and goes westward with a southerly tendency past Yairūr (mile 77) to Aiyūr (mile 85). The intention was that the main line should now turn south to Trivandram and that Aiyūr should be the junction for a branch to Quilon, but only the latter was actually surveyed.

In 1885 Mr. Valentine, of the Travancore Department of Public Works, endeavoured to find a more favourable line from Ariankavu to Quilon. In the upper part of the valley he merely proposes alterations in the details of location, but from mile 66 he leaves Mr. Logan's line altogether and adopts a different route. His line runs west with a northerly tendency, traverses a few miles of intervening high ground and then follows the valley of the Kolatūrpalli keeping in the vicinity of the river till it crosses it at Ponālūr (mile 76). For a few miles farther it is close to the public road, but at mile 82 it takes a sharp turn to the south to Vellikavalli and then runs direct to Quilon being south of the public road and at a distance from it of three or four miles.

On the public road between Ponālūr and Quilon, 12 miles from the former and 16 from the latter, is the large village of Kotarakara. A wish has been expressed by the Travancore Government that the present location should follow generally Mr. Valentine's route, but should, if possible, touch Kotarakara. This has therefore been done, and the line now laid out is kept near the public road from Ponālūr to Kotarakara and so onward to Quilon.

Gradients and Curves.

In July 1884 Mr. Logan submitted the report of his preliminary survey as completed and revised and the following table shows the maximum grades and curves used:—

Mile.	Maximum Gradient.	Sharpest Curve Radius.
0 — 31	1 in 150	1,320
31 — 45½	1 " 100	2,640
45½ — 74½	1 " 60	1,320
74½ — 106	1 " 70	500
	1 " 60	1,056

The summit at Ariankavu is 1,140 feet above mean sea level and the elevation of the proposed tunnel through it is 1,027 feet, which gives a length of 1,266 feet. (The actual figures used by Mr. Logan for his levels have been altered so as to refer the heights to the datum of mean sea level).

In 1885 Mr. Valentine, of the Travancore Department of Public Works, explored the country in order to find a more favourable line. He begins at mile 55 and follows Mr. Logan's general route up to mile 66 from which point to Quilon he adopts a different route. He proposes that the level of the tunnel at Ariankavu shall be 890 feet, or 137 feet lower than the elevation fixed by Mr. Logan, and giving a length of 3,060 feet, as compared with 1,266 feet. This expedient enables him to run a trace of 1 in 100 down the ghat on either side, and he considers that the same limiting gradients can be used on the whole length from

it was not possible to work to anything like a ruling gradient of one per cent. It was obvious that the ruling grade to be adopted must depend chiefly on the level of the tunnel at the summit, and as it had already become clear that it was not lowering it in the interests of work on the Shankotta side alone, no hesitation was felt in reducing the elevation still farther. In the end it has been decided to fix the summit level at 530 and the allows of adopting a ruling gradient of 1.25 per cent. (1 in 80) on the whole ghat section with all curves fully compensated. Assuming the depth of open cutting at the tunnel to be 40 feet (the figure taken by Mr. Logan) the corresponding length of tunnel is 1,146 feet. The improvement secured at the expense of this one piece of work includes the ruling gradient and the character of the work on the whole of the ghat section which may be considered to extend from near Shankotta to near Ponnalur.

From Ponnalur to Quilon, although the hills and ridges are not lofty, they rise together in such an intricate manner that it is impracticable to fix the location on contours and somewhat heavy work will be involved in crossing them. As however a ruling grade of 1.25 per cent. would effect any considerable economy only in a limited length of a mile or two, it has been thought better to adopt a one per cent. grade fully compensated on curves.

A table similar to that on page 14 will therefore show the following results—

Mile.	Ruling Gradient (used on straight only).		Sharpest Curve	
	Per cent.	Equivalent	Angle	Radius
0 — 31	0.78	1 in 130	5°	1,146
31 — 45½	1.00	1 " 100	5°	1,146
45½ — 74	1.25	1 " 80	10°	573
74 — 108	1.00	1 " 100	5°	1,146

Construction and Engineering.

General character of work.

The country traversed by the line from Tinnevely to Shankotta consists partly of valuable irrigated rice land and partly of rolling ground with hard soil and outcrops of rock. The height of banks will seldom be over twelve feet and will average about six feet; and the same may be said of the cuttings of which none are of great length. There will be only few bridges of any magnitude but a considerable number of small bridges mostly over the irrigation channels. As a rule, the foundations are very good, and as building stone of the best quality is abundant everywhere arches will be used as far as possible in preference to girders.

On the Ghat section there will be a constant alternation of short banks and cuttings from 20 to 60 feet high, a tunnel 3,500 feet long at the summit and three tunnels elsewhere. The material excavated from the cuttings, generally rock, will be used to form the banks. There will be a good many culverts and some viaducts of considerable magnitude besides a large bridge over the Kolaturpalli River at Ponnalur.

Between Ponnalur and Quilon banks and cuttings will be rather heavy and there will be one tunnel. On this section there are no large bridges.

The range of mountains forming the main watershed lies north and south, while the line runs east and west parallel to the dip of the country on either side and to the general direction of the drainage. The total waterway to be provided should therefore be small, but it is increased by the two crossings of the Tambraparni and by the large number of irrigation channels and the average per mile comes to 63.4 lineal feet. The larger bridges are briefly noticed below full particulars being given in the List of Important Bridges (Form B. iv, page 37).

EASTERN SECTION.

No. 41. *Tambraparni River* (Mile 10). Fifteen spans of 40 feet girders. The river channel is well defined and a favourable crossing is obtained at a point where it is slightly constricted.

No. 74 *Koraiyar River* (Mile 17). Seventeen spans of 20 feet girders. The river bed is flat and and not well marked, but no better crossing is available.

No. 91 *Tambraparni River* (Mile 20). Thirteen spans of 30 feet arches. The line here re-crosses this river at a point where the bed consists of a continuous sheet of rock.

No. 119 *Katnanadi River* (Mile 26½). Five spans of 30 feet arches.

No. 184 *Chittar River* (Mile 42). Seven spans of 20 feet arches.

GHAT SECTION.

Nos. 67 and 68 *Kaltharurli River* (Mile 61½). Each of four spans of 60 feet arches. At this point the river bends sharply round the end of a bare rocky spur in Camp Gorge which projects between two precipitous cliffs. The line, in passing from one tunnel to another, rests on the end of the spur and crosses the river on each side of it.

No. 88 *Ana Viaduct* (Mile 67½). Six spans of 150 feet girders. The line here crosses a ravine over a thousand feet wide and two hundred feet deep. It is just possible that an alternative alignment may be found which shall cross the valley by a work of lighter character, but time did not allow of the investigation being made during the present season.

No. 135 *Kolaturpalli River* (Mile 75). Five spans of 60 feet arches. The river is here dammed up forming a permanent sheet of water. The bed is of smooth rock and favourable for the construction of an arched bridge. Near this point the road is taken across on a suspension bridge of 200 feet main span with side spans of 100 feet each.

The tunnels run for the greater part of their length through hard solid rock consisting of a bluish grey gneiss. No lining will be necessary nor any special methods of working but, in consideration of the length of the summit tunnel, it will be desirable in this case to employ machine drilling instead of the tedious hand process.

The following is a list of tunnels.

Mile.	Length feet.	Remarks.
54—55	3,500	Ariankavu summit.
61—62	1,450	Camp Gorge.
" — "	800	" "
" — "	950	" "
91—92	650	Elukonam.

