

Public Works (1895) Department.

RAILWAY BRANCH.

G.O., No. 639-40R

DATED 4th October 1895

[Despatch Abstract.]

Brisbane. Mangalore Railway Survey. — Order
that the plans estimate & report on the same
by the Comdg. Engineer for Railways, be forwarded
to the Govt of India.

Forwarding Pros. on the plans estimate
and report on the — Submitted by the Comdg.
Engineer for Railways.

BACK PAPERS.

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FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

ARSIKERI-MANGALORE RAILWAY REPORT,

1895.

REPORT.

Preliminary.—(a) The survey of the Arsikeri-Mangalore Railway was undertaken under the orders of the Government of India conveyed in notification, Public Works Department, No. 416, dated 27th October 1894.

The object is to establish railway connection with Mangalore, a sea-port on the Western Coast, from Arsikeri, a station on the Southern Mahratta Railway (Mysore section), about 160 miles north of Bangalore. The length of the line has been estimated at 137 miles, but this has been obtained from the length of the road and in the final result it is expected to be about 143 miles, the extra length being due to the gradients necessary for an adhesion-line. The origin of the survey is, an application from Messrs. Kirby and Lonsdale for a concession for the construction of a line from

G.O., No. 819 R., 23rd March 1893.
 " " 818 R., 6th May 1893.
 " " 819 R., 6th "
 " " 152 R., 10th March 1894.

Arsikeri through Hassan to Mangalore with branches from Hassan to Mysore and Chickmagalur and an extension from Nunjengod in Mysore territory through Satya-Mangalur to Erode on the Madras

Railway, where it would effect a junction with the narrow gauge system of the South Indian Railway. As a result of these negotiations the survey now under submission was taken up as it really forms the main feature in the schemes proposed.

The primary object is to obtain an outlet for the Mysore State to a port and Mangalore has been for ages the port which has served Mysore. From its situation on the West Coast it is liable for three months every year to the full force of the monsoon and the only routes by which either merchandise or travellers can leave involve a long land journey over roads much cut up during the heavy rain. Mangalore contains a large mercantile population and is a wealthy town and is about the northern limit of the Moplah population who are known to be subject to periodical turbulent out-breaks, and were this to occur at Mangalore from where the garrison has been now removed, it would take at least a week before troops could be brought upon the scene.

Further, the province of South Canara is rich in crops irrigated by the Nitravati and other large rivers which never fail owing to the south-west monsoon, and had transport been available much of the distress in Mysore during the disastrous famine of 1876-77 would have been prevented.

(b) The previous reports will be found in the Government Orders quoted above and with regard to them it is only necessary to point out that a very serious clerical error has crept into the report by Mr. McFarlane at page 8 which has led to the hope that a gradient of 1 in 84 would be possible. This results from the level of the road at the Frontier being given as 1,733

G.O., No. 2043 R., 20th August 1892.

feet above sea-level instead of 733 feet, and this error has been carried through much of the subsequent notes.

(c) From Arsikeri to Hassan the country is much the same as Mysore generally, open rolling plains with deep depressions and high ridges between the valleys. For these 30 miles the line proposed has been located as far as Hassan by the Mysore Government and the attention of the party was chiefly directed to the portion to be done between Hassan and Mangalore. After leaving Hassan the country falls for some 4-9 miles to the Yagatchi river and after crossing another smaller river rises to Palya on the main road. Beyond Palya the rise continues to a place called Barlo at which coffee land is first met. From Barlo to Suklaspur the fall is 360 feet, the whole of which occurs on the road in the first 4 miles from Barlo and the railway has therefore to take a route to the eastward along the ridges dividing the watershed between the

Yagatchi river and the Hemavati which entails increased length to the extent of 3½ miles. At Saklaspur the Hemavati is crossed by the road on an iron bridge of 4 spans of 120 feet supported on screw piles and immediately to the west of the river lies the town of Saklaspur, head-quarters of the Manjarabad taluk. Saklaspur is situated on the end of a ridge branching out from the actual watershed of the Western Ghâts and along this ridge the road runs too close to the Manjarabad hill on which is an old Fort evidently built to command the pass in former days. The actual ridge of the ghâts between the east and west watersheds runs north at about one mile north of Manjarabad and along this watershed the Mudugherry road has been laid out. Mr. Groves' trace crosses this Mudugherry road at a saddle about 3 miles north-east of Manjarabad and measured directly about 1½ miles from Saklaspur. There is, therefore, a very peculiar physical feature at this point in the fact of a river of considerable volume, requiring to span it 4 spans of 120 feet, running parallel to the actual watershed of India only 1½ miles distant and only 83 feet below the saddle, which has been selected for the proposed railway to pass through for the descent to the western plains.

The reduced level of Saklaspur is 2,960 } Difference 83.
The reduced level of saddle is 3,043 }

The river on the western face is the Yettenhalle and the road circles under the Manjarabad hill until it reaches a point in the valley 6 miles from Saklaspur where it crosses the Yettenhalle at reduced level 2,628. The reason for this is that the road abandons the Yettenhalle valley and rises in 2 miles 300 feet to cross into the Maran-halli valley and so work through easier country. The actual descent of the road begins only at 11 miles from Saklaspur up to which point the total fall has been only 525 feet. The railway trace sticks to the Yettenhalle valley and falls only 533 feet in a distance of 7½ miles from the ridge, or 10½ miles from Saklaspur, and at this point enters a gorge down which the river rushes in a series of falls. The reduced level at the head of the gorge is 2,480. From this point the 1 in 40 carried out by Mr. Groves for some seven miles began and at first sight it appeared hopeless to get a 1 in 40 line down a valley in which the road falls 1 in 20. Before debouching on the plain the fall of the road becomes very gradual and, in the result to be explained more fully hereafter by economising every foot and utilizing every favourable spur, a line has been obtained which will meet the line in the plains without any loss of direction or deviation to the north. The road ghât ends at a place called Kemphole 18 miles from Saklaspur and has on it only one zigzag of about ¼ mile in length, its mean gradient being 1 in 27 throughout, but about 1 in 20 on the steepest part of the descent 6½ miles in length. The frontier is at Marlbid 21 miles from Saklaspur and Seradi; the first village in South Canara is eight miles beyond.

The reduced level at the Frontier is 724.
Reduced level at Seradi is 340.

From Seradi to Mangalore the distance by road is 53½ miles and the average fall of the country is only about 6 feet per mile. But the spurs of the ghâts run into the plains nearly as far as Uppinangadi 32 miles from Mangalore and, though of no height, makes the country difficult to work through as it is densely wooded and each line has to be cut and cleared, only to find that some saddle obstructs the trace and a fresh start has to be made. This has been finally settled by breaking through into the valley to the south and putting the bridge over the Nitravati at a point near Uppinangadi. From Uppinangadi to Mangalore the north bank of the Nitravati is obligatory, for a larger tributary, called the Coomodari, comes in from the south, which would require a bridge as large as that of the Nitravati itself, and the subsequent bridge over the Nitravati at Buntwal would be a very long one.

Through South Canara there are no maps of any reliability, the G. T. maps not yet being published; but all existing maps show the main road from Pani-Mangalore to Uppinangadi as on the north bank, whereas it is on the south bank. The country on the north bank has been found from inspection to be well suited for a railway, except near Uppinangadi, where the location being near, the river is necessarily rough the banks being high and steep. From Uppinangadi towards Mangalore the line has been actually located up to near Sirpadi along the bank of the Nitravati. From Sirpadi to Buntwal a ridge runs along the river which will provide a favourable

location and reduce the provision for waterway. A mile from Buntwal, a large stream is crossed which will probably require three spans of 60 feet. Buntwal stands on a hill on the river bank with flat paddy land behind it, and along this the line will run to the Pani-Mangalore ferry. From this to Feringipet, 9 miles from Mangalore, the road rises and falls a good deal owing to the spurs running down to the river; so, as far as can be seen until the work reaches this place, the best alignment will probably be along the river to Feringipet. From thence the whole alignment will be on paddy land to Jeppo, a suburb of Mangalore where extensive coffee works (Morgan and Co.) and tile works (Basel Mission) are situated. It is also an important market centre and the Civil authorities attach importance to its having a station. From Jeppo into the Salt Cotaurs, the line will skirt the river, some little reclamation being required until it reaches the Salt Cotaurs where it is proposed the station should be situated with an extension along the Bunder to meet mercantile requirements.

(d) The gauge is proposed to be the metre gauge, that being the gauge of the Southern Mahratta Railway system and also of the South Indian Railway system with which the other branch lines are proposed to connect it. The group of lines thus proposed would therefore form an important link in the metre gauge system of India, while the line now under survey would give a valuable outlet for the produce of the province.

(e) The fixed point is the same as that used for the survey already sent in by the Mysore Government of the Arsikeri-Hassan section, namely, the "centre of the passenger platform of the Arsikeri station of the Mysore section of the Southern Mahratta Railway."

(f) The total length of the line is expected to be 143 miles, of which 83 miles lie in the Mysore province and 60 miles in South Canara.

Location.—The actual location of the line has been guided by the results of previous work done and has required much modification. The compensation for curvature too involves not only heavier work in the section but greater length. So far, on the line selected, all the curves have, with a few exceptions, been compensated; but without compensation a very much lighter section could be shown. It is a question whether with a ghât gradient of 1 in 40 intervening gradients of 1 in 100 with flatter curves need be compensated. The result of this season's work points very clearly that the ghât if the grade be reduced to, say, 1 in 40 nett, the curves will be easier in consequence of there being more room further down the hill side on each spur and some of the valleys, notably the Kemphole, will yield better crossings lower down the valley.

Division I.—This division extends from Hassan to Saklaspur and has been under Mr. W. P. Milne, Executive Engineer. The work on the ghât proving too much for the limited staff, Mr. Milne was deputed to survey the upper section of the ghât to ensure, as far as possible, a through section. The junction with the work completed by the Mysore Government was made at a point some 49 chains west of Hassan and the station site selected has been retained in the scheme as now submitted. From what can be seen and from what is known to be the wishes of the Durbar, the site of the station will require reconsideration and there will be no difficulty in getting a more convenient site which will interfere less with existing roads and probably afford a better gradient out of the station. The route follows somewhat the line of the main road to Mangalore and at mile 34½ crosses the Yagatchi river about 1½ miles north of the road. The area drained by the Yagatchi is 373 square miles, which would, according to Dicken's formula using coefficient 1,200, require a waterway of 600 feet. A bridge with 4 spans of 40 feet arches has been adopted, as the road bridge 1½ miles lower down consists of 7 spans 25 feet arches and has stood for over 50 years. It has been necessary to deviate from the line of the road and pass through Alur, an important sub-taluk head-quarters, to which a branch road has been made as the route followed by previous survey through Palya on the main road was not feasible at 1 in 100 ruling gradients. It is proposed to investigate a more direct route from Alur to Saklaspur avoiding the Balol saddle and probably shortening the line and saving a considerable rise. The line laid out has ruling gradients of 1 in 100 which do not quite fully compensate the curves for a 12 feet wheelbase, but on revision there is no doubt this will be obtained and the work very much lightened by slight

deviations from the present alignment. At Saklaspur the Hemavati is crossed on a bridge of 5 spans of 100 feet girders. The drainage area is 230 square miles, while the road crosses on a bridge of 4 spans 120 feet. The extra span has been put in to suit the channel and avoid a high bank subject to flood. On the west bank is the station of Saklaspur, the head-quarters of the Manjarabad taluk and an important town, as, near it, roads converge from the Mudugherri and Coorg directions. From Saklaspur to the actual ridge which divides the watershed of India is only 2 miles distant from the Hemavati and the rise only 53 feet.

Division II.—The second division, Saklaspur to the Frontier, has been under Mr. Lilley, Executive Engineer, but the work was so far in excess of what was possible with the limited staff that Mr. Milne's work was stopped in March and he was sent to run the upper six miles of the ghât from Saklaspur to the Yettenhalle crossing. The Hebsalaridge referred to as the actual watershed carries the Mudugherri road which crosses the railway by an overbridge and the upper descent of the ghât begins. The route down the valley is necessarily tortuous with minimum curves of 10° or 573 feet radius and gradients 1 in 66 and 1 in 51, all fully compensated. The Yettenhalle bridge is reached at mile 64½ and at a reduced level of 2,627. The main road here ascends and the railway follows the course of the river as far as the 67½ mile, where it enters a gorge by a tunnel 140 yards rendered necessary by a bend in the stream. At this point the reduced level is 2,480. From this point the lower ghât begins and it has been carried out at a gradient of about 1 in 52, which fully compensates for all curves, so that the gradient should be more properly described as 1 in 40 compensated. From the original trial line run by the Mysore Government it was evident that, without special expedients to gain base, the line would be carried north along the face of the ghât and that owing to the steep beds and continually narrowing valleys the crossing of them would be most difficult. It was therefore arranged to circle two spurs twice, which has resulted in the necessary base being obtained about two miles. The lower ghât contains numerous viaducts and tunnels which the sharp spurs and narrow valleys necessitate. For the viaducts a tentative design has been taken consisting of trestles and 40 feet girders, longer spans being inadmissible on account of the curves. It is clear from this season's work that it would be impossible to cross the Kemphole river at any point further up stream than the crossing now proposed and that the adoption of a steeper grade would place the line more favourably in the valley for crossing. The minimum curve has been maintained at 573 except in a few instances where sharper curves were absolutely necessary. It was considered better to get the line through and establish a good base for the next season's work than to delay trying to get in easier curves which would vastly increase work. The line is now within some 3 miles of the frontier and it will run out close to the Kabbanhalli bridge. The gap at this point unsurveyed, is estimated at 10 miles, of which 8 are on the ghât.

Division III.—The third division, Mysore frontier to Mangalore, has been under Mr. Farewell, Temporary Engineer, who was instructed to begin at Seradi pending the completion of the ghât, as it was doubtful where it would work out. This has proved a very difficult piece of country, there being no maps available of any reliability. One map 4 miles to the inch, dated 1827, is very inaccurate and the more recent surveys are not yet published. The line follows the Kemphole river till it bends to the south when it continues east and crosses the Perisaunt saddle which divides the watershed between the Kemphole and Nitravati rivers. The original trace followed the Ooperhalle, a tributary of the Nitravati, but many trial lines proved it was best to avoid this and tending to the south reach the Nitravati near Uppinangadi, which gives a considerable saving in length and avoids much steep and broken country. The spurs from the hills run out as far as Uppinangadi and the ravines are deep and tortuous, so that a line down the Ooperhalle is not at all a favourable one. The whole country is densely wooded and each line has to be cleared which hampered the work. Crossing the Nitravati about 1 mile above Uppinangadi, the line follows the north bank to Sirpadi, which is about 25 miles from Mangalore, but no map exists from which this can be ascertained. From where the work has stopped near Sirpadi, the country is open and easy and the fall into Mangalore very slight.

The whole project, as now submitted, will, on detailed revision, be much reduced and, where necessary, steps will be taken to secure extra length for compensation of gradients on curves.

Alternative Routes.—The only alternative route which suggests itself is that from Alur to Hulsuligo near Belagode about 5½ miles from Saklaspur, but the country does not appear promising as it is much broken. This will, however, be taken up at once.

The other ghâts, namely, the Boon or Charmadi ghât on the north and the Bisley ghât on the south, have been apparently condemned as unsuited to a railway and there is no doubt that two-thirds of the Mangalore trade follows the Seradi route. Arrangements are being made to send out a party at once to see if any improvement can be effected in the alignment already selected by the Mysore Government between Arsikeri and Hassan. In some places the route seems from the section to be unnecessarily tortuous, and it would be perhaps a lasting advantage to straighten some parts, even though it did involve extra work. The portion referred to is at miles 5 to 15, where the plan shows the line running through mountains and the section at these points only exhibits small cuttings. It is quite possible that the plans do not correctly show the depressions of the valleys, but it has been impossible to go over this portion, as the plans were only received from the Mysore Government in July and the whole staff were engaged on their own division till the end of May.

One other point to which attention must be given is the alteration of the site of the station ground at Hassan previously referred to.

Gradients and Curves.—Above the ghât and below the ruling gradient has been taken at 1 in 100 compensated and the minimum curve at 6° or 955. On the ghât the grade is 1 in 40 compensated, which works out to about 1 in 52. On the sections submitted, the compensation has been calculated for each curve on the 12 feet base as given in the published diagram and a through grade shown. It is not considered that this will materially affect quantities and with so many curves the frequent changes of gradient would have greatly increased the work of reduction on the sections. In one case, on the first division, Hassan to Saklaspur, there is a gradient 1 in 100 which is uncompensated, but this will, it is believed, be eliminated by the proposed alternative route.

On the ghâts the gradients have all been compensated; but it adds very greatly to the length, about 4 miles.

The curves have been kept as far as practicable at the minimum radius; but in two cases it was necessary to put in 350 curves, 7 curves 400, 6 curves 500. As before mentioned, with the grade reduced to 1 in 40 or 1 in 45 nett and a minimum curve of 500 feet, a greatly reduced section would result and the tunnels diminished.

On the third division, Frontier to Mangalore, the ruling gradient has, in all but two cases, been compensated and in revision this will be effected. The minimum curve has also been obtained, but on the plans sent in there is one curve of 570 feet radius which will now be altered. Five curves of 716 also appear on an alternative line adopted, which will all become 955 radius on revision. For the remaining 25 miles the curves will all be easy and the gradients very slight.

Construction and Engineering.—(a) The general character of the work may be described as heavy both on the Mysore plateau and below the ghât, while the ghât on account of its very sudden fall is much broken up by deep ravines which make the section heavy.

(b) The lineal feet of waterway is as below:—

				FEET.
I Division,	Hassan to Saklaspur	...	...	59 per mile.
II "	Saklaspur to Frontier	...	...	179 "
III "	Frontier to Mangalore	...	...	75 "

The total lineal feet of waterway is—

			Minor.	Major.	Total.
I Division	...	...	493	1,460	1,953
II "	...	...	728	2,080	2,808
III "	...	...	987	1,060	2,047

and the average cost per foot run works out—

			Minor.	Major.	Rate over all.
			Rs.	Rs.	Rs.
I Division	...	...	419	321	346 per ft. run.
II "	...	...	555	404	457 "
III "	...	...	434	363	400 "

These rates are admittedly high and will probably be reduced. Arches have been adopted wherever possible instead of girders, and except for the larger bridges, the

quantities have been taken from stone's tables. On the ghâts the bridges are very high, the slopes are so steep.

There are in all 21 tunnels which aggregate 6,955 feet or 2,318 yards. No difficulties are expected, as it is believed that all tunnels will be hard and foundations rock except the Hemavati, where wells are proposed.

(c) Fencing has only been provided at stations. It is considered that a live fence in the climate, both above and below ghât would be successful, but no provision has been made for through fencing.

(d) The permanent-way proposed has followed the proposals of Messrs. Kirby and Lonsdale and is 50lb. per yard above and below ghât and 60lb. per yard between Saklasapur and Seradi. The sleepers proposed are teak, to be obtained either from Karwar or Burma. Timber sleepers, it is thought, are best suited to such a damp climate.

(e) Platforms have only been provided at Mangalore and Saklasapur.

(f) It is proposed to have running sheds at Saklasapur and Mangalore on the supposition that Saklasapur to Seradi will be worked as a ghât section and each of these will have a small workshop for minor repairs. It is presumed the Southern Mahratta Railway will work the line and effect repairs at Hubli or Bangalore.

(g) Water-supply for engine sheds and stations will be from wells except at crossing stations on the ghât where the perennial streams will be led into tanks relieved by an overflow pipe.

(h) The engine-changing stations proposed are—

Arsikeri	...	...	...	...	...	...	...	0
Saklasapur	...	...	...	...	...	...	...	57½, run 57½
Seradi	...	...	...	...	...	...	...	90 „ 32½
Mangalore	...	...	...	...	...	...	...	143 „ 53

and it is thought that twelve engines would suffice, four of them being special ghât engines with short wheel base.

Labour and Materials.—Labour will all have to be imported from the Deccan, as what little labour is available is all engaged on the coffee estates. The country is very sparsely peopled in Mysore; on the ghâts the villages are few and from Marnhalli, near the 68th mile to Seradi, there are scarcely any inhabitants, the country is so unhealthy. There will be great difficulty in carrying out the work on this portion, the natives dread the locality so much.

Materials of excellent quality are available, but the leads for stone in South Canara will be long. Gneiss only occurs in places and the laterite has proved useless for building purposes.

Throughout the whole distance there is an excellent road from which most parts of the line could be reached, some will, however, be very difficult of access till the formation is made.

Wood fuel is available in any quantity in South Canara and on the ghât.

It was hoped from the magnificent appearance of the South Canara forests that they might be made to yield a good supply of sleepers, as teak is plentiful in the neighbouring collectorates, but the forest officer's note holds out no hope of this. Sleepers for current renewals of a wood called bhogi, and which is believed to be the same as pyangadu or akin to it, will be always available and by the time renewals are required the development of the forests may have so increased under careful conservation as to yield enough to make South Canara a future source of supply for sleepers.

Arrangement of staff.—It is proposed to locate the head-quarters of the Engineer-in-Chief and Examiner in one office at Bangalore, where accommodation can be obtained, and so avoid more temporary accommodation on the line.

Direction.—

- 1 Engineer-in-Chief.
- 1 Assistant Engineer Personal Assistant.
- 1 Head Clerk.
- 1 Head Draftsman.
- 6 Clerks.
- 3 Assistant Draftsmen.
- Jemadars, peons, menials.

