

**CONCERNS BOTH BRITISH INDIA
AND INDIAN STATES.**

Political (1897) Department.

ORDINARY MS.

G.O., No. 292

DATED 6-5-98

INDEXED.

[Despatch Abstract.]

Copy of
is T & C 11 pros B & D directing that the
report of an inspection of the Shoranur-
Cochin Railway by the Consulting
Engineer for Railways, Madras, be
forwarded to the Agent, Madras R. for
information & guidance and stating that
the said communication from the Cochin Railway
is the subject of the revision of Land in Bangalore
is submitted.

10/5/91

BACK PAPERS.

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

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.
633	326						
326	25.3.99						
1073/89							

CURRENT No 584

RAILWAY.

Government (1899) of Madras. PUBLIC WORKS.

A/8559

Recd.

Regd.



1899.

Enclosures

Spare copies

G.O., No. 496 Ry., 28th April 1899.

APRIL.

Order No. 292 dated 6.5.99
min Comm. to the Rwdt.
Recorded, pending receipt
in T.O.C.
of communication from the
Cochin Durbar referred to in
para (c) of the Consulting
Engineer's Report.

Memo sent for Secy 9/5/99
Copied and 9/5/99
Super 9/5/99

C.M.S.
9/5/99

M. J. S.

Send in T.O.C. (sent with 38 co.)

Decd 6.5.99

Shoranur-Cochin Railway

Ordered that the report of an inspection of the — by the Consulting Engineer for Railways, Madras, be communicated to the Agent, Madras Railway, for information and guidance and a copy of Proceedings forwarded to the Government of India.

Ref Add original to Shoranur-Cochin file

P Have C. No. 582 cancelled. We cannot have two orders on one file. Dated paper C.M.S. 6/5/99

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read again the following paper:—

G.O., No. 335 Ry., dated 25th March 1899.

Memorandum of Balgatti Conference, dated 12th April 1899, and Consulting Engineer's Note, dated 19th April 1899.

Read also the following paper:—

SHORANUR-COCHIN RAILWAY.

INSPECTION REPORT BY MR. FRANCIS J. E. SPRING, CONSULTING ENGINEER
FOR RAILWAYS, MADRAS.

Leaving Madras on April 9th, I arrived on the 11th at the Cochin Residency at Balgatti near Ernacolum, across the backwater from British Cochin Port. The next two days were spent with the Resident and, at a Conference attended by that gentleman, the Diwan of Cochin and myself, arrangements were formulated in regard to the provision of funds for the building of the railway and other essential preliminaries. The proceedings of the Conference are recorded on a separate Note. They will reach Government in due course. Meanwhile the chief features of the Durbar's proposals are as follows:—

- (a) The Shoranur-Cochin Railway to be a cheap metre gauge railway for slow speeds.
- (b) The railway to be built entirely at the cost of the Cochin Durbar.
- (c) The Madras Railway Company to be asked to name terms for making and working it.
- (d) It will be controlled, if the Government of India has no objection, entirely by the Madras Government.
- (e) Government will be addressed by the Durbar in the Political Department in regard to the question of land traversed by the Railway in Travancore State.

2. A survey has been made under the orders of the Madras Railway Company, and an estimate based on that survey is now under preparation. The permission of the Government of India has been received to the first thirty miles being gone on with. On the present occasion I inspected as much of the alignment adopted by the Madras Railway Company's surveyors as I was able conveniently to get on to, namely, the northern forty and the southern ten miles. The thirteen miles between Shalakudi and Alwaye I did not inspect.

