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*Proceedings of the Madras Government, Public Works Department,
20th September 1875.*

Read the following papers:—

No. 456. Docket from the Government of India, Public Works Department, (Account—Military and Civil,) dated Simla, 20th April 1875, No. 143 A.—M. C.

COPY of the following forwarded to the Secretary to the Government of Madras, Public Works Department, with the request that the Government of India may be furnished with such information as will be necessary in complying with the request of the Right Honorable the Secretary of State for India.

(By order,)

(Signed) J. J. McLEOD INNES, Lieut.-Colonel, R.E.,
Dy. Secy. to the Govt. of India.

From the Secretary of State for India, to the Government of India, Public Works Department, dated 21st January 1875, No. 7.

HEREWITH is transmitted copy of a letter from the Colonial Office, dated 31st ultimo, enclosing an extract from a despatch from the Governor of Ceylon, relative to the excessive cost of repairing roads in that Colony, and requesting to be supplied with any information or suggestions likely to be of service to Mr. Gregory in the matter.

2. It appeared to me that the readiest mode of meeting the Earl of Carnarvon's views would be to forward a copy of Mr. Gregory's communication to your Excellency, and to request you to send to Mr. Gregory, direct, any information which you might think likely to be of use.

3. I accordingly request that this may be done, and that I may be furnished with copies of any papers that may be sent to Mr. Gregory.

DOWNING STREET, 31st December 1874.

I AM directed by the Earl of Carnarvon to transmit to you, to be laid before the Secretary of State for India, an extract from a despatch from the Governor, Ceylon, relative to the excessive cost of repairing roads in that Colony, and I am to state that His Lordship would be obliged to the Marquis of Salisbury, if any information or suggestions could be furnished from the India Office which would be likely to be of service to Mr. Gregory in this matter.

(Signed) R. H. MEADE.

The Under Secretary of State, India Office.

Extract of a despatch from Governor Gregory, to the Earl of Carnarvon, dated 26th October 1874 No. 70.

PARAGRAPH 10.—I am not at all surprised at your Lordship's remarks on the cost of the maintenance of our roads. When the estimates under this head were first laid before me I was perfectly astounded. During many years I have had a practical acquaintance with the making of roads, and with their maintenance as Chairman of the Grand Jury of my county, and as having traced, superintended, and actually stood over the making of roads on my own estate. The difference between the cost of making and maintaining roads here and at home is surprising. I am unacquainted with the average cost of the annual maintenance of roads per mile in England, but the average cost in Ireland was, to the best of my recollection, stated to be £13 per mile in a late Parliamentary Return. At the Galway Summer Assizes of 1873, the average cost of maintenance was £6 per mile for the half-year, to which was to be added 9.5 per cent. for superintendence. The roads throughout Ireland are metalled and excellent, whereas, as you

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perceive from the following return, that the greater portion of the roads in Ceylon are gravelled or what is called "Natural Roads," from which the roots of trees and rocks are cleared, and yet

Memorandum of upkeep in 1870 and 1874.

	No. of Miles.	Average cost per Mile.	No. of Miles.	Average cost per Mile.
Metalled Roads	751	Rs. 812	905.92	Rs. 1,085
Gravelled "	478.5	583	529.23	520
Natural "	1000.25	93	922.25	93
Total	2229.75	442	2357.39	573

the average cost per mile of our roads annually amounts to the prodigious sum of £57, although out of 2,357 miles of road less than 1,000 are metalled. The accompanying table will not explain to your Lordship the reason of this heavy cost of maintenance, but it will show you that 150 miles of metalled road have been completed since 1870. These metalled roads have been almost entirely constructed in coffee-bearing districts, and the very heavy traffic over them, which is constantly increasing as fresh plantations come into existence, accounts for

the large increase under the head of maintenance.

11. I have in vain endeavoured to solve the problem of the heavy cost of road upkeep. I consulted all the most experienced road officers, and they assured me that it was not possible to reduce their estimates. They gave the following reasons for the rate of upkeep:—

Labor, though nominally cheap, was in reality extremely dear from the badness of the workman. The rain, combined with great heat, disintegrated the metal.

Heavy tropical rains saturated the roads with moisture, and the enormous loads carried on narrow wheels ploughed them up in wet weather, thereby causing constant fresh outlay to make them passable. The stamping in of the metal immediately on its being laid down, which is necessary from the steep gradients and the formation of the bullocks' feet, adds greatly to the expense. These explanations, though no doubt perfectly true, did not satisfy me, and I endeavoured to see if it were possible by means of contracts to restrict this charge.

12. The cheapness of the Irish road maintenance is stated by the country Surveyors to be due to the repairs being let out on small contracts, and though the system is acknowledged by them not to be a good one, owing to the constant breaking down of these small contractors, still I thought the experiment might be tried. That expedient was, however, shown at once to be impracticable, as no reliable small contractors were to be found. I then turned to large contractors, and let the maintenance of the very expensive road from Peradeniya to Badalla, 82 miles in length, to Messrs. Reid and Mitchell, the Railway Contractors, for five years, thereby gaining about £500 per mensem, taking the average expenditure on the road for the previous five years by the Department of Works.

13. I have been extremely interested in the result of this experiment, looking on it as a kind of test of the cost of upkeep, as the work would undoubtedly be carried on with the strictest regard to economy. Were Messrs. Reid and Mitchell to make a large profit by the transaction, it would be clear that there was something grievously amiss in almost every road estimate throughout the island. They have, however, now been working their contract for 22 months, and I am assured by Mr. Reid, on whose word I can rely, that the profit has hitherto been very small, if any.

14. In his Administration Report for 1873, the Director of Public Works states that the average cost of the annual upkeep of a mile of metalled road, where the traffic is heavy, is £200. His explanation is thus given: "the cost of metalling a road in Ceylon 14 feet wide is about £400 a mile. Under heavy traffic one-third of the metalling must be replaced per annum costing, say, £160, add for cleaning drains, repair of culverts, £10, and a total of £200 is arrived at." Taking these figures of the Director for granted, and seeing that 150 miles of metalled roads in districts where traffic is heavy, have been made since 1870, the increase of cost is accounted for. Allowing this heavy cost to be unavoidable, Your Lordship will, I fear, remain quite as much puzzled as I am, how £52 per mile can be required for gravelled roads, and over £9 per mile on roads which are little better than tracks without proper drains and culverts.

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No. 457. From the Government of India, Public Works Department, dated Simla, 19th June 1875, No. 194 A.—M. C.

No. 457-A. Do. do. 23rd July 1875, No. 237 A.—M. C.

No. 457-B. From Captain J. L. L. MORANT, R.E., District Engineer, Nilgiris, to Major A. DEC. SCOTT, R.E., Under Secretary to Government, Public Works Department, dated Ootacamund, 20th July 1875, No. 207.

I HAVE the honor to acknowledge your memorandum, No. 23, of the 26th May last, with accompaniments as per margin, herewith returned, and beg to submit the report you require.

2. In furnishing materials for a comparison between the roads on the Nilgiris and those in Ceylon, I think it will serve almost all purposes if I first take the main trunk road, which runs through the district, from the railway terminus at Metapolliem on the east to Goodaloor, in the Wynaad, on the west, and give full particulars regarding it. This main line is divided into the five following parts, which embrace almost every kind of road existing in this district:—

	Length in Miles.
1. The almost level metalled road between Metapolliem and Kullar	6
2. The steeply ascending metalled ghaut road between Kullar and Coonoor	16
3. The generally ascending metalled road between Coonoor and Ootacamund	12
4. The undulating unmetalled road between Ootacamund and Nedivattum	21 and
5. The steeply descending and partly metalled ghaut road down to Goodaloor	10
Total	65

No. 1. *The almost level metalled road between Metapolliem and Kullar.*—The road averages 18 feet in width, 15 feet of the centre being metalled with broken stone, $1\frac{1}{4}$ " cube. The stone is found close at hand all along, and consists of granite intermixed with quartz and red slaty rock. It is easy to break and binds freely. The road is fully drained and bridged. It was constructed thirty or forty years ago. Its annual cost of upkeep is Rupees 110 a-mile, which includes all repairs to drains and bridges, but not to two large ones of 7.36 feet spans and 3.25 feet spans respectively. The rainfall at Metapolliem averages annually 22 inches, and at Kullar 60 inches. Rupees 4,000 are about to be expended in improving and widening 4 miles of this road next to Kullar. Labor at Metapolliem is freely obtained. The annual traffic on this road is

	No. or Tons.
Carts backwards and forwards	10,000
Carriages backwards and forwards	4,167
	1,273

No. 2. *The steeply ascending metalled ghaut road between Kullar and Coonoor.*—This road was constructed about five years ago. It took eight years to complete. It has 12 zigzags. Its gradient is 1 in $18\frac{1}{2}$. It possesses 32 timber bridges of spans varying from 12 up to 70 feet, and 300 dry stone drains from $2\frac{1}{2}$ up to 6 feet wide. The drainage is sufficient. The road is very tortuous. It is 18 feet wide, except in a few very rocky parts, where it is barely 12 or 15 feet wide. It is metalled throughout with about 6

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inches in depth of a rather poor description of stone for a width of 16 feet. But it has no side kerb stones to confine the metal, and its cross section is irregular. The construction of this road cost Rupees 20,370 per mile. Details of this cost will be found in Appendix A.

The traffic on this road since it was opened has averaged annually—

	No.	Tons.
Carts up and down ...	9,024	3,760
Carriages up and down ...	1,273	

The rainfall on the Coonoor Ghaut averages 70 inches per annum; 6 inches having been known to fall in as many hours. The cost of the upkeep of this road is annually Rupees 605 per mile, divided as below. In three or four years more one-half of this sum will suffice; for, since the road was opened to traffic, a good portion of the annual repair allowance has been expended in widening and draining and in providing parts with metal which had not been fully covered out of the original estimate.

Its annual repair allowance per mile is now thus divided:—

	Per Mi'e.	Percentage of whole.
<i>Metalling</i> —Which suffices to keep up the road surface to the proper standard...	Rs. 242	40
<i>General Repairs</i> —Such as cleaning sides, opening catch drains, clearing land slips, removing fallen rocks and debris (some portion of this has also been expended in effecting improvements) ...	277	46
Blasting rocks for metal and for walls, &c. ...	39	6
Building parapet walls and revetments ...	26	4
Repairs to bridges and drains ...	8	1
Sundries ...	13	3
Total ...	605	100

This road is generally kept in good order, and will improve every year as the metal consolidates.

No. 3. *The generally ascending metalled road between Coonoor and Ootacamund.*—This road was constructed about twenty years ago. It averages 15 feet in width and is fully drained. A summary of its gradients is as follows:—

	Percentage of whole.
Between 1 in 12 and 1 in 15 ...	6
„ 1 in 15 and 1 in 19 ...	39
„ 1 in 19 and 1 in 30 ...	25
„ 1 in 30 and 1 in 76 ...	22
Easier than 1 in 100 ...	8
Total ...	100

a stone parapet runs along nearly the whole length of the road, which is fully metalled with broken stone, mostly of a hard description of blue granite, broken small enough to pass through a $1\frac{1}{2}$ " ring. The traffic on this road annually is—

	No.	Tons.
Carts backwards and forwards ...	6,386	2,661
Carriages backwards and forwards ...	900	

The annual rainfall in Ootacamund and at Coonoor is 45 and 65 inches respectively. But much more falls on the intervening mountain of Dodabetta, much of the drainage from which crosses this road. As much as 5.3 and 9.5 inches of rain have been

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recorded in 24 hours. The original cost of this road per mile is not known. Its annual repair allowance per mile is Rupees 275, distributed as follows:—

	Rupees.	Percentage of whole.
Metalling ...	187*	68
General repairs, such as cleaning sides, repairing parapets, cleaning catch drains and drains, &c. ...	62	22
Repairing drains ...	8	3
Blasting rocks for metal and which have fallen on roads, &c. ...	7	3
Sundries ...	11	4
Total ...	275	100

Since the year 1862 Rupees 10,464 have been expended, in addition to the annual repair allowances, in more fully metalling certain parts which had deteriorated. This road is generally kept in good order.