For purposes of construction it is proposed to divide the whole length of 143 miles into 3 divisions—

Length.					Head-quarters.	
I.	0 to 58.3 miles	...	...	...	58.3	Hassan.
II.	58.3 to 83.5 „	...	...	...	25.2	Saklasapur.
III.	83.5 to 143 „	...	...	...	59.5	Mangalore.

In each division three sub-divisions are proposed and the head-quarters of the Assistant Engineers would be—

I { 1. Arsikeri. 2. Hassan. 3. Saklasapur.	II { 1. Saklasapur. 2. Marnhalli. 3. Kemphole.	III { 1. Siradi. 2. Uppinangadi. 3. Buntwal.
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The subordinates would be—

I	...	...	3 Upper, 6 Lower.
II	...	...	6 Do. 6 „
III	...	...	4 Do. 6 „

The extra subordinate allowed for the III Division will be required at Mangalore for the extra work along the foreshore, where some amount of reclamation will be required in connection with the approaches and Bunder lines.

The office establishment proposed for each division is—

1 Head clerk.	4 Tracers.
3 Clerks.	3 Sub-divisional clerks.
1 Cashier.	3 Time-keeper writers for upper subordinates.
1 Draftsman.	

The following extra skilled establishment is proposed:—

- 2 Permanent-way platelayers.
- 6 Permanent Sub-Inspectors.
- 2 Girder erecting foremen.

The Accounts Establishment—

1 Deputy Examiner.	3 Divisional Accountants.
4 Accountants.	3 Do. Accountant's clerks.
8 Clerks.	

The Stores Establishment—

1 Storekeeper, Arsikeri.	3 Divisional Storekeepers.
1 Assistant Storekeeper, Mangalore.	1 Permanent-way Storekeeper.
2 Sub-Storekeepers, Mangalore.	10 Clerks.

The Medical establishment will, owing to the unhealthy nature of the climate, be as follows:—

	Apothecaries.	Hospital Assistants.
I Division	3	1
II „	3	1
III „	3	1

(a) For traffic no special provision during construction will be necessary, except a few signallers and pointsmen, who would be charged to works—

(b) The estimate contains provision for temporary quarters and offices for each division with the exception of those stationed at Mangalore, which being an abandoned cantonment, contains a number of bungalows now vacant which could be

utilized for residences and offices. At none of the other stations through which the line passes is there any accommodation available. The only place where European bungalows exist is at Hassan and these are now fully occupied by the Native officials of the State. Hutting for workmen where necessary will be charged to works. This is only likely to be required on the ghât.

(c) The plateau of Mysore, that is as far as Saklaspur, is healthy, but the ghât is very feverish and at Kemphole the foot of the ghât reduced level 876·62 travellers were always warned against sleeping there. The Survey Staff suffered severely and had to be withdrawn to a higher level in April. Down as far as Uppinangadi the whole country is feverish and unhealthy, and this is the reason for including such a large Medical staff. During the monsoon all work on the ghât will necessarily be suspended, the rainfall being as heavy as 290 inches at Marnhalli, where the rain breaks on the face of the hills; 10 miles inland it is only 80 to 90 inches. During this season therefore and during the most unhealthy months the labour would be probably withdrawn to work on the Mysore plateau and in the lower plains of South Canara. The upper and lower sections of the line could be rapidly completed, but the ghât will require three to four years for completing. The Medical staff will be supplied with temporary quarters, dispensaries and shed hospitals charged to works.

Relations with the Public, &c.—(a) The route selected passes through no military cantonments or camping ground and in no place does it interfere with any public buildings, temples or mosques. At the very end of the current season's work a small Mussulman graveyard is passed through, and it is unfortunately at a place where it is difficult to avoid it. This will have consideration in the revision of the line. The only bridge which might be made available for artillery if considered necessary is the Nitravati near Uppinangadi which would save guns having to cross two ferries, but would entail a longer route through Beltinangady.

(b) The index plan through Mysore has been submitted to the Durbar, who state that they have no suggestions or criticisms to offer. At Mangalore the Collector was consulted and he approved of the site selected for the station. The original site was in the heart of the cantonment, a mile further on and 100 feet higher, which would have meant a heavy grade and an expensive line. The new site is in every way more convenient and less expensive. The districts of both Mysore and South Canara are well supplied with good roads and well bridged and no adaptation of railway bridges for cart or passenger traffic seems to be required.

(c) No case of interference has yet occurred with religious edifices and none are expected to occur.

Land.—The line passes through a poorly cultivated country alternating between waste, dry cultivation and a little rice under irrigation until mile 47 is reached where coffee cultivation begins and down as far as mile 68 the line runs through occasional patches of coffee. The lower ghât is all forest and so is the country down to Uppinangadi where there is a good deal of rice. From thence to Mangalore the land is about half waste, half rice. A through rate has been taken of Rs. 40 per acre, which it is thought, will cover all compensation.

Traffic and statistics.—(a) The traffic statistics of the Arsikeri station on the Southern Mahratta Railway are given in the report submitted with the estimates for the Arsikeri-Hassan section by the Mysore Government, and the station contains ample accommodation for the proposed branch. The stations proposed are—

Talur at 3½ miles.—This is the site of the Harnhalli gold mine and is close to the Harnhalli village. The mine so far has not been very successful.

Lagde at 15½ miles.—Is a moderately large village with an old fort.

Dudda at 19 miles.—A large village with an important market.

Hassan at 30 miles.—Is the head-quarters of the district and contains the Deputy Commissioner's Court. It is not a town of mercantile importance, but is the suggested junction for the branch to Chickmagalur and the connection to Mysore.

Allur at 37½ miles.—A market town and taluk head-quarters.

Barlo at 47 miles.—An unimportant village at the beginning of the coffee tracts and the junction of a road from the south leading to many coffee estates. This may be left out if the new alignment from Alur to Hulsulige be successful, in which case Belgod would be the site for a station instead of Barlo.

Hulsulige at 53 miles.—A coffee siding to serve the important group of estates near this. The position is not quite the most convenient for the planters, but it has been placed here on account of the grading. This will be adjusted on revision.

Saklaspur at 58 miles.—Taluk head-quarters, is a small town on the banks of the Hemavati and is expected to be the most important station between Arsikeri and Mangalore. It is proposed as a changing station for engines, and full provision has been made for staff quarters. Its elevation is 2,960 and the site of the staff quarters will be about 3,000 feet. For traffic it will be the centre for the coffee from Mudgero direction and the Coorg frontier.

Hebsala at 60½ miles.—This is only a coffee siding for the receiving of coffee and delivery of manure, &c.

Yettenhalli at 64½ miles.—This also is only a coffee siding to suit the estates on the Marnhalli and Manjerabad spurs.

These coffee sidings would only be open during the busy season and would be worked under the Saklaspur station.

Marnhalli Gorge at 67½ miles.—This is a proposed ghât-changing station, but it might be left out as it probably would be better to work the ghât engines right into Saklaspur.

Kardamonihole at 74½ miles.—This is a proposed siding for watering and crossing. The stream is perennial and the ascending train could back into the siding and water, while the descending train passed on.

Kemphole at 79½ miles.—Watering station.

Sera-ti at 90½ miles.—A small unimportant village; proposed engine-changing station.

Golitaltu at 101½ miles.—The station is about 1½ miles south of the village. It is expected to afford a considerable grain traffic.

Uppinangadi at 111½ miles.—The station is situated on the north bank, while the village is on the south bank, but the civil authorities do not consider this a disadvantage. A considerable grain traffic is expected. Putthur, the Tahildar's head-quarters, is 7 miles south.

Serpadi at 120 miles.—A large village with extensive cultivation at present entirely dependant on board carriage, there being no roads.

Buntwal and Pani Mangalore at 127½ miles.—These two villages are on the north and south banks, respectively, and are where the ferry is across the Nitravati. Large boats ply from here to Mangalore and are likely to compete with the railway for traffic.

Feringipett at 134½ miles.—A large village in the middle of much cultivation.

Jeppoo at 141½ miles.—A large village where the Basil Mission tile works are situated and also Messrs. Morgan's very extensive coffee cleaning works. It is also a large market and the civil authorities attach importance to a station being placed here.

Mangalore at 143 miles.—The terminus has been fixed at the Salt Cotaurs. A separate note on the port is in the appendix.

(b) The statistics regarding coffee, which is the principal product, have been treated separately and the general traffic prospects has been kept as low as possible to avoid any chance of over-estimating. The bulk of the traffic will certainly be towards the port, but if the improvements in the port are carried out an inwards traffic from Bombay by sea may be certainly expected. European merchants who have been consulted think differently. Some believe the opening up of Mangalore will change the direction of traffic, while others do not. North Mysore planters say that it will not benefit them, but there is a general idea among them all that unless the railway pass through their own estate it is to their advantage having once loaded in carts to cart the coast. Others think differently, but it is a fair assumption that so surely as the cart has with the improvement in roads entirely superseded the pack-bullock, so will the railway supersede the cart.

Local traffic is all that has been considered in the estimate, through traffic cannot be estimated, but the steamer agents feel very certain that it will be a very large one.

The pilgrim traffic to Sringeri is stated to be very large, but until the Chickmagalur line is made it must be regarded as a very doubtful factor in considering the passenger traffic, as pilgrims would be more likely to travel *via* Kadur on the Southern Mahratta Railway and walk to Sringeri.

From all that can be learnt there is no doubt that this line is much desired and that it is a line which will gradually grow in importance and become in time a remunerative line. It will never be an important trunk line and the ghât section may therefore be constructed with sharper curves and steeper gradients and worked as a special section without any risk of its hampering in the future by reason of this, the financial results of a great system. It must be regarded as an important outlet to the sea for the Province of Mysore and part of the Presidency of Madras, and when all the connections are made, an important link in the narrow gauge system of India.

General Remarks.—The only railway with which this can be compared is the Holkar Railway, the ghât is longer and more difficult and the rise very much greater, but the estimate as submitted compares favourably with the published statement of the cost of that railway. It is also to be remembered that, while the ghât section is heavier than the Vindhya ghât, the sections in the plains above and below ghât also are heavier than any portion of that railway.

The plans now submitted show all but the 10 miles gap at the foot of the ghât which has been fully allowed for in the estimate, and the 25 miles to Mangalore from Serpadi which has not yet been completed. The point on which the cost of the line chiefly depends is the ghât and if the grade be steepened, say, to 1 in 40 net and a curve of 450 or 400 feet radius adopted and it be made a special ghât section with special engines, its cost will be vastly reduced. Taking the length of the ghât over the lower section, beginning at 67.75 and ending at 68.4, a distance of 20.65 miles, the compensation for curves on the assumption that it will be 1 in 52 throughout the whole length gives an increased length of 5.63 miles. Above this section the compensation does not affect the length at all, until the 1 in 100 section is reached.

Staff.—The staff employed have been most zealous, and Mr. Lilley especially deserves all praise for his indomitable perseverance in the Kemphole valley, where day after day, the whole camp was fever-stricken and work was quite impossible. Messrs. Milne and Farewell were more fortunate, but all were out until the end of May. The staff was far too weak numerically for such an undertaking, and temporary men would not accept work in the Malanad district. Of the four permanent subordinates sent, two were in bad health, but all worked excellently well. Sergeant Blakebrough came in April quite unfit for work. For the next season's work two Assistant Engineers, either permanent or temporary, are necessary for the ghât and three more subordinates.

If it be desired that work begin, it could be opened out over 80 miles at least in January and the rest in a few months later.

A revised estimate is under submission for the entire completion of the survey and preparation of the final estimate.

The Rack.—It has been impossible to take up the rack section alternative this season owing to deficient staff, nothing but a very sketchy trial line has been run which gives a very heavy section. This must be gone over carefully before any report can be made or estimate framed. In length it will not save much and in cost but very little. It will consist of about 2½ miles of 1 in 10 and 3½ miles of 1 in 25 and cease at or near Kemphole, where it will probably join in with the past season's line. The maintenance of a rack line with such rainfall is a serious consideration.

NOTE ON ESTIMATE.

The estimate submitted amounting to Rs. 1,69,62,253 represents the probable cost of constructing the 143 miles of railway from Arsikeri to Mangalore or Rs. 1,18,617 per mile. The increased cost of the line is due to the ghât section 25.2 miles in length which is estimated at Rs. 2,36,047 per mile. The estimate includes the work from Arsikeri to Hassan already estimated for by the Mysore Government.

When the plans and estimates were received from the Mysore Government in July no detailed estimates were sent, but it was apparent from the printed estimates that under the head of bridge-work, a serious error had crept in. Applying the test of cost per foot run it was found that—

Major bridges 1,188 feet run cost Rs. 68.5 per foot.

Minor bridges 1,064 feet run cost Rs. 141 per foot; in order therefore to bring the bridging up to its probable cost, the estimate has been increased up to Rs. 250 per foot run in each case which gives an increase of Rs. 3,31,503.

Ballast and permanent-way have been increased by Rs. 1,34,881 to provide 50 lb. rails instead of 41½ lb. in accordance with Messrs. Kirby and Lonsdale's proposals. Under other heads the cost has been increased to assimilate it with the portion now under survey. The whole increase is Rs. 7,73,967 which increases the cost per mile of this Arsikeri-Hassan section from Rs. 66,049 to Rs. 91,803.

The estimate for the remainder has been calculated from the plans and sections submitted and the two gaps not yet surveyed taken into the estimate at a proportionate cost head by head. Excluding the ghât section, the cost averages Rs. 97,478 per mile.

Preliminary Expenses.—This amounts to Rs. 2,02,522 and includes Rs. 22,602 already spent by the Mysore Government as well as the estimated cost of completing the survey. The original estimate was Rs. 643 per mile, but the country was not known by those who prepared the estimate and the greater portion has been assumed to be open plain country, whereas it is not.

Land.—Land has been taken at 20 acres per mile at a rate of Rs. 40 per acre which, considering the large amount of waste land, will, it is believed, allow a sufficient margin to compensate for interference with coffee land.

Formation.—The cost of formation is Rs. 61,07,850 or Rs. 42,702 per mile, which is due to the heavy work on the ghât on which division the formation alone costs Rs. 1,29,271 per mile. This will undoubtedly come down on revision, but it would be vastly reduced if the ghât were made a special section with curves of 400 feet and a gradient of 1 in 40 net as suggested in the report.

The rates by sections are:—

	Per mile.
	Rs.
Arsikeri to Hassan	28,254
Hassan to Saklaspur	21,153
Saklaspur to Frontier	1,29,271
Frontier to Mangalore	23,558

On the ghât there are 6,955 lineal feet of tunnels which works out to Rs. 63,160 per mile.

Bridge-work.—As before explained, the original estimate for the first section has been increased and this gives the mileage rates—

	Per mile.
	Rs.
Arsikeri-Hassan	18,734
Hassan-Saklaspur	16,330
Saklaspur-Frontier	55,981
Frontier-Mangalore	27,977

These rates per mile seem fairly to follow the feature of the country and the rainfall.

Fencing.—No remark.

Electric Telegraph.—Construction purposes only.

Ballast and Permanent-way.—The estimate follows the proposals of Messrs. Kirby and Lonsdale for 50 lb. rails above and below ghât and 60 lb. rails on the ghât, the mileage rate for which averages throughout Rs. 21,674.

By sections the rates are :—

	Per mile.
	Rs.
Arsikeri to Hassan	21,832
Hassan to Saklaspur	21,815
Saklaspur to Frontier	25,671
Frontier to Mangalore	19,830

The rates have been calculated on the assumption that it would be better to land the permanent-way material at Marmagod for the first three sections. The slight difference between the first and second is due to length of sidings proposed, which, in the absence of the details of the estimate, have not been altered as it is trifling. The third section difference is due to the 60 lb. rail which is to be landed at Marmagod as it appears better to lay the ghât with the lead down hill. The markedly smaller cost of the last section is due to the material being landed at Mangalore and consequent saving in railway transport.

Stations and Buildings.—The total cost under this head amounts to Rs. 6,98,763, or a mileage rate of Rs. 4,886. This provides for third-class stations throughout, except at Mangalore where a larger station is proposed for which Rs. 50,000 has been assumed. Each station has a third-class waiting shed and watering arrangements. Saklaspur has been selected as the principal engine-changing station on the supposition that the ghât would be worked as a special section. At Seradi a running room has been provided. Staff-quarters of the double unit type have been provided for guards and drivers at Saklaspur and Mangalore and adequate accommodation at all stations for the working staff of the arched roof pattern in use on the Rajputana-Malwa Railway.

Plant.—The figures under this head have been obtained by a *pro rata* deduction from the published figures of the cost of the Southern Mahratta Railway.

Ferries.—Nil.

Rolling-stock.—In the estimate sent in for the Arsikeri-Hassan section no provision was made for rolling-stock on the supposition that it would be worked by the Southern Mahratta Railway. Admitting this it seems that an additional branch of 143 miles must have its equipment and that more rolling-stock will be required. The figures have been obtained by deduction from the Southern Mahratta Railway mileage rates under this head and divided proportionately among the two heads.

General Charges.—The general charges have been calculated as detailed in the report for a period of three years for the work above and below ghât and for four years for the ghât section.

ARSIKERI-MANGALORE RAILWAY (METRE GAUGE).

1ST DIVISION (34.29 MILES).

Gradient Abstract.

Inclination.	Number of each.	Total length.	Percentage of total length of line.
		MILES.	
1 in 61 } Ghât	1	2.60	7.30
1 in 66	1	1.67	4.86
1 in 100 } Net	1	8.82	25.72
1 in 109	1	1.06	3.10
1 in 110 } r/s Comp	4	10.72	31.30
1 in 115	1	1.74	5.07
1 in 124	1	0.92	2.71
1 in 200	1	0.68	1.98
1 in 250	2	2.47	7.20
1 in 750	1	1.29	3.76
Level	9	6.47	18.96
Total	23	34.29	100.00

2ND DIVISION (16.174 MILES).

Gradient Abstract.

Inclination.	Number of each.	Total length.	Percentage of total length of line.
		MILES.	
Level	2	1.84	5.19
1 in 40	1	1.49	9.21
1 in 325, or 1.44 per cent.	1	1.10	6.80
1 in 62, or 1.62	1	2.48	15.33
1 in 53.8, or 1.88	1	6.93	42.86
1 in 50, or 2.0	1	3.38	20.90
1 in 47, or 2.13	1		
Total	..	16.17	99.99

3RD DIVISION (27.14 MILES).

Gradient Abstract.

Inclination.	Number of each.	Total length.	Percentage of total length of line.
		MILES.	
1 in 100, or 1 per cent. 2 compensated only	4	6.79	21.33
1 in 111, or 0.9 per cent.	1	.94	3.46
1 in 114, or 0.88	1	1.42	5.23
1 in 117, or 0.85	1	.78	2.88
1 in 133, or 0.75	1	1.33	4.90
1 in 200, or 0.5	1	.41	1.51
1 in 217, or 0.46	1	.61	2.25
1 in 229, or 0.44	1	.46	1.68
1 in 300, or 0.33	1	1.18	4.36
1 in 310, or 0.32	1	.99	3.65
1 in 400, or 0.25	1	.85	3.13
1 in 450, or 0.22	1	.94	3.46
1 in 500, or 0.2	1	1.34	4.93
1 in 700, or 0.14	1	2.64	9.72
1 in 1,200 or 0.08	1	2.27	8.36
1 in 1,600 or 0.06	1	4.20	15.48
Level	..		
Total	..	27.14	99.99

NOTE.—Mile 27.14, actual length graded.

1ST DIVISION (34.29 MILES).

Curve Abstract.

Angle of curvature or radius.	Number of each.	Total length.	Total curvature.
		MILES.	DEGREES.
1°—0' (radius 5,730 feet)	8	0.64	24.0
2°—0' " 2,865 "	7	1.20	127.0
3°—0' " 1,910 "	35	3.55	662.30
4°—0' " 1,432 "	3	0.81	107.0
5°—0' " 1,146 "	16	2.08	548.0
6°—0' " 968 "	28	5.91	1,873.30
8°—0' " 716 "	1	0.08	24.30
9°—0' " 636 "	1	0.09	44.30
10°—0' " 573 "	20	2.37	1,254.0
Total	106	16.43	4,585.9

Ratio of curvature to total length of line 47.92.
Average amount of curvature per mile 183.66.

2ND DIVISION (16.174 MILES).

Curve Abstract.

Angle of curvature or radius.	Number of each.	Total length.	Total curvature.
		MILES.	DEGREES.
2°-0' (radius 3,865 feet)	1	.05	5°
5°-0' (" 1,146 ")	2	.08	21°
6°-0' (" 956 ")	1	.06	18°
10°-0' (" 573 ")	87	7.65	4,042°
11°-28' (" 500 ")	6	1.32	798°
14°-19' (" 400 ")	7	.55	842°
16°-22' (" 350 ")	2	.48	401°
Total ..	..	10.47	5,927°

Ratio of curvature to total length of line 54.7 per cent.
Average amount of curvature per mile 366.64.

3RD DIVISION (27.27 MILES).

Curve Abstract.

Angle of curvature or radius.	Number of each.	Total length.	Total curvature.
		MILES.	DEGREES.
1°-0' (radius 5,730 feet)	1	.45	23° 8'
2°-0' (" 3,863 ")	13	1.47	155° 2'
3°-0' (" 3,110 ")	14	1.84	291° 5'
4°-0' (" 2,563 ")	7	.75	158° 4'
5°-0' (" 2,146 ")	1	.22	58° 1'
6°-0' (" 1,811 ")	29	3.37	1,067° 6'
8°-0' (" 1,433 ")	6	.61	217° 7'
10°-0' (" 1,146 ")	1	.11	58° 1'
Total ..	..	8.82	2,070° 4'

Ratio of curvature to total length of line = 32.34 per cent.
Average amount of curvature per mile = 75.9 degrees.