3. If I can convey an impression of the physical features of the country traversed, it will be comparatively easy to indicate the general characteristics of the faults of the very faulty survey. Hills running up to some thousands of feet in altitude lie more or less along the coast but from 15 to 25 miles back from it. Spurs from these hills run down and far out into the comparatively low coast belt. Between the hills and the coast there is a remarkable series of lagoons, channels and backwaters, communicating in places with the sea over sand bars of more or less importance, and filled with water less or more salt according as the fresh water of the rivers from the neighbouring hills more or less prevails over the salt water flowing in from the sea. For miles at a time these backwaters, parallel to the coast, are only a few hundred feet wide, but at

places they spread out into great lakes. They are the highways of the country and carry an immense traffic. They are connected up at their north end with Tirur station of the Madras Railway by a series of canals in a more or less inefficient state, according to the season: and at the other end they extend far southwards into Travancore. Although for many miles at a time these backwaters are only separated from the sea by a barrier of sand like those fringing the Palikát and Chilká lakes on the East Coast, yet they frequently pass for miles between banks of hard moorum and laterite. This brings me to the principal physical features of the part of the country traversed by the railway. It has everywhere a skeleton of laterite and granitic gneiss, and the hollows between the laterite ribs are more or less filled in level, a few feet above the sea, by the denuded debris of ages, so that the effect is exactly as if one took a perfectly level clay plain like that of the Ganges valley and covered it all over in a most irregular manner with split-sausage shaped ridges of moorum and laterite, sometimes isolated like islands, sometimes long, complicated, winding or star-shaped, and sometimes trending away up to the east to join the hills. Whether a surveyor's line can or cannot be carried so as to avoid most of these ridges depends a good deal on the size and the lie of them. Sometimes they can be avoided with a little curving; more often it is possible to use them for the purpose of lifting the gradient out of the low-lying and expensive rice lands; but sometimes there is nothing for it but to dash boldly through them where they are thinnest because there is no circumventing them. These moorum and laterite "split-sausages", as using a culinary metaphor I may appropriately name them, are densely covered with groves of cocoa-nut, jak, mango and other fruit and shade trees; and amongst the trees scattered about, not in streets but in isolated homesteads, are the houses of the people. The country which looks deserted except where the cultivators are swarming in the fields, is densely populated, large tracts carrying over 1000 people to the square mile; but very little of all this is seen until one penetrates amongst the groves on the laterite ridges. In certain places where the hills, of which the laterite ridges are the low-lying spurs, are not more than a mile or two away, notably in the northern four or five miles of the line, the steering of a route through the rough ground is not such an easy feat, and it is necessary to curve continuously with a view to the avoidance, I will not say of heavy work, for there is not much of that, but of unnecessary undulations in the grades.

4. I hope that the above description of the peculiar physical features of the country will make it easy to understand the principal defects in the Madras Railway Company's survey. The first idea to grasp is that had money been unlimited and had a 1 in 300 or flatter grade been the limiting grade, a line might pretty well be struck straight across country anywhere, without anything very wonderful in banks or cuttings. But if banks and cuttings are to average less than 10 feet, and to seldom exceed 25—a thing to be greatly desired when it is understood that the object which His Highness the Rajah has in view is to obtain a railway to his capital for the sum of 50 lakhs—, it is perfectly obvious that pretty steep grades must be used and that money is well spent on careful detailed survey. The chief fault of the survey is its long straight lines through a kind of country in which, if it were in England, an Engineer would be curving pretty well all the time. This means not only a great deal of heavy and useless work, but, worse, dips in the grade which, with a little care and but little detour, might well have been avoided. For instance in places one finds a 20-ft. bank for a quarter or half a mile where if the straight had been abandoned by the surveyor and the line slewed a few yards to one side a 2-ft. bank or 2-ft. cutting might perfectly well have been got. It looks as if the surveyors had followed a flag until they knocked up against something big enough to stop them, and then turned off, but did not like to waste half a day's work by going back a few chains to find the best turn-off place. Then intersection points are conveniently made on high clean hills whence a view may be obtained, and the awkwardness of a curve in the deepest part of a cutting is ignored. And so on and so on.

5. Mr. Stoney, the Chief Engineer of the Madras Railway, who had nothing to do with the survey, was with me during the inspection; needless to say he quite sees its numerous faults, and how to correct them, as well as I do, and he will now proceed to have them set right. I need only therefore describe a few of the most typical and characteristic of them here.