No. 4. *The undulating unmetalled road between Ootacamund and Neddivattum.*—This road was opened for traffic about six years since. It is well lined out and rejoices in easy gradients, none being steeper than 1 in 19, many parts being almost level. It averages 18 feet in width, some parts being much narrower. Over bridges it is only 10 or 12 feet wide. It has 15 timber bridges of spans varying 12 up to 112 feet, and 109 dry stone drains. It is catch drained throughout. Its drainage suffices. Only one-fourth of its whole length is metalled with a somewhat indifferent stone, laid 3 inches deep. The rest of the surface is the natural soil, which in dry weather forms an admirable road, but will not stand traffic during rain. During the heaviest part of the monsoon, for about two months in a year, the road is almost impassable. Its original construction cost Rupees 3,179 per mile, details of which are given in Appendix B. Its annual traffic is—

	No.	Tons.
Carts to and fro ...	1,000	416
Carriages to and fro ...	143	

Its annual repair allowance is Rupees 110 per mile, thus divided:—

	Rupees.	Percentage of whole.
General repairs, such as cleaning sides and catch drains, filling up ruts with earthy gravel, cleaning drains, &c. ...	67	61
Metalling ...	33	30
Repairs to bridges and drains ...	10	9
Total ...	110	100

The rainfall at Ootacamund is 45 inches annually, and at Neddivattum 157 inches per annum. The greater part of this road is exposed to the full force of the south-west monsoon. This road is an admirable dry-weather road, but it can never be good at all seasons unless it is metalled.

No. 5. *The steeply descending and partly metalled ghaut road down to Goodaloor.*—This road was opened to traffic five years ago. It was not fully completed, and would require an expenditure of Rupees 2,000 per mile to finish it off. It descends by a uniform gradient of 1 in 18, averages 14 feet in width, and is fully bridged, drained, and catch drained, having 9 timber bridges of spans varying from 10 up to

* This sum is insufficient to keep up the whole road surface to a proper standard. It ought to be increased by one third. Or a general renewal ought to be carried out every eight years in addition to the present annual repair allowance.

30 feet, and 140 dry stone drains. It has seven zigzags. One-half of the length of this ghaut is metalled with 4 inches in depth of broken stone of an inferior quality, the other half being composed of a hard binding soil. Its cost of construction was Rupees 8,140 per mile, details of which are given in Appendix C. The annual traffic on this ghaut is the same as on No. 4, and its annual repair allowance is also identical and divided in a similar manner. Its small repair allowance, combined with its incomplete state, only allow the road to be kept in fair repair. This road is exposed to the full force of the south-west monsoon, and the annual rainfall upon it is as much as 200 inches.

3. Having thus described this trunk road in detail, it will be well to add that no portion of its road surface is ever tamped or rolled. The broken metal is thrown down during rainy weather where required, that part being first well picked up with a pickaxe, and we look to the traffic to consolidate it. Unless the drainage is insufficient, or the drains become choked and there be an overflow, we never find the rains wash the loose metal on the trunk road above detailed. On some of the other district roads, where the gradients are steeper, this does occur. Another point deserving of notice is that all the drains up to 6 feet span are built entirely of dry rubble stone, the stones being large and well bounded, and the covering stones laying on each of the walls not less than 9 inches. No mortar is ever used. These drains answer admirably. My predecessor thus reported to Government in 1865, on the occasion of a violent storm of rain which had then visited these hills:—"I was very much struck on inspecting the line to find how well the dry rough stone drains did their work. In some cases these drains had upwards of 10 feet head of water on their inner sides which was discharged without the slightest injury to the drains."

4. The geological formation of the Nilgiris is of the primitive igneous order, the mass of the mountains being granite frequently passing into sienite. Innumerable dykes or channels of basaltic rock, hornblende, quartz and other minerals intersect the granite. Hornblende rock is also found to occur in various parts of the hills. This rock is highly ferruginous. It intersects the granite and sienite in deep dykes, which, having a greater tendency to decomposition than those rocks, frequently occasion chasms, in which water lodging and wearing away the sides causes the disruption of large masses, which are continually parting from the parent rock, especially after heavy rains. Laterite is also found in many parts of the Nilgiris, generally in an advanced stage of decomposition. No stratified rocks make their appearance in any part of the district, except at the little frequented north-east angle of the plateau. Nor does any limestone exist anywhere on these hills in any form or shape. The road metal is obtained from the granite, sienite, hornblende, and laterite. The granite and sienite if broken small enough to pass every way through a one and a quarter inch ring, form a hard and durable road surface for heavy traffic, but they take time to consolidate. They are difficult to break, and the rock has generally to be blasted with powder for the purpose.

5. Marsdon's stone-breaking machines (of which two have lately been imported into this district) are very useful in breaking up these hard, tough rocks. Each machine is worked by four pairs of bullocks, weighs nearly 2 tons, occupies a space of 2,500 or 3,000 square feet, and breaks the metal at a cost of from $1\frac{1}{2}$ to $2\frac{1}{2}$ Rupees per cubic yard, turning out 12 cubic yards per diem. The same metal broken by

hand costs from Rupees 3 to $4\frac{1}{4}$ per cubic yard. When broken by coolies it is almost impossible to ensure the metal being of uniform hardness and size. The machine travels on wheels, and can be dragged from one place to another by a pair of bullocks. It costs Rupees 1,200 delivered in the district. It is called Blake's patent stone breaker, and is manufactured by H. R. Marsdon, Soho Foundry, Leeds. The following table shows the sizes of the machines, the product per hour of each size of road metal from hard rock when run with a speed of 250 revolutions per minute; the power required to perform this duty, the whole weight of each sized machine, and the weight of the heaviest piece when separated for transportation:—

Size of Stone admitted.	Product of broken Stone per hour.	Power required to obtain given quantity.	Total Weight of Machine.	Weight of Frame.	Price net on Wheels at Leeds.
INCHES.	C. YDS.	H. P.	CWT. Q. LBS.	CWT. Q. LBS.	£
6 × 4	$1\frac{1}{2}$	2	36 0 0	18 0 0	80
10 × 7	3	4	78 0 0	37 0 0	147
15 × 7	$4\frac{1}{2}$	6	120 0 0	54 0 0	190
15 × 9	...	...	130 0 0	66 0 0	...
20 × 9	6	8	156 0 0	74 0 0	255
24 × 12	8	10	220 0 0	110 0 0	370

The machines may be driven by any power less than that given in the table, yielding a product per hour smaller in proportion.

6. The Hornblende forms a very good road coating for moderate traffic. It is obtained without blasting, is readily broken, and binds together quickly. The laterite is only suited for light carriage traffic, and should only be used on those parts of the road where the drainage is good and the under-soil dry. Moisture tends to disintegrate it. It differs much in quality, and hardens very much by being dug up and exposed to the weather for a year before it is broken and laid on the road. It is generally found in reefs, and the stone has usually to be carted from the quarries.

7. The cost of these three descriptions of rock is generally as follows:—

	Granite and Sienite.			Hornblende.			Laterite.
	RS.	A.	P.	RS.	A.	P.	ANNAS.
Cost per cubic yard broken into road metal to pass through a 1½ inch, 1½ inch, or 2 inch ring, and stacked near road-side, stone being found pretty close to the road ...	2	4	0	1	4	0	6 to 8
Cost per cubic yard broken into road metal to pass through 1½ inch, 1½ inch, or 2 inch ring, and stacked near road-side, stone being found pretty close to the road, including the blasting of the rock	*3	0	0	} Never blasted.			
	4	4	0				
Cost per 100 square yards of spreading metal over road to a depth of 2 inches	Rs. 1 or nearly As. 3 per C. yard.						

On the above data the cost per mile of laying on a road granite metal 6 inches thick and 14 feet wide without rolling, &c., would be from Rupees 3,337 to Rupees 6,075. With the exception of the Ootacamund station roads, none of the metal in this

* The European prisoners break this stone at the Ootacamund Jail, and it is delivered to us there at Rupees 3 per cubic yard, including the blasting of the rock.

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district is carted. The stone is generally found near enough to the road-side not to require carting. The carting of granite and laterite costs from Annas 12 to 14 per cubic yard conveyed up to 1 mile, and Rupees 1 to 1½ per cubic yard conveyed up to 2 miles, including the loading and unloading of the cart. It depends on state of road over which the metal is conveyed, and whether the carts can or cannot go right up to where the metal is broken or quarried. The distance from which the metal may be carted does not make so great a difference as might at first sight be supposed. The loading of the cart takes a long time, and is done by the cartmen themselves. If the distance is short the number of trips is not so much greater as if the distance is long, owing to the time, &c., consumed in additional loading and unloading, a labor which the cartmen dislike.

8. The following table of work exacted from work-people and others on the different parts of the above trunk road will probably be of service:—

Description of Work.	Road No. 2.	Road No. 3.	Road No. 4.	Road No. 5.
	From Kullar to Coonoor.	From Coonoor to Ootacamund.	From Ootacamund to Nedivattum.	From Nedivattum to Goodaloor.
	One Cooly will break per diem No. of C. Yds.	One Cooly will break or dig per diem No. of C. Yds.	One Cooly will break per diem No. of C. Yds.	One Cooly will break per diem No. of C. Yds.
Breaking granite or sienite already blasted; 1 man in 5 being allowed for sledge-hammering the larger blocks.	2	1	1	1
Breaking hornblende picked up and collected; 1 man in 5 being allowed for sledge-hammering the larger stones.	2	1	1	1
Breaking up laterite into road-metal after being dug out of the earth	...	1	1	1
Digging up the laterite only out of the quarry	...	2	...	...
	One Cooly will collect and stack per diem No. of C. Yds.	One Cooly will collect and stack per diem No. of C. Yds.	One Cooly will collect and stack per diem No. of C. Yds.	One Cooly will collect and stack per diem No. of C. Yds.
Rough rubble stone not blasted brought to site and stacked.	2 1½	2 1½	2 1½	2 1½
	One man will bore per diem No. of Rg. feet.	One man will bore per diem No. of Rg. feet.	One man will bore per diem No. of Rg. feet.	One man will bore per diem No. of Rg. feet.
Boring granite or sienite with steel jumpers...	1	1	1	1
	Number of yards to be done by one man. No. of Rg. yards.	Number of yards to be done by one man. No. of Rg. yards.	Number of yards to be done by one man. No. of Rg. yards.	Number of yards to be done by one man. No. of Rg. yards.
Cleaning both sides of the road and opening water lables at intervals of 6 yards	30	30	30	30

The accompanying general table marked D will perhaps also be of service.

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9. With regard to the whole district, the following abstract of all its roads and the amounts allotted for their repairs per annum will probably be useful:—

Description of Road.	Total Number of Miles.	Annual Repair Rate per Mile.	Total Annual Repair Allowance.
	MILES.	RS.	RS.
Coonoor Ghaut metalled road	16	605	9,680
Ootacamund Roads. Metalled with granite broken small and rolled and well looked after	9	330	2,970
Ootacamund to Coonoor. Metalled...	12	275	3,300
Do. roads. Metalled with laterite, rolled and well looked after	7	220	1,540
Kotagherry station roads, very steep, much wash, special allowance, unmetalled	2½	137½	340
Roads chiefly unmetalled, of earth, but well drained, worst parts here and there covered with broken stone	153	110	16,830
Roads chiefly good bridle-paths, 9 feet wide or very little used, cart roads 12 feet wide drained of earth	52½	55	2,890
Bridle-paths 4 or 5 feet wide, rough and steep, indifferently drained	13	27½	357½
Total ...	265	...	37,907½

The whole of the roads lumped together and divided according to their natures will be as follows:—

	No. of Miles.
Metalled with granite or with sienite	35½
Do. with hornblende	43½
Do. with laterite	58½
Earthen roads	79
Bridle-paths	48½
Total	265

10. The only roads in this district which are rolled are those in the Cantonment of Ootacamund, and it is only within the last three or four years that this has been done. These roads have been better constructed in the first instance than the district roads, and more care is taken with their annual repairs. For granited roads Rupees 330 per mile are annually expended on repairs as follows:—

	Per Mile. RS.	Percentage of whole.
Metalling	210	65
Rolling	50	15
Cleaning sides, catch and cross drains, cutting hedges, &c....	57	16
Sundries	13	4
Total	330	100

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In future years, as the roads become more completely covered with metal, the cost of metalling will decrease while that of rolling increase.