1ST DIVISION (LENGTH 34.29 MILES).

Bridge Abstract.

Type of bridge.		Total number of spans.	Waterway. Linear feet.
Class.	Spans.		
Slabs ..	2 feet ..	4	8
	4 " ..	44	132
	5 " ..	27	135
	6 " ..	8	48
Arched bridges.	10 " ..	11	110
	20 " ..	3	60
	30 " ..	3	90
	40 " (a) ..	4	160
	40 " (b) ..	16	640
	100 " (c) ..	6	600
Total for whole line		125	1,953
Average per mile ..		..	57

(a) Yagachi, 4 spans 40 feet.

(b) Mile 21, 4 " "

" 23, 2 " "

" 62, 6 " "

" 68, 6 " "

(c) Hemavata, 5 spans 100 feet.

Yettinhalla, 1 span "

2ND DIVISION (16.174 MILES).

Bridge Abstract.

Type of bridge.		Total number of spans.	Waterway. Linear feet.
Class.	Spans.		
Cost Rs. 846 per foot.	Open tops ..	2 x 2 feet ..	32
	Slab drains ..	2 x 2 feet ..	30
	Arched ..	5 feet ..	32
	" ..	10 " ..	11
	" ..	15 " ..	3
Cost Rs. 406 per foot.	" ..	20 " ..	8
	Girders ..	20 feet ..	1
	Viaduct ..	2 x 40 feet (1) ..	3
	" ..	3 x 40 " (3) ..	9
	" ..	5 x 40 " (3) ..	15
2,000	" ..	6 x 40 " (3) ..	18
	" ..	8 x 40 " (1) ..	1
	Total for whole line		2,808
Average per mile ..		..	173.6

3RD DIVISION (27.27 MILES).

Bridge Abstract.

Type of bridge.		Total number of spans.	Waterway. Linear feet.
Class.	Spans.		
Open tops ..	2 feet ..	3	6
Flat tops ..	2 feet ..	7	14
	4 " ..	4	16
Arched culverts.	4 feet ..	14	56
	5 " ..	6	25
	6 " ..	11	66
	8 " ..	2	16
	10 " ..	31	310
Girder bridges ..	15 " ..	10	150
	20 " ..	12	240
	12 feet ..	4	48
	20 " ..	2	40
	40 " two of one span ..	2	80
	60 " three of one span ..	3	180
	100 " one of one span ..	1	100
	100 " one of seven spans ..	7	700
Total for whole line		..	2,047
Average per mile ..		..	75.06

COFFEE CULTIVATION.

In the original orders for the survey, the Government of India directed that a map be prepared "to show the tract in which coffee is grown, the alignment of the railway and of the roads leading from the coffee tracts to the coast." To carry this out the assistance of three of the oldest and most important European planters was called and the area coloured in represents the coffee zone of Mysore and inside this area are situated all the coffee estates. The green portions represent the principal sites of gardens and the sepia coloured roads represent the routes to the coast.

The entire area of the "Zone" amounts to 1,862 square miles or 1,191,605 acres, of this there are registered as coffee gardens 164,785 acres or, say, about one-seventh.

It must however be understood that the entire area of each estate is not under coffee; a great deal is still uncultivated, some is paddy or rice land, a good deal is forest land and much of the land under cultivation is represented by new plantations which do not produce any crop for four years and are exempt during that period from assessment.

From information received from the Planters' Associations it appears that extension of the coffee industry is possible in North Mysore to a considerable extent, but in South Mysore the whole available land has been absorbed and the only possible extension will be under irrigation. The figures supplied by the Planters' Associations and the Civil authorities agree in quantity very accurately and from these it seems that the total number of estates is as follows:—

North Mysore.

European	...	...	...	...	559	aggregating	ACRES.
Native	...	...	...	...	11,747	"	40,318
							65,796
Total	...	...	...	...	12,306		106,114

South Mysore.

European	...	...	...	...	286	aggregating	ACRES.
Native	...	...	...	...	16,369	"	21,637
							36,983
Total	...	...	...	...	16,675		58,620
Grand Total	...	...	...	...	28,981		164,734

There are therefore 28,981 gardens which represent an acreage of 164,734 or sub-dividing it—

European	...	...	...	...	865	representing	ACRES.
Native	...	...	...	...	28,116	"	61,955
							102,779

The maximum estate held by any one proprietor is returned by the Civil authorities—

North Mysore	...	...	...	...	...	...	ACRES.
South	...	...	...	...	...	...	3,240
							8,825

The minimum is given as 10 of an acre and are Native holdings, of which there are a very large number. The South Mysore Planters' Association have given an approximate proportion between coffee, cardamom and jungle in South Mysore which is—

Coffee	...	...	...	...	...	...	PER CENT.
Cardamom	...	...	...	...	...	...	31
Forest and other	...	...	...	...	...	...	18
							51

No such proportion has been suggested by the North Mysore Association, but it is assumed that no serious error would result in applying the same proportion to the entire province and would obtain then the following result:—

Coffee	...	...	...	...	...	...	ACRES.
Cardamom	...	...	...	...	...	...	19,206
Forest, &c.	...	...	...	...	...	...	11,147
							31,602

and for Native estates—

Coffee	...	...	...	...	...	...	RS.
Cardamom	...	...	...	...	...	...	31,861
Forest, &c.	...	...	...	...	...	...	18,500
							52,418
							1,02,779

Between the European and Native estates the difference is most marked; for, while the one may be ranked with high class gardening, the latter are left very much to chance. Some are however reported to be maintained in a high state of efficiency.

The outturn on an average on a European estate may be taken at from 3 to 4 cwt. per acre and on a Native estate from 1½ to 2 cwt. per acre. Applying in each case the lower figure to the acreage under actual coffee, as obtained above, we get the coffee crop as follows:—

European	...	...	...	...	...	...	TONS.
Native	...	...	...	...	...	...	2,881
							2,389
							5,270

The actual export from Mangalore during 1893-94 was 6,000 tons, of which some 2,000 came from Coorg and 4,000 from Mysore and about 3,000 tons of this came down the Siradi ghât. It is then safe to assume that with the railway, before the branches are opened, not less than 4,000 tons of coffee may be expected to travel 80 miles, while the remainder will probably for some time continue to come to Mangalore; when the branches are made, this will cease. Under present arrangements carts are contracted for at a rate which varies from Rs. 21 in North Mysore to Rs. 24 in South Mysore per cart for a double trip to Mangalore and back so that the cost of carriage of a ton of coffee and a return trip with one ton of manure engages two carts at a rate of about Rs. 45.

Taking the present cost of carriage of one ton of coffee and one ton of manure at Rs. 45 and the rail charges at 75 of an anna per ton mile for 80 miles we get—

						RS. A. P.	RS. A. P.
Carriage coffee	...	...	...	...	...	3 12 0	
Carriage manure	...	...	...	...	...	3 12 0	
							7 8 0
Present cost of carriage	...	...	...	...	...		45 0 0
Which leave a balance of	...	...	...	...	...		37 8 0

in favour of the railway carriage, which taking the cost of manure at Rs. 50 per ton enables the planter without increasing his present expenditure to purchase 75 per cent. more manure per ton of coffee which, while increasing outturn of crop, must increase the railway earnings.

The Secretary, North Mysore Planters' Association, states that, on his own estate and on many others, as much as 1 ton of manure per acre is used annually on half the estate in alternate years or an average of ½ ton of manure per acre annually.

On the above figures therefore the following estimate for coffee is based:—

Coffee annually	...	...	...	...	...	...	TONS.
Manure as at present	...	...	...	...	...	...	4,000
Extra manure at 75 per cent.	...	...	...	...	...	...	4,000
Food for 70,000 coolies at 2 lb. per diem for 300 days	...	...	...	...	...	...	3,000
Machinery building materials, &c.	...	...	...	...	...	...	18,750
							5,000
							34,750

The North Mysore Planters' Association consider that 75 ton per acre represent the average export and import for coffee estates and 50 of a ton is about the figure for native estates. This being the case we obtain from the foregoing acreages:—

European	19,206 acres at 75 ton	...	...	...	...	...	TONS.
Native	31,865 " at 50 "	...	...	...	...	...	14,405
							15,930
Total	...	...	...	...	...	...	30,335

It appears therefore that it is quite safe to assume that the coffee industry represents not less than 30,000 tons and that in carrying into the traffic estimate 20,000 tons as due to coffee alone places the estimate at a figure which is fully certain of realization.

The figures now put forward have been submitted to the Secretaries of the North and South Planters' Associations and they consider that they fairly represent the coffee statistics. The Secretary, North Mysore Association, considers the proportion of coffee,

cardamoms and forest too low for North Mysore and would estimate the area under coffee at 50 per cent. of the gross acreage. This would increase the estimate considerably but the figures have not been recast to meet this; because until the Chickmagalur branch is made the railway will only affect South Mysore at first and North Mysore in the more adjacent parts gradually. When the branches are made there is no doubt all the coffee except that grown near Kadur will find its way by rail to the coast and only a small proportion come to Bangalore for shipment at Madras. In Mangalore there are three immense coffee clearing works—Messrs. Morgan, Messrs. Arbutnott, Messrs. Saldanha. The Coorg coffee chiefly goes to Tellicherry, but of the North Coorg coffee at present comes in at Manjerabad and passes down the Siradi ghāt.

Manure is procured chiefly from Mangalore and Bangalore and consists of fish manure, bone dust and other patent chemical manures for which there is a great demand and the present tendency of the planters is to increase the manure. There is little doubt that with the railway, the Coast agents would establish manure depôts at Saklespur.

TRAFFIC.

Coffee as the great product of Mysore has been treated separately and, as before stated to be well within the margin of a safe estimate, only 20,000 tons due to the coffee industry is brought forward in this estimate, which when branches to Chickmagalur and perhaps Coorg are established will certainly be doubled.

Enquiries at the toll bars were fruitless they declined to give any information as to the number of carts or what they stated was manifestly unreliable. The usual reply was "I pay Rs. 3,600 for this toll bar and I know nothing more," their fear being that any accurate returns being published would lead to increased rents. Taking Rs. 3,600 at As. 4 per cart, it represents 14,400 carts or net 7,000 tons without allowing any profit to the contractors. Taking the Feringipett toll bar the nearest to Mangalore its rent seems to have ranged from Rs. 3,800 to Rs. 4,300 or an average of Rs. 3,962 over five years and through this gate passes the concentrated traffic of three routes—Chamardi, Siradi and Bisly ghât. If the contractors' profits be assessed at the Maruhalli toll bar as low as Rs. 100 per month, this would give the number of carts at As. 4 each to 19,200, so that the present traffic of the Siradi ghât is not less than 10,000 tons and is more probably 20,000 tons.

Mr. Purniya, Deputy Commissioner at Hassan, in his estimate (G.O., No. 152 R., dated 10th March 1891), gives a grand total of 24,812 tons, which Mr. Muirhead comments upon in his report No. 583 R.E., to the Agent, Southern Mahratta Railway, and he estimates the total imports and exports at 4,707 tons and it is clear how he was misled. He and Colonel Lindsay passed down the Siradi ghât in May after all the season had closed and reached Mangalore when the weather was so bad that they caught probably the last boat before the port closed. The coffee season ends in March and during December, January, February and March the strings of carts travel in constant trains of 20 and 25 up and down by night and day. To get carts to come up during May and the monsoon months very high rates have to be paid for all the bullocks are then employed above and below the ghât in agricultural work. One other point on which Mr. Muirhead has been led away is in regard to the statistics collected by Mr. Palmer, Agent to the Bank of Madras at Mangalore, where he has been in his present position for 25½ years and whose daily business puts him in a better position than any one else to form a reliable estimate. He gives the very low figures of—

									Tons.
Exports	...	...	...	...	...	...	...	...	2,538
Imports	...	...	...	...	...	...	...	...	4,073
								Total	<u>6,611</u>

which the Collector considers too low and proposes a cautious increase of only 25 per cent. For the reasons stated under the head of coffee these figures seem all to have erred on the side of being too low.

Taking the Deputy Commissioner's figures—

Total export to Mangalore	...	...	...	...	...	...	14,907
Import to Mysore	...	...	...	...	...	...	9,905

... to coffee industry, i.e., 2,600 tons a

and reducing the export by the items due to coffee industry, i.e., 2,600 tons and similarly reducing the imports by 1,400 the amount shown as contingent on coffee, tools, manure, &c., we get the following as representing exports and imports exclusive of the coffee industry.

	TONS.
...	12,307

							TONS.
							12,307
Total export	...	...	...	...	...	...	<u>8,505</u>
Import	...	...	...	...	...	...	
						Total	... 20,812
Add amount due to coffee industry	...	...	...	...	...	...	<u>20,000</u>
						Total	... 40,812

which will be taken into the estimate at a mileage of 90 miles.

which will be taken into the estimate at a mileage of 90 miles. But this is not the whole traffic which must be looked for. South Canara contains forest land at the foot of the hills of some 300 square miles not yet fully conserved, from which the Forest officer expects the railway would obtain at once 10,000 tons of firewood and other produce over an average mileage of 50 miles. In this it should be noted that the firewood reserves of Mangalore have lately failed. Besides this the forests expect to produce annually 750 tons of wood pavement for export. The Forest Department are now engaged in organizing these forests and expect great development up to 40,000 tons per annum.

The internal traffic of South Canara may be put down at 10,000 tons per annum, which is now carried by cart and boat. Between Uppinangadi and Pani Mangalore, the river is navigated by small canoes which carry about $1\frac{1}{2}$ tons and are poled down the rapids and the navigation is most dangerous on account of the rocky bed. All this would be usurped by the railway, say 10,000 tons per annum for an average of 32 miles.

The passenger traffic has been taken at 300,000 passengers yearly and this does not seem an excessive estimate, when the Planters in South Mysore estimate that they employ 20,000 coolies from below ghât, who travel four times a year. The railway would lead to great deal of extra passenger traffic impossible to estimate, but it must be remembered that Mangalore for four months is closed as a port and the only egress is by a long land journey to Calicut or Arsikeri. It is an important mercantile centre and will certainly require a considerable traffic. It is intended to carry forward 300,000 third-class passengers with 70 miles each on an average. First and second class passengers are left out of the estimate and nothing taken for mails specie and other small items.

ABSTRACT.				rs.
				1,72,175
40,812 tons at .75 annas x 90 miles	...	...	...	25,195
10,750 forest produce at .75 annas x 50 miles	...	...	...	14,062
10,000 tons local at .75 annas x 32 miles	...	...	...	2,10,000
300,000 passengers at .16 annas x 70 miles	...	...	...	
		Total	...	4,21,432
		Working expenses at 60 per cent.	...	2,52,859
		Net profit	...	1,68,573

This would represent as gross earnings Rs. 58 per mile per week or say a return of 1 per cent.

PORT OF MANGALORE.

PORT OF MANGALORE.

The Port of Mangalore is situated on the West Coast in Latitude 12-54 North Longitude 74-50 East and is an open roadstead with an inner harbour now only navigable by native craft. Steamers lie off at anchor and are served by cargo boats.

The lines of steamers calling there are the British India Steam Navigation Company two steamers weekly, one bound north, the other south, and the Bombay Steam Navigation Company (Shepherd and Company) who send two steamers weekly from Bombay, Mangalore being the southern limit of their traffic. Until lately Messrs. Shepherd's steamers used to enter the inner harbour but since one of them grounded on a shoal, they lie off in the roadstead. The inner harbour is a long lagoon about 7 miles long and $\frac{1}{2}$ a mile wide formed by the river Ghorpuri on the north and the Nitravati on the south. The sand bank which encloses this lagoon is about 400 feet wide and about 7 feet above high water level and form a substantial natural break-water. There are two bars, one on the north which is always closed and the other on the south which is the mouth of the Nitravati. The silting up of the inner harbour has been going on gradually for years due chiefly to the Ghorpuri river bringing down silt and having lost its force by expanding into a wide estuary and being of insufficient force and volume to maintain its bar open, it brings silt down the whole length of the harbour which at the slack water intervals between tides is deposited. The Nitravati on the south is much larger river, its drainage area being 1,410 square miles against 352 square miles for the Ghorpuri river or say four times the volume. The fall of these rivers is very slight and the tide ebbs and flows for about 7 miles above Mangalore. To make the port efficient it is proposed to shut out the Ghorpuri river by a bund across the Lagoon near the Sultan's Battery and leave it to find its way to sea through its own bar and by a system of groynes and training walls to concentrate the full force of the Nitravati upon its own bar. This would leave the inner harbour almost a still water basin and it could be easily dredged to any extent required. A quay wall could be built with a loading jetty capable of berthing two coasting steamers. In the dry season the reflux of the tide concentrated on the bar would clear any silt brought in, and if two pier heads were built, say 500 feet apart, no attrition need be feared and a channel permanently navigable except during the monsoon would be assured. The question of the harbour is under investigation and it is a matter which should be carried out at the same time as the railway for the efficiency of the port will be an important factor in the success of the railway. Besides being an important port and mercantile centre, Mangalore is the seat of a very large and important tile manufacture, there being no less than ten manufactories of the well known Mangalore tile which is so rapidly making its way in India, and there are large weaving establishments also here. When communication by rail is established these industries will receive a great impetus, as at present, they are unable to find carts sufficient to meet the demands on them for tiles. All over Mysore the Mangalore tile is replacing the old half round tile even in Native houses.

(Signed) W. G. GILCHRIST,
Engineer-in-Chief.

ARSIKERI-MANGALORE RAILWAY ESTIMATES,

1895.

ARSIKERI-MANGALORE RAILWAY SURVEY.

METRE GAUGE (143 MILES).

Abstract of cost of Railway.

Heads of accounts.	Total cost in rupees.			
	Sub-heads.		Main heads.	
	Total cost.	Rate per mile.	Total cost.	Rate per mile.
	Rs.	Rs.	Rs.	Rs.
I. Preliminary expenses	2,02,522	1,416	2,02,522	1,416
1. Survey expenses	..	..	..	..
2. Plant	..	792	1,12,295	792
3. Establishment	1,12,295	..	61,07,830	42,712
II. Land	45,15,182	31,576	..	..
III. Formation	16,92,648	11,137	41,00,405	28,675
1. Earth-work	..	..	..	..
2. Tunnel	23,12,303	16,170	..	..
IV. Bridge-work	17,88,102	12,506	1,98,099	1,365
1. Large bridges	..	..	..	..
2. Minor bridges	49,607	346	..	..
V. Fencing, &c.	1,42,342	995	..	..
1. Fencing	6,268	44	..	..
2. Road crossings	14,200	100	74,300	100
3. Mile and gradient posts	..	..	83,66,257	23,471
VI. Electric telegraph	2,56,912	1,797	..	..
VII. Ballast and permanent-way	30,99,346	21,674	6,98,763	4,886
1. Ballast	..	..	..	..
2. Permanent-way	2,12,457	1,492	..	..
VIII. Stations and buildings	23,764	166	..	..
1. Stations and offices	1,74,221	1,232	..	..
2. Workshops, store buildings, &c.	9,85,327	1,996	43,756	266
3. Staff quarters	..	..	..	..
4. Station machinery	16,169	112	..	..
IX. Plant	23,166	162	..	..
1. Engineering	4,432	31	..	..
2. Locomotive, carriage and wagon	..	..	..	..
3. Station and office furniture	..	..	..	..
X. Ferries, &c.	..	..	..	..
1. Ferries	11,44,000	8,000	11,44,000	8,000
2. Floating bridges	..	..	..	..
XI. Rolling-stock	..	..	9,83,924	6,874
1. Locomotive	..	..	..	..
2. Carriage and wagon	1,33,584	934	..	..
XII. General charges	8,94,640	4,857	..	..
1. Direction	82,800	369	..	..
2. Engineering	88,000	621	..	..
3. Stores	12,200	92	..	..
4. Audit and account	..	..	..	..
5. Medical and sanitation	..	..	..	..
6. Locomotive	..	..	..	..
7. Traffic	..	..	..	..
Total	..	..	1,69,62,253	1,18,617

Total expenditure Rs. 1,69,62,253.
Total rate per mile Rs. 1,18,617.

4

Grand Total, Arsikeri to Mangalore, 143 miles

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IV. I.—Major Bridges—cont.

[illegible]

Minor Bridges.