6. A class of error which occurs very frequently is too low grading when a higher formation would be economical as substituting cheap bank for expensive cutting. It is not so much that cutting should be led to bank, for that is difficult to secure in a country where earthwork will be done for the most part with petty basket labour, but that the minimum of cost is got when due regard is had to the fact that the rates for cuttings are high and many of them are bottomed in rock, while the rate for bank is low. There was an idea of minimizing the area of rice land to be taken up, but that can perfectly well be provided for by arranging to promptly give back all land outside a strip say 10 feet at each side of the slopes of all banks and cuttings. If land is wanted for future repairs or diversions it can always be got in a Native State with the minimum of red-tape. Amongst the numerous places where this *office-fault*, as distinguished from field-fault, has been committed I need only mention, as typical, the following chainages 19-23, 59-5, 69-76, 79, 83-88, all on the first section.

7. The second type of fault is illustrated on the long 2 mile straight line between chainage 6 and 17 of first section. Here for an actual net ascent of 33 feet in a length of 9,000, there are dips of grade of 27 feet which I believe to be avoidable, necessitating 1 in 80 where perhaps with a bit of curving one in 150 might be got or at least 1 in 100. The country here is on the flank of a series of moorum and rock spurs from a high ridge, and it is perfectly adapted for the picking of the best line with the aid of cross sections down the spurs and down the valleys. Yet so far as I can ascertain, no such sections were ever made and a straight line was adopted in place of five or six reverse 1,000 foot curves.

8. A notable instance of the class of fault just referred to is to be found at chainage 62, where a 50-ft. cutting can apparently be easily avoided. Here too there are no cross sections, while it is just such a place as demands that the line through it should be deliberately located on the cross sections with the aid of drawing-office curves. A skilled surveyor may light upon the best line through such a place on the first or second shot by "following the flag", but this casual method of work has certainly not resulted, on this occasion, in the best line being found, or anything like it.

9. Another instance is at Alwaye town, where, between the river crossing, chainage 710, and chainage 790, the line climbs to what seems to me to be a quite unnecessary height of 20 feet, and at the same time not only goes away from the town, but makes it necessary to put the railway station on a most inconvenient and unsuitable site. The line ought apparently to curve sharp off to the west on crossing the bridge and between 710 and 790 to find its way through the low ground near the town so as if possible to avoid rising altogether, and anyhow to rise as little as may be. On the line so found a half mile of straight ought if possible to be found for the railway station, in the low ground between the town and the ridge where the present line runs, and as near the river as possible. Here again I must see evidence in the form of intelligent cross sectioning that the surveyor has not merely followed the flag.

10. South of Alwaye, at chainages 830-890 and 900-1,000, the section can obviously be greatly improved by the use of curving instead of the long straight lines that have been adopted. In the former place a very little slewing will bring the line on high and dry land in light bank or cutting instead of in high bank through paddy fields. At the latter place, the best line must be laid down with office curves on the plan when the latter has been covered with proper cross sections taken off the present line as a base.

11. The next class of faults is where following the straight has led the alignment either close past a ridge which with a little curving might well have been availed of to lighten the bank, or deep into an island, as it were, of moorum which might easily have been circumvented by curving with a view to lighten work. Instances of such places are numerous between Kurumali bridge and Trichur station, near 44-46 and 37-40 of section II, and 56-57 and 44 of section I. Mr. Stoney fully understands what I mean and will doubtless pass the necessary orders.

12. The site of the station at the important town of Trichur has not been well selected. It was necessary to bring it up to the Kokala navigable canal which gives access to all the backwaters. But the whole alignment ought, apparently, to be kept some 800 feet to the east, so as to be on the moorum instead of down in deep water

in the paddy land. I have marked on the map a considerable area of ground which should be fully surveyed and cross-sectioned so as to show how best the station may be located, so that, while avoiding important houses of the town, it may be well placed engineeringly and conveniently situated for business. There seems to be no use in crossing the Kokala canal by a bridge. It can stop at the railway, and be widened out into a suitable basin so as to connect with the railway sidings, and the present canal goods shed must then be moved. Indeed it may well be utilized at the joint wharf of the canal and railway.