Fencing will be required only at the principal stations and at one or two places where the line runs through villages. The soil and climate seem to be suitable for the growth of a green fence but as this is not quite certain the estimate provides for the ordinary type with five wires on iron standards.

The type of Permanent Way in most general use on the South Indian Railway consists of a 50lbs. bull-headed rail on cast iron pot sleepers weighing 70lbs. each. The State Railway type of 41½lbs. flat-footed rail is also used in conjunction with wooden sleepers, with transverse steel sleepers and, for a short length on the main line, with special cast iron pot sleepers each weighing 55lbs. In May 1894 the Director-General of Railways circulated a note by Mr. Horace Bell on the relative advantages of steel and cast iron sleepers which elicited from Mr. Logan, Chief Engineer, South Indian Railway, a Report on the subject based on his own experience. He finds that the steel sleepers show signs of failing under the pressure of the rail, and moreover their material is too thin to offer a prolonged resistance to corrosion. He is well satisfied with the 70lbs. pot sleepers under a 50lbs. rail, but thinks that the 55lbs. pot sleepers under the 41½lbs. rail are too light and that a 70lbs. sleeper would be better.

The opinion here given must naturally be of great weight in deciding the type of Permanent Way for the Tinnevely-Quilon Railway, which is an extension of the South Indian Railway.

With regard to the rail it is not expected that the traffic will be very heavy, at least for some years and as the line will be an expensive one in any case there is every motive for keeping down first cost where possible. The difference in cost between a 41½ lbs. rail and a 50 lbs. rail would come to Rs. 1,350 per mile and as about 120 miles are required this represents a difference of Rs. 1,58,000 for the whole line.

As to sleepers the weight of authority appears to be against the transverse steel pattern and the choice rests between wooden sleepers and cast iron pots. It must be remembered that the line runs for a great part of its length through the heart of the Travancore forests and if sleepers are procured from these forests the expenditure will be upon produce already belonging to the State while the price of labour, carriage, etc., will also be spent in the State. The Dewan of Travancore is anxious that this source of supply should be drawn upon as far as possible and the Conservator of Forests thinks that he can supply 100,000 sleepers of selected woods at from Rs. 3 to Rs. 4 each or say an average rate of Rs. 3½ each. This would be rather less than half the quantity required and the remainder might be procured from other forests to the north, being shipped from Cochin and Calicut to Quilon. They would not cost more than Rs. 4½ each and the average rate for the whole line may be safely taken at Rs. 4 each. The cost of a sleeper consisting of two cast iron pots, tie bar, gbs, cottars, wooden cushions and keys would amount to at least Rs. 6½. This gives a difference of Rs. 2½ per sleeper or Rs. 5,000 per mile amounting to Rs. 6,00,000 for the whole line. Taking into consideration the economy of first cost and the advantage of using local produce it is proposed to adopt a flat-footed steel rail weighing 41½ lbs. per yard on jungle-wood sleepers.

Passenger Platforms will generally be 600 feet long and 40 feet wide and will be flush with the rail. At the ghat stations, which are mainly for crossing trains and for watering, smaller platforms will be provided.

No provision is made for separate workshops as the line is merely an extension of the South Indian Railway.

Water is abundant everywhere and can always be obtained near the surface. No special arrangements will be necessary.

Tinnevely is already an engine station and there is a shed there having accommodation for 6 engines. The length of the line, 103 miles, appears suitable for an engine run and it is therefore proposed to provide a similar shed at Quilon for the stabling of 6 engines together with staff quarters for a Foreman, 4 Drivers, 6 Firemen, and a Rolling Stock Inspector and also an Office and Store.

Labour and Materials.

For carrying out ordinary railway construction work the petty contract system gives by far the best results. This system has been successfully followed for many years all over the country and has produced a large number of experienced men with a following of efficient subordinates and workmen who are ready to take up work in any part of India. All that is necessary is the exercise of a little discretion in allotting to each a kind and quantity of work proportioned to his resources and the capital he can command. The large contractor put in charge of, perhaps, a whole line is an unmitigated nuisance. He merely, as a rule, parcels out the work to smaller men who require just as much or more supervision on the part of the engineering staff as if the work were done departmentally. The labour and responsibility of the Engineer are not diminished though the control of matters affecting his success and his reputation is practically surrendered into the hands of another.

As to the supply of unskilled labour it is not anticipated that any special arrangements will be necessary. For nearly half its length the line runs through the populous Tinnevely district. It is true that for about 30 miles it traverses uninhabited forest and for

nearly 30 miles more it passes through a thinly populated part of Travancore where there is little or no surplus labour. But for the whole distance it is in the vicinity of a trunk road and quite in touch with the Southern Madras districts, the inhabitants of which constantly travel to seek work elsewhere. All that is necessary is that proper arrangements shall be made for housing and feeding the people and as hutting materials are abundant and the road offers every facility for carting supplies this amounts to nothing more than is done on railway work even in populous localities when the coolies generally have their own camps and their own particular food-sellers in each.

The conditions are very favourable for the supply of materials.

The stone available nearly everywhere is a hard bluish grey granitoid gneiss of excellent quality for masonry. Examples of fine slabs and pillars are common and it is not unusual to see in temples and other buildings cleanly cut hammer-dressed shafts of a length of 15 feet or more.

A form of crystalline calcite is found in several places and kankar also occurs in fair quantities between Tinnevely and Shenkotta. Beyond this lime is generally made from sea shells procured from the backwaters running inland to within a few miles of Kotarakara.

Timber and fuel can be obtained in unlimited quantities from the Travancore forests.

The weathered stone lying on the surface of the country forms excellent ballast. Broken stone will, of course, be abundant on the Ghat section of the line.

It is proposed that jungle-wood sleepers be used for the whole line. Half the supply will come from the local forests and will be delivered about the middle of the line. The other half will be delivered at Quilon and will be led out by rail as the road is laid from that end.

There is a tile factory at Quilon manufacturing tiles of the Mangalore pattern, and these are coming into very general use in the vicinity. Laid over boarding they form a cool, efficient and cheap roof and may be generally used.

A metalled road runs in the near vicinity of the line for its whole length and carts are abundant in the Tinnevely District. Stone for bridges will always be procurable near to site. Girders will be trained out as rails are laid. Permanent Way will be laid telescopically from Quilon but if it should be found desirable to lay a portion from the Tinnevely end the rails will be brought by South Indian Railway from Tuticorin or other convenient port and the sleepers will be carted from Shenkotta and distributed along the line. A considerable quantity of light tramway material will be used in excavating cuttings on the Ghat Section but it will not be necessary to lay any temporary line for transport in the ordinary sense.

A good deal of engineering work goes on in the Tinnevely District in connection with roads and irrigation and the prevailing rates are reasonable. In Travancore generally labour is scarce and rates are high but as there is every facility for communication it is expected that people will flock in from elsewhere, and there is no reason why rates should be higher than in Tinnevely. But, in truth, local rates can seldom be adhered to under entirely new conditions, when a work of great magnitude is started and requires prompt completion. Provided the locality is fairly accessible rates for railway work follow a fairly uniform standard of their own not varying much unless on account of some very special circumstances which do not exist in the present case. Information on this subject has been obtained from the Executive Engineer, Tinnevely Division, from the Local Funds Engineer, from the Chief Engineer, South Indian Railway, and others. The estimates of the East Coast Railway and other lines have also been referred to, and, for work on the Ghat section, advantage has been taken of the experience of the Engineer-in-Chief, Nilgiri Railway, on which line very similar conditions prevail.