Section.	Description.	Excavation.	Concrete.	Masonry.	Asblar.	Arching.	Ironwork.	Timber.	Girders.	Total.
I	1,064	CUBIC FEET.	CUBIC FEET.	CUBIC FEET.	CUBIC FEET.	CUBIC FEET.	CWT.	CUBIC FEET.	TONS.	Ra.
II	Coating under Ra. 4,000 over Ra. 6,000	L. feet of bridging at Ra. 260 per foot. 145,464 39,884	73,220 16,671	1,02,035 86,614	4,716 807	13,402 11,509	2,90 ..	45½ ..		2,86,000
	"	185,318	89,961	2,47,649	6,513	30,771	2,80	45½	..	
	Total quantities	Ra. 10 per 1,000 1,463	Ra. 25 per 100 22,490	Ra. 30 per 100 74,295	Ra. 75 per 100 4,165	Ra. 75 per 100 23,078	Ra. 15 per cwt. 42	Ra. 3 per c. foot. 136	..	1,26,039
	Rate								..	6,314
	Cost								Add contingent at 6 per cent. ..	1,32,873
									Grand Total ..	
III	Coating under Ra. 4,000	304,607	156,221	{ 222,186 91,651	{ 6,925 2,266	{ 36,389 40,277	16 68	434-67	2-37	
	" over Ra. 4,000	218,768	87,126	{ 280,215 86,272	{ 2,693 496	{ .. }	..	..	..	
	Total quantities	523,375	243,347	{ 502,376 141,923	{ 10,618 2,781	{ 76,666 }	15-68	434-67	2-37	
	Rate	Ra. 10 per 1,000	Ra. 25 per 100	Ra. 35 per 100	Ra. 100 per 100	Ra. 75 per 100	Ra. 15 per cwt.	Ra. 3 per c. foot.	Ra. 270 per ton.	
	Cost	5,233	60,997	{ Ra. 30 2,03,831 42,677	{ Ra. 75 10,818 2,086	{ Ra. 75 per 100 57,500	236	1,303	640	2,84,911
									Add contingent at 6 per cent. ..	19,241
									Total ..	4,04,152
									Unsurveyed 3 miles, at Ra. 18,193 ..	84,576
										4,88,728
IV	Coating under Ra. 4,000	181,192	91,479	234,918	5,936	25,371	7-02	177-17	7-82	
	" over Ra. 4,000	301,036	115,810	580,874	6,130	67,758	2-10	42-67	2-86	
	Total quantities	482,227	210,289	816,792	12,066	93,129	9-13	219-84	10-68	
	Rate	Ra. 10 per 1,000	Ra. 25 per 100	Ra. 35 per 100	Ra. 100 per 100	Ra. 75 per 100	Ra. 15 per cwt.	Ra. 3 per c. foot.	Ra. 270 per ton.	
	Cost	4,823	52,674	286,353	12,066	89,848	138	600	2,684	4,28,346
									Unsurveyed 22 miles, at Ra. 16,708 ..	5,02,666
									Grand Total ..	9,31,001
									Grand Total of Minor Bridging ..	17,88,102
									(Rate per mile)	12,608

V.—Fencing.

Section.	Number of miles.	Fencing.	Road crossings.	Mile and gradient posts.	Total of section.	Rate per mile.
I	80-05	14,420	19,475	12,68	36,161	1,170
II	28-24	7,836	21,900	1,100	30,836	1,092
III	25-21	2,766	10,827	1,034	14,627	589
IV	59-50	24,486	90,140	2,960	1,17,475	1,975
Total	143-00	49,507	1,42,342	6,250	1,98,069	1,385

PERMANENT-WAY.

DETAILS OF COST OF ONE MILE, 50 lb. RAIL.

Section I.

	RS.
Rails 78-57 tons, at Rs. 80 per ton f.o.b.	6,286
Fish plates, 4-51 tons, at " 98 "	442
Fish bolts, 0-62 ton, at " 164 "	102
Spikes, 4-16 tons, at " 216 "	899

Add—

87-86 tons.	Total	7,729
Freight to Portuguese Frontier at Rs. 3-3 per maund	...	488
Port and customs dues	...	210
Carriage from Frontier to Arsikori at 1 anna per ton per mile	...	1,446
Unloading and stacking in depôt in Arsikori, Rs. 2 per ton	...	176

2,220 sleepers at Rs. 3-8-0 each	...	7,700
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Total cost at Arsikori (167 tons)	...	17,749
Store charges, loading, &c., 2½ annas per ton	...	26
Haulage, 15 miles, 1½ annas per ton mile	...	209
Laying at 4 annas per yard	...	440
Maintenance, at Rs. 100 per mile per month, for six months	...	600

Total ... 19,024

	MI.LS.
Length of section	80-05
Sidings	2-794

Total	32-844 miles at Rs. 19,024 per mile	6,24,824
	Contingencies, 5 per cent.	31,241

Grand total ... 6,56,065

Cost per mile ... Rs. 21,832

Section II.

	RS.
Total cost at Arsikori as per section I	17,749
Store charges, loading, &c., at 2½ annas per ton	26
Haulage from depôt to rail-head, 45 miles, at 1½ annas per ton per mile	626
Laying, &c., per mile	440
Maintenance, six months, at Rs. 100 per month	600
Total per mile	19,441

	MI.LS.
Length of section	28-24
Sidings	1-94

Total	30-18 miles at Rs. 19,441	5,86,729
	Contingencies at 5 per cent.	29,336

Grand total ... 6,16,065

Cost per mile ... Rs. 21,815

COST OF 1 MILE OF 60 lb. RAILS AT ARSIKORI.

Section III.

	RS.
Rails, 94-28 tons, at Rs. 80 per ton	7,542
Fish plates, 5-00 ton, at " 98 "	490
Fish bolts, 0-62 ton, at " 164 "	102
Spikes, 4-16 ton, at " 216 "	899
Bearing plates, 0-97 ton, at " 168 "	161

Total	9,194
Freight to Portuguese Frontier at Rs. 3-3 per maund	582
Freight to Arsikori at 1 anna per ton per mile	1,726
Loading, &c., at Rs. 2 per ton	210
Port and customs dues	210

2,200 sleepers at Rs. 3-8-0	...	7,700
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Cost of one mile at Arsikori (185 tons)	...	19,622
Loading and unloading at 2½ annas per ton	...	29
Haulage, 72 miles, at 1½ annas per ton per mile	...	1,249
Laying per yard at 4 annas	...	440
Maintenance, six months, at Rs. 100 per month	...	600

21,940

	MI.LS.
Length, Section III	25-216
Sidings	1-060

26-276 miles at Rs. 21,940	6,16,495
Contingencies at 5 per cent.	30,825

Grand total ... 6,47,320

Rate per mile ... Rs. 25,671.

STATIONS AND BUILDINGS.
Stations and Offices.

Name of station.	Class.	Mileage.	Distance apart.	Station buildings.	Goods shed.	Passengers platform.		Goods platform.	Latrine.	III Class shed.	Remarks.
						Length rail level.	Length 1-3 above rail.				
Talar ..	III	28	..	sq. ft.	sq. ft.	ft.	ft.	sq. ft.	sq. ft.	sq. ft.	
Hegde ..	III	16 1/2	1 1/2	757	1,742	800	..	250	200	1,600	
Dudda ..	III	19	3	757	1,742	800	..	280	200	1,500	
Huasa ..	III	25 1/2	10 1/2	1,500	1,742	..	600	280	200	1,600	
Aler ..	III	37 1/2	7-60	757	1,742	800	..	250	200	1,160	
Helol ..	C.M.	47	8-60	757	..	400	..	250	200	1,500	
Maemalli ..	C.S.	62 1/2	8-75	757	1,742	..	600	..	..	..	
Sahasapur ..	III	84 1/2	8-78	1,800	..	400	..	..	..	..	
Holeasa ..	C.S.	60 1/2	4-45	757	..	400	..	..	..	..	
Manarbad road ..	III	64 1/2	8-25	757	..	400	..	..	..	..	
Maraballi Gorge ..	III	67 1/2	8-78	757	..	400	..	..	..	..	
Kedmani ..	Water.	79	4-60	..	1,742	600	..	250	200	1,160	
Kesphul ..	III	90 1/2	11-60	757	..	400	..	250	200	1,160	
Siradi ..	III	101 1/2	11-00	757	1,742	600	..	..	..	..	
Chilata ..	III	111 1/2	10-00	757	..	600	..	..	..	..	
Uppinangudi ..	III	120	8-60	757	..	600	..	..	..	..	
Bemipudi ..	III	127 1/2	7-50	757	..	600	..	..	..	..	
Buntwall ..	III	134 1/2	7-00	757	1,742	600	..	250	200	..	
Perinzipet ..	III	141 1/2	7-00	757	..	..	800	..	..	..	
Jeppoo ..	III	141 1/2	7-00	757	1,742	..	..	..	..	..	
Total ..	..	..	..	15,869	19,678	9,200	1,800	2,250	2,000	13,960	
Rate ..	..	..	..	sq. 2-7	sq. 2	sq. 1-6	sq. 6	sq. 6	sq. 1	sq. 2-3	
Cost ..	..	..	..	42,446	39,356	12,300	10,800	13,600	2,000	32,085	
Mangalore ..	..	..	..	80,000	..	..	..	..	400	..	
Grand Total ..	..	..	..	92,816	39,356	12,300	10,800	13,600	2,400	32,085	

Rs. 2,05,287
Contingencies 6 per cent. 10,164
Grand Total 2,13,451
Rate per mile 1,493

Excess 50,000 includes also goods shed and platform.

Staff Quarters.

Name of station.	Class.	Mileage.	Distance apart.	Station Master's quarters.	Assistant Station Master's quarters.	Menial's quarters.	Loco-motive foreman.	P.W. Inspector.	A.P.W. Inspector.	Running room.	Guard's and Driver's quarters.	Engineer's quarters.	Loco-motive menial's quarters.	Remarks.
Talur ..	III	38	32	240	..	320	..	2,000	..	..	..	..	..	..
Bangde ..	III	16	11	240	..	320	..	..	..	..	..	..	..	..
Dande ..	III	19	8	240	..	320	..	..	..	..	..	..	..	..
Hassan ..	III	29	10	900	..	480	..	..	240	..	..	..	..	..
Alur ..	III	27	7	240	..	320	..	..	..	..	..	..	..	..
Alur ..	III	47	9	240	..	320	..	..	..	..	..	..	..	..
Misavalli ..	C.S.	67	8	..	..	..	..	..	..	..	..	..	..	..
Sakleshpur ..	C.S.	68	8	..	..	..	..	..	..	..	..	..	..	..
Hobela ..	III	60	1	240	..	320	..	..	..	..	..	..	..	..
Mananabadi road ..	III	61	1	..	..	..	..	..	..	..	..	..	..	..
Mananabadi Gorge ..	III	62	1	..	..	..	..	..	..	..	..	..	..	..
Kedmani ..	III	78	4	..	..	..	..	..	..	..	..	..	..	..
Kemphal ..	III	80	11	240	..	480	..	..	..	..	..	..	..	..
Cholittatu ..	III	101	11	240	..	320	..	..	..	..	..	..	..	..
Uppinangadi ..	III	120	10	240	..	320	..	..	..	..	..	..	..	..
Neerpedi ..	III	127	8	240	..	320	..	..	..	..	..	..	..	..
Buntewall ..	III	134	7	240	..	320	..	..	..	..	..	..	..	..
Perungipet ..	III	141	7	240	..	480	..	..	..	..	..	..	..	..
Jeppoo ..	III	..	..	..	..	..	..	..	..	..	..	..	..	..
On line ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total ..	..	..	..	2,820	3,840	6,720	8,000	4,000	1,200	6,000	10,000	9,600	1,920	..
Rates ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cost ..	..	..	..	7,614	9,216	13,440	8,100	10,800	3,240	13,500	27,000	9,600	2,940	..
Mangalore ..	..	..	..	6,000	680	2,400	6,000	4,000	..	13,600	27,000	..	2,000	..
(Grand Total ..	..	..	..	13,614	9,796	15,840	14,100	14,800	8,240	27,000	64,000	9,600	5,640	..
Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rates ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cost ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mangalore ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
(Grand Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rates ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cost ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mangalore ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
(Grand Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rates ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cost ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mangalore ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
(Grand Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rates ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

Railway.

Read the following papers:—

ARSIKERI-MANGALORE RAILWAY.

Note by the Consulting Engineer for Railways.

The project is forwarded in an incomplete state; the approximate distance is 144 miles from Arsiakeri station on the Southern Mahratta Railway to the sea-port of Mangalore.

2. The portion from Arsiakeri to Hassan, mile 30, was surveyed by the Engineer of the Mysore Durbar in 1894. The present survey is submitted from Hassan, mile 30 to mile 80, and leaving a gap of 11 miles—from mile 91 at Seradi (the foot of the ghâts) to beyond Uppinangadi, mile 117, being a total of 76 miles—the ghât extends from Hebsala, mile 60, to Seradi, mile 91.

3. *Location.*—From Hassan to Hebsala the limit of curves is $60^\circ = 955$ feet and grades of $1/100$. Twenty miles beyond Hebsala is the division of British and Mysore territory, and the preliminary plan having been submitted to the Mysore Durbar for their instructions as to the route which was to be taken—this route followed very nearly that recommended by their own engineer in his reconnaissance of 1894—they replied that they had no opinion or criticisms to offer and it was therefore adopted.

4. From Hebsala to Seradi the general instructions to the Engineer-in-Chief were to choose the best engineering line, and this has resulted so far in locating a line of $\frac{1}{4}$ grades (compensated to $\frac{1}{4}$, $\frac{1}{8}$ and $\frac{1}{4}$ with curves of $11.4^\circ = 500$ R. and $16^\circ = 350$ R. getting base by means of two spirals at chains 203/207 and 213/217. Owing to the formation of the hills, neither a switch-back nor a line running round the north of the hill at mile 78 afford any better means of lengthening the line.

5. The ghât portion to be satisfactorily examined requires another season's work. It is not severe enough for a rack line which would only be justified by a grade worse than $\frac{1}{4}$, and at least 5 or 6 miles long in one continuous length, and as the direct line between Seradi to Hebsala, a distance of about 16 miles and a difference of level of 2,763 feet, would give an approximate grade of $\frac{1}{4}$, the only alternative seems to be to try and improve the present necessarily hasty location on a basis of $\frac{1}{4}$ compensated grade.

6. The length from Seradi, mile 91, to Uppinangadi, mile 111, with curves of 6° and grades of $\frac{1}{4}$ approximate in character to the Hassan-Hebsala portion. The deviation from mile 97 to 100 would eliminate the long and heavy bank.

7. The estimate of *preliminary expenses* of Rs. 1,416 per mile includes the expenditure incurred for the Mysore State in the Arsiakeri-Hassan location *plus* the sanctioned expenditure of Rs. 88,000 during the present survey *plus* the estimated amount of Rs. 92,000 required to complete the survey.

8. The rate per mile for *formation* in earth-work and tunnels is moderate by comparison for the heavy grades; there is much uncertainty about the necessity for lining the tunnels, and the *bridge work* is rather light in amount. Of the sketch designs, I

approve of the large number of arched bridges, but not of the steel viaducts, for which, if the curves admit, I believe 60 feet spans would be more economical. The information regarding foundations is meagre and the cost of the masonry and steel bridges is not separated.

9. *Fencing* should be of wire and not live.

10. *Ballast and Permanent-way*.—No mention is made of the character of the ballast, but it is most likely that abundant stone of good quality is to be had.

The weight of rails of 50 lb. for the easy and 60 lb. for the steep grades and the use of teak sleepers is approved.

11. Generally the estimate is reliable for the surveyed portion of the line, but as has been before stated, it requires the completion of the survey.

12. *Traffic*.—Under the orders conveyed in Government of India No. 798 R.C. of 21st August 1894, Mr. Gilchrist submits a plan and report on the coffee traffic estimates.

13. The result of these inquiries is given in the abstract of traffic and works out to the same visible return on capital as was arrived at before by the Southern Mahratta Railway authorities and are here given for comparison :—

Southern Mahratta Railway estimate.

	RS.	RS. A. P.
5,884 tons per annum at 9 pies per ton mile over 137 miles	37,780	5 5 0 per mile week.
75 per cent. of 300,000 passengers over 69 miles	1,66,718	23 0 0
Add—10 per cent. for rebate under branch line terms and deduct 60 per cent. for working.		
Result is 87,782, which is less than 1 per cent. on capital of 94 lakhs.		

Mr. Gilchrist's estimate.

	RS.
Goods, 61,562 tons per annum at 9 pies per ton mile over average 57 miles	2,11,432
300,000 passengers at 2 pies over 70 miles	2,10,000
Deduct—Working expenses at 60 per cent.	
Result is 168,573, which is a return of 1 per cent. on capital of 169 lakhs.	

14. *Mangalore Port*.—Mr. Gilchrist sends with his report a short note on the works needed in his opinion to make this port efficient. As this is being dealt with by Mr. Walch, I refrain from offering any remarks beyond saying that there appears to be only a slight difference of opinion as to the character of the engineering work required to effect the improvement.

28th September 1895.

(Signed) F. R. UPCOTT,
Consulting Engineer for Railways.

Note by the Consulting Engineer for Railways.

Note on estimate submitted to complete the survey.

The total length is 144 miles; of this 30 miles has been located by Mr. Groves, costing Rs. 22,602, half of which sum was supplied by the Mysore State.

2. The result of Mr. Gilchrist's work has been 76 miles surveyed, of which 30 miles are finally and 46 miles partially located (requiring further examination), at a cost of Rs. 88,000. Thus leaving 38 miles unsurveyed.

3. Mr. Gilchrist forwards an estimate of Rs. 91,920 for establishment only for 12 months to complete the work. I think the survey should be completed in nine months at a monthly cost of an Engineer establishment of Rs. 4,000 = 36,000 and petty establishment of Rs. 600 = 5,400 which should be 84 miles at 500 per mile = 42,000.

4th October 1895.

(Signed) F. R. UPCOTT,
Consulting Engineer for Railways.

ORDER—No. 639 R., dated 4th October 1895.

The Consulting Engineer for Railways submits plans and estimate and a report on the Arsikere-Mangalore Railway Survey sanctioned in Government of India letter No. 1075 R.C., dated 25th October 1894.

2. In the note by the Consulting Engineer it is pointed out that the project is incomplete and the approximate estimate of cost, 1.2 lakhs per mile, somewhat high, and that further survey work to complete the unsurveyed portion and to obtain a more economical alignment of the ghât section is very desirable.

3. The data on which the estimate of traffic is based are very meagre, and it is the opinion of His Excellency the Governor-in-Council that the prospective benefits to be gained by the Mysore State, which has no port within a reasonable distance connected by rail, and the future advantages to the South Canara district and the coffee estates served by the proposed line cannot be adequately gauged by the present traffic which would be greatly developed by the railway.

4. The reports, plans and estimates are therefore submitted to the Government of India with the opinion of His Excellency the Governor in Council that the completion of the survey with a further examination of the prospects of traffic is justified by the enormous importance of this line to the Mysore State and the suggestion that that state might reasonably be invited to bear its proportion of the cost of the survey, if the concession granted to Messrs. Kirby and Lonsdale for one year has lapsed.

[Here enter No. 640 R., dated 4th October 1895.]

(True Extract.)

(Signed) F. R. UPCOTT,
Joint Secy. to Govt., P.W.D.,
Railway Branch.

To the Engineer-in-Chief, Arsikere-Mangalore Railway Survey.
" Resident in Mysore.
" Examiner, Public Works Accounts.
" Collector of South Canara.
" Revenue Department.

ENDORSEMENT—No. 610 R., dated 4th October 1895.

Forwarded.

(By order.)

(Signed) F. R. UPCOTT,
Joint Secy. to Govt., P.W.D.,
Railway Branch.

Ed. J. P. Oliver.
Hpare Copies

RAILWAY.

Govt. of {1895} Madras.

PUBLIC WORKS.

Dated October, 4th.

Recd.

Encl.

G.O. Nos. 639, 640 R., 4th Oct.
1895.

OCTOBER.

**Arsikeri-Mangalore Railway
Survey**

Forwarding Proceedings on the plans,
estimate and report on the — submitted by
the Consulting Engineer for Railways.

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Report.

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Coffee.

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Port of Mangalore.

Mysore Estimate Arsikeri

To Hassan.

Govt Orders. No 619 R d/23 Mar 92.

" " 818 R. d/6 May 1893.

" " 819 R d/6 May 1893.

" " 152 R d/10 March 1894.

" " 2043 R d/20 Aug 1892.

Report.

Preliminary (a) The Survey of the Arsikere-Mangalore Railway was undertaken under the orders of the Government of India conveyed in a notification Public Works Department No 416 dated 27th October 1894.

The object is to establish Railway connection with Mangalore, a seaport on the Western Coast from Arsikere a station on the Southern Mahratta Railway (Mysore Section) about 100 miles North of Bangalore. The length of the line has been estimated at 137 miles but this has been obtained from the length of the Road and in the final result it is expected to be about 143 miles, the extra length being due to the gradients necessary for an adhesion line. The origin of the survey is an application from Messrs Kirby and Lonsdale for a concession for the

G. O. 619 R. 23rd March 1893.

G. O. 818 R. 6th May 1893.

G. O. 819 R. 6th May 1893.

G. O. 152 R. 10th March 1894.

construction of a line from Arsikere through Hassan to Mangalore with branches from Hassan to Mysore and Chikmagalur and an extension from Chikmagalur in Mysore Territory through Patya. Mangalore

to cross on the Madras Railway where it would effect a junction with the narrow gauge system of the South Indian Railway. As a result of these negotiations the survey now under submission was taken up as it really forms the main feature in the schemes proposed.

The primary object is to obtain an outlet for the Mysore State to a port and Mangalore has been for ages the port which has served Mysore. From its situation on the West Coast it is liable for 3 months every year to the full force of the monsoon and the only routes by which either merchandise or travellers can leave involve a long land journey over roads much cut up during the heavy rains. Mangalore contains a large mercantile population and is a wealthy town and is about the Northern limit of the Koptah population who are known

to the extent of $3\frac{1}{4}$ miles. At Saklaspur the Hemavati is crossed by the Road on an Iron Bridge of 4 spans of 120 feet supported on screw piles and immediately to the West of the River lies the town of Saklaspur, head quarters of the Manjarabad Taluk. Saklaspur is situated on the end of a ridge branching out from the actual Watershed of the Western Ghats and along this ridge the road runs to close to the Manjarabad Hill on which is an old Fort evidently built to command the pass in former days. The actual ridge of the Ghats between the East and West Watersheds runs North at about 1 mile North of Manjarabad and along this watershed the Mudugherri road has been laid out. Mr. Groves' trace crosses this Mudugherri road at a saddle about 3 miles North East of Manjarabad and measured directly about $1\frac{1}{2}$ miles from Saklaspur. There is, therefore, a very peculiar physical feature at this point in the fact of a River of considerable volume, requiring to span it 4 spans of 120 feet, running parallel to the actual Watershed of India only $1\frac{1}{2}$ miles distant and only 83 feet below the saddle, which has been selected for the proposed Railway to pass through for the descent to the Western plains. The

Red: Level of Saklaspur is 2960.