13. An important and *quasi*-political matter is the anxiety of the Chief of Edapilly, a fief of Travancore, that the line should pass if possible entirely outside his estate instead of right through the middle of it. The Engineer was directed to enquire into this, but he surveyed round to the south and east where the diversion would be of excessive length, instead of round to the north and west where the diversion would apparently be short. A traverse should now be run round the approximate boundary, on the west and north, of the Edapilly Chief's estate. The survey should also show the family temples which the Chief desires should not be separated from his residence by the railway line. On receipt of this information I shall be in a position to pass orders as to the route to be adopted.

14. I am not satisfied that the question of the site for the Cochin terminus (at Ernacolum) has been gone into with sufficient care. A detail survey of the whole neighbourhood is required showing the property likely to be affected if the line is carried back of the jail and down to the face of the navigable backwater south of the jail. It is obviously of the utmost importance that the railway should so terminate as to suit the convenience of traffic on the backwater, as well as that of Cochin trade with which the future success of the railway is so intimately bound up.

15. Almost everywhere along the line good granitic gneiss is to be found within reasonable distance. This has not been much quarried heretofore, for laterite blocks have usually been found quite good enough for the public road bridges of the State. It will therefore probably be found necessary to go to Bellary and Hyderabad for quarrymen accustomed to work it. At Bezwada this stone had been cut out with rows of wedges at great expense, and but sparingly used in temples and important structures, until my gangs of Bellary Waddahs showed the Telugus how to burn it off cheaply, and now the Godavari bridge piers are being built from the same quarries as were used for that over the Kistna. There is any quantity of good laterite, mixed of course with bad, and when picked with judgment it is quite good enough for culverts.

16. There will be no great difficulty about the major bridges; nearly everywhere river channels and flood marks are very well defined. I saw borings going on at the Alwaye river, and the man in charge was stopping the boring on getting to the end of his piping instead of getting more piping and not stopping until he got either to 60 feet in sand or to something else fit to found on. Mr. Stoney passed orders.

17. The excellent tiles, of the quality well known as Mangalore tiles, made in factories all over the country seem to indicate that very good bricks can be got in any quantity. From what I hear, however, nobody in these parts knows how to make bricks cheaply, and no wonder when one sees what the rainfall is and how it is distributed throughout the seasons.

18. It is the intention of the Durbar to enter at once on extensive forest operations with a view to securing the necessary 150,000 sleepers within the next couple of years. There would appear to be lots of timber of the limited number of species known in this part of India to be suitable for sleepers. The Durbar would also be wise to get out timber for all the structures for which it will be wanted. The Forest officers can doubtless in due time receive a list from the railway men, but meanwhile trees might be cut, e.g., teak, irul, irumbakam, *mesua ferrea*, &c., and logs might be floated down to convenient centres and properly seasoned. The Durbar would also be well advised to get a stock of fuel for locomotive purposes. The Locomotive Department of the Madras Railway could advise the Forest officer about this, just as the Engineer can advise him in regard to sleepers and timber for carpentry.

19. I understand that lime is everywhere plentiful, from the shells of the sea-shore which form the universal source of lime for building along this coast.

20. The Madras Railway Engineers would save a great deal of time by now getting out English indents, especially for rails, for locomotives and for construction rolling-stock. There will be no delay in sending indents home, as the money is all available, but there will, I fear, be some delay at home in supplying them. So the sooner indents go the better.

21. I shall now indicate the relative importance which I attach to priority in correcting the faults referred to in paragraphs 6 to 14. I shall refer to them by paragraphs. Paragraph 6, do at once in the office. Paragraphs 7, 8, 9, 10 must be corrected on the ground before I can consider it safe to make over the sections referred to for construction, and I must approve of the work of the Surveyor. Paragraphs 12 and 13, can be done while the surveys just referred to are being done. The faults referred to in paragraph 11 may be corrected by the Engineers after construction begins; the alterations will be slight ones as a rule, and must be sedulously looked out for and made before land is acquired or work begun at the faulty location.