The prices of English material are taken from the Abstract issued by the Director-General of Railways for the quarter ending 31st December 1894. Exchange has been calculated at eighteen rupees per one pound sterling, equivalent to 13½ pence per rupee.

Rates will vary in different parts of the line, but averages have been taken for framing the estimates and these are given in the following list —

LIST OF RATES.

		LIST OF RATES.	Section of Line		
		Per.	East.	Ghat.	West.
EARTHWORK—					
Earth	...	1,000 cu. ft.	5	8	25
Muram or Laterite	...	" "	20	25	50
Rock	...	" "	50	50	120
TUNNELS					
BALLAST—		lin. foot.		150	
Sand	...				4
Broken stone	...				6
BRIDGEWORK—		100 cu. ft.	4	4	
Excavation, dry	...	" "	6	6	
" wet	...	" "			10
Concrete	...	1,000 cu. ft.	10	25	50
Masonry in foundations	...	" "	50	100	20
" " superstructure...	...	" "	20	25	30
" " arching, small, and slabs	...	100	30	30	42
" " " large	...	" "	42	42	50
" " coping	...	" "	80	80	100
" " ashlar	...	" "	100	100	80
" " bridge flooring	...	" "	80	80	100
Dry Stone Work	...	" "	100	100	25
Pitching	...	" "	25	25	15
Petty Ironwork	...	" "	15	15	8
Woodwork	...	" "	8	8	15
Stoneware Pipes, 12 inch	...	cwt.	15	15	3
ERECTION OF GIRDERS—		cu. foot.	3	3	2
6 feet to 20 feet	...	lin. foot.	2	2	
40 "	...				30
60 "	...				45
150 "	...	ton.	30	30	50
WORK IN BUILDINGS—		" "	45	45	80
Excavation, etc.	...	" "	50	50	
Concrete	...	" "	80	80	5
Masonry	...	1,000 cu. ft.	5	5	20
Flooring of concrete	...	100 "	20	25	25
Plaster, etc.	...	" "	25	25	3
Roofing, country tiles	...	" sq. ft.	25	3	22
" " Quilon tiles	...	" "	3	22	40
Woodwork	...	" "	22	40	3
Doors and windows, 1st class	...	" "	40	3	1.5
" " 2nd "	...	cu. foot.	3	1.5	1
SUNDRY—		sq. "	1.5	1	
Gravel, rolled and finished	...	" "	1		2
Metalling "	...	" "			4
Platform Fence	...	100 sq. ft.	2	2	2
Laying Permanent Way	...	" "	4	2	440
Erecting wire fence	...	lin. foot.	2		400
Iron Roofing, complete	...	mile.	440	400	60
Clearing jungle, heavy	...	" "	400	60	
" " light	...	100 sq. ft.	60	400	40
Ironwork, local	...	mile.	40	40	15
	...	cwt.	15	15	

Arrangement of Staff

It is not very easy to divide the line into suitable sections for construction purposes. The total length being only 103 miles it would at first sight appear sufficient to form two Divisions. But, as on the Ghat section there are so many heavy works each requiring minute personal attention, it seems essential that this section alone shall constitute one Division and that it shall be limited in length. This being the case three Divisions become necessary of which those on the east and west are rather shorter than usual.

The arrangement will thus be as below :—

Division.	Miles.		Head quarters of Executive Engineer.	Assistant Engineers.
	From	To Length.		
Eastern	0—	48 48	Tinnevely.	3 with 16 miles each.
Central	48—	72 24	Thammalli.	3 " 8 " "
Western	72—	103 31	Quilon.	2 " 16 " "

For the head-quarters of the Engineer-in-Chief, Quilon, possesses advantages in that suitable accommodation would probably be available. But its situation on the coast would be an objection in the opinion of some and, as there is a road close to the railway for its whole length with regular postal communication established, it is really of little importance as far as the work is concerned where the head-quarters are fixed. The hills near the Ariankavu summit would offer an ideal place of residence. The final choice might well be left to the individual actually appointed to the post.

No bungalows are available at Tinnevely, the European quarter at Palamcottah being inconveniently remote. There are dāk bungalows and rest-houses at various points along the line which would be convenient when on tour, but it is unlikely that any of them could be acquired exclusively for railway purposes. Except at Quilon, it will be necessary to build temporary houses for all Executive and Assistant Engineers and other officers, and for European Subordinates. Native Subordinates will find accommodation in the villages except on the Ghat section. Some of the workmen will live in the villages but there will be, as usual, a large proportion accommodated in temporary camps along the line and hutting material for these will be abundant and cheap. On the Ghat section temporary houses will be required for every one. The larger kind must be tiled as thatch would be in constant danger from jungle fires. Clearings of considerable area must be made for the workmen's camps and the huts must be placed in isolated groups. They are certain to be burnt down at intervals, an event not without its advantages in sweetening up the vicinity, but it is as well that the conflagrations should be of moderate and reasonable magnitude.

The Eastern Division lies mostly in a dry and healthy district. The Western Division extends from the mountains to the sea and the locality is subject to a rainfall of 60 to 80 inches, which is somewhat excessive for people accustomed to the dryer districts of Madras, who will form the bulk of the labour supply and who may be liable to suffer somewhat in health. It can be met to a certain extent by careful hutting, but there will be a tendency for men to return to their homes and for work to slacken during the wetter months.

The real difficulties will be encountered on the Central Division and what these are may be roughly inferred from the experience of the Survey party. There were about 50 men employed on instrument work with the different officers and subordinates and a gang of about 100 men opening up lines and clearing jungle, and the majority of these were Tamils from the Tinnevely district. During December the camps were at Pulari between Shenkotta and Ariankavu, supplies were obtainable in the village and health was good. In January a move forward was made into the jungle the camps being at various points between Ariankavu and Camp Gorge. An arrangement was made to establish a travelling camp shop supplying

ordinary articles of food. Health was good until the end of the month when the days became hot while a furious and rather cold wind howled down the Gorge all night. Fever of a strong and depressing type at once became prevalent and the gangs began to melt away, the Tamils returning to their homes as soon as they could walk. Every member of the staff in turn went down with fever and work was somewhat impeded. Subsequent moves brought the camps into touch with the village of Ponalur and, the Malayalam inhabitants beginning to take kindly to the work, the strength of the gangs was re-established. Matters were greatly improved in March by which time operations were clear of the denser jungle, and in April field work was completed. There was therefore no experience of May, but fever is said to prevail just before the rains.

It is evident therefore that there will be a considerable amount of sickness to contend with, but probably much may be done to mitigate it by opening up a wide strip along the line and by clearing fairly large areas for camps. The most necessary precaution, however, will be the establishment of efficient guard and control over the stream which will form the one source of water supply for all purposes for the people located along its banks. A judicious system of restrictions to ensure that the water shall not be contaminated will do more than anything else to preserve health. Food-sellers will probably follow the work people, but in this matter a method of subsidy and control may be advisable.

Medical.

An Assistant Surgeon will be in charge of all medical and sanitary matters with his head quarters near the middle of the line and a hospital at the same place. He will have under him three medical subordinates in charge of small dispensaries whose principal duty will be to travel constantly along the line attending to the sick in their own camps.

Relations with Government Departments, and the Public.

Military.