For those coated with laterite Rupees 220 are annually expended per mile as follows:—

	Rupees per Mile.	Percentage of whole.
Metalling	136	62
Rolling	20	9
Cleaning sides, catch and cross drains, cutting hedges, &c.	56	25
Sundries	8	4
	220	100

Large sums have also from time to time been expended in effecting improvements. Both the above kinds of road are rolled with heavy rollers, each weighing from 2 to 3 tons, and drawn by two pairs of bullocks. The granited roads require more rolling than those covered with laterite, but when once consolidated last much longer. The laterite wears and washes and requires more frequent renewal. On the whole the roads are in very good order. The metal is spread thinly and the traffic is light. There is not much wear from the traffic. On some of these roads an under-layer of large blocks of laterite from 6 to 12 inches thick has been laid, and over the centre part of this lower layer small broken granite, 2 or 3 inches thick, has been spread. In this way the granite is never worked down into the under soil and so lost. Nor does the laterite, the blocks of which adhere to each other, ever work up through the granite to the surface. The lower soil is first sectioned and prepared for the laterite blocks. The blocks are rammed in and partly rolled, and then the granite is laid on in two or three thin layers. There is no doubt that where the granite is laid directly on the soil it often sinks into and is lost, particularly where the traffic is heavy, the soil soft, or the rainfall large. In digging up old metalled roads for new drains the metal has been found at a depth of 2 feet below the road surface. The cross section is made to vary with the gradient, being flatter as the gradient is easier.

11. With regard to the labor on these hills, I beg first to quote a paragraph of a letter addressed by the Commissioner of the Nilgiris to Government. He says "a planter of great experience informs me that, owing to the difficulty of procuring labor, each acre of open land only uses at present the labor of half a cooly, that is to say an estate of 100 acres only employs a standing body of 50 coolies. The proper quantity of labor is one cooly per acre. The full complement would probably be procurable if there was a rail. These are facts indicating the accuracy of this presumption. A male cooly emigrating from the Madras Presidency to Ceylon receives on the estates in that island 22s. per month, and his food costs him 15s. His savings are therefore 7s. per month. On these Hills he receives Rupees 7 per month, and his food costs him Rupees 4. He saves therefore Rupees 3 or Shillings 6. A woman cooly in Ceylon receives s18. She therefore saves s6. A woman here gets Rupees 4, and her food costs Rupees 3. Her savings are Rupee 1 or s2." The following tabular statement will supply further information:—

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Statement showing prices of food grain, &c., on the Nilgiris and at Coimbatore.

	RICE, 1ST SORT.	RICE, 2ND SORT.	CHOLUM.	CUMBOO.	SALT.	WHEAT.
	No. of lbs. per 1 Rupee.	No. of lbs. per 1 Rupee.	No. of lbs. per 1 Rupee.	No. of lbs. per 1 Rupee.	No. of lbs. per 1 Rupee.	No. of lbs. per 1 Rupee.
Nilgiri Hills	17.42	19.75	34.59	38.22	19.05	21.62
At Coimbatore	22.26	23.36	41.43	53.43	34.38	28.87
	RS.	RS.	RS.	RS.	RS.	RS.
Per ton on Nilgiris	125.5	114.7	64.4	63.2	114.4	103.6
Per ton at Coimbatore	160.6	95.8	54.0	41.6	65.1	77.5

The price of labor on these hills is as follows:—

SKILLED LABOR.				COMMON COOLIES.	
Description of Labor.	Rate per Diem.	Description of Labor.	Rate per Diem.	Description of Labor.	Rate per Diem.
	RS. A. P.		RS. A. P.		RS. A. P.
Maistry	1 4 0	Smith, 1st class...	1 0 0	Head cooly or gangman ...	0 10 0
Stone-cutter, 1st class ...	1 8 0	Carpenter, 1st class ...	1 0 0	Cooly man ...	0 5 0
Stone-cutter, 2nd class ...	1 4 0	Carpenter, 2nd class ...	0 14 0	Do. woman ...	0 3 0
Bricklayer, 1st class ...	1 0 0	Carpenter, 3rd class ...	0 12 0	Do. ...	0 3 6
Bricklayer, 2nd class ...	0 12 0	Painter, 1st class.	0 12 0	Cooly boy ...	0 3 0
		Do. 2nd "	0 10 0	Do. ...	0 2 3
		Smith, 2nd "	0 14 0		

12. Quite one-half of the labor on our hill roads is imported. The indigenous population, which for the most part consists of agriculturalists, work fitfully and only at certain periods of the year. The demand for labor is greater than its supply. Hence as much work is not obtained out of the workmen as in more favored districts. The climate also is often against the work, full pay having to be sometimes given for part of a day's labor. I append a statement of our district work rates which may be of service—*Vide* Appendix E.

13. In conclusion, it may be stated generally that the roads in this district are, with few exceptions, not of that first rate class which more populous countries with a large traffic enjoy, nor are they attempted to be kept up in really first rate order. But they suffice for the wants of the people. Economy rather than efficiency has been studied. The making of new roads has been pushed on with great rapidity, and the traffic has been too small to justify a large expenditure. The roads have, in the first place, been made only barely to suffice for wheeled traffic, and thus a portion of the annual repair allowance is wasted from deficient drainage and other causes. It is a question whether it would not have been better to spend the same amount of money on a more restricted number of roads, and thus have obtained a fewer number of miles of a more perfect character. For the cost of the annual upkeep of roads is very materially enhanced by bad gradients, imperfect drainage, irregular widths, tortuousness, and generally poor construction.

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APPENDIX A.
Expenditure in constructing the New Coonoor Ghaut.

Quantity.	Particulars.	Rate.	Per	Amount.	Total.	Cost per Mile.
1.—Benching out.						
827,655	Cubic yards of earthwork, 1st-class...	Rs. A. P. 0 2 0	C. yd.	56,192 12 3		
102,643	Do. do. 2nd-class...	0 3 6	"	22,453 4 0		
38,337	Do. do. 3rd-class...	0 4 6	"	10,782 7 0		
14,219	Do. do. 4th-class...	0 5 6	"	4,888 0 0		
16,379	Do. of raising embankments ...	0 2 6	"	4,429 4 6		
37,307	Do. of blasting and removing rocks ...	2 0 0	"	80,821 12 0		
16	Mile stones ...	7 8 0	Each.	120 0 0		
16	Miles check channel ...	147 5 0	Mile.	2,356 14 0		
16	Do. levelling the road ...	300 0 0	"	4,800 0 0		
				1,86,844 5 9		11,677 12 0
2.—Revetments and Parapets.						
47,103	C. yards of revetment and parapets.	0 12 0	C. yd.	41,021 12 0		
		to 0 15 0			41,021 12 0	2,563 12 0
3.—Bridges and Drains.						
1	Timber bridge, 70 feet span ...	7,600 0 0	Each.	7,600 0 0		
1	Do., 56 " " " " " " " "	5,140 0 0	"	5,140 0 0		
1	Do., 40 " " " " " " " "	3,677 0 0	"	3,677 0 0		
5	Do., 20 " " " " " " " "	982 0 0	"	4,910 0 0		
6	Do., 15 " " " " " " " "	800 0 0	"	3,000 0 0		
25	Do., 12 " " " " " " " "	375 8 0	"	9,387 8 0		
9	Drains, 8 feet ...	400 0 0	"	3,600 0 0		
44	Stone covered drains ...	168 0 0	"	7,392 14 0		
27	Do. do. ...	125 0 0	"	3,375 0 0		
16	Do. do. ...	100 0 0	"	1,600 0 0		
228	Common drains ...	14 0 0	"	5,402 0 0		
		to 25 0 0			55,084 6 0	3,442 12 0
4.—Metalling.						
15,803	Cubic yards of metalling ...	...	"	13,838 13 6	13,338 13 6	833 12 0
	Compensation for land and sundries.	...	...	...	29,628 0 0	1,852 0 0
	Grand Total ...	...	...	...	3,25,917 5 8	20,370 0 0
	Total length, 16 miles.					

APPENDIX B.
Expenditure in constructing the road from Ootacamund to Neddivattum.

Quantity.	Particulars.	Rate.	Per	Amount.	Total.	Cost per Mile.
1.—Benching out.						
144,123	Cubic yards, 1st and 2nd class earthwork ...	Rs. A. P. 1 0 0	8 yds.	18,015 4 0		
70,621	Do., 3rd and 4th do. ...	1 0 0	6 "	11,770 2 8		
24,422	Do., earth filling ...	0 2 0	C. yd.	8,032 12 0		
5,080	Do., blasting and removing rocks ...	2 0 0	"	10,160 0 0		
14	Miles check channel ...	150 0 0	Mile.	2,100 0 0		
				45,098 2 8		2,147 8 0
2.—Revetments and Parapets.						
1,375	Cubic yards revetments and parapets	1 0 0	C. yd.	1,375 0 0		
					1,375 0 0	65 8 0
3.—Bridges and Drains.						
1	Timber bridge, 36 feet span...	1,715 0 0	Each.	1,715 0 0		
2	Do., 20 " " " " " " " "	1,630 0 0	"	3,260 0 0		
4	Do., 15 " " " " " " " "	725 0 0	"	2,900 0 0		
4	Do., 12 " " " " " " " "	575 0 0	"	2,300 0 0		
1	Do., 8 " " " " " " " "	385 0 0	"	385 0 0		
161	Rough stone drain, 1st-class ...	50 0 0	"	8,050 0 0		
2	Do. " 2nd " " " " " " " "	25 0 0	"	50 0 0		
	Sundries ...	...	...	...	18,660 0 0	838 8 0
		...	...	...	1,628 13 4	77 8 0
	Grand Total ...	...	...	...	66,762 0 0	3,179 0 0
	Total length, 21 miles.					

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APPENDIX C.
Expenditure in constructing the Road from Neddivattum to Goodaloor.

Quantity.	Particulars.	Rate.	Per	Amount.	Total.	Cost per Mile.
1.—Benching out.						
33,183	Cubic yards of earthwork, 1st class	Rs. A. P. 0 4 0	C. yd.	9,545 12 0		
31,081	Do. do. 2nd " "	0 5 0	"	9,713 12 0		
45,873	Do. do. 3rd " "	0 6 0	"	17,202 6 0		
17,615	Do. do. 4th " "	0 8 0	"	8,757 8 0		
9,526	Do. do. filling and raising embankments.	0 4 6	"	2,679 3 0		
4,796	Do. of blasting and removing rocks.	3 0 0	"	14,388 0 0		
7	Miles check channel ...	150 0 0	Mile.	1,050 0 0		
10	Do. levelling the road ...	300 0 0	"	3,150 0 0		
					60,485 10 0	6,648 8 0
2.—Revetments and Parapets.						
3,098	Cubic yards of revetment ...	1 8 0	C. yd.	4,647 0 0		
					4,647 0 0	464 12 0
3.—Bridges and Drains.						
1	Timber bridge, 20 feet span...	800 0 0	Each.	800 0 0		
2	Do., 12 " " " " " " " "	400 0 0	"	800 0 0		
146	Rough stone drains ...	30 0 0	"	4,380 0 0		
	Do. do. ...	100 0 0	"	400 0 0		
	Sundries ...	...	...	...	6,380 0 0	638 0 0
		...	...	...	3,887 6 0	388 12 0
	Grand Total...	...	...	...	81,400 0 0	8,140 0 0
	Total length 10 miles.					

APPENDIX D.

Description of Work.	One Brick-layer will lay per Diem without Scaffolding.	To do 100 Square Ft. requires.	Description of Work.
Brick and mud walls 2 feet thick with common bazaar bricks.	No. of Bricks. 500	No. of Men. 1½	Plastering, common, ½ inch thick.
Brick and mud walls 2 feet thick with good table bricks.	400	2	Plastering ½ inch thick, good, smoothed.
Brick and mortar walls 1½ feet thick with common bazaar bricks.	400	4	Plastering one inch with hydraulic mortar.
Brick and mortar walls 1½ feet thick with good table bricks.	350	5	Plastering ½ inch thick, fairly polished with shell lime.
Flooring brick on edge with common bazaar bricks.	600	6	Plastering ½ inch thick, very well polished with shell lime.
...	...	½	Common white-washing, one coat.