22. There is usually in this Presidency a great deal of needless cutting down of trees on railway land. Government has just passed an order that only such trees are to be cut down and sold by the Civil officers as the Railway Engineers may point out, e.g., all lying within a width of 40 feet on either side of centre line. But trees in station grounds, and wherever they need not be cut, must be left standing not only on account of the valuable shade and fruit they afford, especially in station grounds, but because the strip of land at either side to be ultimately sold back to the cultivators will have lost less of its value if its trees have not been eradicated. The Dewan of His Highness the Rajah of Cochin expressed his desire that a similar policy should be adopted in the case of the Cochin Railway.

ORDER—No. 496 Ry., dated 28th April 1899.

The promised communication from the Cochin Durbar will be awaited. The Consulting Engineer's report will be forwarded to the Agent, Madras Railway Company, for information and guidance. For the additional expense on survey account which will be necessitated by the improvements now ordered—expenses likely to be many times recouped in cost of construction—, provision will have to be made in the project estimate by adding to actual survey outlay a sufficient sum under the head "Preliminary expenses." A copy of these Proceedings will be forwarded for the information of the Government of India, who will be separately addressed later on.

[Here enter No. 497 Ry., dated 28th April 1899.]

(True Extract.)

Thurston B. Spring
Under Secretary.

To the Agent and Manager, Madras Railway.
" Examiner, Guaranteed Railway Accounts.
" Consulting Engineer for Railways.
" Political Department. ✓
" Resident in Travancore and Cochin, through the
Political Department.

RAILWAY.

Government {1899} of Madras. PUBLIC WORKS.

Recd. 4 - MAY 1899
Regd. 1899.

Enclosures

Spare copies

G.O., No. 496 Ry., 28th April 1899.

Order
Mio

Forwarded

APRIL.

426
5/5/99

Chief Secretary.

Shoranur-Cochin Railway

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FOR RAILWAYS, MADRAS.

Leaving Madras on April 9th, I arrived on the 11th at the Cochin Residency at Balgatti near Ernacolum, across the backwater from British Cochin Port. The next two days were spent with the Resident and, at a Conference attended by that gentleman, the Diwan of Cochin and myself, arrangements were formulated in regard to the provision of funds for the building of the railway and other essential preliminaries. The proceedings of the Conference are recorded on a separate Note. They will reach Government in due course. Meanwhile the chief features of the Durbar's proposals are as follows:—

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2. A survey has been made under the orders of the Madras Railway Company, and an estimate based on that survey is now under preparation. The permission of the Government of India has been received to the first thirty miles being gone on with. On the present occasion I inspected as much of the alignment adopted by the Madras Railway Company's surveyors as I was able conveniently to get on to, namely, the northern forty and the southern ten miles. The thirteen miles between Shalakudi and Alwaye I did not inspect.

3. If I can convey an impression of the physical features of the country traversed, it will be comparatively easy to indicate the general characteristics of the faults of the very faulty survey. Hills running up to some thousands of feet in altitude lie more or less along the coast but from 15 to 25 miles back from it. Spurs from these hills run down and far out into the comparatively low coast belt. Between the hills and the coast there is a remarkable series of lagoons, channels and backwaters, communicating in places with the sea over sand bars of more or less importance, and filled with water less or more salt according as the fresh water of the rivers from the neighbouring hills more or less prevails over the salt water flowing in from the sea. For miles at a time these backwaters, parallel to the coast, are only a few hundred feet wide, but at