Red: Level of Saddle is 3043 } difference 83.

The River on the Western face is the Yettenhalle and the Road circles under the Manjarabad Hill until it reaches a point in the valley 6 miles from Saklaspur where it crosses the Yettenhalle at Red: Level 2628. The reason for this is that the Road abandons the Yettenhalle valley and rises in 2 miles 300 feet to cross into the Maranahalle valley and go on through easier country. The actual descent of the Road begins only at 11 miles from Saklaspur up to which point the total fall has been only 525 feet. The Railway trace picks to the Yettenhalle valley and falls only 533 feet in a distance of $7\frac{3}{4}$ miles from the ridge

to be subject to periodical turbulent outbreaks and were this to occur at Mangalore from where the garrison has been now removed it would take at least a week before troops could be brought upon the scene -

Further the province of South Kanara is rich in crops irrigated by the Attavati and other large rivers which never fail owing to the South-West Monsoon, and had transport been available much of the distress in Mysore during the disastrous Famine of 1876-'77 would have been prevented.

- (b) The previous reports will be found in the Government orders quoted above and with regards to them it is only necessary to point out that a very serious clerical error has crept into the report by Mr. Farlane at page 8 which

S. O. 2043.R. 20th Aug. 1892.

has led to the hope that a gradient of 1 in 84 would be possible. This results from the

level of the road at the frontier being given as 1733 feet above sea-level instead of 733 feet, and this error has been carried through much of the subsequent notes.

- (c) From Arsikere to Hassan the country is much the same as Mysore generally, open rolling plains with deep depressions and high ridges between the valleys. For these 30 miles the line proposed has been located as far as Hassan by the Mysore Government and the attention of the party was chiefly directed to the portion to be done between Hassan and Mangalore. After leaving Hassan the country falls for some 4.9 miles to the Yagatchi River and after crossing another smaller river rises to Palya on the main Road.

Beyond Palya the rise continues to a place called Barlo at which coffee land is first met. From Barlo to Saklaaput the fall is 360 feet, the whole of which occurs on the Road in the first 4 miles from Barlo and the Railway has therefore to take a route to the Eastward along the ridges dividing the watershed between the Yagatchi River and the Hemavati which entails increased length to

or $10\frac{3}{4}$ miles from Saklaspur and at this point enters a gorge down which the river rushes in a series of falls. The Red Level at the head of the gorge is 2480. From this point the 1 in 40 carried out by Mr. Groves for some 7 miles began and at first sight it appeared hopeless to get a 1 in 40 line down a valley in which the road falls 1 in 20. Before debouching on the plain the fall of the road becomes very gradual and in the result to be explained more fully hereafter by economising every foot and utilising every favourable spur a line has been obtained which will meet the line in the plains without any loss of direction or Deviation to the north. The Road Chat Ends at a place called Kemphole 18 miles from Saklaspur and has on it only one zigzag of about $\frac{1}{2}$ mile in length its mean gradient being 1 in 27 throughout but about 1 in 200 on the steepest part of the descent $6\frac{1}{2}$ miles in length. The frontier is at Barbid 21 miles from Saklaspur and Peradi the first village in South Canara is 8 miles beyond. The Red Level at the Frontier is 724.

Red Level at Peradi is 340.

From Peradi to Mangalore the distance by Road is $53\frac{1}{2}$ miles and the average fall of the country is only about 6 feet per mile. But the spurs of the ghats run into the plains nearly as far as Upinangady 32 miles from Mangalore and though of no height makes the country difficult to work through as it is densely wooded and each line has to be put and cleared only to find that some paddle obstructs the trace and a fresh start has to be made. This has been finally settled by breaking through into the Valley to the South and putting the bridge over the Nittravati at a point near Upinangady. From Upinangady to Mangalore the north Bank of the Nittravati is obligatory for a larger tributary called the Coomodari comes in from the South which would require a bridge as large as that of the Nittravati itself and

and the subsequent bridge over the Attiravati at Buntwal
would be a very long one—

Through South Canara there are no maps of any
reliability the G.I. maps not yet being published but
all existing maps show the main road from Pani. Man-
galore to Upinangady as on the North Bank whereas it
is on the South Bank— The country on the North Bank
has been found from inspection to be well suited for a
Railway except near Upinangady where the location
being near the river is necessarily rough, the Banks
being high and steep— From Upinangady towards
Mangalore the line has been actually located up to near
Pirpadi along the Banks of the Attiravati. From Pirpadi
to Buntwal a ridge runs along the river which will pro-
vide a favorable location and reduce the provision for
waterways. A mile from Buntwal a large stream is
crossed which will probably require 3 spans of 80 feet.
Buntwal stands on a hill on the River Bank with
flat paddy land behind it and along this the line
will run to the Pani-Mangalore ferry. From this to
Teringipet 9 miles from Mangalore the road rises and
falls a good deal owing to the spurs running down to
the river so as far as can be seen until the work
reaches this place the best alignment will probably
be along the River to Teringipet— From thence the
whole alignment will be on Paddy land to Jeppo a
suburb of Mangalore where extensive Coffee works
(Morgan & Co) and Tile Works (Basil Mission) are
situated. It is also an important market centre
and the Civil authorities attach importance to its
having a station. From Jeppo into the Salt Coasters
the line will skirt the river some little reclamation
being required until it reaches the Salt Coasters
where it is proposed the Station should be situated
with an extension along the River to meet mercantile
requirements.

- requirements.
- (d). The gauge is proposed to be the metre gauge that being the gauge of the Southern Mahratta Railway system and also of the South Indian Railway system with which the other branch lines are proposed to connect it. The group of lines thus proposed would therefore form an important link in the metre gauge system of India while the line now under survey would give a valuable outlet for the produce of the Province.
- (e). The fixed point is the same as that used for the Survey already sent in by the Mysore Government of the Arsikere-Hassan Section namely the "centre of the passenger platform of the Arsikere Station of the Mysore Section of the Southern Mahratta Railway".
- (f). The total length of the line is expected to be 143 miles of which 83 miles lie in the Mysore Province and 60 miles in South Canara.

Location.

The actual location of the line has been guided by the results of previous work done and has required much modification. The compensation for curvature too involves not only heavier work in the Section but greater length. So far on the line selected all the curves have with a few exceptions been compensated but without compensation a very much lighter section could be shown. It is a question whether with a ghât gradient of 1 in 40 intervening gradients of 1 in 100 with flatter curves need be compensated. The result of this season's work points very clearly that the ghât if the grade be reduced to say 1 in 40 nett the curves will be easier in consequence of there being more room further down the hill side on each spur and some of the valleys notably the Hemphole will yield better crossings lower down the valley.

Division I

This Division extends from Hassan to Saklasput and has been under Mr. H. P. Milne, Executive Engineer. The

7.
The work on the ghât proving too much for the limited staff Mr. McIlne was deputed to survey the upper section of the ghât to ensure as far as possible a through section. The junction with the work completed by the Mysore Government was made at a point some 49 chains West of Hassan and the station site selected has been retained in the scheme as now submitted. From what can be seen and from what is known to be the wishes of the Durbar the site of the station will require reconsideration and there will be no difficulty in getting a more convenient site which will interfere less with existing roads and probably afford a better gradient out of the Station. The route follows somewhat the line of the Main Road to Bangalore and at mile $34\frac{3}{4}$ crosses the Yagatchi River about $1\frac{1}{4}$ miles North of the Road. The area drained by the Yagatchi is 373 square miles which would according to Dickens' Formula using coefficient 1200 require a waterway of 500 feet. A Bridge with 11 spans of 40 feet arches has been adopted as the Road Bridge $1\frac{1}{2}$ miles lower down consists of 7 spans 25 feet arches and has stood for over 50 years. It has been necessary to deviate from the line of the Road and pass through Alur an important Sub-Taluk head quarters to which a branch road has been made as the route followed by previous survey through Palya on the main road was not feasible at 1 in 100 ruling gradients. It is proposed to investigate a more direct route from Alur to Baklaspur avoiding the Balol saddle and probably shortening the line and saving a considerable rise. The line laid out has ruling gradients of 1 in 100 which do not quite fully compensate the curves for a 12 feet wheelbase but on revision there is no doubt this will be obtained and the work very much lightened by slight deviations from the present alignment. At Baklaspur the

the Hemavati is crossed on a Bridge of 5 spans of 100 feet girders. The drainage area is 230 square miles while the road crosses on a Bridge of 4 spans 120 feet. The extra span has been put in to suit the channel and avoid a high Bank subject to flood. On the West Bank is the station of Saklaspur the head quarters of the Manjerabad Taluk and an important town as near it roads converge from the Mudugherry and Coorg directions. From Saklaspur to the actual ridge which divides the watershed of India is only 2 miles distant from the Hemavati and the rise only 53 feet.

Division II.

The Second Division, Saklaspur to the Frontier has been under Mr. Lilley, Executive Engineer but the work was so far in excess of what was possible with the limited staff that Mr. Milnes' work was stopped in March and he was sent to run the upper 6 miles of the ghât from Saklaspur to the Yettenhalla crossing. The Hebsala Ridge referred to as the actual watershed carries the Mudugherry road which crosses the Railway by an overbridge and the upper descent of the ghât begins. The route down the valley is necessarily tortuous with min. curves of 10° or 573 feet radius and gradients 1 in 66 and 1 in 51 all fully compensated. The Yettenhalla Bridge is reached at mile $64\frac{1}{4}$ and at a Red Level of 2627. The main road here ascends and the Railway follows the course of the River as far as the $67\frac{3}{4}$ mile where it enters a gorge by a Tunnel 140 yards rendered necessary by a bend in the stream. At this point the Red Level is 2480. From this point the lower ghât begins and it has been carried out at a gradient of about 1 in 52 which fully compensates for all curves so that the gradient should be more properly described as 1 in 40 compensated. From the original trial line run by the Mysore Government it was evident that without special expedients to gain base the line would be carried

North

North along the face of the ghât and that owing to the steep beds and continually narrowing valleys the crossing of them would be most difficult. It was therefore arranged to circle two spurs twice which has resulted in the necessary base being obtained about 2 miles. The lower ghât contains numerous viaducts and tunnels which the sharp spurs and narrow valleys necessitate. For the viaducts a tentative design has been taken consisting of trestles and 40 feet girders, longer spans being inadmissible on account of the curves. It is clear from this season's work that it would be impossible to cross the Hemphole River at any point further upstream than the crossing now proposed and that the adoption of a steeper grade would place the line more favorably in the valley for crossing. The min. curve has been maintained at 573 except in a few instances where sharper curves were absolutely necessary. It was considered better to get the line through and establish a good base for the next season's work than to delay trying to get in easier curves which would vastly increase work. The line is now within some 3 miles of the Frontier and it will run out close to the Habbanhalli Bridge. The gap at this point unurveyed is estimated at 10 miles of which 8 are on the ghât.

Division III.

The Third Division, Mysore Frontier to Mangalore has been under Mr. Farewell, Temporary Engineer who was instructed to begin at Peradi pending the completion of the ghât as it was doubtful where it would work out. This has proved a very difficult piece of country, there being no maps available of any reliability. One map 4 miles to the inch dated 1827 is very inaccurate and the more recent surveys are not yet published. The line follows the Hemphole River till it bends to the South when it continues East and crosses the Perisaumby saddle which divides the watershed between

between the Kemphole and Nittravati rivers. The original trace followed the Ooperhale a tributary of the Nittravati but many trial lines proved it was best to avoid this and trending to the South reach the Nittravati near Upinangady, which gives a considerable saving in length and avoids much steep and broken country. The spurs from the hills run out as far as Upinangady and the ravines are deep and tortuous so that a line down the Ooperhale is not at all a favourable one. The whole country is densely wooded and each line has to be cleared which hampered the work. Crossing the Nittravati about 1 mile above Upinangady the line follows the North Bank to Sirpadi which is about 25 miles from Mangalore, but no map exists from which this can be ascertained. From where the work has stopped near Sirpadi the country is open and easy and the fall into Mangalore very slight.

The whole project as now submitted will on detailed revision be much reduced and where necessary steps will be taken to secure extra length for compensation of gradients on curves.

Alternative Route The only alternative route which suggests itself is that from Alur to Hulbailige near Belagode about 5½ miles from Ballaspet, but the country does not appear promising as it is much broken. This will, however, be taken up at once.

The other ghâts namely the Boon or Channadi ghât on the North and the Bislegh ghât on the South have been apparently condemned as unsuitable to a Railway and there is no doubt that two-thirds of the Mangalore Trade follows the Sirpadi route. Arrangements are being made to send out a party at once to see if any improvement can be effected in the alignment already selected by the Mysore Government between Arsilori and Hassan. In some places the route runs from the section to be

11.
be unnecessarily tortuous and it would be perhaps a lasting advantage to straighten some parts even though it did involve extra work. The portion referred to is at miles 5 to 15 where the plan shows the line running through mountains and the section at these points only exhibits small cuttings. It is quite possible that the plans do not correctly show the depressions of the valleys but it has been impossible to go over this portion as the plans were only received from the Mysore Government in July and the whole staff were engaged on their own Division till the end of May.

One other point to which attention must be given is the alteration of the site of the station ground at Hassan previously referred to -

Gradients & Curves.

Above the ghāt and below the ruling gradient has been taken at 1 in 100 compensated and the min. curve at 6° or 955. On the ghāt the grade is 1 in 40 compensated which works out to about 1 in 52. On the sections submitted the compensation has been calculated for each curve on the 12 feet base as given in the published diagram and a through grade shown. It is not considered that this will materially affect quantities and with so many curves the frequent changes of gradient would have greatly increased the work of reduction on the sections. In one case, on the Ist Division, Hassan to Sattaspur there is a gradient 1 in 100 which is uncompensated but this will it is believed be eliminated by the proposed alternative route.

On the ghāts the gradients have all been compensated but it adds very greatly to the length, about 4 miles.

The curves have been kept as far as practicable at the min. Radius but in two cases it was necessary to put in 350 curves, 7 curves 400, 6 curves 500. As before

before mentioned with the grade reduced to 1 in 40 or 1 in 45 rest and a min. curve of 500 feet a greatly reduced section would result and the tunnels diminished.

On the Third Division, Frontier to Mangalore the ruling gradient has in all but two cases been compensated and in revision this will be effected. The minimum curve has also been obtained, but on the plans sent in there is one curve of 570 feet Radius which will not be altered. Five curves of 716 also appear on an alternative line adopted which will all become 955 Radius on revision. For the remaining 25 miles the curves will all be easy and the gradients very slight.

Construction
and
Engineering

The general character of the work may be described as heavy both in the Mysore Plateau and below the ghât, while the ghât on account of its very sudden fall is much broken up by deep ravines which make the Section heavy.

(b) The lineal feet of Waterway is as below:—

I Division. Hassan to Paklaspur. . . 59 feet per mile
II Division. Paklaspur to Frontier. . . 179 feet per mile
III Division. Frontier to Mangalore. . . 75 feet per mile.

The total lineal feet of waterway is,

	Minor.	Major.	Total
I Division.	493.	1460	1953
II Division.	728.	2080.	2808.
III Division.	987.	1060	2047.

and the average cost per foot run works out

	Minor.	Major.	Rate over all
I Division.	Rs 419.	Rs 321.	Rs 346 per foot run.
II Division	Rs 585.	Rs 404.	Rs 457 — " —
III Division	Rs 434.	Rs 363.	Rs 400 — " —

These rates are admittedly high and will probably be reduced. Arches have been adopted wherever possible instead of girders and except for the larger bridges the quantities have been taken from Stone's tables. On the ghats the
Bridges.

Bridges are very high the slopes are so steep.

There are in all 21 Tunnels which aggregate 6955 feet or 2318 yards. No difficulties are expected as it is believed that all Tunnels will be hard and Foundations rock except the Kemavati where wells are proposed.

(C) Fencing has only been provided at Stations. It is considered that a live fence in the climate both above and below ghât would be successful, but no provision has been made for through fencing.

(d) The Permanent Way proposed has followed the proposals of Messrs Kirby & Lonsdale and is 50 lbs per yard above and below ghât and 60 lbs per yard between Saklasput and Beradi. The sleepers proposed are Teak to be obtained either from Karwar or Burmah. Timber sleepers it is thought are best suited to such a damp climate.

(e) Platforms have only been provided at Mangalore and Saklasput.

(f) It is proposed to have Running sheds at Saklasput and Mangalore on the supposition that Saklasput to Beradi will be worked as a ghât section and each of these will have a small workshop for minor repairs. It is presumed the Southern Mah. Ratta Railway will work the line and effect repairs at Hubli or Bangalore.

(g) Water supply for Engine sheds and Stations will be from wells except at crossing stations on the ghât where the perennial streams will be led into Tanks relieved by an overflow pipe.

(h) The Engine changing stations proposed are

Arsikere—

Saklasput— 57½ run 57½.

Beradi — 90. run 34

Mangalore— 143. run 53.

and it is thought that 12 engines would suffice, 4 of them being

being special ghāt Engines with short base wheel.
Labour & Materials. Labour will all have to be imported from the Dec.
can as what little labour is available is all engaged on
the Coffee Estates. The country is very sparsely peopled
in Mysore, on the ghāts the villages are far and from
Marhalli near the 68th mile to Seradi there are scarce
by any inhabitants, the country is so unhealthy. There
will be great difficulty in carrying out the work on
this portion, the natives dread the locality so much.

Materials of excellent quality are available but the
leads for stone in South Canara will be long. Gneiss
only occurs in places and the laterite has proved useless
for building purposes.

Throughout the whole distance there is an excellent
road from which most parts of the line could be reached,
some will, however, be very difficult of access till the
formation is made.

Wood Fuel is available in any quantity in
South Canara and on the ghāt.

It was hoped from the magnificent appearance of the
South Canara Forests that they might be made to yield a
good supply of sleepers as Teak is plentiful in the neigh-
bouring Collectorate, but the Forest Officers' note holds out
no hope of this. Sleepers for current renewals of a wood
called Bhogi and which is believed to be the same as
Pyangadu or akin to it will be always available and by
the time renewals are required the development of the
Forests may have so increased under careful conservation
as to yield enough to make South Canara a future
source of supply for sleepers.

It is proposed to locate the Head Quarters of the
Engineers in Chief and Examiner in one office at
Bangalore where accommodation can be obtained and
so avoid more Temporary accommodation on the
line

Arrangement
of Staff

line.

Direction.

1. Engineer in Chief
1. Assistant Engineer, Personal Assistant.
1. Head Clerk.
1. Head Draftsman.
6. Clerks.
3. Assistant Draftsmen.
- Sanadars, Pono Menials

For purposes of Construction it is proposed to divide the whole length of 143 miles into 3 Divisions.

	Length.	Head Quarters.
I	0 to 58.3 miles. 58.3.	Hassan
II	58.3 to 83.5 miles 25.2	Saklaspur.
III	83.5 to 143 miles 59.5	Mangalore.

In each Division three sub divisions are proposed and the Head Quarters of the Assistant Engineers would be.

I.	{ 1. 2. 3.	Arisikeri Hassan. Saklaspur.
II	{ 1. 2. 3.	Saklaspur. Mamhalla Hemphole.
III	{ 1. 2. 3.	Siradi. Upin Angady Bimtrah

The Subordinates would be.

I.	3 Upper.	6 Lower.
II.	6 Upper.	6 Lower.
III	4 Upper.	6 Lower.

The extra subordinate allowed for the III Division will be required at Mangalore for the extra work along the foreshore where some amount of reclamation will be required in connection with the approaches and Bunder Lines.

The

(b). The Estimate contains provision for Temporary Quarters and Offices for each Division with the exception of those stationed at Mangalore which being an abandoned Cantonment contains a number of Bungalows now vacant which could be utilized for residences and Offices. At none of the other stations through which the line passes is there any accommodation available. The only place where European Bungalows exist is at Hassan and these are not fully occupied by the Native Officials of the State. Hutting for Workmen where necessary will be charged to works. This is only likely to be required on the ghât.

(c). The plateau of Mysore, that is as far as Pattasput is healthy but the ghât is very feverish and at Kemphole the foot of the ghât Red. Level 876.62 Travellers were always warned against sleeping there. The Survey Staff suffered severely and had to be withdrawn to a higher level in April. Down as far as Upinangady the whole country is feverish and unhealthy, and this is the reason for including such a large medical staff. During the monsoon all work on the ghât will necessarily be suspended, the rainfall being as heavy as 290 inches at Marnahalli where the rain breaks on the face of the Hills, 10 miles inland it is only 80 to 90 inches. During this season therefore and during the most unhealthy months the labour would be probably withdrawn to work on the Mysore plateau and in the lower plains of South Canara. The upper and lower sections of the line could be rapidly completed but the ghât will require 3 to 4 years for completing. The medical staff will be supplied with Temporary quarters Dispensaries and Shed Hospitals charged to works.

Relations with the Public etc.