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APPENDIX D.—(Concluded.)

Description of Work.	No of Running Yards to be done by one Man.	One Man will dig per Diem.	Description of Work.
Roadwork 1 yard out of solid, bank 4 feet high, completing work fully and smoothing.	8	3	Road widening, easy soil in good weather, 3 yards out of the solid.
Roadwork 1 yard out of solid, bank 1½ feet high, completing work fully and smoothing.	15	2½	Road widening, easy soil in good weather, wheeling distance 30 yards.
Roadwork 1 yard out of solid, bank 4 feet high, through shola, completing work fully.	6	1½	Road widening, easy soil in good weather, wheeling distance 50 yards.
Roadwork 1 yard out of solid, bank 1½ feet high, completing work fully through shola.	10	2	Digging foundations for buildings in average soil.
Catch drains 2 feet by 2 feet in wet weather, and easy soil including clearing roots and movable rocks.	9	1½	Digging foundations for buildings in average soil, wheeling distance 30 yards.
Catch drains 2 feet by 2 feet in dry weather and hard soil.	6	¾	Digging laterite or gravel under average circumstances.

Description of Work.	One Cart will carry.	To do 100 Square Ft. requires.	Description of Work.
Metal for roads	C. yds. 1½	No. of Men. 1½	Pointing with mortar, common, ordinary.
Bricks	Number. 200	No. of Men. 3	Better pointing with mortar.
Slaked lime	C. yds. ¾	No. of Men. 4	Best pointing with mortar.
Sand	C. yds. 1½	No. of Men. 4	Turning of tiles including chunam borders (ordinarily.)
Broken bricks	C. yds. ¼	No. of Men. 2	Laying tiles fresh on a building, double ordinary pan tiles.
Firewood, &c.	lbs. 750 or 1,000	...	

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APPENDIX E.
Schedule of Rates of Work and Materials obtaining in the Nilgiri District of the Madras Presidency in 1875.

Details.	Per	Rate.						Remarks.
		Estimate.			Actual.			
		RS.	A.	P.	RS.	A.	P.	
<i>Rates of Materials not including carriage to site, Bricks and Tiles.</i>								
Stock bricks, table moulded, 8½" × 4½" × 2½", made of clay worked in a pug mill, sound and well burnt in a kiln, the clay is carefully selected, delivered at the brick yard, 15 per cent. of bats being allowed.	1,000	13	0	0	13	0	0	3-8-0 carriage in addition.
Stock bricks, machine moulded, made of well-tempered clay worked carefully in a pug mill, the bricks are pressed and well burnt in a kiln, delivered at the brick yard, 15 per cent. of bats being allowed, 9" × 4½" × 2½".	1,000	18 to 22			18 to 22			These bricks are peculiarly good, they have to be moulded twice, once on the table and once in the machine; they also require more firewood, hence their enhanced cost.
Native bricks 7" × 3½" × 2", made of earth, no care taken with the clay, indifferently burnt, very poor in every way.	1,000	7	0	0	7	0	0	3-8-0 carriage in addition.
Saving bricks, hard, sound, thoroughly burnt, made of well selected clay, 12" × 12" × 1½".	1,000	100	0	0	100	0	0	3-8-0 carriage in addition.
Pillar bricks 1½ feet diameter, hard, sound, thoroughly burnt, in quadrants.	1,000	25	0	0	25	0	0	These bricks require great care in manufacture, they take long to dry and many crack in drying and burning. 3-8-0 carriage in addition.
Flat tiles for roofing 5" × 5" × 1½", average weight of every 10 tiles 8½ lbs.	1,000	6	0	0	6	0	0	
an tiles 1st quality, sound, well burnt, ring when struck, absorb little or no moisture, average weight of every 10 tiles 12½ lbs.	1,000	8	0	0	8	0	0	
an tiles, 2nd quality, made of poorer clay and not so good as above, not used if the first can be got, average weight of every 10 tiles 11½ lbs.	1,000	6	0	0	6	0	0	
<i>Stone.</i>								
Rough stone quarried and stacked granite or sienite, not less than 1 cubic foot and not exceeding 2 cubic feet.	Cubic yard	1 & 2			1 & 2			
Stone hammer, dressed (roughly squared) granite or sienite, the stone is very hard and difficult to work.	100 C. ft.	150	0	0	150	0	0	Seldom used.
Stone granite or sienite, squared and dressed to size, labor only.	...	...			...			Not used.

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Schedule of Rates of Work and Materials obtaining in the Nilgiri District, &c.—(Continued.)

Details.	Per	Rate.						Remarks.
		Estimate.			Actual.			
Stone.—(Concluded.)								
Laterite cut into blocks, stone roughly squared, not less than 1 cubic foot each.	100 stones.	RS.	A.	P.	RS.	A.	P.	Not used by this department in the district, but private persons sometimes employ it.
		30	0	0	30	0	0	
Flooring stones 12" × 12", not less than 6 inches thick, fair dressed on face and sides.	100 "	50 to 65			50 to 65			The stone is chiefly procured at Coonoor, where it is cheaper than at Ootacamund, to which place it is carted.
Stone slabs, rough split, they average 2 cubic feet each, size 6' × 1' × 1'.	100 C. ft.	100	0	0	100	0	0	The stone slabs are paid for by the running feet, they cost 1 Rupee the running foot, used almost solely for road drains.
Lime.								
Lime stone, broken, small, delivered at kiln, of no particular size.	C. yard.	26	0	0	26	0	0	These stones are brought from the low country about 10 miles from the foot of the ghaut.
Lime, burnt and delivered, un-slacked, delivered at building site, stones which do not subsequently slack deducted.	"	25	8	0	25	8	0	
Lime, burnt and delivered, already slacked, fresh, clean lime, well burnt.	"	13	0	0	13	0	0	
Firewood, cut and stacked, obtained from Sholah trees, no brushwood, average size 3 feet long.	"	2	8	0	2	8	0	
Firewood, cut and stacked, obtained from Australian trees, average size 3 feet long.	"	2	4	0	2	4	0	
Sand, clean, sharp, and delivered at the work site, washed in river before brought.	"	3	0	0	3	0	0	
Timber and Roofing Materials.								
Teakwood, full of holes and cracks in log, but well seasoned.	C. foot.	2	0	0	2	0	0	Carriage in addition.
Teakwood, sawn into scantlings.	"	3	8	0	3	8	0	Wastage extra. Seldom used.
Teakwood, wrought and fitted...	"	4	0	0	4	0	0	
Junglewood in the rough, averaging 20 cubic feet in the log, insufficiently seasoned.	"	1	8	0	1	8	0	
Bamboo, 1st-class, 25 to 30 feet long, average diameter 3 to 4 inches.	100	75	0	0	75	0	0	
Bamboo, 2nd-class, 10 to 12 feet long, average diameter 3 to 4 inches.	100	50	0	0	50	0	0	
Bamboo, 3rd-class, 10 to 12 feet long, average diameter 3 to 4 inches.	100	30	0	0	30	0	0	
Bundles of thatch, 5 feet girth, 4 feet long.	Each ...	4 to 6 As.			4 to 6 As.			

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Schedule of Rates of Work and Materials obtaining in the Nilgiri District, &c.—(Continued.)

Schedule of Rates of Work and Materials		RATE.						Remarks.
Details.	Per.	Estimate.			Actual.			
		RS.	A.	P.	RS.	A.	P.	
<i>Iron.</i>								
Europe, bar iron, wrought ...	lb.	0	5	0	0	5	0	
Europe steel bar for jumpers and chisels, cast steel, drilling bars, from 1½" to 1¼" in diameter.	"	0	8	0	0	8	0	
Corrugated iron sheets 6' x 2' 3", thickness or gauge ⅜", weighing 20 lbs. per sheet.	Sheet ...	4	0	0	4	0	0	
Corrugated iron sheets 7' x 2' 3", thickness or gauge ⅜", weighing 21 lbs. per sheet.	"	4	8	0	4	8	0	
Corrugated iron sheets 8' x 2' 3", thickness or gauge ⅜", weighing 22½ lbs. per sheet.	"	5	0	0	5	0	0	
Continuous sheet iron, 2 feet broad, thickness or gauge ⅜", weighing 1 lb. the running foot.	Rg. foot.	0	9	0	0	9	0	
<i>Road Materials.</i>								
Hard granite or sienite stone, broken, small enough to pass every way through a 1¼" ring, without blasting, stacked near road side.	C. yard.	2	8	0	2	8	0	
Hard granite or sienite stone, broken, small enough to pass every way through a 1¼" ring, including blasting, stacked near road side.	"	4	4	0	4	4	0	The European Prisoners at Ootacamund break it up for Rs 3 per cubic yard at the jail, including blasting.
Laterite stone, broken, small enough to pass through a 2" ring, and stacked at quarry including digging.	"	1	4	0	1	4	0	
Laterite stone dug out of quarry in large lumps at quarry.	"	1	2	0	1	2	0	
<i>RATES OF WORK.</i>								
<i>Foundation.</i>								
Excavating, exclusive of baling, &c.	100 C. feet.	1	0	0	1	0	0	
Concrete, composition 1 of lime to 3 of broken brick bats well rammed in 3 inch layers.	100 "	32	0	0	32	0	0	
<i>Masonry Work.</i>								
Rubble in mortar, stones not less than ¼ C. foot, mortar 1 of lime to 2 of sand, bond stones at every 6 feet intervals.	100 "	40 & 45			40 & 45			The granite in this district is generally so hard and breaks into such awkward shaped stones that a great deal of mortar is consumed in filling up interstices; the work is expensive and hardly ever done.
Rubble, dry in revetment, with stones not less than 3 C. feet, with bond stones at every 6 feet intervals, stone blasted.	100 "	5	0	0	5	0	0	

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Schedule of Rates of Work and Materials obtaining in the Nilgiri District, &c.—(Continued.)

Details.	Per	RATE.						Remarks.
		Estimate.			Actual.			
<i>Roofing.—(Concluded.)</i>								
Corrugated iron roofing, &c., complete, including sheets, thickness or gauge $\frac{1}{8}$ inch, weighing 21 to 23 lbs. a sheet, bolts, teak rafters, &c., 3 inches lap.	100 Sq. ft.	RS.	A.	P.	RS.	A.	P.	
		80	0	0	80	0	0	
<i>Woodwork.</i>								
Best teakwood wrought and placed in large beams, such as girders, &c.	Cubic feet.	3	8	0	3	8	0	} Exclusive of wastage.
Best teakwood wrought and placed in small beams, bressummers, joist, &c.	"	4 and 5 Rs.			4 and 5 Rs.			
Best teakwood wrought and placed in trusses, partitions, door frames, &c.	"	RS.	A.	P.	RS.	A.	P.	
		5	0	0	5	0	0	
Best teakwood wrought and placed in furniture or windows, &c.	"	6	0	0	6	0	0	
Best junglewood, such as Vengay wrought and fitted.	"	3	0	0	3	0	0	
Best teakwood pannel doors and windows, including frames and fittings, but not painted, frames about 4" x 4", plain pannels 4," brass hinges, 3 to each leaf, brass bolts 2 altogether, and brass hooks all of best kind.	Square ft.	3	8	0	3	8	0	
Best teakwood venetian and glazed doors and windows complete, including frames and fittings, but not painted, frames about 4" x 4," plain pannels 4," brass hinges 3 to each leaf, brass bolts 2 altogether, and brass hooks all of best kind, including glass.	"	2	4	0	2	4	0	
Best teakwood batten doors and windows, including frames and fittings, but not painted, frames about 4" x 4," 4" brass hinges, 3 to each leaf, brass bolts 2 altogether, and brass hooks all of best kind.	"	1	12	0	1	12	0	
Best teakwood windows and ventilator with $\frac{3}{4}$ " iron bars, 4" from centre to centre complete, including frames and fitting, but not painted.	"	4	8	0	4	8	0	
<i>Ironwork.</i>								
Iron grated doors made with $\frac{3}{4}$ " iron, 4" from centre to centre, gratings fixed and well tarred, wrought iron let into wooden frame, doors 4' x 6' 6," one horizontal bar.	"	10	0	0	10	0	0	

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Schedule of Rates of Work and Materials obtaining in the Nilgiri District, &c.—(Continued.)