places they spread out into great lakes. They are the highways of the country and carry an immense traffic. They are connected up at their north end with Tirur station of the Madras Railway by a series of canals in a more or less inefficient state, according to the season: and at the other end they extend far southwards into Travancore. Although for many miles at a time these backwaters are only separated from the sea by a barrier of sand like those fringing the Palikát and Chilká lakes on the East Coast, yet they frequently pass for miles between banks of hard moorum and laterite. This brings me to the principal physical features of the part of the country traversed by the railway. It has everywhere a skeleton of laterite and granitic gneiss, and the hollows between the laterite ribs are more or less filled in level, a few feet above the sea, by the denudated debris of ages, so that the effect is exactly as if one took a perfectly level clay plain like that of the Ganges valley and covered it all over in a most irregular manner with split-sausage shaped ridges of moorum and laterite, sometimes isolated like islands, sometimes long, complicated, winding or star-shaped, and sometimes trending away up to the east to join the hills. Whether a surveyor's line can or cannot be carried so as to avoid most of these ridges depends a good deal on the size and the lie of them. Sometimes they can be avoided with a little curving; more often it is possible to use them for the purpose of lifting the gradient out of the low-lying and expensive rice lands; but sometimes there is nothing for it but to dash boldly through them where they are thinnest because there is no circumventing them. These moorum and laterite "split-sausages", as using a culinary metaphor I may appropriately name them, are densely covered with groves of cocanoot, ják, mango and other fruit and shade trees; and amongst the trees scattered about, not in streets but in isolated homesteads, are the houses of the people. The country which looks deserted except where the cultivators are swarming in the fields, is densely populated, large tracts carrying over 1000 people to the square mile; but very little of all this is seen until one penetrates amongst the groves on the laterite ridges. In certain places where the hills, of which the laterite ridges are the low-lying spurs, are not more than a mile or two away, notably in the northern four or five miles of the line, the steering of a route through the rough ground is not such an easy feat, and it is necessary to curve continuously with a view to the avoidance, I will not say of heavy work, for there is not much of that, but of unnecessary undulations in the grades.

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5. Mr. Stoney, the Chief Engineer of the Madras Railway, who had nothing to do with the survey, was with me during the inspection; needless to say he quite sees its numerous faults, and how to correct them, as well as I do, and he will now proceed to have them set right. I need only therefore describe a few of the most typical and characteristic of them here.

6. A class of error which occurs very frequently is too low grading when a higher formation would be economical as substituting cheap bank for expensive cutting. It is not so much that cutting should be led to bank, for that is difficult to secure in a country where earthwork will be done for the most part with petty basket labour, but that the minimum of cost is got when due regard is had to the fact that the rates for cuttings are high and many of them are bottomed in rock, while the rate for bank is low. There was an idea of minimizing the area of rice land to be taken up, but that can perfectly well be provided for by arranging to promptly give back all land outside a strip say 10 feet at each side of the slopes of all banks and cuttings. If land is wanted for future repairs or diversions it can always be got in a Native State with the minimum of red-tape. Amongst the numerous places where this *office-fault*, as distinguished from field-fault, has been committed I need only mention, as typical, the following chainages 19-23, 59-5, 69-76, 79, 83-88, all on the first section.

7. The second type of fault is illustrated on the long 2 mile straight line between chainage 6 and 17 of first section. Here for an actual net ascent of 33 feet in a length of 9,000, there are dips of grade of 27 feet which I believe to be avoidable, necessitating 1 in 80 where perhaps with a bit of curving one in 150 might be got or at least 1 in 100. The country here is on the flank of a series of moorum and rock spurs from a high ridge, and it is perfectly adapted for the picking of the best line with the aid of cross sections down the spurs and down the valleys. Yet so far as I can ascertain, no such sections were ever made and a straight line was adopted in place of five or six reverse 1,000 foot curves.

8. A notable instance of the class of fault just referred to is to be found at chainage 62, where a 50-ft. cutting can apparently be easily avoided. Here too there are no cross sections, while it is just such a place as demands that the line through it should be deliberately located on the cross sections with the aid of drawing-office curves. A skilled surveyor may light upon the best line through such a place on the first or second shot by "following the flag", but this casual method of work has certainly not resulted, on this occasion, in the best line being found, or anything like it.