The route selected passes through no military Cantonments or Camping Ground and in no place does it interfere with any Public buildings, temples or Mosques. At the very end of the current season's work a small Mussulman

16
The Office Establishment proposed for each Division is.

- 1 Head Clerk.
- 3 Clerks.
- 1 Cashier
- 1 Draftsman.
- 4. Tracers.
- 3 Sub. divisional clerks.
- 3 Timekeeper writers for Upper subordinates.

The following extra skilled Establishment is proposed

- 2 Permanent Way Platelayers.
- 6. " Sub Inspectors.
- 2 Girder erecting Foremen.

The Accounts Establishment.

- 1. Deputy Examiner.
- 4. Accountants.
- 8. Clerks.
- 3. Divisional Accountants
- 3. " " Clerks.

The Stores Establishment

- 1 Storekeeper. Arsikere.
- 1 Assistant Storekeeper. Mangalore.
- 2. Sub Storekeepers. Mangalore.
- 3. Divisional Storekeepers.
- 1. Permanent Way Storekeeper
- 10. Clerks.

The Medical Establishment will owing to the un-healthy nature of the climate be as follows: —
Apothecaries. Asst. Assistants

I Division.	3.	1.
II Division.	3.	1.
III Division.	3.	1.

For Traffic no special provision during Construction will be necessary except a few signallers and pointmen who would be charged to works —

Moussoulman Graveyard is passed through and it is unfortunately at a place where it is difficult to avoid it. This will have consideration in the revision of the line. The only Bridge which might be made available for Artillery if considered necessary is the Nittavati near Upinangady which would save guns having to cross two ferries but would entail a longer route through Belimangady.

(b). The Index Plan through Mysore has been submitted to the Durbar who state that they have no suggestions or criticisms to offer. At Mangalore the Collector was consulted and he approved of the site selected for the station. The original site was in the heart of the Cantonment a mile further on and 100 feet higher which would have meant a heavy grade and an expensive line. The new site is in every way more convenient and less expensive. The Districts of both Mysore and South Canara are well supplied with good roads and well bridged and no adaptation of railway bridges for cart or passenger traffic seems to be required.

(c) No case of interference has yet occurred with religious edifices and none are expected to occur.

Land. The line passes through a poorly cultivated country alternating between waste, dry cultivation and a little rice under irrigation until mile 47 is reached where coffee cultivation begins and down as far as mile 68 the line runs through occasional patches of coffee. The lower ghāt is all forest and so is the country down to Upinangady where there is a good deal of rice. From thence to Mangalore the land is about half waste, half rice. A through rate has been taken of Rs 40 per acre which it is thought will cover all compensation.

it has been placed here on account of the grading. This will be adjusted on revision.

Saklaspur at 58 miles. Taluk Head Quarters, is a small town on the Banks of the Hemavati and is expected to be the most important station between Aitkeri and Bangalore. It is proposed as a changing station for engines, and full provision has been made for Staff Quarters. Its elevation is 2960 and the pile of the Staff Quarters will be about 3000 feet. For Traffic it will be the centre for the coffee from Mudgere direction and the Coorg frontier.

Hebsala at 60 $\frac{1}{4}$ miles. This is only a Coffee siding for the receiving of Coffee and delivery of Manure etc.

Gettenhalli at 64 $\frac{1}{3}$ miles. This also is only a Coffee siding to suit the Estates on the Mamhalli and Manjerabad spurs.

These Coffee sidings would only be open during the busy season and would be worked under the Saklaspur Station.

Mamhalli Gorge at 67 $\frac{3}{4}$ miles. This is a proposed ghat changing station, but it might be left out as it probably would be better to work the ghat engines right into Saklaspur.

Kardamonihole at 74 $\frac{1}{2}$ miles. This is a proposed siding for watering and crossing. The stream is perennial and the ascending train could back into the siding and water while the descending train

19
Traffic and Statistics. The traffic statistics of the Arsikere Station on the Southern Malabar Railway, are given in the report submitted with the Estimates for the Arsikere. Hassan Section by the Mysore Government, and the station contains ample accommodation for the proposed Branch.

The Stations proposed are:

Taluv at $3\frac{3}{4}$ miles. This is the site of the Hamballi Gold mine and is close to the Hamballi village. The mine so far has not been very successful.

Bagde at $15\frac{1}{4}$ miles. Is a moderately large village with an old Fort.

Dudda at 19 miles. A large village with an important market.

Hassan at 30 miles. Is the Head Quarters of the District and contains the Deputy Commissioner's Court. It is not a town of mercantile importance but is the suggested junction for the Branch to Chickmagalur and the connection to Mysore.

Muv at $37\frac{3}{4}$ miles. A marked town and Taluk Head Quarters.

Barlo at 47 miles. An important village at the beginning of the Coffee Tracts and the junction of a road from the South leading to many coffee estates. This may be left out if the new alignment from Muv to Hulculige be successful in which case Belagod would be the site for a Station instead of Barlo.

Hulculige at 53 miles. A coffee siding to serve the important group of Estates near this. The ~~and~~ position is not quite the most convenient for the planters but it

Train passed on.

Hemphole at $79\frac{1}{4}$ miles. Watering Station.

Seradi at $90\frac{1}{2}$ miles. A small unimportant village.

Proposed Engine changing station.

Golitahtu at $101\frac{1}{2}$ miles. The station is about $1\frac{1}{2}$ mile South of the village. It is expected to afford a considerable grain traffic.

Upinangady at $111\frac{1}{2}$ miles. The station is situated on the North Bank while the village is on the South Bank but the Civil authorities do not consider this a disadvantage - A considerable grain traffic is expected. Further the Tahsildar's Head Quarters is 7 miles South.

Serpadi at 120 miles. A large village with extensive cultivation at present entirely dependant on boat carriage there being no roads.

Bumbtal and Pani Mangalore } at $127\frac{1}{2}$ miles. These two villages are on the North and South Banks respectively and are where the ferry is across the Nitravati. Large boats ply from here to Mangalore and are likely to compete with the Railway for traffic.

Springipett at $134\frac{1}{2}$ miles. A large village in the middle of much cultivation.

Jeppo at $141\frac{1}{2}$ miles. A large village where the Basil Mission Tile works are situated and also Messrs Morgan's very extensive coffee clearing works. It is also a large market and the Civil authorities attach importance to a station being placed here.

Mangalore at 143 miles. The terminus has been fixed at the Salt Coasters. A separate note on the Port is in the Appendix.

- (b). The statistics regarding Coffee which is the principal product have been treated separately and the General Traffic prospects has been kept as low as possible to avoid any chance of over estimating. The bulk of the Traffic will certainly be towards the Port, but if the improvements in the Port are carried out an inwards traffic from Bombay by sea may be certainly expected. European Merchants who have been consulted think differently. Some believe the opening up of Mangalore will change the direction of Traffic while others do not. North Mysore Planters say that it will not benefit them, but there is a general idea among them all that unless the Railway pass through their own Estate it is to their advantage having once loaded in carts to cart to the Coast. Others think differently. but it is a fair assumption that so surely as the cart has with the improvement in roads entirely superseded the pack-bullock so will the Railway supersede the cart.

Local Traffic is all that has been considered in the Estimate, Through Traffic cannot be estimated but the Steamer Agents feel very certain that it will be a very large one.

The Pilgrim Traffic to Sringeri is stated to be very large, but until the Chickmagalur line is made it must be regarded as a very doubtful factor in considering the passenger Traffic as pilgrims would be more likely to travel via Kadur on the Southern Mahratta Railway and walk to Sringeri.

From all that can be learnt there is no doubt that this line is much desired and that it is

a line which will gradually grow in importance and become in time a remunerative line. It will never be an important Trunk line and the ghāt section may therefore be constructed with sharper curves and steeper gradients and worked as a special section without any risk of its hampering in the future by reason of this the financial results of a great system. It must be regarded as an important outlet to the sea for the Province of Mysore and part of the Presidency of Madras, and when all the connections are made, an important link in the narrow gauge system of India.

General Remarks

The only Railway with which this can be compared is the Holhar Railway, the ghāt is longer and more difficult and the rise very much greater, but the estimate as submitted compares favourably with the published statement of the cost of that Railway. It is also to be remembered that while the ghāt section is heavier than the Vindhyā ghāt the sections in the plains above and below ghāt also are heavier than any portion of that Railway.

The plans now submitted show all but the 10 miles gap at the foot of the ghāt which has been fully allowed for in the estimate and the 23 miles to Bangalore from Seppadi which has not yet been completed. The point on which the cost of the line chiefly depends is the ghāt and if the grade be steepened say to 1 in 40 nett and a curve of 450 or 400 feet radius adopted and it be made a special ghāt section with special Engines, its cost will be vastly reduced. Taking the length of the ghāt over the lower section beginning at 67.75 and ending at 88.44 a distance of 20.65 miles, the compensation for

of 1 in 25 and cease at or near Hemphole where
it will probably join in with the past season's
line. The maintenance of a Rack line with such
Rainfall is a serious consideration—

Officer

Note on Estimate.

The Estimate submitted amounting to Rs 169,62,253 represents the probable cost of constructing the 143 miles of Railway from Arsikere to Mangalore at Rs 1,18,617 per mile. The increased cost of the line is due to the ghāt section 25.2 miles in length which is estimated at Rs 2,36,047 per mile. The Estimate includes the work from Arsikere to Hassan already estimated for by the Mysore Government.

When the plans and Estimates were received from the Mysore Government in July no detailed estimates were sent but it was apparent from the printed Estimates that under the Head of Bridgework a serious error had crept in. Applying the test of cost per foot run it was found that

Major Bridges. 1188 feet run cost Rs 68.5 per foot.

Minor Bridges. 1064 feet run cost Rs 141 per foot.

In order therefore to bring the Bridging up to its probable cost the Estimate has been increased up to Rs 250 per foot run in each case which gives an increase of Rs 3,31,503.

Ballast and Permanent Way have been increased by Rs 1,34,881 to provide 50 lbs rails instead of 48½ lbs in accordance with Messrs Lonsdale & Kirby's proposals. Under other heads the cost has been increased to assimilate it with the portions now under survey.

The whole increase is Rs 7,73,967 which increases the cost per mile of this Arsikere-Hassan Section from Rs 66,049 to Rs 91,803.

The Estimate for the remainder has been calculated from the plans and sections submitted and the two gaps not yet surveyed taken into the Estimate at a proportionate cost head by head.

Excluding the ghāt section the cost averages Rs 97,478 per mile.

This.

200 125 310

Preliminary
Expenses.

This amounts to Rs 2,02,522 and includes Rs 22,602 already spent by the Mysore Government as well as the estimated cost of completing the Survey. The original estimate was Rs 643 per mile, but the country was not known by those who prepared the estimate and the greater portion has been assumed to be open plain country whereas it is not.

Land.

Land has been taken at 20 acres per mile at a rate of Rs 40 per acre which considering the large amount of waste land will, it is believed, allow a sufficient margin to compensate for interference with coffee lands.

Formation

The cost of Formation is Rs 61,07,850. or Rs 42,702 per mile which is due to the heavy work on the ghāt on which Division the Formation alone costs Rs 129,271 per mile. This will undoubtedly come down on revision, but it would be vastly reduced if the ghāt were made a special section with curves of 400 feet and a gradient of 1 in 40 nett. as suggested in the report.

The rates by sections are

Arsikere to Hassan	Rs 28,254 per mile
Hassan to Saklaspur	Rs 21,153 — " —
Saklaspur to Frontier	Rs 129,271 — " —
Frontier to Mangalore	Rs 23,558 — " —

On the ghāt there are 6955 linear feet of Tunnel which works out to Rs 63,160 per mile.

Bridgework.

As before explained the original estimate for the first section has been increased and this gives the mileage rates.

Arsikere Hassan	Rs 18,734 per mile
Hassan Saklaspur	Rs 16,330 — " —
Saklaspur Frontier	Rs 55,981 — " —

Frontier

Frontier Mangalore Rs 27,977 per mile

These rates per mile seem fairly to follow the feature of the country and the rainfall.

Fencing - No remark.

Electric Telegraph. - Construction purposes only.

Ballast and Permanent Way. The estimate follows the proposals of Messrs. Kirby and Lonsdale for 50th rails above and below ghāt and 60th rails on the ghāt, the mileage rate for which averages throughout Rs 21,674.

By sections the rates are.

Assiari to Hassan Rs 21,832 per mile.

Hassan to Ballasapur Rs 21,815 — " —

Ballasapur to Frontier Rs 25,671 — " —

Frontier to Mangalore Rs 19,830 — " —

The rates have been calculated on the assumption that it would be better to land the Permanent Way material at Mormugao for the first three sections. The slight difference between the first and second is due to length of sidings proposed, which in the absence of the details of the estimate have not been altered, as it is trifling. The third section difference is due to the 60th rail which is to be landed at Mormugao as it appears better to lay the ghāt with the lead down hill. The markedly smaller cost of the last section is due to the material being landed at Mangalore and consequent saving in Railway transport.

Stations and Buildings. The total cost under this head amounts to Rs 6,98,763 or a mileage rate of Rs 4,886. This provides for 3rd Class Stations throughout, except at Mangalore where a larger station is proposed for which Rs 50,000 has been assumed.

assumed. Each station has a 3rd class waiting shed and watering arrangements. Saklasput has been selected as the principal engine changing station on the supposition that the ghât would be worked as a special section. At Seradi a pumping room has been provided. Staff Quarters of the double unit type have been provided for Guards and Drivers at Saklasput and Mangalore and adequate accommodation at all stations for the working staff of the arched roof pattern in use on the Rapputana. Malwa Railway.

Plant.

The figures under this head have been obtained by a pro rata deduction from the published figures of the cost of the Southern Malwa Railway.

Services.

Nil.

Rolling Stock.

In the Estimate sent in for the Azeikari Hassan Section no provision was made for Rolling Stock on the supposition that it would be worked by the Southern Malwa Railway. Admitting this it seems that an additional Branch of 143 miles must have its equipment and that more Rolling Stock will be required. The figures have been obtained by deduction from the Southern Malwa Railway mileage rates under this head and divided proportionately among the ^{two} heads.

General Charges.

The General charges have been calculated as detailed in the report for a period of three years for the work above and below ghât and for four years for the ghât section.

W. F. L. J.
S. J. in Chief

1st Division

Form R II.

ARSIKERI-MANGALORE RAILWAY.

(Metre Gauge.)

34.29 Miles

Gradient Abstract.

INCLINATION.	Number of each.	Total Length.	Percentage of total length of line.
		Miles.	
1 in 51	1	2.50	7.30
1 in 66 } Ghat	1	1.57	4.58
1 in 100 } Net	1	5.82	16.97
1 in 109	1	1.09	3.15
1 in 110 } $\frac{1}{100}$ Comp.	4	10.73	31.30
1 in 115 }	1	1.74	5.07
1 in 124	1	0.93	2.71
1 in 200	1	0.68	1.98
1 in 250	2	2.47	7.20
1 in 750	1	1.29	3.76
Level	9	5.47	15.95
Total		23	34.29
			100.00

W. J. J. J.

2nd Division

FORM R II.

ARSIKERI-MANGALORE RAILWAY.
(Metre Gauge.)

16.174 Miles

Gradient Abstract.

INCLINATION.	Number of each.	Total Length. Miles.	Percentage of total length of line.
Level	2	.84	5.19
1 in 225 or .44 per Cent.	1	1.49	9.21
1 in 52 or 1.92 per Cent.	1	1.10	6.80
1 in 53.3 or 1.88 per Cent.	1	2.43	15.03
1 in 50 or 2.0 per Cent.	1	6.93	42.86
1 in 47 or 2.13 per Cent.	1	3.38	20.90
TOTAL ...		16.17	99.99

W. J. J. J.

Division III.

Gradient Abstract.

INCLINATION.	Number of each.	Total Length.	Percentage of total length of line.
1 in 100, or 1 per Cent	4	5.79	21.33
2 compensated only	1	.94	3.46
1 in 111, or 0.9 per Cent	1	1.42	5.23
1 in 114, or 0.88 per Cent	1	.78	2.88
1 in 117, or 0.85 per Cent	1	1.33	4.90
1 in 200, or 0.5 per Cent	1	.41	1.51
1 in 217, or 0.46 per Cent	1	.61	2.25
1 in 229, or 0.44 per Cent	1	.45	1.66
1 in 300, or 0.33 per Cent	1	1.18	4.35
1 in 310, or 0.32 per Cent	1	.99	3.65
1 in 400, or 0.25 per Cent	1	.85	3.13
1 in 450, or 0.22 per Cent	1	.94	3.46
1 in 500, or 0.2 per Cent	1	1.34	4.93
1 in 700, or 0.14 per Cent	1	3.64	13.41
1 in 1200, or 0.08 per Cent	1	2.27	8.36
1 in 1600, or 0.06 per Cent		4.20	15.48
Level			
TOTAL ...		27.14	99.99

Note. Mile 27.14, actual length of gradient.

W. J. C. R. S.

I. Division
34.29 miles

Curve Abstract.

ANGLE OF CURVATURE OR RADIUS.	Number of each.	Total Length.	Total Curvature.
1° 0' (R 5730)	5	0.44	34-0
2° 0' (R 2865)	7	1.20	127-0
3° 0' (R 1910)	25	3.55	562-30
4° 0' (R 1432)	3	0.51	107-0
5° 0' (R 1146)	16	2.08	548-0
6° 0' (R 953)	28	5.91	1873-30
8° 0' (R 716)	1	0.08	32-30
9° 0' (R 636)	1	0.09	44-30
10° 0' (R 573)	20	2.37	1251-0
TOTAL ...			4583-20

Ratio of Curvature to total length of Line. 47.92

Average amount of Curvature per mile. 133.65

16.174 mls

Curve Abstract.

ANGLE OF CURVATURE OR RADIUS.	Number of each.	Total Length.	Total Curvature.
		Miles.	Degrees.
2° 0' (Radius 2865 ft.)	1	-05	5
5° 0' (Radius 1146 ft.)	2	-08	21
6° 0' (Radius 968 ft.)	1	-06	18
10° 0' (Radius 573 ft.)	87	7-65	4042
11° 28' (Radius 500 ft.)	6	1-32	798
14° -19' (Radius 400 ft.)	7	-85	642
16° -22' (Radius 350 ft.)	2	-46	401
TOTAL ..		10-47	5927

Ratio of Curvature to total length .. 64.7 per cent.

Average amount of Curvature per mile. 366.52.

W. J. J. J.

27.27 miles.

Curve Abstract.

ANGLE OF CURVATURE OR RADIUS.	Number of each.	Total Length.	Total Curvature.
		Miles.	Degrees.
1°-0' (Radius 5736 ft.)	1	.45	23° 8'
2°-0' (Radius 2868 ft.)	13	1.47	165° 2'
3°-0' (Radius 1910 ft.)	14	1.84	291° 3'
4°-0' (Radius 1433 ft.)	7	.75	158° 4'
5°-0' (Radius 1146 ft.)	1	.22	58° 1'
6°-0' (Radius 955 ft.)	29	3.37	1067° 6'
8°-0' (Radius 716 ft.)	5	.61	257° 7'
10°-0' (Radius 573 ft.)	1	.11	58° 1'
TOTAL ...		8.82	2046° 4'

Ratio of Curvature to total length of Line. = 32.34 per cent
 Average amount of Curvature per mile. = 76.9 degrees.

W. J. ...

1st Division

Form R III.

ARSIKERI-MANGALORE RAILWAY.

(Metre Gauge.)

Length 34.29 miles

Bridge Abstract.

TYPE OF BRIDGE.		Total Number of Spans.	Waterway. — Lineal Feet.
Class.	Spans.		
Slabs	2 ft.	4	8
	3 ft.	44	132
	5 ft.	27	135
	6 ft.	8	48
Arched Bridges	10 ft.	11	110
	20 ft.	3	60
	30 ft.	2	60
	40 ft. (a)	4	160
	40 ft. (b)	16	640
Girder Bridges	100 ft. (c)	6	600
	(a) Yagachi - 4 spans 40 ft.		
	(b) mile 31 - 4 spans 40 ft.		
	" 38 - 2 " 40		
	" 62 - 5 " 40		
	" 63 - 5 " 40		
	(c) Hemavati - 5 spans 100 ft.		
	Yettihalla - 1 " 40		
TOTAL FOR WHOLE LINE ...		125	1953
Average per mile, ...			57

10.1.10
Officer

2² Division

Form R III.

37

ARSIKERE-MANGALORE RAILWAY.

(Metric Gauge.)

16.174 Miles

Bridge Abstract.

TYPE OF BRIDGE.		Total Number of Spans.	Waterway. — Lineal Feet.
Class.	Spans.		
Open Tops.	2x2 feet	32	128
Slab Drains	2x2 feet	30	120
Arched	5 feet	32	160
Arched	10 feet	11	110
Arched	15 feet	2	30
Arched	20 feet	8	160
Girder	20 feet	1	20
Viaduct	2x40 feet — (1)	2	80
Viaduct	3x40 feet — (3)	9	360
Viaduct	5x40 feet — (3)	15	600
Viaduct	6x40 feet — (3)	18	720
Viaduct	8x40 feet — (1)	1	320
TOTAL FOR WHOLE LINE ...			2808
Average per mile.			173.6

Cost Rs 585 per foot.

728
Cost was Rs 18 per foot.
2080

W. J. J. J.

Ariseh J. J. J. J.