Quilon is a military cantonment having a large open area intersected with roads planted with trees lying outside the town. The bungalows and military buildings are concentrated to one side of this and the whole area is much larger than is required for ordinary parade purposes. The proposed station site is towards the northern edge of this open ground with its end abutting on one of the main roads of the town. The selection is approved by the Commandant of the regiment now stationed at Quilon, who states that it will not interfere with any military arrangements.

The Public.

A station has been provided at every large village along the route in the Tinnevely district, the average distance apart being about 6 miles. On the Ghat section there will be little passenger traffic and stations for watering and crossing trains are placed about 10 miles apart. On the western section stations are provided at the larger villages and these also are about 10 miles apart. In nearly every case the station will be within half a mile of the village. Small semi-permanent buildings will be erected of the type approved by the Director-General of Railways for the East Coast Railway.

Religious Buildings.

The number of temples and religious buildings in the Tambraparni Valley is exceptionally large and it has been a work of some difficulty to lay out a line which shall entirely avoid them. In one or two cases it has been impossible to approach a convenient station site without running very close to a building, but none will be actually injured. A limit of 30 feet has been taken as the nearest allowable distance from the centre line to any part of a structure.

Land.

In the Tambraparni Valley there is an elaborate system of irrigation watering a most fertile soil on which large and valuable crops are produced. Endeavour has been made as far as possible to skirt this land and though it has of course been impossible to avoid the

fields altogether great care has been taken to reduce the damage to a minimum. Near Tinnevely the rice fields are said to be worth Rs. 3,000 per acre and between this and Shenkotta they vary from Rs. 500 to Rs. 2,000. The proportion of dry cultivation is small but that of waste and rocky ground considerable so that the average cost on this section will be reduced and will not amount to be more than Rs. 6,000 per mile.

On the Central Division, with the exception of a few patches of plantains, there is only rock and jungle and the land is worth practically nothing.

On the Western Section the line sometimes crosses the primitive paddy fields lying in the hollows between the hills and also traverses occasional gardens which are dotted over the face of the country as the inhabitants live in separate enclosures and avoid the usual Indian practice of massing their dwellings together. But inferior land is met with over the greater part of this section.

Taking the line therefore as a whole though very valuable land is occasionally traversed there is so much that is practically worthless that the average will not exceed Rs. 3,500 per mile.

Traffic and Statistics.

In attempting to frame any estimate of probable traffic, it is necessary to take into consideration the varying nature of the country passed through. For a distance of 45 miles the line traverses a fertile and productive district, about half this length being in the valley of the Tambraparni with its rich irrigated soil and many wealthy and prosperous villages. It may be said generally to serve the taluqs of Tinnevely, Ambasamudram and Tenkasi with a united area of 987 square miles which would correspond to a strip of country 22 miles in width along the course of the railway. The population of this area is nearly 600,000 giving a density of about 600 per square mile.

In Travancore territory the line first traverses the small taluq of Shenkotta, which is fairly populous, and then enters the taluq of Patanapuram, a great part of which, near the railway at least, consists of uninhabited jungle and after this it passes into the more thickly populated country towards the coast. Generally speaking the length of 58 miles may be said to serve the following taluqs, the figures relating to which are taken from the very able and interesting Report of the Census of Travancore for 1891 by Mr. V. Nagam Aiya, the Census Commissioner.

Taluq.	Area. Sq. miles.	Population.
Shenkotta ...	65	32,088
Pattanapuram ...	400	39,447
Kotarakara ...	234	71,517
Quilon ...	154	121,935
Total	853	264,987

This corresponds roughly to a strip of country 15 miles wide, the average density of the population being 310 per square mile.

The traffic now carried by road via Ariankavu only amounts to about 4,000 tons per year both ways. That between Travancore and Tinnevely by the Aramboli road is about 25,000 tons a year. Of passengers there are probably 100 per day on each road. But, in truth, it may be admitted that so far as regards the western portion of the line the traffic awaits development and can hardly be said to be actually in sight.

Perhaps the best way to estimate the probable traffic is to take the returns showing current traffic on such part of an existing open line as may be considered to resemble the proposed line in its general conditions. With this end in view figures have been obtained showing the earnings on the south-west line of the Madras Railway which, for this purpose, is divided into three sections. It is considered that the length from Podanur to Calicut may be taken as very similar to the Tinnevely-Quilon Railway, and on this section the receipts for the half-year ending 30th June 1894 amounted to Rs. 160 per mile per week.

Figures have also been obtained from the South Indian Railway for the half-year ending 31st December 1894, and for this purpose the line is divided into thirteen sections. None of them much resemble the Tinnevely-Quilon line as a whole, but the portion passing through the Cauvery valley is not unlike the length of 45 miles from Tinnevely to Shenkotta. The receipts on this part of the line amount to about Rs. 250 per mile per week and for present purposes it may be assumed that the receipts on the length from Shenkotta to Quilon would at first be about Rs. 50 per mile per week. The receipts per week on the whole line would thus be as below—

Miles.	Rs.	Rs.
45 @ 250	..	11,250
58 @ 50	..	2,900
Total 103	..	14,150

or an average of Rs. 137 per mile per week. Taking a rate intermediate between this average of Rs. 137 and the Rs. 160 of the Podanur-Calicut section, it may be expected that Rs. 150 per mile per week will represent the gross annual revenue of the railway within a few years of opening for traffic.

It is assumed that an arrangement will be made for the South Indian Railway to work the line using its own rolling stock and receiving 55 per cent. of the gross earnings, the net revenue thus amounting to 45 per cent. of the gross receipts. On the assumption made above the total earnings for the year would be—

Rs.	Weeks.	Miles.	Rs.
150	52	103	8,03,400

and the net earnings would be 45 per cent. of this or Rs. 3,61,530. This, it will be seen, is equivalent to 3.55 per cent. on Rs. 101,02,018 the estimated capital cost of the railway.

COONOR,
September 1895.

E. I. SHADBOLT,
Engineer-in-Chief,
Tinnevely-Quilon Railway Survey.

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TINNEVELLY-QUILON RAILWAY.

Length 103.33 Miles.

SURVEY

OF

1895.

ESTIMATE

OF THE

COST OF CONSTRUCTION.

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	Distant Signal
	Engine Turntable
	Sundry Works

E. P. Andrews

Engineer-in-Chief

Tinnevely Quilon Railway

Cornwall

25th Sept 95

TINNEVELLY-QUILON RAILWAY. (Gauge '3-3½')

NOTE ON ESTIMATE.

The Tinnevely-Quilon Railway is an extension of the South Indian Railway from Tinnevely, the present terminus, to Quilon on the west coast a distance of 103 miles.

The eastern portion of the line is through undulating but fairly open country, the middle section is through difficult hilly country, and the western section through a region sufficiently broken and hilly to involve rather heavy work. In this Estimate different rates have been adopted for work in the different sections instead of average rates for the whole line.

The following points may be noted with regard to the various heads of work.

I. *Preliminary*.—The estimate is based on the actual cost of the survey of 1895.

II. *Land*.—The approximate area per mile is calculated from the plans.

III. *Formation*.—Earthwork quantities are calculated from average heights. Slopes of banks are usually taken at 2 to 1, but rock banks in the ghat section are taken at 1½ to 1. Slopes of cuttings are taken at 1 to 1.

Tunnels are estimated at a rate per lineal foot based on the rates of the Nilgiri Railway.

IV. *Bridge-work*.—Special designs have been prepared for a few of the larger bridges but, when applicable, quantities have been taken from Stone's Bridge and Culvert Table.