Details.	Per	RATE.						Remarks.
		Estimate.			Actual.			
		RS.	A.	P.	RS.	A.	P.	
Europe iron, wrought	lb.	0	5	0	0	5	0	
<i>Painting.</i>								
Carson's paint, 1 coat	100 S. feet	3	0	0	3	0	0	3 lbs. of paint, 1 bottle of raw linseed oil, $\frac{1}{2}$ bottle of boiled linseed oil, $\frac{1}{4}$ bottle of turpentine.
Carson's paint, 2 coats	"	6	0	0	6	0	0	6 lbs. of paint, 2 bottles of raw linseed oil, 1 bottle of boiled linseed oil, $\frac{1}{2}$ bottle of turpentine.
Carson's paint, 3 coats	"	9	0	0	9	0	0	9 lbs. of paint, 3 bottles of raw linseed oil, $1\frac{1}{2}$ bottles of boiled linseed oil, 1 bottle of turpentine.
White paint, 1 coat	"	1	14	0	1	14	0	3 lbs. of paint, 1 bottle of linseed oil, $\frac{1}{4}$ bottle of turpentine.
White paint, 2 coats	"	3	12	0	3	12	0	6 lbs. of paint, 2 bottles of linseed oil, $\frac{1}{2}$ bottle of turpentine.
Red paint, 1 coat	"	1	14	0	1	14	0	3 lbs. of paint, 1 bottle of linseed oil, $\frac{1}{4}$ bottle of turpentine.
Red paint, 2 coats	"	3	12	0	3	12	0	6 lbs. of paint, 2 bottles of linseed oil, $\frac{1}{2}$ bottle of turpentine.
Green paint, 1 coat	"	1	14	0	1	14	0	3 lbs. of paint, 1 bottle of linseed oil, $\frac{1}{4}$ bottle of turpentine.
Green paint, 2 coats	"	3	12	0	3	12	0	6 lbs. of paint, 2 bottles of linseed oil, $\frac{1}{2}$ bottle of turpentine.
Best wood oiling, 1 coat	"	1	8	0	1	8	0	
Best wood oiling, 2 coats	"	3	0	0	3	0	0	
Best wood oiling, 3 coats	"	4	0	0	4	0	0	
Tarring with boiling coal-tar including brushes, &c.	"	2	0	0	2	0	0	
<i>Earthwork.</i>								
Excavating (exclusive of trimming slopes) 1 yard in depth, and depositing on bank up to 2 yards high with a lead of not more than 20 yards in light soil.	C. yard.	0	3	0	0	3	0	
Excavating (exclusive of trimming slopes) 1 yard in depth and depositing on bank up to 2 yards high with a lead of not more than 20 yards in hard clay or shale.	"	0	5	0	0	5	0	

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Schedule of Rates of Work, &c., prevailing in the several Districts of the Madras Presidency for the half-year ending 30th September 1872.

DISTRICTS.

Description of Work.

	Ganjam.	Vizagapa- tam.	Godavary.	Kistna.	Nellore.	Cuddapah.	Kurnool.	Bellary.	Presidency.	Chingleput.	North Arcot.	South Arcot.
Labour.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Bricklayers	...	...	...	...	0 7 3	0 10 4	0 9 9	...	...	...	...	...
Stone-cutters	...	...	...	...	0 7 0	0 10 4	...	...	...	...	...	...
Carpenters	...	...	...	...	0 7 3	0 11 2	0 10 8	...	...	...	...	...
Smiths	...	...	...	...	0 7 0	0 10 11	0 11 6	...	...	...	...	...
Sawyers	...	...	...	...	0 4 0	0 10 4	0 7 6	...	...	...	...	...
Man cooly	...	...	...	...	0 2 3	0 2 8	0 3 3	...	...	...	...	...
Woman cooly	...	...	...	...	0 1 5	0 2 1	0 1 8	...	...	...	...	...
Boy cooly	...	...	...	...	0 1 3	0 1 2	...	...	...	...	...	...
Materials.												
Wall bricks	...	...	...	...	5 8 2	5 5 1	6 4 7	...	...	...	...	...
Native bricks	...	...	...	...	4 2 6	3 7 3	5 3 4	...	...	...	...	...
Pan-tiles	...	...	...	...	1 1 5	2 13 7	4 14 0	...	...	...	...	...
Flat-tiles for roofing	...	...	...	...	1 2 11	...	0 9 2	0 15 1	...	...	...	...
Granite broken small for roads	0 6 5	...	...	...	1 4 0	3 0 6	3 10 7	0 4 0	...	...	...	...
Laterite gravel for roads	0 1 3	...	...	...	...	...	...	...	...	...	...	...
Teak-wood in the log	...	...	...	...	1 4 0	2 3 0	1 9 5	...	...	...	...	...
Jungle-wood in the log	...	...	...	...	...	...	...	...	...	...	...	...
Rates of Work.												
Rubble masonry in mortar	6 15 2	...	...	...	...	...	...	...	...	...	...	...
Rough-stone, large, packed in aprons	...	...	...	...	...	...	...	...	...	...	...	...
of bridges	...	...	...	...	...	...	...	...	...	...	...	...
Brick-work in chunnam	9 15 3	19 13 11	16 8 5	20 6 3	...	1 2 4	0 9 6	0 12 7	...	...	...	...
Do. in clay	6 9 0	...	11 6 4	11 6 6	...	14 3 9	14 9 4	23 7 0	...	...	...	...
Flooring with granite paving stones.	...	...	...	...	...	10 5 6	11 9 3	18 11 8	...	...	...	...
Do. with paving bricks	...	...	...	...	...	...	...	...	...	...	...	...
Do. with asphalt 2" thick laid	...	...	...	...	...	...	...	...	...	...	...	...
on concrete	...	16 1 11	...	...	...	...	...	...	...	...	...	...
Plastering with lime plaster, two coats	2 6 8	3 0 6	3 2 7	3 9 9	...	4 1 2	3 12 1	3 15 0	...	...	...	...
White and color washing	...	...	0 5 0	0 5 3	...	0 5 8	0 4 9	0 5 3	...	...	...	...
Best terraced roofing, exclusive of wood-work	...	17 2 11	26 4 0	25 3 10	...	27 11 1	32 8 1	37 7 8	...	...	...	...
Thatch roofing, including wood-work	...	...	4 12 0	...	...	...	6 12 0	...	...	...	...	...
Teak-wood, wrought and fitted	...	...	3 5 5	2 11 8	8 12 0	4 8 9	4 4 7	4 3 7	...	...	...	...
Jungle-wood do.	...	1 10 5	1 9 3	1 11 6	...	...	2 5 9	2 8 5	...	...	...	...
Teak-wood panel doors and win- dows, including frames, fastenings, &c., complete	...	...	...	...	...	...	...	...	...	...	...	...
Do. venetian do.	...	...	0 15 6	...	...	...	1 1 4	...	...	...	...	...
Do. baton do.	...	...	0 8 8	...	...	...	1 10 0	1 13 8	...	...	...	...
Europe iron, wrought	0 8 0	...	...	...	...	...	0 15 0	1 6 4	...	...	...	...
Native do.	0 3 0	...	...	...	...	...	...	...	...	...	...	...

(Signed) J. L. L. MORANT, Captain, R.E.,
District Engineer, Nilgiris.

Proceedings of the Madras Government, Public Works Department,
20th September 1875.

Description of Work.	DISTRICTS.									
	Salem.	Bangalore.	Tanjore.	Trichino- poly.	Coimba- ture.	Nilgiris.	Malabar.	Wynaad.	South Canara.	Madura.
Labor.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Bricklayers	...	0 7 9	...	0 7 2	...	0 12 3	0 11 0	0 15 8	0 13 6	0 10 6
Stone-cutters	...	0 11 6	...	0 8 0	...	1 0 4	...	...	...	0 10 6
Carpenters	...	0 8 6	...	0 7 7	...	0 10 10	0 10 10	1 1 0	0 14 0	0 11 2
Smiths	...	0 11 0	...	0 8 0	...	0 12 9	0 10 6	0 15 8	0 10 8	0 10 8
Sawyers	...	0 6 0	...	0 6 0	...	...	0 10 0	...	...	0 10 8
Man cooly	...	0 3 0	...	0 2 7	...	0 4 8	0 4 5	0 7 0	0 3 8	0 8 8
Woman cooly	...	0 1 8	...	0 1 7	...	0 2 9	0 2 1	0 8 0	0 2 8	0 1 11
Boy cooly	...	0 1 3	...	...	...	0 3 6	0 2 6	0 3 0	0 2 7	0 1 6
Materials.										
Wall bricks	...	7 0 0	...	3 11 10	...	15 10 8	7 8 0	9 4 0	...	4 13 4
Native bricks	...	5 0 0	...	2 10 6	...	8 0 0	7 0 0	5 2 0	...	...
Flat-tiles	...	3 4 0	...	2 6 4	...	6 8 0	4 1 0	9 0 0	...	2 0 6
Flat-tiles for roofing	...	2 4 0	...	1 10 0	...	5 0 0	3 14 8	6 8 0	...	1 9 6
Granite broken small for roads	...	1 4 0	...	...	...	...	...	...	...	...
Laterite gravel for roads	...	0 7 0	...	2 9 6	...	2 3 9	2 1 7	1 7 0	...	...
Teak-wood in the log...	...	2 8 0	...	...	...	1 8 0	1 0 0	0 13 0	...	...
Jungle-wood in the log	...	1 8 0	...	...	...	...	...	...	...	...
Rates of Work.										
Rubble masonry in mortar	...	...	...	17 11 4	...	60 0 0	...	...	...	...
Rough stones, large, packed in aprons	...	...	...	...	...	...	...	...	...	...
of bridges	...	...	...	...	...	...	...	...	...	...
Brick-work in chimneys	...	13 9 3	...	...	...	45 0 0	18 8 0	39 0 0	...	2 1 0
Do. in cisterns	...	7 9 0	...	...	...	30 0 0	14 0 0	25 0 0	...	15 11 10
Flooring with granite paving stones.	...	8 7 2	...	...	...	90 0 0	...	...	...	11 1 9
Do. with paving bricks	...	...	...	...	...	25 0 0	...	...	...	...
Do. with asphalt 4" thick laid	...	...	...	...	...	...	...	...	...	...
on concrete	...	13 2 11	...	...	...	80 0 0	20 8 0	27 0 0	...	30 0 0
Plastering with lime plaster, two coats	...	8 5 2	...	...	...	13 0 0	3 14 8	11 8 0	...	4 7 0
White and color washing	...	...	...	...	...	0 14 0	0 4 9	0 6 0	...	0 8 0
Best terraced roofing, exclusive of	...	...	...	...	...	...	...	...	...	0 7 0
wood-work	...	27 8 0	...	...	...	160 0 0	85 0 0	...	...	33 8 0
Thatch roofing, including wood-work	...	...	...	...	...	...	...	...	...	...
Teak-wood, wrought and fitted	...	3 12 0	...	...	...	...	...	...	...	...
Jungle-wood, do.	...	3 8 0	...	...	...	...	...	...	...	...
Teak-wood panel doors and win-	...	...	...	...	...	...	...	...	...	...
dows, including frames, fastenings,	...	...	...	...	...	...	...	...	...	...
&c., complete	...	...	...	...	...	...	...	...	...	...
Do. venetian do.	...	...	...	...	...	...	...	...	...	...
Do. batten do.	...	...	...	...	...	...	...	...	...	...
Europe iron, wrought	...	...	...	...	...	...	...	...	...	...
Native do.	...	...	...	...	...	...	...	...	...	...