9. Another instance is at Alwaye town, where, between the river crossing, chainage 710, and chainage 790, the line climbs to what seems to me to be a quite unnecessary height of 20 feet, and at the same time not only goes away from the town, but makes it necessary to put the railway station on a most inconvenient and unsuitable site. The line ought apparently to curve sharp off to the west on crossing the bridge and between 710 and 790 to find its way through the low ground near the town so as if possible to avoid rising altogether, and anyhow to rise as little as may be. On the line so found a half mile of straight ought if possible to be found for the railway station, in the low ground between the town and the ridge where the present line runs, and as near the river as possible. Here again I must see evidence in the form of intelligent cross sectioning that the surveyor has not merely followed the flag.

10. South of Alwaye, at chainages 830-890 and 900-1,000, the section can obviously be greatly improved by the use of curving instead of the long straight lines that have been adopted. In the former place a very little slewing will bring the line on high and dry land in light bank or cutting instead of in high bank through paddy fields. At the latter place, the best line must be laid down with office curves on the plan when the latter has been covered with proper cross sections taken off the present line as a base.

11. The next class of faults is where following the straight has led the alignment either close past a ridge which with a little curving might well have been availed of to lighten the bank, or deep into an island, as it were, of moorum which might easily have been circumvented by curving with a view to lighten work. Instances of such places are numerous between Kurumali bridge and Trichur station, near 44-46 and 37-40 of section II, and 56-57 and 44 of section I. Mr. Stoney fully understands what I mean and will doubtless pass the necessary orders.

12. The site of the station at the important town of Trichur has not been well selected. It was necessary to bring it up to the Kokala navigable canal which gives access to all the backwaters. But the whole alignment ought, apparently, to be kept some 800 feet to the east, so as to be on the moorum instead of down in deep water

in the paddy land. I have marked on the map a considerable area of ground which should be fully surveyed and cross-sectioned so as to show how best the station may be located, so that, while avoiding important houses of the town, it may be well placed engineeringly and conveniently situated for business. There seems to be no use in crossing the Kokala canal by a bridge. It can stop at the railway, and be widened out into a suitable basin so as to connect with the railway sidings, and the present canal goods shed must then be moved. Indeed it may well be utilized at the joint wharf of the canal and railway.

13. An important and *quasi*-political matter is the anxiety of the Chief of Edapilly, a fief of Travancore, that the line should pass if possible entirely outside his estate instead of right through the middle of it. The Engineer was directed to enquire into this, but he surveyed round to the south and east where the diversion would be of excessive length, instead of round to the north and west where the diversion would apparently be short. A traverse should now be run round the approximate boundary, on the west and north, of the Edapilly Chief's estate. The survey should also show the family temples which the Chief desires should not be separated from his residence by the railway line. On receipt of this information I shall be in a position to pass orders as to the route to be adopted.

14. I am not satisfied that the question of the site for the Cochin terminus (at Ernacolum) has been gone into with sufficient care. A detail survey of the whole neighbourhood is required showing the property likely to be affected if the line is carried back of the jail and down to the face of the navigable backwater south of the jail. It is obviously of the utmost importance that the railway should so terminate as to suit the convenience of traffic on the backwater, as well as that of Cochin trade with which the future success of the railway is so intimately bound up.

15. Almost everywhere along the line good granitic gneiss is to be found within reasonable distance. This has not been much quarried heretofore, for laterite blocks have usually been found quite good enough for the public road bridges of the State. It will therefore probably be found necessary to go to Bellary and Hyderabad for quarrymen accustomed to work it. At Bezwada this stone had been cut out with rows of wedges at great expense, and but sparingly used in temples and important structures, until my gangs of Bellary Waddahs showed the Telugus how to burn it off cheaply, and now the Godavari bridge piers are being built from the same quarries as were used for that over the Kistna. There is any quantity of good laterite, mixed of course with bad, and when picked with judgment it is quite good enough for culverts.