V. *Fencing*.—No remarks.

VI. *Electric Telegraph*.—The capital cost is not included, arrangements will be made by the Telegraph Department in the usual way and charges will go against Revenue.

VII. *Ballast and Permanent Way*.—Provision is made for the State Railway type of rail weighing 41½ lbs per yard laid on jungle-wood sleepers which will be chiefly obtained from the Travancore forests.

VIII. *Stations and Buildings*.—It is proposed, in the first instance, to provide small semi-permanent buildings of the type approved by the Director-General of Railways for the East Coast Railway. The estimates of cost have been based on approximate rates per square foot of area.

IX. *Plant*.—Mileage rates have been taken based on the actual expenditures incurred on certain open lines of railway modified to meet the circumstances of the case.

X. *Ferries*.—Nil.

XI. *Rolling Stock*.—No provision is made for Rolling Stock as it is assumed that the line will be worked and the rolling stock supplied by the South Indian Railway.

XII. *General Charges*.—Mileage rates have been taken based on the actual outlay under this head on certain open lines of railway. The rates approximate to those of the East Coast Railway and the Bellary-Kistna Railway.

Rates.

Information on this subject has been obtained from local sources and the estimates of lines recently under construction have also been referred to. The prices of English material are derived from the quarterly Abstract issued by the Director-General of Railways. Exchange has been calculated at Rs. 18 per £1 sterling, equivalent to 18-3 pence per rupee. The rates adopted in the Estimate are given in the following List:—

LIST OF RATES.

	Per.	Section of Line.		
		East.	Ghat.	West.
EARTHWORK—	1,000 cu. ft.	5	8	6
Earth ...	" "	20	25	25
Muram or Laterite ...	" "	50	50	50
Rock ...	lin. foot.	...	150	120
TUNNELS ...				
BALLAST—	100 cu. ft.	4	4	4
Sand ...	" "	6	6	6
Broken stone ...	" "			
BRIDGEWORK—	1,000 cu. ft.	10	25	10
Excavation, dry ...	" "	50	100	50
" wet ...	" "	20	25	20
Concrete ...	100 "	30	30	30
Masonry in foundations ...	" "	42	42	42
" " superstructure ...	" "	80	80	80
" arching, small, and slabs ...	" "	100	100	100
" " large ...	" "	80	80	80
" coping ...	" "	100	100	100
" ashlar ...	" "	25	25	25
" bridge flooring ...	" "	15	15	15
Dry Stone Work ...	" "	8	8	8
Pitching ...	cwt.	15	15	15
Petty Ironwork ...	cu. ft.	3	3	3
Woodwork ...	lin. ft.	2	2	2
Stoneware Pipes, 12 inch				
ERECTION OF GIRDERS—	ton.	30	30	30
6 feet to 20 feet ...	" "	45	45	45
40 " ...	" "	50	50	50
60 " ...	" "	80	80	80
150 " ...	" "			
WORK IN BUILDINGS—	1,000 cu. ft.	5	5	5
Excavation, etc. ...	100 "	20	25	20
Concrete ...	" "	25	25	25
Masonry ...	sq. ft.	3	3	3
Flooring of concrete ...	" "	22	22	22
Plaster, etc. ...	" "	40	40	40
Roofing, country tiles ...	" "	3	3	3
" Quilon tiles ...	cu. ft.	1.5	1.5	1.5
Woodwork ...	sq. "	1	1	1
Doors and windows, 1st class ...	" "			
" " 2nd " ...	" "			
SUNDRY—	100 sq. ft.	2	2	2
Gravel, rolled and finished ...	" "	4	4	4
Metalling " ...	lin. ft.	2	2	2
Platform Fence ...	mile.	440	440	440
Laying Permanent Way ...	" "	400	400	400
Erecting wire fence ...	100 sq. ft.	60	60	60
Iron Roofing, complete ...	mile.	40	40	40
Clearing jungle, heavy ...	" "	15	15	15
" " light ...	cwt.			
Ironwork, local ...	" "			

TINNEVELLY-QUILON RAILWAY

(Gauge 3' 3 3/8")

103.33 Miles.

General Abstract.

HEADS OF ACCOUNT.	SUB-HEADS				MAIN HEADS	
	Expenditure in India.	Material from England.	Total Cost.	Rate per Mile.	Total Cost.	Rate per Mile.
I. Preliminary Expenses.						
1. Survey Expenses ...	13,081	...	13,081	127	72,512	702
2. Plant ...	4,223	...	4,223	41	...	...
3. Establishment ...	55,208	...	55,208	536	...	...
II. Land.	3,59,460	...	3,59,460	3,478	3,59,460	3,478
III. Formation.						
1. Earthwork ...	29,41,894	...	29,41,894	28,470	40,24,894	38,951
2. Tunnels ...	10,83,000	...	10,83,000	10,481	...	...
IV. Bridgework.						
1. Major Bridges ...	11,88,755	2,61,978	13,90,733	13,459	24,01,451	23,240
2. Minor Bridges ...	10,04,339	6,379	10,10,718	9,781	...	...
V. Fencing, etc.						
1. Fencing ...	7,290	...	7,290	...	94,788	917
2. Road Crossings ...	49,362	19,710	27,000	261	...	...
3. Mile and Gradient Posts ...	18,426	...	49,362	478	...	...
VII. Ballast and Permanent Way.						
1. Ballast ...	3,42,930	...	18,426	178	...	...
2. Permanent Way ...	10,43,078	6,64,712	3,42,930	3,819	20,50,720	19,846
VIII. Stations and Buildings.						
1. Stations and Offices ...	91,256	...	17,07,790	16,527	...	...
2. Staff Quarters ...	1,25,081	...	...	...	3,41,403	3,304
4. Station Machinery ...	72,881	52,685	91,256	884	...	...
IX. Plant.						
1. Engineering ...	12,360	...	1,25,081	1,210	...	...
3. Locomotive ...	1,180	5,000	1,25,066	1,210	...	...
4. Station and Office Furniture ...	15,450	...	12,360	120	33,990	330
XII. General Charges.						
1. Direction ...	72,100	...	6,180	60	...	...
2. Engineering ...	6,18,000	...	15,450	150	7,62,800	7,576
3. Stores ...	51,500	...	...	...	...	...
4. Audit and Account. ...	30,900	...	72,100	700	...	...
5. Medical and Sanitation ...	10,300	...	6,18,000	6,000	...	...
Total ...	92,11,554	9,50,464	10,300	100	1,01,62,018	98,346

TINNEVELLY-QUILON RAILWAY.

(Gauge 3'-3 3/8")

ABSTRACT ESTIMATES.

I. Preliminary Expenses.

1. Survey Expenses.

2. Plant.

3. Establishment.

Particulars, Pages 14 to 17.

Sub-heads of Account.	Cost.		Rate per Mile.	
	Sub-heads	Main heads	Sub heads.	Main heads.
	Rs.	Rs.	Rs.	Rs.
I. SURVEY EXPENSES.		13,081		127
a. Field Expenses ..	11,845		115	
b. Office Expenses...	1,236		10	
II. PLANT.		4,223		41
a. Camp Equipage ...	5,150		50	
b. Furniture ...	824		8	
c. Surveying Instruments ...	5,150		50	
d. Drawing Instruments ...	721		7	
e. Tools ...	618		6	
Gross Total	12,468		121	
Credits expected	8,240		80	
Net Total	4,223		41	
III. ESTABLISHMENT.		55,208		536
a. Salaries ...	45,938		446	
b. Travelling Allowances ...	6,180		60	
c. Office Contingencies ...	2,472		24	
d. Audit and Account ...	618		6	
Cost of Survey 103 miles		72,512		704

TINNEVELLY-QUILON RAILWAY.