Bridge Abstract. (27.27 miles)

TYPE OF BRIDGE.		Total Number of Spans.	Waterway. Linear Feet.
Class.	Spans.		
Open tops	2 feet	3	6
Flat tops	2 feet	7	14
	4 feet	4	16
Arched Culverts	4 feet	14	56
	5 feet	5	25
	6 feet	11	66
	8 feet	2	16
	10 feet	31	310
	15 feet	10	150
	20 feet	12	240
Girder Bridges	12 feet	4	48
	20 feet	2	40
	40 feet, 2 of one Span	2	80
	60 feet, 3 of one Span	3	180
	100 feet, one of one Span	1	100
	" one of seven Spans	7	700
TOTAL FOR WHOLE LINE ...			2047
Average per mile. ...			75.06

W. J. J. J.

Coffee cultivation.

In the original orders for the Survey the Government of India directed that a map be prepared "to shew the tract in which coffee is grown, the alignment of the Railway and of the roads leading from the coffee tracts to the Coast." To carry this out the assistance of three of the oldest and most important European planters was called and the area coloured in represents the coffee zone of Mysore and ^{inside} ~~beside~~ this area are situated all the coffee Estates. The green portions represent the principal sites of gardens and the Sepia coloured Roads represent the routes to the Coast.

The entire area of the "Zone" amounts to
1862 square miles, or 11,91,605 acres
Of this there are registered as
Coffee Gardens. 1,64,785 Acres
or say, about 1/7th.

It must however be understood that the entire area of each Estate is not under coffee, a great deal is still uncultivated some is Paddy or rice land, a good deal is Forest land and much of the land under cultivation is represented by new plantations which do not produce any crop for four years and are exempt during that period from assessment.

From information received from the Planters Associations it appears that expansion of the coffee industry is possible in North Mysore to a considerable extent but in South Mysore the whole available land has been absorbed and the only possible extension will be under Irrigation. The figures supplied by the Planters Associations and the local authorities agree in quantity very accurately and from these it seems that the total number of Estates is as follows.

North

North Mysore.

European	559 aggregating	40,318 acres
Native	<u>11,747</u>	<u>65,796</u> "
	12,306	1,06,114

South Mysore.

European	286	21,637
Native	<u>16,369</u>	<u>36,983</u>
	16,675	58,620

Grand Total 28,981

There are therefore 28,981 gardens which represent an acreage of 1,64,734 or subdividing it

European	865 representing	61,955 Acres
Native	28,116	1,02,779

The maximum estate held by any one Proprietor is returned by the Civil Authorities

as North Mysore	32,440 Acres
South Mysore	8,825 "

The minimum is given as 10 of an Acre and pre Native holdings of which there are a very large number.

The South Mysore Planters Association have given an approximate proportion between Coffee Cardamom and jungle in South Mysore which is

Coffee	31 per cent
Cardamom	18 " "
Forest & other	51 " "

No such proportion has been suggested by the North Mysore Association but it is assumed that no serious error would result in applying the same proportions to the entire province and would obtain then the following result -

Coffee	19,206	
Cardamom	11,147	
Forest etc.	31,603	61,955 acres

and for Native Estates

Coffee 31861

Cardamum 18500

Forest etc: 52,418 . 102,779 acres.

Between the European and Native Estates the difference is most marked for ~~which~~^{while} the one may be ranked with high class gardening the latter are left very much to chance. Some are however reported to be maintained in a high state of efficiency.

The outturn on an average on a European Estate may be taken at from 3 to 4 Cwt. per acre and on a Native Estate from $1\frac{1}{2}$ to 2 Cwt. per acre. Applying in each case the lower figure to the acreage under actual Coffee as obtained above we get the Coffee crop as follows.

European . 2881 Tons

Native . 2389 . 5270 Tons.

The actual export from Bangalore during 93-94 was 6000 Tons of which some 2000 came from Coorg, and 4000 from Mysore and about 3000 Tons of this came down the Siradi Ghat. It is then safe to assume that with the Railway before the branches are opened not less than 4000 Tons of Coffee may be expected to travel 80 miles while the remainder will probably for some time continue to come to Bangalore when the branches are made this will cease.

Under present arrangements carts are contracted for at a rate which varies from Rs 21 in North Mysore to Rs 24 in South Mysore per cart for a double trip to Bangalore and back so that the cost of carriage of a ton of Coffee and a return trip with one ton of manure engages two carts at a rate of about Rs 45.

Taking the present cost of carriage of one Ton of Coffee and one Ton of manure at Rs 45 and the rail charges at .75 of an anna per ton mile for 80 miles we get

Carriage Coffee Rs 3.12.0

Carriage manure . " 3.12.0 . Rs 7.8.0

Present

Present cost of Carriage Rs 45-0-0
 which leave a balance of " 37-8-0
 in favour of the Railway Carriage, which taking the cost
 of manure at Rs 50 per ton enables the Planter without in-
 creasing his present expenditure to purchase 75 per cent
 more manure per ton of Coffee which while increasing out-
 turn of crop must increase the Railway earnings.

The Secretary North Mysore Planters Association states
 that on his own Estate and on many others as much as
 1 ton of manure per acre is used annually, on half the
 Estate in alternate years or an average of $\frac{1}{2}$ ton of manure
 per acre annually.

On the above figures therefore the following estimate
 for coffee is based -

Coffee Annually	4000 tons.
Manure as at present.	4000 tons.
Extra manure at 75 per cent.	3000 tons.
Food for 70,000 Coolies at 2 lbs. per diem for 300 days.	18750 tons.
Machinery building materials etc. etc.	5000 tons. 34,750

The North Mysore Planters Association consider that .75 ton
 per acre represent the average export and import for Coffee
 Estates and .50 of a ton is about the figure for Native
 Estates. This being the case we obtain from the foregoing
 acreages.

European 19,206 acres @ .75 ton	14,405
Native 31,865 " " .50 "	<u>15,930</u>
	30,335

It appears therefore that it is quite safe to assume that the
 coffee industry represents not less than 30,000 tons, and
 that in carrying into the Traffic Estimate 20,000 tons, as
 due to coffee alone places the Estimate at a figure which
 is fully certain of realization.

The figures now put forward have been submitted to the
 Secretary

Secretaries of the North and South Planters Associations and they consider that they fairly represent the Coffee Estates. The Secretary North Mysore Association considers the proportion of coffee cardamoms and forest too low for North Mysore and would estimate the area under Coffee at 50 per cent of the gross acreage. This would increase the estimate considerably but the figures have not been recast to meet this because until the Chikmagalur branch is made the Railway will only affect South Mysore at first, and North Mysore in the more adjacent parts gradually. When the branches are made there is no doubt all the Coffee except that grown near Kadur will find its way by Rail to the Coast and only a small proportion come to Bangalore for shipment at Madras. In Mangalore there are three immense Coffee cleaning works Messrs. Morgan, Messrs. Struthuott, Messrs. Saldanha. The good coffee chiefly goes to Tellicherry but of the North born Coffee at present comes in at Mangalore and passes down the Arabi Ghat.

Manure is procured chiefly from Mangalore and Bangalore and consists of fish manure, bone dust & other patent chemical manures for which there is a great demand and the present tendency of the Planters is to increase the manure. There is little doubt that with the Railway the Coast Agents would establish manure depots at Palkessur.

W. Frederick St
Pres in Council

in March and during December January February and March the strings of carts travel in constant trains of 20 & 25 up and down by night and day. To get carts to come up during May and the monsoon months very high rates have to be paid for all the bullocks are then employed above and below the ghat in agricultural work. One other point on which Mr. Muirhead has been led away is in regard to the Statistics collected by Mr. Palmer Agent to the Bank of Madras at Mangalore where he has been in his present position for 25 1/2 years and whose daily business puts him in a better position than any one else to form a reliable Estimate. He gives the very low figures of

Exports -	2538 Tons
Imports -	4073 Tons
	<u>6611 Tons</u>

which the collector considers too low and proposes a cautious increase of only 25 per cent. For the reasons stated under the head of coffee these figures seem all to have erred on the side of being too low.

Taking the Deputy Commissioners figures

	Tons
Total Export to Mangalore	14907
Import to Mysore	9905

and reducing the export by the items due to Coffee Industry i.e. 2600 Tons and similarly reducing the Imports by 1400 the amount shown as Contingent, on coffee, Tools, Furniture etc: we get the following as representing Exports & Imports exclusive of the Coffee Industry

Total Export	12307
Import	8505
Total	<u>20812 Tons</u>

Add amount due to Coffee Industry	20000 Tons
Total	<u>40812 Tons</u>

which

Abstract.

40812 Tons @ .75 Annas x 90 miles	Rs 172,175
10,750 Forest Produce	
@ .75 Annas x 50 miles	25,195
10,000 Tons Local	
@ .75 Annas x 32 miles	14,062.
300,000 Passengers	
@ .16 Annas x 70 miles	2,10,000

	Rs 4,21,432
Working Expenses @ 60%.	2,52,859.

Nett Profit Rs 1,68,573.

This would represent ^{gross} earnings Rs 50 per mile per week or pay a return of 1 per cent.

Port of Mangalore.

The Port of Mangalore is situated on the West coast in Latitude 12.54 North Longitude 74.50 East, and is an open roadstead with an inner Harbour now only navigable by Native craft. Steamers lie off, at anchor and are served by cargo boats. The lines of Steamers calling there are the B. I. S. N. Company two steamers weekly one bound North the other South and the Bombay S. N. Company (Shepherd & Co) who send two Steamers weekly from Bombay Mangalore being the Southern limit of their traffic. Until lately Messrs. Shepherds steamers used to enter the inner Harbour but since one of them grounded on a shoal they lie off in the roadstead.

The inner harbour is a long lagoon about 7 miles long and $\frac{1}{2}$ a mile wide formed by the River Ghorepuri on the North and the Nitravati on the South. The sandbank which encloses this lagoon is about 400 feet wide and about 7 feet above high water level and forms a substantial natural breakwater. There are two bars one on the North which is always closed and the other on the South which is the mouth of the Nitravati. The silting up of the inner Harbour has been going on gradually for years due chiefly to the Ghorepuri River bringing down silt and having lost its force by expanding into a wide estuary and being of insufficient force and volume to maintain its bar open, it brings silt down the whole length of the Harbour which at the slack water intervals between tides is deposited. The Nitravati on the South is much larger river its drainage area being 1410 square miles against 352 square miles for the Ghorepuri River or say 4 times the Volume. The fall of these rivers is very slight and the tide ebbs and flows for about 7 miles above Mangalore.

To make the Port efficient it is proposed to shut out the Ghorepuri River by a Bund across the Lagoon near the

Sulthan Battery and leave it to find its way to sea through its own bar and by a system of groynes and training walls to concentrate the full force of the Nitravati upon its own bar. This would leave the inner Harbour almost a still water basin and it could be easily dredged to any extent required. A Quay wall could be built with a loading jetty capable of berthing two Coasting Steamers. In the dry season the reflux of the tide concentrated on the bar would clear any silt brought in, and if two pier heads were built say 500 feet apart no attrition need be feared and a channel permanently navigable except during the monsoon would be assured. The question of the Harbour is under investigation and it is a matter which should be carried out at the same time as the Railway for the efficiency of the Port will be an important factor in the success of the Railway.

Besides being an important Port and Mercantile Centre Mangalore is the seat of a very large and important Tile manufacture there being no less than 10 manufactories of the well known Mangalore Tile which is so rapidly making its way in India, and there are large weaving Establishments also established here. When communication by Rail is established these industries will receive a great impetus as at present they are unable to find carts sufficient to meet the demands on them for tiles. All over Mysore the Mangalore tile is replacing the old half round tile even in Native houses.

W. Speer
Resident

Abstract of Cost of Railway

Heads of accounts	Total Cost in Rupees			
	Sub. Heads		Main Heads	
	Total Cost	Rate per mile	Total Cost	Rate per mile
I. Preliminary Expenses. -	2,025 22	14 16	2,025 22	14 16
1. Survey Expenses.				
2. Plans.				
3. Establishment.				
II. Land -	113 29 5	7 92	113 29 5	7 92
III. Formation. -			610 78 30	42 7 12
1. Earthwork.	45 15 18 2	31 5 7 5		
2. Tunnel.	159 26 48	11 13 7		
IV. Bridge work. -			4100 40 5	28 6 7 5
1. Large Bridges	23 12 30 3	16 1 7 0		
2. Minor Bridges	178 8 10 2	12 50 5		
V. Fencing etc.			198 0 9 9	13 8 5
1. Fencing.	47 50 7	34 6		
2. Road Crossings	142 34 2	9 9 5		
3. Mile and Gradient posts.	6 2 50	44		
VI. Electric Telegraphs. -	14 3 00	1 00	14 3 00	100
VII. Ballast and Permanent way.			335 6 25 7	23 4 7 1
1. Ballast	25 6 9 12	17 9 7		
2. Permanent Way.	309 9 34 5	21 6 7 4		
VIII. Stations and Buildings			698 7 63	48 9 6
1. Stations and Offices	213 4 5 1	14 7 3		
2. Workshops, Store buildings etc.	23 7 6 4	1 6 6		
3. Staff Quarters	14 6 2 2 1	12 3 2		
4. Station Machinery	28 5 3 2 7	19 7 5		
IX. Plant. -			43 7 58	30 6
1. Engineering	16 15 9	11 3		
2. Locomotive Carriage & Wagon	23 16 6	16 2		
3. Station & Office furniture	44 33	31		
X. Ferris etc. -				
1. Ferris.				
2. Loading Bridges				
XI. Rolling Stock	1144 40 00	80 00	1144 40 00	80 00
1. Locomotive				
2. Carriage & Wagon.				
XII. General charges.			983 02 4	68 7 4
1. Direction.	133 58 4.	93 4.		
2. Engineering.	694 64 0.	485 7.		
3. Stores.	52 800	369.		
4. Audit and accounts	88 000	621.		
5. Medical & Sanitation	13 200	92		
6. Locomotive				
7. Traffic.				
		Total.	169 62 25 3	118 61 7.

W. H. H. H.

Total Expenditure Rs. 16,96,253

Abstract of Railway. 25.218 miles of Cost

HEADS OF ACCOUNT.	SUB-HEADS.		MAIN HEADS.		SUB-
	Est.	Rate per mile.	Total Cost.	Rate per mile.	Total Cost.
I.—Preliminary Expenses				1579	
Survey Expenses					
Plant					
Establishment					
II.—Land				800	
III.—Formation			3259704	129271	
Earth-work	56	66111			1401739
Tunnels	48	63160			
IV.—Bridge Work			1411610	55981	
Major Bridges	82	37789			783626
Minor	28	18192			931001
V.—Fencing			14627	580	
Fencing	66	110			24486
Road Crossings	27	429			90140
Mile and Gradient posts	34	41			2850
VI.—Electric Telegraph				100	
VII.—Ballast and Permanent-way			691022	27404	
Ballast	02	1733			106143
Permanent-way	20	25671			1179895
VIII.—Stations and Buildings				5138	
Stations and Offices					
Workshops, Store Buildings, &c.					
Staff Quarters					
Station Machinery					
IX.—Plant				306	
Engineering					
Locomotive, Carriage & Wagon					
Station and Office Furniture					
X.—Ferries &c.					
XI.—Rolling Stock				8000	
XII.—General Charges				6874	
TOTAL EXPENDITURE				236047	
TOTAL RATE PER MILE					

(5952161)

Without
Total

way 143 miles

Metric Gauge

station
Post

Revirement Tunnel Total	Costing	Ground	Cost of each
Cost	5%	Total	Section
8,08,596	40,430	8,49,025	8,49,025
50 2,40,153	5,68,916	28,446	5,97,362

50 8,02,245 1,00,180 8 8,14,7 6,95,520 1,38,700 27,84,480 1,39,139 29,24,019

at Rs. 1,11,895 per mile

3,35,685 3,25,9,701

40 7,21,88 1,57,718 6 8,263

5,65,489

Rs 66,500 per mile

2,66,000

Rs 40,000 per mile

1,20,000

Rs 18,000 per mile

4,50,000

14,01,739 14,01,739

Total Amchere to Mangalore 143 miles

Rs. 61,04,830

Rate per mile Rs. 42,712.

Official

3 Anvikere Mangalore Rail III Home Abstract of

Sections	Embankment	Soft	Cutting	Hard	Rail
	Quantity	Cost	Quantity	Cost	Quantity

Section I.

Section II 4,35,000 5 3678 61,13,039 5 48904 63,35,239 15 95,029 48,03,994
301,92,887 6 1,81,153

Section III 23,54,264 8 1,38,341 81,76,155 8 65,410 174,50,110 15 2,61,753 1,60,44 87
119,80,186 6 71,882

Added for three additional miles unmeasured

Section IV 50,94,086 6 3,05,466 35,29,757 8 28,236 92,75,438 15 1,39,134 18,04,724
Side drains 12,272

Added for four miles from Sranier to Kubbinkulla at
three miles from Kubbinkulla to Sranier at
twenty five miles from Sranier to Mangalore at

Grand Total

Arsikere Mangalore Railway. 143 miles Metre Gauge.

IV. I. Major Bridges.

IV. I. Major Bridges.																							
Section.	Number of Bridge.	Description and Span.	Excavation of Foundations.	Concrete	Masonry	Ashtlar	wt Iron girders	Qty iron	Timber	Total cost Indian.	Total cost English.	Total cost	Contingencies.	Cost of each Bridge.	Cost of each Section.	Rate per mile.							
															2.97.000	9.883							
1188 lin ft major bridges @ 250 Rs per lin ft.																							
ii	1	4x40 girders	29540	7385	78621	334	36.16	757	302	29528	7232	36760	1835	38598									
	5	2x40 "	32487	8122	81864	342	16.08	339	150	28937	3616	32553	1628	34181									
		4x40 arches	70851		75232	2683	Arch	1860		29071		29071	1454	30525									
		2x30' arches	51730		31210	1386	Arch	104700	450	12390		12390	619	13009									
		5x100' girders	68640	20564	75761	2628	358.20	104700	450	119978	82386	202364	10118	212482									
		Total ii Divn	253248	36071	342678	7373	358.20	105796	3Rs						328795	11643.							
		Rate	Rs 10/-	Rs 25/-	Rs 75	70Rs	105Rs	15Rs	2705	219904	93234	313138	15657	328795									
		Cost	2532	9018	102669	5530	37871	3258															
iii	92	5x40 girders	8184		31348	242	110.805	663		23292	25485	48777	2439	51216									
	93	5x40 "	10100		51088	277	114.621	663		29659	26363	56022	2801	58823									
	99	1x100 "	42641		13941	675	71.640	92		12913	16477	29390	1469	30859									
	143	5x40 "	8421		29835	238	143.445	397		12698	13684	26582	1329	27911									
	144	3x40 "	4675		14068	198	60.364	397		8797	11300	20097	1005	21102									
	151	3x40 "	3399		6439	159	49.132	663		19017	27238	46255	2312	48567									
	154	5x40 "	5966		12431	182	118.427	397		29207	19638	48845	2442	51287									
	158	3x40 "	8950		53372	282	85.382	795		42084	42981	85065	4250	89318									
	160	6x40 "	11800		56221	282	186.873	264		28103	10449	38552	1927	40479									
	175	2x40 "	8485		63312	297	45.430	1061		43618	71431	115049	5753	120802									
	181	8x40 "	10930		21471	202	310.570	795		40267	44107	84394	4219	88613									
	201	6x40 "	11366		49659	272	191.768	663		30880	34118	64998	3250	68248									
	209	5x40 "	9202		37061	252	148.340	795		31727	42981	74708	3735	78443									
	214	6x40 "	9102		26863	227	186.673	8308															
		Total iii Divn	153221		370732	2591	1823.676	3Rs		230Rs					839515								
		Rate	Rs 10/-		96377	1194	105Rs			24926	380097	419444	799541	39974	839515								
		Cost	1532		35Rs	75Rs	1.91485			add for 3 miles unsurveyed @ 37.789 per mile.				113367	952882	37789							
					158669	3487				87	12480	4216	16696										
iv		1x60 girders	21641		28068	696	21.08	187		21923	16477	38400											
		1x100 "	19530		34529	1364	71.64	87		21306	4216	25522											
		1x60 "	82606		49086	737	21.08	87		11934	4216	16150											
		1x60 "	35392		26511	564	501.48	696		1309	126638	1.15340	2.41978										
		7x100 "	266829	17304	135132	12575	9.04	58		21843	1808	23651											
		1x40 "	24971	6243	54112	286	9.04	58		20637	1808	22445											
		1x40 "	23870	5968	50916	278	152.96	696		1873													
		Total iv Divn	105874	29515	378374	16500	507.48	675		Rs 3					384842								
		Rate	Rs 10	Rs 25	Rs 35	100Rs	Rs 105								98784								
		Cost	8439	7379	132431	16500	65871			522	5619	236761	148081	384842									
															add for 7 miles @ Rs: 14.112 per mile.								
															add for 2.5 miles @ Rs: 10.000 per mile.								
Grand Total Major Bridges. Arsikere to Mangalore 143 miles.															2312303	16170							

W. J. J. J.

Arsikeri Mangalore Railway.

143 Miles

Metre Gauge.

Minor Bridges.