Proceedings of the Madras Government, Public Works Department,
20th September 1875.

No. 457-C. From District Engineer, Nilgiris, dated 18th August 1875, No. 266.

No. 457-D. Do., Malabar, dated 17th July 1875, No. 62.

No. 457-E. From T. D. HARRIS, Esq., Officiating District Engineer, Malabar, to Major A. DEC. SCOTT, R.E., Under Secretary to Government, Public Works Department, dated Calicut, 4th September 1875, No. 86.

In obedience to the instructions contained in your memorandum, No. 293, dated 26th ultimo, I have the honor to forward a revised statement showing the average cost of construction and maintenance of roads in the Malabar District.

2. *Roads Nos. 1 and 2.*—The cost of the construction of these two roads under the several sub-heads has been furnished as near an approach as it could be possible to give, and I regret that I am unable to give this information from actuals of work done for want of records. There are no roads in this district which are metalled throughout, but partly metalled and partly gravelled, about half in proportion to each other.

3. *Roads Nos. 3 and 4.*—The cost of construction has been obtained from actuals of work done.

4. The annual maintenance allowance for the roads is not found adequate for properly maintaining them, as after intervals of three or four years an outlay for metalling and graveling and for general improvements, such as rebuilding tunnels and platform bridges and widening the road in places, is necessary.

5. The stone generally used for metalling is granite and sienite, is well suited for the roads here, and wears well.

6. Road materials are in some places obtained with great facility, being quite close to the road, and in others they have to be brought from a distance of one to two miles. No good gravel can be found from the 18th mile of the Tambercherry road to the foot of the ghaut, and no good gravel can be had on the road from Cannanore to the Coorg frontier from the 27th mile to the foot of the ghaut. This road passes over very uneven ground, but it has been improved from time to time and contoured round the hills till the gradient is made easy of over the whole line, and it is plain that great zeal and ability has been displayed on the work in various ways. The Tambercherry road is similar; the cost of ghaut work on both roads is excluded, but it was very heavy and admirably executed; it must have been costly, but I regret that I am unable to state the cost thereof; the wooden bridges on all rivers of road are a mistake as also laterite masonry; the occasion for wooden bridges has gone by, both the roads to the frontier are exceedingly feverish during a great part of the best working season and are shunned by all classes of work people; on the whole these roads, with the exception of the bridges, are in good order throughout the year. 330 Rupees a mile would be a sufficient maintenance allowance over the worst portion when properly made and bridged and Rupees 220 is sufficient over the good sound laterite soil.

*Proceedings of the Madras Government, Public Works Department,
20th September 1875.*

7. I would here give an estimate for the construction of roads at the present including iron bridges with granite and brick culverts :—

	RS.
Paving with boulders, 1 foot thick...	1,760
Metalling with broken stone, 6 inches thick	2,640
Gravel blind, 6 inches thick	1,320
	5,720
Earthwork and catch drain, &c.	1,760
Clearing jungle	100
Bridges and Drains	2,500
Compensation for land taken up	275
Blasting rock	400
	10,755
Sundries and Superintendence at 5 per cent	537
	11,292
Total estimated cost for constructing one mile of road at the present time	11,292

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Names of Roads.	AVERAGE COST OF CONSTRUCTION OF ROADS PER MILE.								
	Earth-work, i.e., benching out, excavating, embankments, &c.	Revetment and Parapet walls.	Bridges and drains.	Metalling.	Gravelling.	Sundries and compensation for land.	Cutting and blasting rock.	Cutting jungle.	Paving with boulders, &c.
1	2	3	4	5	6	7	8	9	10
<i>Roads partly metalled and partly gravelled.</i>									
1.—Road from Calicut to Mysore Frontier via Tambercherry ghaut, 27 miles.	800	...	1,000	2,640	...	120	200	100	...
Do. do., portion gravelled	800	...	1,000	...	1,320	120	200	100	...
2.—Road from Cannanore to Coorg frontier, 35 miles	1,093	...	1,500	2,640	...	120	100	75	...
Do. do., portion gravelled...	1,093	...	1,500	...	1,320	120	100	75	...
<i>Roads gravelled.</i>									
3.—Road from Pandikad via Wundoor to Chernpoya, 14 miles.	556	...	400	...	115	115	57	33	...
<i>Roads unmetalled and ungravelled.</i>									
4.—Road from 10th mile of Tambercherry road to Tiruvembaddy, 10 miles.	430	...	537	...	...	57	75	25	...

CALICUT,
4th September 1875.

Statement showing the Average Cost of Construction and Maintenance of Roads and Rates of Labor and Road Materials in the Maabar District.

AVERAGE COST OF MAINTAINING ROADS PER MILE PER ANNUM.							Remarks.	Cost of living of an able-bodied cooly.	DAILY RATE OF HIRE FOR SKILLED LABOR.						Rate of hire of a cart per diem.	Rate of hire of a cart per mile.	Rate of hire of cooly per diem.	Burnt lime per parah.	Jungle-wood, wrought and fitted, per cubic foot.	Broken granite per cubic yard.	Laterite gravel per cubic yard.	Earth-work per cubic yard.	Bricks per 1,000.	Cart traffic per year.	Pack Cattle per year.
Average total cost per mile.	General repairs, i.e., cleaning sides, catch drains, filling up ruts.	Metalling.	Repairs to bridges and drains.	Blasting and removing rock from surface of road.	Superintendence, clearing jungle, &c.	Total.			Carpenters.	Masons.	Stone-cutters.	Bricklayers.	Smiths.	Painters.											
11	12	13	14	15	16	17			19	20	21	22	23	24											
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		Rs.	Rs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs.	Rs.	
4,640	60	152	—	16	20	248	The Tambercherry road runs over good sound though rather soft laterite soil to the 14th mile; from the 14th to the 25th mile the soil is soft laterite, except in the 23rd and 24th mile a small portion of the road passes over granite rock; from 25th mile a foot of ghaut, 23th mile, the road is made over very soft decomposed laterite soil and through several paddy flats of clay soil; the whole line is a series of ups and downs, but the gradients are easy with one or two exceptions for but short distances.	0 3 0	0 6 0 to 0 12 0	0 8 0 to 1 0 0	0 10 0 to 0 14 0	0 6 0 to 0 12 0	0 10 0 to 0 12 0	0 10 0 to 1 0 0	1 4 0	0 8 0	0 3 6 to 0 6 0	...	1 4 0	1 8 0	0 12 0	0 2 0	5 0 0	36,000	7,000
5,313	82	220	28	—	—	330	The road from Cannanore to the Coorg frontier as far as the 15th mile is made over good sound laterite, from that to the Irrity bridge at the 27th mile the soil is soft decomposed laterite more or less. And the last eight miles to the foot of the ghaut is still softer and passes over mud flats; this is a deviation and the metalling has not yet been completed.	0 3 4	0 4 0 to 1 0 0	0 4 0 to 0 12 0	0 8 0 to 0 12 0	0 5 0 to 0 10 0	0 6 0 to 1 0 0	0 8 0 to 1 0 0	1 4 0	0 3 6	0 3 3 to 0 6 0	0 4 6	1 4 0	2 0 0	0 12 0	0 3 6	5 0 0	48,000	10,000
1,276	13	37	5	—	—	55	This is the actual cost of the roads, and they are in passable order for such roads.	0 3 0	0 8 0 to 0 8 0	0 4 0 to 0 8 0	0 6 0 to 0 12 0	0 6 0 to 0 13 0	0 8 0 to 1 0 0	0 8 0 to 1 0 0	1 4 0	0 8 0	0 3 6 to 0 6 0	...	1 4 0	1 8 0	0 12 0	0 2 0	5 0 0	7,200	3,600
1,124	13	37	5	—	—	55		0 3 0	0 6 0 to 0 12 0	0 4 0 to 1 0 0	0 10 0 to 0 14 0	0 6 0 to 0 12 0	0 10 0 to 0 12 0	0 10 0 to 1 0 0	1 4 0	0 8 0	0 3 6 to 0 6 0	...	1 4 0	1 8 0	0 12 0	0 2 0	5 0 0	7,200	1,800

(Signed) T. D. HARRIS,
Officiating District Engineer, Malabar.

Proceedings of the Madras Government, Public Works Department,
20th September 1875.

MEMORANDUM.

THERE has been considerable delay in obtaining the particulars regarding the expense of road construction and maintenance in this Presidency which are required by the letter from the Government of India marginally noted; but it was considered that unless specific details were furnished which would enable a direct comparison to be made with similar items of expenditure in Ceylon, the purpose of the requisition would not be attained, and it has been necessary to refer to the districts more than once in order to obtain the most complete information.

2. Reports have now been furnished from Malabar and the Nilgiris, two districts in which the conditions under which roads are constructed and maintained approximate most closely to those in Ceylon.

3. The District Engineer, Nilgiris, has given very clear and complete information of the kind required, in reference to the main road from Mettapolliem to Goodalore, via Coonoor and Ootacamund, as well as the district roads generally; and, as his rates and estimates are based on records of actual work done, they may apparently be fully relied on.

The District Engineer, Malabar, has given details of the cost of construction and maintenance of four roads, aggregating 86 miles in length, viz., from Calicut to the Mysore frontier, 27 miles; from Cannanore to the Coorg frontier, 35 miles; from Pandikad to Charupaya, 14 miles; and from the 10th mile on the Tambercherry road to Tiruvembady, 10 miles.

The particulars regarding the two first as regards total cost both of maintenance and construction are apparently derived from records such as estimates, but the distribution of the outlay under the several sub-heads has been suggested by general experience more than from information derived from accounts. All the details given of the two roads last mentioned are, it is assumed, gleaned from the booked expenditure.

The roads above referred to are of various natures—metalled, gravelled, and both unmetalled and ungravelled. The gradients vary also from those suited to a low level country to those necessary for the ascent of a mountain chain.

4. The information regarding the cost of the maintenance of the roads in Ceylon given in Governor Gregory's letter, which forms an enclosure to the letter of the Government of India already quoted, is not sufficiently detailed to enable a close comparison to be made here between the outlay in both localities, and the cost of construction is merely alluded to incidentally, as regards one item, viz., that of metalling. This defect can no doubt be easily remedied by reference to the accounts of expenditure, and as the outlay in this Presidency has been classified under distinct sub-heads, and the wages, cost of food and tasks of the laborers are specified in the appendices, all the data necessary for allotting to the various causes of increased cost in Ceylon, their proper degree of importance will apparently be at hand.

5. While summarising here the results exhibited of the cost of construction and maintenance of roads in Malabar and the Nilgiris, it will be as well, however, to add to the statements the Ceylon data so far as they are available, and those adopted in

Proceedings of the Madras Government, Public Works Department,
20th September 1875.

B
Statement showing the Cost of Maintenance of certain Roads in the Nilgiris and Malabar compared with that current in Ceylon.

District.	Name of Road.	Metalling.	General Repairs.	Blazing Books.	Building Parapet walls and Revetments.	Repairs to bridges and drains.	Sundries.	Total.	Traffic Carts per annum.	
Coimbatore and Nilgiris.	Mettapolliem, Kullar	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. ...	Rs. 110	Rs. 10,000	A low country road, bridged drained, and metalled; details not given.
Do.	Kullar, Coonoor	* 242	277	39	26	8	13	\$ 605	9,024	A ghaut road rising 5,000 feet, 18 feet wide.
Do.	Coonoor, Ootacamund	187	62	7	...	8	11	275	6,386	Gradients 1-12 to 1-76, 15 feet wide.
Do.	Ootacamund, Neddivittum	† 33	67	...	...	10	...	110	1,000	Undulating; easy gradients.
Do.	Neddivittum, Goodalore	† 33	67	...	...	10	...	110	1,000	A ghaut road.
Malabar	Calicut, Mysore frontier	152	60	16	...	...	20	248	36,000	Easy gradients, metalled or gravelled.
Do.	Cannanore, Coorg frontier	220	82	...	...	28	...	330	48,000	Do. do.
Do.	Pandikad, Cherupoya	37	13	...	...	5	...	55	7,200	Gravelled only.
Do.	Tambercherry road, Tiruvembady	...	50	...	...	5	...	55	7,200	Neither metalled nor gravelled.
	Ceylon roads, Governor Gregory...	1,600	400	...	...	...	...	2,000	...	Heavy traffic, metalled road.
		...	...	...	...	...	...	1,035	...	Average for metalled roads.
		...	...	...	...	...	...	520	...	Do. gravelled.
		...	...	...	...	...	...	98	...	Do. not metalled nor gravelled.