(Gauge 3'-3 3/8")

ABSTRACT ESTIMATES.

II. Land.

Item	Quantity, acres.	Rate per acre.	Amount.
		Rs.	Rs.
Special ...			
Irrigated, 1st class ...	72	1,500	1,08,000
" 2nd " ...	130	1,000	1,30,000
Cultivated, Ordinary ...	157	400	62,800
Waste ...	973	50	48,650
Forest ...	266	20	5,320
	469	10	4,690
Average rate per acre	Total...	2,067	
Equivalent area per mile			3,59,460
	20	174	

III. Formation.

		1. Earthwork.		
Item	Quantity.	Rate.	Per.	Amount.
		Rs.		Rs.
Banks ...	35,633,760			
" ...	12,150,600	5	1,000 cu. ft.	1,78,169
Cuttings ...	82,158,600	6	"	72,904
" ...	3,125,000	10	"	6,57,269
Clearing Line ...	24,172,500	25	"	31,250
" " ...	24,888,400	50	"	604,812
	77	40	"	12,44,420
Contingencies ...	26	400	mile.	3,080
			"	10,400
Total...		5	cent.	28,01,804
				1,40,090
				29,41,894

III. Formation.

		2. Tunnels.		
Item	Quantity.	Rate.	Per.	Amount.
Ariankavu Summit, Mile 54-55				
Camp Gorge (a) ...	3,500	150	lin. ft.	5,25,000
" (b) ...	1,450	150	"	2,17,500
" (c) ...	800	150	"	1,20,000
Elukonam ...	950	150	"	1,42,500
	650	120	"	78,000
Total...				10,83,000

TINNEVELLY-QUILON RAILWAY. (Gauge 3' 3 3/8".)
ABSTRACT ESTIMATES.

IV. Bridgework.

Particulars, Pages 28 to 39.

1. Major Bridges.

Number.	Mileage.	OPENING.			AMOUNT.			REMARKS.
		No.	Length.	Girders or Arches.	Indian.	English.	Total.	
			Ft.		Rs.	Rs.	Rs.	
EASTERN SECTION.								
14	2-21	5	20	G	5,355	2,809	8,164	Namakulam Channel.
16	2-33	3	20	G	3,481	1,685	5,166	Arugankulam "
37	9-26	3	20	G	4,659	1,685	6,344	Kodagan "
41	9-75	15	40	G	58,058	28,775	86,833	Tambraparni River.
52	11-43	4	20	G	3,909	2,247	6,156	Kanadian Channel.
74	16-94	17	20	G	24,319	9,551	33,870	Koraiyar River.
85	19-44	5	20	G	6,195	2,809	9,004	Kanadian Channel.
91	20-00	13	30	A	49,619	...	49,619	Tambraparni River.
119	26-50	5	30	A	36,261	...	36,261	Katnanadi "
132	29-20	5	20	G	23,164	2,809	25,973	Viranadi "
143	32-75	4	20	G	5,107	2,247	7,354	...
160	39-24	1	40	G	9,912	1,914	11,826	Alkanyar "
184	42-09	7	20	G	19,545	3,933	23,478	Chittar "
GHAT SECTION.								
53	57-44	2	30	A	79,456	...	79,456	Muriyapanjam River.
66	60-96	3	20	A	66,656	...	66,656	Kaliharoti. "
67	61-36	4	60	A	61,239	...	61,239	" "
68	61-47	4	60	A	61,243	...	61,243	" "
88	67-36	6	150	G	5,51,774	1,41,574	6,93,348	Ann Viaduct.
135	75-02	5	60	A	82,159	...	82,159	Kolaturpalli River.
164	80-01	5	20	A	21,062	...	21,062	...
188	85-31	3	20	A	17,582	...	17,582	Phulavan River.
Totals					11,88,755	2,01,978	13,90,733	

2. Minor Bridges.

IV. Bridgework.

Particulars, Pages 40 to 53.

Item.	Amount.		
	Indian.	English.	Total.
	Rs.	Rs.	Rs.
EASTERN SECTION 202 Minor Bridges	1,74,376	6,106	1,80,482
GHAT 190 " "	7,67,262	...	7,67,262
WESTERN 37 " "	62,701	273	62,974
Total	10,04,339	6,379	10,10,718

TINNEVELLY-QUILON RAILWAY. (Gauge 3' 3 3/8".)
ABSTRACT ESTIMATES.

V. Fencing, etc.

Particulars, Page 54.

1. Fencing.

Item.	Quantity.	Rate.	Per.	Amount.
Wire Fencing at 10 Stations, each 0.91 mile	9.1	Rs.		Rs.
" " Quilon	1.4			
" " Sundry places	4.5			
Total miles.	15.0			
INDIAN CHARGES	15	486	Mile.	7,290
ENGLISH	15	1,314	"	19,710
Total Indian and English.	15	1,800	"	27,000

V. Fencing, etc.

Particulars, Pages 54, 55.

2. Road Crossings.

Item.	Quantity.	Rate.	Per.	Amount.
Road Crossings with 24 gates		Rs.		Rs.
" " " 12 "	4	1,146	Each.	4,584
" " " posts and chains	37	804	"	33,078
	45	260	"	11,700
Total				49,362

V. Fencing, etc.

Particulars, Page 55.

3. Mile and Gradient Posts.

Item.	Quantity.	Rate.	Per.	Amount.
Mile Posts		Rs.		Rs.
Gradient Posts and Pillars	103	12	Each.	1,236
Tangent Pillars	508	30	"	15,240
Numbering Telegraph Posts	346	20	"	6,920
	2,060	0.5	"	1,030
Total				18,426

TINNEVELLY-QUILON RAILWAY.

(Gauge 3'-3 3/8").

ABSTRACT ESTIMATES.

VII. Ballast and Permanent Way.

Particulars, Page 56.

1. Ballast.

Item.	Quantity.	Rate.	Per.	Amount.
		Rs.		Rs.
Main Line ... Miles...	103.33			
Sidings:—				
Pettai	0.61			
Shermadevi	0.61			
Kaladakuruchi	0.61			
Ambasamudram	0.61			
Kadyam	0.61			
Tenkasi	0.61			
Shenkotta	0.41			
Ariankavu	0.41			
Utakal	0.61			
Ponalur	0.61			
Kotarakara	0.61			
Kundurai	4.06			
Quilon				
Total Sidings...	10.98			
Total ...	114.31	3,000	Mile	3,42,930

VII. Ballast and Permanent Way.

Particulars, Page

2. Permanent Way

Item.	Quantity.	Rate.	Per.	Amount.
		Rs.		Rs.
INDIAN CHARGES.				
Main Line Miles...	103.33			
Sidings (See under "Ballast") ...	10.98			
Total Indian	114.31	9,125	Mile	10,43,078
ENGLISH CHARGES	114.31	5,815	"	6,64,712
Total Indian and English	114.31	14,940	"	17,07,790

TINNEVELLY-QUILON RAILWAY.

ABSTRACT ESTIMATES.

VII. Stations and Buildings.

Particulars, page.