Section	Description	Excavation	Concrete	Masonry	Abutment	Archings	Ironwork	Timber	Girders	Total
		cft	cft	cft	cft	cft	cwt	cft	Tons.	
I	1064 L ft. of Bridging @ Rs. 250/- per ft.									266000
II	Costing: under 4000/-	145464	73290	162035	4746	18802	2.80	45 1/3		
	" over "	39884	16671	85614	807	11969		45 1/3		
	Total Quantities	185348	89961	247649	5553	30771	2.80	45 1/3		126059
	Rate	10/- 0/0	25/- 0/0	30/- 0/0	75/- 0/0	75/- 0/0	15/- cwt	3/- cft		6314
	Cost	1853	22490	74295	4165	23078	42	136		132373
	Add costing @ 5 p.c. Grand Total Rs.									
III	Costing: under 4000/-	304507	156221	222160	6925	36389	15.68	434.67	2.37	
	" over "	218768	87726	91651	2285	40277		434.67	2.37	
	Total Quantities	523275	243947	313811	9210	76666	15.68	434.67	2.37	384911
	Rate	10/- 0/0	25/- 0/0	35/- 0/0	100/- 0/0	75/- 0/0	15/- cwt	3/- cft	27/- ton	19241
	Cost	5233	60987	203831	75/-	57500	236	1303	640	404152
	Add costing @ 5 p.c. Total Rs.									54576
	Unsurveyed 3 miles @ 18192/-									458728
IV	Costing: under 4000/-	181192	91479	234918	5936	25371	7.03	177.17	7.82	
	" over "	301035	118810	580374	6130	67758	2.10	42.67	2.86	
	Total Quantities	482227	210289	815292	12066	93129	9.13	219.84	10.68	
	Rate	10/- 0/0	25/- 0/0	35/- 0/0	100/- 0/0	75/- 0/0	15/- cwt	3/- cft	27/- ton	428345
	Cost	4822	52574	285353	12066	69848	138	660	2884	502656
	Unsurveyed 32 miles @ 15708/-									931001
	Grand Total									1788102
	Grand Total of Minor Bridging Rs. Rate per mile Rs. 12,505									

W. J. J. J.

Metre Gauge.

Arsikere Mangalore Railway

143 Miles.

V. Fencing

Section	No. of miles	Fencing	Road Crossings	Mile and Grading posts	Total of Section	Rate per mile
i	30.05	14420	19475	1266	35161	1170
ii	28.24	7836	21900	1100	30836	1092
iii	25.21	2766	10827	1034	14627	580
IV	59.50	24485	90140	2850	117475	1975
Total	143.00	49507	142342	6250	198099	1385

W. J. J. J.

Engineer-in-Charge
Mangalore Ry. Stn.

1.5.

$R_{2.7}$	$R_{2.7}$	$R_{2.1}$	$R_{2.2}$
-----------	-----------	-----------	-----------

Grand Total Rs. 176,221.
Rate per mile Rs. 12.32

W. F. F. F. F.

Permanent Way.

Details of Cost of one mile 50 lbs. Rail.

Section 1.

Rails. 78.57 tons at Rs. 80 per ton f.o.b.	Rs. 6286.	
Fish plates. 4.51 - - - 98 - - -	442	6
Fish bolts 0.62 - - - 164 - - -	102	
Spikes 4.16 - - - 216 - - -	899	0
	<u>Total Rs. 7729</u>	0

Total 87.86 tons.

Add freight to Portuguese Frontier @ -13/3 per ton d. 488
210

Port and customs dues -

Carriage from Frontier to Arica @ -1/- per ton per round. 1446

Unloading and stacking in depot in Arica @ 2/- per ton 176

Total Rs. 10049

7700

2220 Sleepers @ 3/8/- each -

Total cost at Arica. (167 tons). Rs. 17749.

Store charges loading & unloading. 2 1/2 ans. per ton. 209

Haulage. 15 miles 1 1/3 ans. per ton mile. 440

Laying at 4 ans. per yard.

Maintenance at Rs. 100/- per mile per month 600.

for six months - - - - - 19024

Length of section - Miles 30.05

Sidings - 2.794

Miles 32.844 at 19.024 per mile Rs. 624.8

Contingencies 5% - 31.2

Grand Total Rs. 656.0

Cost per mile = Rs. 21,832.

W. Speck

Permanent Way.

Section ii

Total Cost at Arrick as per Section i -	Rs. 17741
Store charges loading sea. at $2\frac{1}{2}$ ans. per ton -	26
Haulage from Depot to Rail-head 45 miles } -	626
at $1\frac{1}{3}$ ans. per ton per mile -	440
Laying sea. per mile -	600
Maintenance 6 months at 100/- per month -	
Total - per mile Rs 19441.	

Length of Section - 28.24 Miles

Sidings - 1.94 -

Total 30.18 Miles at Rs 19441 = Rs. 586,729

Contingencies at 5% - 29336

Grand Total Rs. 6,16,065

Cost per Mile = Rs. 21,815

W. J. J. J.

Permanent Way.

Section III

Cost of One Mile of 60 lbs. Rails at Arsi Kere.

Rails 94.28 tons at Rs. 80/- per ton -	Rs. 7542
Fish plates 5.00 . . . 98/- . . .	490
Fish bolts 0.62 . . . 164/- . . .	102
Spikes 4.16 . . . 216/- . . .	899
Bearing plates 0.97 . . . 166/- . . .	161
	<u>Rs. 9194</u>
Freight to Portuguese Frontier @ -13/3 per round -	582
Freight to Arsi Kere -11/- per ton per mile -	1726
Loading & unloading 2/- per ton -	210
Port and Customs dues -	210
	<u>Rs. 11,922</u>
2200 Sleepers @ 3/8/-	7700
Cost One Mile at Arsi Kere (185 tons).	<u>Rs. 19,622</u>
Loading & unloading @ 2 1/2 annas per ton .	29
Haulage 72 miles @ 1 1/2 annas per ton per mile -	1249
Laying per yard @ -14/-	440
Maintenance 6 months at 100/- per month -	600
	<u>Rs. 21,940</u>

Length Section III -	25.216 miles
Length Sidings -	1.060
	<u>26.276 miles at Rs. 21,940 =</u>
	Rs. 6,16,495
	Contingencies at 5%
	30,825
	<u>Rs. 6,47,32</u>

Rate per mile = Rs. 25,671.

W. P. S. S. S.

Permanent Way

Section IV

87.86 ton P.W. as section I Rs. 7.729
 2200 sleepers at Rs. 3/8 7.700

Rs. 15.429

26

Loading &c. - 167 tons at 2 1/2 ann.

418

Haulage - 167 tons 30 miles at 1 1/3 ann 440

Laying 14/ per yds

600

Maintenance 100/- per month - for 6 months

Rs. 16.913

Length 50 lbs rails 52.5 miles

Sickness 4.86

57.36 @ Rs. 16.913 - Rs. 970.130

1.53.580

Length 60 lbs rails 7.00 @ Rs. 21.940

Rs. 11.23.710

Contingencies @ 5% 56.185-

Grand Total - Rs. 11.79.895

Rate per mile Rs. 19.830

W. J. J. J.

Stations & Buildings. Stations and Offices.

Arsikeri Mangalore Railway
(Metre Gauge.)
143 miles.

Name of Station	Class.	Mileage	Distance apart		Station Build-ings.	Goods shed	Passenger Platform		Goods Platform	Latrine	III Class Shed	
			miles	Sq. feet			Length Rail Level	Length 13 above Rail			Sq. feet	Sq. feet
Talur.	III	3 $\frac{3}{4}$	3 $\frac{3}{4}$	757	1742	600	-	-	250	200	1500	
Bagade.	III	15 $\frac{1}{4}$	11 $\frac{1}{2}$	757	1742	600	-	-	250	200	1500	
Dudda.	III	19	3 $\frac{3}{4}$	757	1742	600	-	-	250	200	1500	
Hassan.	-	29 $\frac{3}{4}$	10 $\frac{3}{4}$	1500	1742	-	-	600	250	400	1150	
Alur.	III	37 $\frac{1}{2}$	7.50	757	1742	600	-	-	250	200	1500	
Balol.	C.S.	47	9.50	757	-	400	-	-	-	-	-	
Masralli.	C.S.	52 $\frac{3}{4}$	5.75	757	-	400	-	-	-	-	-	
Saklespur.	III	58 $\frac{1}{2}$	5.75	1500	1742	-	-	600	250	200	1500	
Hebsala.	C.S.	60 $\frac{1}{4}$	1.75	757	-	400	-	-	-	-	-	
Manzarabad Rd.	III	64 $\frac{1}{2}$	4.25	757	-	400	-	-	-	-	-	
Maranhalli Gorge.	III	67 $\frac{3}{4}$	3.25	757	-	400	-	-	-	-	-	
Kadmani.	III	74 $\frac{1}{2}$	6.75	757	-	400	-	-	-	-	-	
Kempkul.	Water	79	4.50	-	-	-	-	-	250	200	1150	
Siradi.	III	90 $\frac{1}{2}$	11.50	757	1742	600	-	-	-	-	-	
Golitalu.	III	101 $\frac{1}{2}$	11.00	757	-	400	-	-	250	200	1150	
Uppinangadi.	III	111 $\frac{1}{2}$	10.00	757	1742	600	-	-	-	-	-	
Seerpadi.	III	120	8.50	757	-	600	-	-	-	-	-	
Buntwall.	III	127 $\frac{1}{2}$	7.50	757	-	600	-	-	-	-	-	
Feringipet.	III	134 $\frac{1}{2}$	7.00	757	-	600	-	-	-	-	-	
Jeppoo.	III	141 $\frac{1}{2}$	7.00	757	1742	-	-	600	250	200	-	
Totals.				15869	19678	8200	1800	2250	2000	13950		
Rates.				Rs. 2.7	Rs. 2	Rs. 1.5	Rs. 6	Rs. 6	Rs. 1	Rs. 2.3		
Rupees.				42846	39356	12300	10800	13500	2000	32085		
Mangalore Rupees.				50,000	-	-	-	-	400	-		
Grand Total				92,846	39,356	12,300	10,800	13,500	2,400	32,085		

Total Rs 2,03,287
Contingencies 5% 10164.

Grand Total Rs. 2,13,451
Rate per mile 1.473

Rs 50,000 includes also Good shed and Platform.

Official

Station Buildings Staff Quarters

Name of Station.	Class	Mileage	Distance apart.		Station Masters Quarters	Quarters for Station Masters or Signallers	Menials Quarters	For men	P.W. Inspector	A.P.W. Inspector
			miles	by feet	by feet	by feet	by feet	by feet	by feet	by feet
Talur	III	3 1/2	3 1/2	240	-	320	-	2000	-	-
Bagade	III	15 1/2	11 1/2	240	-	320	-	-	-	-
Dudda	III	19	3 1/2	240	-	320	-	-	-	-
Hassan		29 1/2	10 1/2	700	240	480	-	-	-	2
Alur	III	37 1/2	7.50	240	240	320	-	-	-	-
Balol	C.S.	47	9.50	-	240	320	-	-	-	-
Masralli	C.S.	52 1/2	5.75	-	240	320	-	-	-	-
Saklasapur	III	58 1/2	5.75	240	240	480	3000	2000	2	-
Hebsala	C.S.	60 1/2	1.75	-	240	320	-	-	-	-
Manzarabad R.	III	64 1/2	4.25	-	240	320	-	-	-	2
Maranhalli Gorge	III	67 1/2	3.25	-	240	320	-	-	-	-
Kadmani	III	74 1/2	6.75	-	240	320	-	-	-	-
Kemphal	III	79	4.50	-	-	-	-	-	-	-
Siradi	III	90 1/2	11.50	240	240	480	-	-	-	2
Golitalu	III	101 1/2	11.00	-	240	320	-	-	-	-
Uppinangadi	III	111 1/2	10.00	240	240	320	-	-	-	-
Deerpadi	III	120	8.50	-	240	320	-	-	-	2
Buntwall.	III	127 1/2	7.50	-	240	320	-	-	-	-
Feringipet	III	134 1/2	7.00	-	240	320	-	-	-	-
Jajpoo	III	141 1/2	7.00	240	240	480	-	-	-	-
Onepine										
Totals					2820	3840	6720	3000	4000	12
Rates					R. 2.7	R. 2.4	R. 2.0	R. 2.7	R. 2.7	R. 2
Rupces.					7614	9216	13440	8100	10800	32
Mangalore - Rupces.					6000	580	2400	6000	4000	-
Grand Total.					13614	9796	15840	14100	14800	32

Form R VI.

✓

Station Machinery.

ARSIKERE-MANGALORE RAILWAY.

(Metre Gauge.)
(Length 14.3 miles)

NAME OF STATION.	Station Ashpit.		WATER COLUMNS.		PIPING.		WATER TANK.		Weighing Machine.	Carriage Examining Pit.	SWITCHES CROSSING.		Main Signals.	District Signals.	WEIGH BRIDGES.		ENGINE SHAFT, Area.	Tonne Turntable.	Platform Crane.	Washing-cut Apparatus.	No. Buffer stops.	No. Hand Lamp.	No. Steam Lamp.	No. Land house/Store.			
	No.	Inches.	Number.	Diameter.	Feet.	Inches.	Capacity.	Cub. ft.			No.	Feet.			No. 1 m 9 1/2.	No. 1 m 6 3/4.									No.	Tons.	Sq. feet.
Taluv.	2	6"	2	6"	700	6	5 1/2	1	1		2	1	1	2						1	1	1	1				
Agadi.																											
Badde.	2	6"	2	6"	700	6	5 1/2	1	1		2	1	1	2	1	25				1	1	1	1				
Macean.	1.	6"	2	6"	700	6	5 1/2	1	1		2	1	1	2						3	1	1	1				
Alur.																											
Bald (Coffee siding)																											
Murali (Coffee siding)																											
Pallagur.	2	6"	2	6"	750	6	10 2 1/2	1	1		2	1	1	2	1	25	3000	1		1	3	1	1				
M. G. S. (Coffee siding)																											
Monrabat Road.																											
Mamhalli (Crossing)																											
Kadaman (Crossing)																											
Kempthul (Crossing)																											
Kempthul (sidings)																											
Stradi.	4.	6"	3	6"	1200	6	5 1/2	1	-		2	5	1	2		3000	1		1	3	1	1	1				
Gole to the (Crossing)																											
Carried over TOTAL ...	11		20.		6900	6	61 4 1/4	14.			25	20	14	26	2	6000	2		2	17	8	2	10				

W. S. D. S. S.

Station Machinery.

ARSIKEREI-MANGALORE RAILWAY.

(Water Gauge.)
(Depth = 14.3 miles)

[illegible]

W. C. C. C.

British Bangalore Ry.

Notes Consulting Engineer -

1. The project is forwarded in an incomplete state - the approximate distance is 14 1/2 miles from Aradine Station on the Southern Railway to the sea port of Bangalore -
2. The portion from Aradine to Hassan M. 30 was surveyed by the engineer of the Mysore Division in 1894 - The present survey is 1 1/2 miles from Hassan M. 30 to mile 80 and leaving a gap of 11 miles - from mile 91 at Seradi (the foot of the plateau) to beyond Uppinagadi mile 117 being a total of 76 miles the present estimate from Hebsala M. 60 to Seradi M. 91

3. Location From Hassan to Hebsala the limit of curves is $6^{\circ} = 956 \text{ ft}$ and grades of too 20 miles beyond Hebsala is the division of British & Mysore Territory - and the preliminary plan having been submitted to the Mysore Division for their instructions as to the route which was to be taken - this route followed very nearly that recommended by their own engineer in his reconnaissance of 94 - they replied that they had no opinion or criticisms to offer - and it was therefore adopted - From Hebsala to Seradi the present instructions to the up. in chief were to choose the best engineering line and this has resulted so far in locating a line of $\frac{1}{40}$ grades (compensated to $\frac{1}{40}$) $\frac{1}{50}$ and $\frac{1}{53}$ with curves of $11.6^{\circ} = 500 \text{ R}$ - and $16^{\circ} = 350 \text{ R}$ getting back by means of 2 bridges there at chains $\frac{203}{207}$ and $\frac{213}{217}$ - 77

5. The present portion to be satisfactory examined requires another seasons work - It is not better enough for a 4 mile line which would not be justified by a grade worse than $\frac{1}{16}$ and at least 5 or 6 miles long in one continuous section.

77
 going to the junction of the hills - with a curve back on a line rising across the base of the hills at mile 70 or about the line

the direct line between Teradi to Heboala
a distance of about 16 miles and a difference
of level of 2763 feet would give the grade
of 50 the only alternative seems to be to try
& improve the present necessary hasty
location on a basis of to compensated
grade - xx

xx the length from
Teradi to Heboala is 16 miles
in 11 miles with a grade of 50
the distance to the terminus
would be 5 miles - the
grade would be 100.

7. The estimate of preliminary expenses of 1416 Rs
per mile includes the expenditure incurred for
the survey of the route - known location
plus the sanctioned expenditure of 84,000 Rs
during the present survey plus the estimated
amount of 92,000 Rs required to complete the
survey.

8. The rate per mile for formation in tunnels
is moderate for comparison for the heavy path
and the bridge work is rather light in amount.
Of the sketch designs - I approve of the large
number of arched bridges but not of the
steel viaducts for which if the curves admit the tunnels
I believe 60 ft spans will be more economical.
The information regarding formation is
incomplete - and the cost of the masonry & steel bridge is not specified.

9. Fencing should be of wire and not live.
10. Ballast & Permanent Way - No mention is
made of the character of the ballast but it
is most likely that abundant stone of good
quality is found in the local
The weight of rails of 50 lbs for the heavy
& 60 lbs for the steel girders is approved.

11. Generally the estimate seems reliable for the
purveyed portion of the line but as has been
before stated - it requires the completion of
the survey.

Traffic

12.

Under the orders conveyed in prot. of order
No 798 R.C. of 24 Aug 94 - Mr. Fildes has
a plan & report on the traffic estimates -
The result of these inquiries is given in
the abstract of traffic and works out to
the same visible return on capital as was
arrived at before by the Southern Railway
authorities and are here given for com-
parison

13.

S. M. R. estimate

5884 tons per annum @ 9 paise per ton mile once
137 miles = 37.706% = 5-5-0 paise weekly
75% of 30000 passengers @ 69 miles
(= 1.68.718% = 23-0-0 paise weekly

Add 10% for rebate under branch line
terms and deduct 60% for working.
Result is 87.782 which is less than 1% on
capital of 94 lacs.

M. Fildes estimate

goods tons per annum @ 9 paise per ton mile
61,562 tons @ 57 miles = 2.11.432 Rs
passengers @ 2 paise per 10 miles
30000 passengers = 2.10.000

Deduct working expenses at 60%
Result is 1.68.573 which is a return of
1% on capital of 169 lacs.

14.

Mangalore Port

Mr. Fildes sends with his report a short
note on the works needed in his opinion to
make this port efficient - as this is being
read with Mr. Walsh I refrain from
offering any remarks beyond saying that there

~~Opinion of what is needed and how to
carry out the improvements appear upon
the same in both opinions (the the engine)
work to~~

appears to be only a slight difference of opinion
as to the character of the engineering work re-
quired to effect the improvement

Mll 28/95

Arsikere-Mangalore Railway.

26
Note on estimate submitted to --
complete the survey.

1. The total length is 144 miles of
this 30 miles has been located by
Mr. Groves cost Rs. 22,002 half
of which sum was supplied by the
Mysore State.

2. The result of Mr. Gilchrist's work
has been 78 miles surveyed, of --
which 30 miles are finally, and 40
miles partially located (requiring
further examination) at a cost of
Rs. 89,000. Thus leaving 33 miles
unsurveyed.

3. Mr. Gilchrist forwards an esti-
mate of Rs. 91,323 for establish-
ment only for 12 months to com-
plete the work. I think the sur-
vey should be completed in 9 months
at a monthly cost of an --
Engineer establishment

of Rs. 4,000 = 36,000

and petty establishment

of Rs. 600 = 5,400

which would be 94 miles at 500 per
mile = 47,000.

Mll 4/10/95

A-

46

Order: dated 4th October 1925.

Railways submits plans and estimate
and a report on the Assiut-Minia-

long Railway Survey sanctioned in --
Government of India letter No. 1075

P. C. dated 25th October 1921.

2. In the Note by the Consulting Engineer it is pointed out that the project is incomplete and the approximate estimate of cost 1.2 lakhs -- per mile ^{is somewhat} [very] high and that further survey work to complete the unsurveyed portion and to obtain a more economical alignment of the short section is very desirable.

2. The data on which the estimate of traffic is based are very meagre and it is the opinion of His Excellency the Governor in Council that the prospective benefits to be ^{the} ~~be~~ derived by Mysore State, which has no port within a reasonable distance connected by rail and the ~~farther~~ ^{future} advantages to the South Canara District and

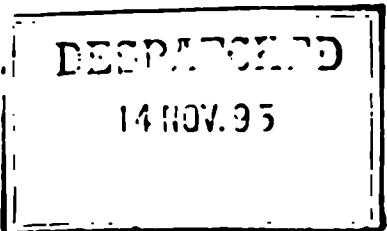
the

the coffee estates served by the proposed
line, cannot be adequately
the present traffic
which would be greatly deve-
loped by the Railway.

4. The reports plans and estimates
are therefore submitted to the Govern-
ment of India with the opinion of His --
Excellency the Governor in Council that
the completion of the survey with a fur-
ther examination of the prospects of --
traffic is justified by the enormous im-
portance of this line to the Mysore State
and the suggestion that that state might
reasonably be invited to bear its propor-
tion of the cost of the survey, if the
concession granted to Messrs Kirby
and Lonsdale for one year has lapsed.

JHE N° 640 R of 1st Oct 1895
Forwarded

7/11
4
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To
The Secy. in Ch. A. M. B. Esq.
- Mr. P. W. B. Esq.
- Revenue Dept.
- Resident in Mysore
- Collector of S. Canara

Pres. Office to be
on 5-10-95
with Report of the
+ a book of papers

16/10
2/10/10