* This outlay is insufficient and ought to be increased to Rupees 250.

† Only one-fourth of the length is metalled.

‡ Only one-half of this road is metalled.

§ One-half, this will suffice when the road has been fully metalled.

The metalled roads in Malabar are stated to require a general repair every four years in addition, so that probably the annual charge under each head should be doubled.

(Signed) A. DEC. SCOTT, Major, R.E.,
Under Secretary.

MEMORANDUM.

THERE has been considerable delay in obtaining the particulars regarding the expense of road construction and maintenance in *this Presidency* which are required by the letter from the Government of India marginally noted; but it was considered that unless specific details were furnished which would enable a direct comparison to be made with similar items of expenditure in Ceylon, the purpose of the requisition would not be attained, and it has been necessary to refer to the districts more than once in order to obtain the most complete information.

No. 143-A. ^M_C, 20th April 1875.

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4. The information regarding the cost of the maintenance of the roads in Ceylon given in Governor Gregory's letter, which forms an enclosure to the letter of the Government of India already quoted, is not sufficiently detailed to enable a close comparison to be made here between the outlay in both localities, and the cost of construction is merely alluded to incidentally, as regards one item, *viz.*, that of metalling. This defect can no doubt be easily remedied by reference to the accounts of expenditure, and as the outlay in this Presidency has been classified under distinct sub-heads, and the wages, cost of food and tasks of the laborers are specified in the appendices, all the data necessary for allotting to the various causes of increased cost in Ceylon, their proper degree of importance will apparently be at hand.

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Coimbatore and Nilgiris.	Mettapolliem, Kullar	RS. ...	RS. ...	RS. ...	RS. ...	RS. ...	RS. ...	RS. 110	RS. 10,000	A low country road, bridged drained, and metalled; details not given.
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Do.	Tambercherry road, Tiruvembady	...	50	...	...	5	...	55	7,200	Neither metalled nor gravelled.
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		...	...	...	...	...	...	1,035	...	Average for metalled roads.
		...	...	...	...	...	...	520	...	Do. gravelled.
		...	...	...	...	...	...	98	...	Do. not metalled nor gravelled.

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(Signed) A. DE C. SCOTT, Major, R.E.,
Under Secretary.

*Proceedings of the Madras Government, Public Works Department,
20th September 1875.*

No. 458.

ORDER THEREON, 20th September 1875, No. 2,711.

CIVIL WORKS, No. 32-A.

ORDERED that the following letter
be sent:—

(Here enter, No. 2,712, dated 20th September 1875.)

(True Extract.)

Major-General, R.E.,
Secretary to Government.

*Proceedings of the Madras Government, Public Works Department,
20th September 1875.*

the present correspondence may be supplemented by details furnished by Captain Schaw, R.E., and printed in the 6th Volume of the Professional Papers of the Corps of Royal Engineers.

6. The annexed statement compares the cost of construction of the roads in the Nilgiris, Malabar, and Ceylon so far as it is entered on in the correspondence or
Statement A.

reports here available. The charge for metalling in Ceylon is manifestly largely in excess of the average cost of the same work in this Presidency. The charges per mile for excavation and the total for construction, as given by Captain Schaw, exceed those here current, except in the case of roads ascending the ghauts. But, in order to arrive at any definite conclusion, the rates per cubic yard paid for excavation, blasting, stone-breaking and carting, &c., in each locality must be compared, and the schedules of rates current which have been furnished by the District Engineers will afford the means of doing so.

7. It is, however, the cost of maintenance of the Ceylon roads which is chiefly in question, and this is compared with the results in Malabar and the Nilgiris in the annexed Statement B. The actual number of carts traversing the Ceylon roads referred is not stated, nor is the cost of metal per cubic yard given. A comparison of the quantity of metal per cart required for renewals in this Presidency and in Ceylon would be a rough test of the relative economy of management in that particular respect.

OOTACAMUND,
15th September 1875.

(Signed) A. DEC. SCOTT, Major, R.E.,
Under Secy. to Government, P.W.D.

Proceedings of the Madras Government, Public Works Department,
20th September 1875.

A.
Statement showing the Average Cost per mile of Roads in the Nilgiris, Malabar, and Ceylon.

District.	Name of Road.	Earth and Rock work in excavation, benching out embankments and blasting and cutting jungle.	Revetments and Parapet Walls.	Bridges and Drains.	Metalling.	Gravelling.	Paving with boulders 1 foot deep.	Sundries and compensation for land.	Total per Mile.	Total length.	Width.
1	2	3	4	5	6	7	8	9	10	11	12
Nilgiris	Coonor Ghaut ...	RS. 11,677	RS. 2,564	RS. 3,443	RS. 1,833	RS. ...	RS. ...	RS. 1,852	RS. 20,369	Miles. 16	Feet. 18
	Ootacamund to Neddittum ...	2,147	66	888	...	...	...	79	3,179	21	15
	Neddittum, Goodalore Ghaut...	6,648	464	638	...	...	...	389	8,140	10	14
Malabar	Calicut to Mysore frontier ...	1,100	...	1,000	2,640	1,320	880	120	4,640	27	...
	Cannanore to Coorg frontier ...	1,273	...	1,500	2,640	1,320	880	120	5,313	35	...
	Pandikaad to Charupoya ...	646	...	400	...	115	...	115	1,276	14	...
Ceylon	Branch to Tiruvembady ...	530	...	537	...	...	...	57	1,124	10	...
	General cost of metalling a road 14 feet wide.	...	...	...	4,000	...	...	...	...	...	...
	Governor Gregory's letter ...	...	...	...	...	...	...	...	...	...	...
	Cost of road (hill side) 14 feet, vide Captain Schaw, R.E. ...	*750	...	...	3,480	...	...	...	\$6,500	...	...

* Metalling 15 feet wide, allowance stated to be insufficient.

† This road is incomplete and would require Rupees 2,800 per mile additional.

‡ Exclusive of blasting.

§ Stated by Captain Schaw to be the average cost of a 14 feet road exclusive of bridges.

(Signed) A. DE C. SCOTT, Major, R.E.,
Under Secretary.

PUBLIC WORKS DEPARTMENT,
OOTACAMUND, 20th September 1875.

No. 459.

No. 2,712.

FROM

MAJOR-GENERAL G. W. WALKER, R.E.,

Secretary to the Government of Madras,

Public Works Department,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA,

Public Works Department.

CIVIL WORKS, No. 32-B.

SIR,—With reference to your letters marginally noted, I am directed to forward the following documents:—

No. 143 A $\frac{M}{C}$, dated 20th April 1875.

„ 194 A $\frac{M}{C}$, „ 19th June „

„ 237 A $\frac{M}{C}$, „ 23rd July „

1. A report from the District Engineer, Nilgiris, relative to the cost of construction and maintenance of roads in that district with enclosures.

2. A similar report from the District Engineer, Malabar, with enclosures.

3. A summary of the above.

2. I am also to state that the delay which has taken place in replying to the reference made to this Government has been caused by a desire to furnish the fullest information possible and the consequent necessity of several references to the District Officers.

I have the honor to be,

Sir,

Your most obedient servant,

Major-General, R.E.,
Secretary to Government.

Exd. by E. C. Shunker and W. J. Lewis.

Spare Copies

25 P.P.O.

All communications
should be addressed to
the Secretary.

No. 143. *L. A. M.*
to

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

ESTABLISHMENT.

Account

Military and Civil

Simla, 20th April 1875

*Copy of the following forwarded to the
Secretary to the Government of Madras, Public Works
Department, with the request that the Government of
India may be furnished with such information as
will be necessary in complying with the request of the
Right Honble the Secretary of State for India -*

By Order

A. M. Wood Jones

Secretary to Govt. of India

*COPIED
21-4-75*

No. 7 dated 21st January 1875.

*From the Secretary of State for India, to the Government
of India, Public Works Department.*

*1. Herewith is transmitted copy of a letter
from the Colonial Office, dated 31st ultimo, enclosing*

and

an extract from a despatch from the Governor of Ceylon, relative to the excessive cost of repairing roads in that Colony, and requesting to be supplied with any information or suggestions likely to be of service to Mr Gregory in the matter.

2. It appeared to me that the readiest mode of meeting the Earl of Carnarvon's views would be to forward a copy of Mr Gregory's communication to Your Excellency, and to request you to send to Mr Gregory, direct, any information which you might think likely to be of use.

3. Accordingly request that this may be done, and that I may be furnished with copies of any papers that may be sent to Mr Gregory.

Downing Street
31st December 1874

I am directed by the Earl of Carnarvon to transmit to you, to be laid before the Secretary of State for India, an extract from a despatch from the Governor, Ceylon, relative to the excessive cost of repairing roads in that Colony, and I am to state that His Lordship would be obliged to the Marquis of Salisbury, if any information or suggestions could be furnished from

from the India Office which would be likely to be of service to Mr Gregory in this matter.

Yours faithfully
The Under Secretary of State for India
A. R. H. Meade

Extract of a despatch from Governor Gregory to the Earl of Carnarvon, dated October 26th 1874 No 70.

10 I am not at all surprised at your Lordship's remarks on the cost of the maintenance of our Roads. When the Estimates under this head were first laid before me I was perfectly astounded. During many years I have had a practical acquaintance with the making of roads, and with their maintenance as Chairman of the Grand Jury of my Country, and as having traced, superintended and actually stood over the making of roads on my own Estate. The difference between the cost of making and maintaining roads here and at home is surprising. I am unacquainted with the average cost of the annual maintenance of roads per mile in England but the average cost in Ireland was to the best of my recollection stated to be £13 per mile in a late Parliamentary Return. At the Galway Summer Assizes of 1873, the average cost of maintenance was £5 per mile for

for the half year, to which was to be added 9.5 per Cent for Superintendence. The roads throughout Ceylon are metalled and excellent, whereas, as you perceive from the following Return that the greater portion of the Roads in Ceylon are gravelled or what is called "Natural Roads" from which the roots of trees and rocks are cleared, and yet the average cost per mile of our roads annually amounts to the prodigious sum of £57 although out of 2,357 miles of Road less than 1000 are metalled the accompanying Table will not explain to Your Goodship the reason of this heavy cost of maintenance, but it will show you that 150 miles of Metalled roads have been completed since 1870. These metalled Roads have been almost entirely constructed in Coffee bearing districts, and the very heavy traffic over them which is constantly increasing as fresh Plantations come into existence accounts for the large increase under the head of maintenance.

11 I have in vain endeavoured to solve the problem of the heavy cost of road up keep. I consulted all the most experienced road officers and they assured me that it was not possible to reduce their

Return of up keep in 1870 & 1874

	Metalled Roads	Gravelled Roads	Natural Roads	Total
Miles	157	478.5	93	628.5
Average Cost per mile	612	588	922.25	442.25
No. of Miles	157	478.5	93	628.5
Average Cost per mile	612	588	922.25	442.25

their Estimates. They gave the following reasons for the rate of up keep - 3

Labour though nominally cheap was in reality extremely dear from the badness of the workman. The rain combined with great heat disintegrated the metal.

Heavy tropical rains saturated the Roads with moisture and the enormous loads carried on narrow wheels ploughed them up in wet weather thereby causing constant fresh outlay to make them passable. The stamping in of the metal immediately on its being laid down, which is necessary from the steep gradients and the formation of the bullocks feet, adds greatly to the expense. These explanations though no doubt perfectly true did not satisfy me, and I endeavoured to see if it were possible by means of Contracts to restrict this charge.