	Postal	Shermadost	Kaladatsurohi	Ambasemundram	Kadayan	Tenkali	Shankolia	Atrankora	Utkal	Ponahat	Kotabakra	Kundural	Qosim	Total
Station Building	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,125	1,125	1,500	1,500	1,500	3,750	21,000
Passenger Platform	820	820	820	820	820	820	820	410	410	820	820	820	820	9,840
Goods Platform	...	1,138	...	...	...	1,138	...	...	...	...	...	...	5,760	8,936
Platform Fence	1,400	1,400	1,400	1,400	1,400	1,400	1,400	...	...	1,400	1,400	1,400	1,400	15,400
Name Boards	50	50	50	50	50	50	...	...	...	50	50	50	50	650
Latrines	400	400	400	400	400	400	400	200	200	400	400	400	600	5,000
Lamp Posts	160	150	150	150	150	150	150	150	150	150	150	150	150	1,950
Yard and Approaches	1,000	1,000	1,000	1,000	1,000	1,000	1,000	600	600	1,000	1,000	1,000	3,000	14,200
Gates	125	125	125	125	125	125	125	...	...	125	125	125	250	1,000
Well, 6 ft. diameter	800	800	800	800	800	800	...	800	...	800	...	800	...	6,400
Ponteman's Shelters	80	80	80	80	80	80	80	80	80	80	80	80	320	1,280
Goods Sheds	...	1,000	...	...	1,000	...	...	...	...	...	...	...	4,000	6,000
Totals	6,325	8,433	6,325	6,325	8,433	5,616	3,415	2,615	6,325	5,525	-6,325	20,100	91,256	

VIII. Stations and Buildings.

Particulars, Page 58.

ABSTRACT ESTIMATES.

TINNEVELLY-QUILON RAILWAY.

VIII. Stations and Buildings
Particulars, Pages 59 to 68.

ABSTRACT ESTIMATES

TINNEVELLY-QUILON RAILWAY.
ABSTRACT ESTIMATES.

(Gauge 3'-3 1/4")

VIII. Stations and Buildings.
Particulars, Pages 59 to 68.

ENGLISH CHARGES.

4. Station Machinery.

	Pettai.	Shenmugav.	Kadayan.	Tenkasi.	Shenkotta.	Athakav.	Uthai.	Ponshur.	Kottarakkum.	Kundakur.	Quilon.	Total.
Water Columns	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...
Piping	...	...	...	...	...	...	...	...	...	...	...	...
Water Tank, 1024 cu. ft.	...	...	...	...	...	...	...	...	...	...	...	...
Hand Pump	...	...	...	...	...	...	...	...	...	...	...	...
Points and Crossings	...	...	...	...	...	...	...	...	...	...	...	...
Signals home	...	...	...	...	...	...	...	...	...	...	...	...
" distant	...	...	...	...	...	...	...	...	...	...	...	...
Weighing Machines, Goods	...	...	...	...	...	...	...	...	...	...	...	...
" Parcels	...	...	...	...	...	...	...	...	...	...	...	...
Dating Presses	...	...	...	...	...	...	...	...	...	...	...	...
Turntable	...	...	...	...	...	...	...	...	...	...	...	...
Totals	1,974	1,974	1,974	1,974	6,441	1,555	6,022	1,974	6,441	1,974	11,967	52,685

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TINNEVELLY-QUILON RAILWAY. (Gauge 3'-3 3/8")
ABSTRACT ESTIMATES.

XI. Plant.

1. Engineering.
2. Locomotive.
4. Station and Office Furniture.

Item.	Indian.	English.	Total.
<i>Mileage rates are based on actual expenditure on recently opened lines.</i>			
<i>Rate for Engineering plant includes only Open Line plant. The cost of plant for construction goes against the works on which it is used.</i>			
ENGINEERING PLANT ... 103 Miles @ Rs. 120...	12,360	...	12,360
LOCOMOTIVE PLANT ... 103 Miles @ Rs. 60...	1,180	5,000	6,180
STATION AND OFFICE FURNITURE... 103 Miles @ Rs. 150...	15,450	...	15,450
Total...	...	...	33,990

XII. General Charges.

1. Direction.
2. Engineering.
3. Stores.
4. Audit and Account.
5. Medical and Sanitation.

Item.	Mile.	Rate per Mile.	Amount.
<i>Mileage Rates are based in actual expenditure on open lines especially the Bellary-Kistna Railway.</i>			
DIRECTION	103	700	72,100
ENGINEERING	103	6,000	6,18,000
STORES...	103	500	51,500
AUDIT AND ACCOUNTS	103	300	30,900
MEDICAL AND SANITATION	103	100	10,300
Total ...	103	7,600	7,82,800

11

TINNEVELLY-QUILON RAILWAY.

(Gauge 3'-3 3/4")

103.33 Miles.

List of Articles Required from England.

Item.	Quantity.	English Cost.			Rate of Exchange.	English Cost in Rupees.	Indian Charges.	Total.	Date by which delivery is required.
		P. O. B.	Freight.	Total.					
		£	£	£	Rs. 18 per £ 1 or 13-3 pence per rupee.	Rs.	Rs.	Rs.	13
Major Bridges, Girders	1,043 tons.	10,200	1,021	11,221		2,01,978	5,105	2,07,083	Not known.
Minor "	30-09 "	322	32	354		6,379	180	6,559	
Fencing	15-00 miles.	974	121	1,095		19,710	605	20,315	
Permanent Way	114-31 "	31,683	5,245	36,928		6,64,712	26,225	6,90,937	
Station Machinery	"	2,777	150	2,927		52,685	750	53,435	
Plant, Locomotive	"	250	28	278		5,000	140	5,140	
Total	"	46,206	6,597	52,803		9,50,454	32,985	9,83,439	

TINNEVELLY - QUILON RAILWAY.

Note by Consulting Engineer. for Railways, Madras.

Location - The report gives very accurately the history of the 2 routes, Northern and Southern, advocated by the Travancore officials and the engineers of the South Indian Railway.

2. As, in 1886 it was ordered by the Madras Government that the route chosen must rest with the Travancore Government, and the cost of the entire Survey having been accepted by them in 1894, The Northern route was ordered to be surveyed in detail connecting the towns of Tinnevelly - the terminus. - Shermadevi, Kalada-kundu and Tenkasi in British territory and Shencotta in Native - by way of the Tambraparni river - which is twice crossed instead of the direct line to Tenkasi which is destitute of inhabitants and cultivation.

3. From Shencotta mile 45 to Ponalur mile 76 the orders were to select the best engineering line over the Ariankavu pass with grades of $\frac{1}{80}$ and curves of 10-573 feet radii.

4. From Ponalur mile 76 to Quilon mile 103 a modification of the route known as Mr. Valentine's route has been taken to serve the town of Kotarrakara which was desired by the Travancore Government.

5. The Engineer-in-Chief by putting the $\frac{1}{80}$ grades on the straight and the curves of 573' R on $\frac{1}{75}$ grades has located a better alignment than either Mr. Logan who advocated $\frac{1}{30}$ grades or Mr. Valentine who assumed $\frac{1}{80}$ grades, and he crosses the summit by a tunnel of 3500 feet in length at mile 54 $\frac{1}{2}$ at an elevation of 850 feet.