16. There will be no great difficulty about the major bridges; nearly everywhere river channels and flood marks are very well defined. I saw borings going on at the Alwaye river, and the man in charge was stopping the boring on getting to the end of his piping instead of getting more piping and not stopping until he got either to 60 feet in sand or to something else fit to found on Mr. Stoney passed orders.

17. The excellent tiles, of the quality well known as Mangalore tiles, made in factories all over the country seem to indicate that very good bricks can be got in any quantity. From what I hear, however, nobody in these parts knows how to make bricks cheaply, and no wonder when one sees what the rainfall is and how it is distributed throughout the seasons.

18. It is the intention of the Durbar to enter at once on extensive forest operations with a view to securing the necessary 150,000 sleepers within the next couple of years. There would appear to be lots of timber of the limited number of species known in this part of India to be suitable for sleepers. The Durbar would also be wise to get out timber for all the structures for which it will be wanted. The Forest officers can doubtless in due time receive a list from the railway men, but meanwhile trees might be cut, *e.g.*, teak, irul, irumbakam, *mesua ferrea*, &c., and logs might be floated down to convenient centres and properly seasoned. The Durbar would also be well advised to get a stock of fuel for locomotive purposes. The Locomotive Department of the Madras Railway could advise the Forest officer about this, just as the Engineer can advise him in regard to sleepers and timber for carpentry.

19. I understand that lime is everywhere plentiful, from the shells of the sea-shore which form the universal source of lime for building along this coast.

20. The Madras Railway Engineers would save a great deal of time by now getting out English indents, especially for rails, for locomotives and for construction rolling-stock. There will be no delay in sending indents home, as the money is all available, but there will, I fear, be some delay at home in supplying them. So the sooner indents go the better.

21. I shall now indicate the relative importance which I attach to priority in correcting the faults referred to in paragraphs 6 to 14. I shall refer to them by paragraphs. Paragraph 6, do at once in the office. Paragraphs 7, 8, 9, 10 must be corrected on the ground before I can consider it safe to make over the sections referred to for construction, and I must approve of the work of the Surveyor. Paragraphs 12 and 13, can be done while the surveys just referred to are being done. The faults referred to in paragraph 11 may be corrected by the Engineers after construction begins; the alterations will be slight ones as a rule, and must be sedulously looked out for and made before land is acquired or work begun at the faulty location.

22. There is usually in this Presidency a great deal of needless cutting down of trees on railway land. Government has just passed an order that only such trees are to be cut down and sold by the Civil officers as the Railway Engineers may point out, e.g., all lying within a width of 40 feet on either side of centre line. But trees in station grounds, and wherever they need not be cut, must be left standing not only on account of the valuable shade and fruit they afford, especially in station grounds, but because the strip of land at either side to be ultimately sold back to the cultivators will have lost less of its value if its trees have not been eradicated. The Dewan of His Highness the Rajah of Cochin expressed his desire that a similar policy should be adopted in the case of the Cochin Railway.

ORDER—No. 496 Ry., dated 28th April 1899.

The promised communication from the Cochin Durbar will be awaited. The Consulting Engineer's report will be forwarded to the Agent, Madras Railway Company, for information and guidance. For the additional expense on survey account which will be necessitated by the improvements now ordered—expenses likely to be many times recouped in cost of construction—provision will have to be made in the project estimate by adding to actual survey outlay a sufficient sum under the head "Preliminary expenses." A copy of these Proceedings will be forwarded for the information of the Government of India, who will be separately addressed later on.

[Here enter No. 497 Ry., dated 28th April 1899.]

(True Extract.)

[Signature]

Under Secretary.

To the Agent and Manager, Madras Railway.
 " Examiner, Guaranteed Railway Accounts.
 " Consulting Engineer for Railways.
 " Political Department.
 " Resident in Travancore and Cochin, through the
 Political Department.

Ed. T. K. Narayana Aiyangar.

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