6. The relative costs of the preliminary detailed

detailed surveys are:-

Mr. Logan's preliminary survey revised by the Consulting Engineer in 1886

106 miles costing 80,81,846 = 78,400 per mile

Mr. Valentine's revision of above

106 miles costing 94,38,931 = 89,000 per mile

The present detailed survey

106 miles costing 101,62,018 = 98,845 per mile

7. I gather from the reports Mr. Logan's line crossed the pass at an elevation of 1187 feet and Mr. Valentine's at an elevation of 1000 feet. While as noticed before Mr. Shadbolt's line crosses at 850 feet so that he saves 287 and 150 feet of height for every ton of weight hauled over the pass as well as having easier gradients, ^{and} ~~so that~~ the engines in use on the South Indian Railway will be able to take full trains over the ghaut without being divided. Moreover the working expenses will be less than in the case of the cheaper lines.

8. The plans of the ghaut are without contours and meagre so that detailed criticism of the location is impossible.

9. Construction. The facilities appear particularly good - stone can be obtained throughout - bridge foundations are reported good, though no borings appear to have been made, and a great many bridges are arched which is an advantage, though I am doubtful if the local mason can build the 60 feet elliptical arches designed.

10. At the Ana Viaduct 6 spans of 150 feet the masonry piers of which are 300 feet high. I suggest steel piers as possibly more economical.

No data for calculating the waterway of the bridges is

given.

11.

11. ²⁸/₂₅ The amount of bridging and earthwork per mile is moderate and cannot I think be reduced.

12. Fencing if used at all should be of wire not live fences which have proved costly to maintain.

13. Permanent way and Ballast. It is not stated what quantity of ballast is estimated for under the heads of sand and broken stone but the former is only admissible under metal sleepers. I am doubtful of the economy of jungle wood sleepers, it all depends on the quality, which is not specified.

14. If the 41 lbs. rail be adopted which I do not recommend, there should be one or two extra sleepers to each rail length. As there are 20 miles of ghaut, this should certainly have the 50 lbs rail.

15. Stations. To render the Quilon station complete for export and import traffic the line should be continued to the sea face.

16. The other heads of estimate call for no remark and I do not advise any reduction in the total estimated cost of 98,845 Rs. per mile.

17. Traffic. Mr. Shadbolt, to estimate this, takes corresponding (or nearly so) lengths of the Madras and South Indian Railways from which he assumes Rs. ^{Rs. mile per week} 150 may be expected and this will pay (working expenses being 55% of gross earnings) $8\frac{1}{2}$ per cent on the capital cost.

18. There are no available statistics of traffic but the above would mean 280 tons of goods over the whole line daily at 9 pias per ton mile and 1028 passengers over the whole line daily at 2 pias per mile.

19. I append the opinion of Devan V. Ramengar in

83. I append to this letter some notes furnished to me by Mr. Horsley as to the relative merits from his point of view of the rival routes.

84. I also forward copy of an address lately presented to His Highness the Maharaja signed by Mr. Cameron, of the Scottish Indian Coffee Company, Mr. Darragh and other merchants and traders, who are non-officials and keen men of business, urging the adoption of the northern route.

85. Lastly, I may add that the Travancore Government do not stand alone in their advocacy of the northern route. Mr. Puckle, Mr. Macgregor, Mr. Barton, Mr. William Logan, have all advocated it before them, and they are all men intimately acquainted with the country and competent to form a sound opinion on the question.

86. After what I have stated above, it is scarcely necessary for me to add that, on a careful reconsideration of the merits of the alternative routes, His Highness is clearly in favour of Quilon being made the terminus of the railway and of the northern route, through the Tambraparni valley, Shencottah and Punalore, being adopted.

87. A light railway from Trivandrum to Kottai, costing perhaps some 10 or 12 lakhs of rupees, would serve all the purposes of the passenger and goods traffic, present or prospective, between those places, and this the Travancore Government can supply at any time.



Argued
30
645
CURRENT NO. 1548
PUBLIC WORKS DEPARTMENT,
RAILWAY BRANCH.
PROCEEDINGS OF THE MADRAS GOVERNMENT.

Read the following

Letter from the Government of India, Public Works Department, No. 1092 R.C. dated 31st October 1894.

In continuation of the Government of India's telegrams No. 1077 R.C., dated 25th October 1894 and No. 1091 R.C., dated 31st October 1894, I am directed to convey the sanction of the Government of India to the estimate received with your letter No. 1178 D, dated 9th October 1894 amounting to Rupees 72,000-0-0 of the cost of the Tinnevely-Quilon Railway survey (northern route).

2. On the Travancore Durbar paying the cost of the survey into a Government treasury, the work may be put in hand the amount received being credited to Deposits in the accounts of the Examiner, Public Works Accounts, Madras and the outlay being recorded against that head. A report should be made for the information of the Government of India.

3. You will be addressed in a separate communication about staff of the survey.

Letter from the Resident in Travancore, to the Chief Secretary to Government, Madras, No. 3577 dated 7th November 1894.

Order thereon, No. 628 R. dated 30th September 1895.

The plans and estimates of the Tinnevely-Quilon ---
railway Survey with a note by the Consulting Engineer for Rail-
ways, Madras, will be forwarded to the Resident in Travancore and
Cochin through the Political Department for the consideration -
of the Travancore Government with the hope that the study of -
them will result in an early statement of policy that may lead
to Railway communication being established with the South Indian
railway system.

As far as the project in British territory is con-
cerned the Madras Government is of opinion that the alignment
to the border is one most likely to serve the district and the
estimate may be accepted.

(True Extract)

F. K. Russell

Joint Secretary to Government,

P. W. D. Railway Branch.

To,

The Political Department.

NO. 1318

Post Sept 18

1895.

Public Works Department.

Railway Branch.

CHIEF SECRETARY
30. SEP. 1895
GOVERNMENT OF MADRAS

No. 628.22.

Dated *30th September 1895*
Despatched *Do*

Received *330*
Regd

Encls *3*

SUBJECT.

*Tinnevely-Quilon
Railway Survey*

*Forwarding plans
and estimates with note
by Cons. Eng. for P.W.D. for
the consideration of the
Travancore Government*

598: 7-9-95 lat
papers.

32
645



Political
Department.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Read the following paper:—

Proceedings of the *Public Works* Department, *By Branch,* dated 30th September 1895.
No. 628.R

ORDER, dated 30 Sept 1896, No. 645 his

Resident in Travancore & Cochin
Communicated to the ~~Accountant General~~

Early action

CB. 30/9/95
1/10/95

~~True Extract~~

Resubmitted to Ld. of the Interior
to the drafts.

20/9/95

Chief Secretary

Send to CB. with file

Rest in JSC (with file in orig) 30/9
To the ~~Accountant General~~ *By Branch*
Department.

FINANCIAL.

To
THE ACCOUNTANT-GENERAL.

ted
ed.
l.

G.O., 189 , No.

SUBJECT.

Communicating Proceedings of the
Department regarding

ORDINARY, MS.

2
645

Pol. DEPARTMENT.

G.O. DATED 30-9-95
No. 645

When given for copying.

[Despatch Abstract.]

Comm. to the Res.
in Travancore & Cochin
for early action, Pres.
P.W.D., Railway
Branch, forwarding
for the consideration
of the Travancore
Govt. plans and
estimates in connection
with the Tinnevely-
Sivilon Railway
veg.

1793/75

277/96

842/96

Transferred
26/2/96

AS AGRAN ORDER OF GOVERNMENT, TATED
185, No. MISCELLANEOUS.

STATEMENT WITH DITTO

ORDER OF GOVERNMENT

ORDER OF GOVERNMENT

STATEMENT WITH DITTO

PATENT NOT FILED AT, BEING HELD FOR DISPOSITION
IN ORIGINAL (not paper).

A - Copy in full
B - Not to be copied
C - Copy abstract only
D - Copy leading only