12. The cheapness of Irish road maintenance is stated by the Country Surveyors to be due to the repairs being let out on small contracts and though the system is acknowledged by them not to be a good one owing to the constant breaking down of these small Contractors, still I thought the experiment might be tried that expedient was however shown at once to

for to be impracticable as no reliable small contractors
were to be found. Then turned to large contractors
and let the maintenance of the very expensive
road from Peradeniya to Padalla, 82 miles
in length, to Messrs Reid and Mitchell, the
Railway Contractors for five years thereby gaining
about £500 per m: taking the average expenditure
on the Road for the previous five years by
the Department of Works.

23¹³ I have been extremely interested
in the result of this experiment looking on
it as a kind of test of the cost of up keep,
as the work would undoubtedly be carried on
with the strictest regard to economy. Were
Messrs Reid and Mitchell to make a large
profit by the transaction it would be
in clear that there was something seriously
amiss in almost every Road Estimate
throughout the Island. They have, however
now been working their contract for 22 months
and I am assured by Mr Reid, on whose
work I can rely, that the profit has hitherto
been very small if any.

14. In his administration report for
1873 the Director of Public Works states that
the average cost of the annual up keep
of

of a mile of Metalled road where the traffic is
heavy is £200. His explanation is thus given.
The cost of Metalling a Road in Ceylon 14 feet
wide is about £400 a mile. Under heavy traffic
one third of the metalling must be replaced
per annum costing say £133. add for cleaning
Drains, repair of Culverts £40 and a total
of £200 is arrived at. Taking these figures
of the Director for granted and seeing that
150 miles of Metalled roads in districts
where traffic is heavy have been made
since 1870, the increase of cost is accounted
for. Allowing this heavy cost to be unavoidable,
Y.L. will, I fear, remain quite as much
puzzled as I am how £32 per mile
can be required for gravelled roads and over
£9 per mile on roads which are little better
than tracks without proper drains and
Culverts.

No. 194 A.
GOVERNMENT OF INDIA.
PUBLIC WORKS DEPARTMENT.
ACCOUNT.
Military and Civil

To The Secretary to the
Government of Madras,
Public Works Department.
Dindigul, 19th June 1875.

I am directed to invite attention to
Public Works Department's Correspondence No 143 A
dated 20th April 1875 giving cover to a Despatch
from the Secretary of State No 7 dated 21st January
1875, and to request that the information therein
called for in regard to the cost of maintenance
of roads in Ceylon may be furnished as soon
as possible.—

I have the honor to be,
Sir,

Your most obedt servant,

M. C. S. S.

By Secy. to Govt. of India

Mr. 1875 A. 194
No 28/3.
A. C. S. S.
Cost of India.
Date 20th April 1875.
Recd. 29th
No 143 A.

The Secretary of the
Government of Madras,
Public Works Department,
Dindigul, 19th June 1875.
I am directed to invite attention to
Public Works Department's Correspondence No 143 A
dated 20th April 1875 giving cover to a Despatch
from the Secretary of State No 7 dated 21st January
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PUBLIC WORKS DEPARTMENT.
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from the Secretary of State No 7 dated 21st January
1875, and to request that the information therein
called for in regard to the cost of maintenance
of roads in Ceylon may be furnished as soon
as possible. —

I have the honor to be,
Sir,

Your most obedt servant,

M. C. S. S.

By Secy. to Govt. of India

Mr. 1875 A. 194
No 28/3.
A. C. S. S.
Cost of India.
Date 20th April 1875.
Recd. 29th
No 143 A.

The Secretary of the
Government of Madras,
Public Works Department,
Dindigul, is requested to
furnish the information
called for in the above
Despatch, and to request
that the information therein
called for in regard to the
cost of maintenance of
roads in Ceylon may be
furnished as soon as
possible.

No. 237. A.
M.C.
GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

ACCOUNT.

Military & Civil

To the Secretary to the
Government of Madras
Public Works Department
Sule, 23^d. July 1875.

Sir

I am directed to invite attention to
~~Public Works Department~~ Endorsement No 143 ^A_{M.C.}
dated 20th April 1875 giving cover to a despatch
from the Secretary of State No 7 dated 21st
January 1875. and to request that the information
therein asked for in regard to the cost of mainte-
nance of roads in Ceylon may be furnished
at an early date. —

I have the honor to be
Sir,
Your most obedient servant

J. M. Leod Esq.,
Secy. Secy. to Govt. of India

communications
to be addressed
Secretary.

Offr. 1875 L.C.C.
No 6669

From Govt of India.
C.M. & M. No 157.

Chile. 19 June 1875

Decd. 28th June 1875
No 194 M.C.

Desiring attention to
letter No 143 ^A_{M.C.} d/-
20th April 1875 regarding
the maintenance of roads
in Ceylon, and requesting
the published as early
as possible with the
information therein
afforded in —
J. M. Leod Esq.,
Secy. Secy. to Govt. of India

District Engineer's office
Colacammund 20th July 1875

No. 207

From

Captain J. A. D. Morant R.E.
District Engineer
Nilghevins

To

Major A. C. Scott R.E.
Under Secretary to Government
D. O. W.

Sir

Enclosures
1. Original letter
from the Govt of
India No 1143 Ath
dated 20th April
1875 & schedule
of rates.

I have the honor to acknowledge your
Memo No 23 of the 26th May last with accompani-
ments as per margin herewith returned, and beg to
submit the report you require.

In furnishing materials for a comparison
between the roads on the Nilghevins and those in
Ceylon, I think it will serve almost all purposes
if I first take the main trunk road, which runs
through the District from the railway terminus
at Metapolliam on the East to Goodaloor in the
Wynnad on the West, and give full particulars
regarding it. This main line is divided into the
five following parts which embrace almost every
kind of road existing in this District.

The

20th 1875 Delle
No 6070

From
Govt of Madras

Date 23rd July 1875

No 237
M.E.

S. G. 27/1. 20-5-75

Regarding early

submission of info.

relative regarding

Cost of Maintenance

of roads in Ceylon,
checked for in Madras.
- sent 28th 14th 1875
- 1. April 1875

No 5728

At Madras 27th July

1. The almost level metalled road between Metapolliam and Kullar. Length in miles 6
2. The steeply ascending metalled ghant road between Kullar and Coonoor. 16
3. The generally ascending metalled road between Coonoor and Ootacamund. 12
4. The undulating unmetalled road between Ootacamund and Naddiwattam, and 21
5. The steeply descending and partly metalled ghant road down to Goodaboor. 10
- Total = 65 miles

1. The almost level metalled road between

Metapolliam and Kullar. — The road averages 18

feet in width, 15 feet of the centre being metalled with

broken stone 1½" cube. The stone is found place at

hand all along and consists of granite intermixed

with quartz and red slaty rock. It is easy to break

and binds freely. The road is fully drained and

bridged. It was constructed 30 or 40 years ago.

Its annual cost of upkeep is Rs 110 a mile which

includes all repairs to drains and bridges but not to

two

two large ones of 7.36 feet spans and 3.25 feet spans respectively. The rain fall at Metapolliam averages annually 22 inches, and at Kullar 60 inches.

Rs 1000 are about to be expended in improving and widening ½ miles of this road near to Kullar.

Labour at Metapolliam is freely obtained. The annual traffic on this road is

parts backwards and forwards 10000 or 1167
carriages backwards and forwards 1273

2. The steeply ascending metalled ghant road between Kullar and Coonoor. — This road

was constructed about 5 years ago. It took 8

years to complete. It has 12 zigzags. Its grade

is 1 in 18½. It possesses 32 timber bridges

of spans varying from 12 up to 70 feet and 300 dry

stone drains from 2½ up to 6 feet wide. The

drainage is sufficient. The road is very tortuous.

It is 18 feet wide except in a few very rocky parts

where it is barely 12 or 15 feet wide. It is metalled

throughout

throughout with about 6 inches in depth of a rather poor description of stone for a width of 16 feet. But it has no side kerb stones to confine the metal, and its cross section is irregular.

The construction of this road cost Rs 20370 per mile. Details of this cost will be found in Appendix A.

The traffic on this road since it was opened has averaged annually:

Carts up and down — 9024 or 3760

Carriages up and down — 1273

The rain fall on the Boonoo Ghaut averages 70 inches per annum; 6 inches having been known to fall in as many hours. The cost of the upkeep of this road is annually Rs 605 per mile, divided as below. In 3 or 4 years more one half of this sum will suffice, for since the road was opened to traffic a good portion of the annual

repair

repair allowance has been expended in widening and draining and in providing parts with metal which had not been fully covered out of the original estimate.

Its annual repair allowance per mile is now thus divided:

	Rs mile	Percentage of whole
Metalling { which suffices to keep up the road surface to the proper standard }	242	40

General Repairs — such as cleaning sides, opening catch drains, clearing land slips, removing fallen rocks and debris (some portion of this has also been expended in effecting improvements)	277	46
---	-----	----

Clacking Rocks for metal & for walls	39	6
--------------------------------------	----	---

Building parapet walls and revetments	26	4
---------------------------------------	----	---

Repairs to bridges and drains	8	1
-------------------------------	---	---

Sundries	13	3
----------	----	---

Total Rs 605	100
--------------	-----

This road is generally kept in good order, and will improve every year as the metal consolidates.

123. The generally ascending metalled road

between

between Coonoor and Ootacamund. This road was constructed about 20 years ago. It averages 15 feet in width and is fully drained. A summary of its gradients is as follows:-

	Percentage of whole
Between 1 in 12 and 1 in 15	6
— " — 1 in 15 and 1 in 17	39
— " — 1 in 17 and 1 in 30	25
— " — 1 in 30 and 1 in 46	22
Easier than 1 in 100	8
	<u>100</u>

a stone parapet runs along nearly the whole length of the road, which is fully metalled with broken stone mostly of a hard description of blue granite broken small enough to pass through

a 12" ring. The traffic on this road annually is

Wheeled carts backwards and forwards — 6386 or 2661

Carrriages backwards and forwards 900

The annual rain fall in Ootacamund and at Coonoor is 45 and 65 inches respectively. But much more falls on the intervening mountain

of Wodaibetta, much of the drainage from which passes this road. As much as 5.3 and 9.5 inches of rain have been recorded in 24 hours. The original cost of this road per mile is not known. Its annual repair allowance per mile is Rs 275 distributed as follows:-

	Rupers	Percentage of whole
Metalling	187*	68
General Repairs such as cleaning sides, repairing parapets, cleaning catch drains and drains &c	62	22
Repairing drains	8	3
Collecting rocks for metalling and which have fallen on road	7	3
Sundries	11	4
Total	<u>Rupers 275</u>	<u>100</u>

Since the year 1862 Rs 10,464 have been expended in addition to the annual repair allowance.

* This sum is insufficient to keep up the whole road surface to a proper standard. It ought to be increased by one third. Or a general renewal ought to be carried out every 8 years in addition to the present annual repair allowance.

in more fully metalling certain parts which had deteriorated. This road is generally kept in good order.

No. 4. The undulating unmetalled road between Ootacamund and Reddivattam.

This road was opened for traffic about 6 years since. It is well laid out and rejoins in easy gradients, none being steeper than 1 in 19, many parts being almost level. It averages 18 feet in width, some parts being much narrower. Over bridges it is only 10 or 12 feet wide. It has 15 Timber Bridges of spans varying 12 up to 112 feet, and 109 dry stone drains. It is catch drained throughout. Its drainage suffers. Only $\frac{1}{4}$ of its whole length is metalled with a somewhat indifferent stone laid 3 inches deep. The rest of the surface is the natural soil

soil which in dry weather forms an admirable road, but will not stand traffic during rain. During the heaviest part of the monsoon for about 2 months in a year the road is almost impassable. Its original construction cost Rs. 3179 per mile, details of which are given in appendix B. Its annual traffic is

Number of	Trucks	or	Trains
Carts to and fro	1000	or	416
Trains to and fro	143		

Its annual repair allowance is Rs. 110 per mile thus divided

	Rupies	Percentage of whole
General Repairs, such as cleaning sides and catch drains	6.7	6.1
fitting up ruts with earthy gravel, cleaning drains &c.	33	30
Metalling	10	9
Repairs to bridges and drains	110	100

The rain fall at Ootacamund is 41.5 inches annually and at Reddivattam 15.7 inches per annum. The greater part of this road is exposed to the full force of the South west monsoon

transverse. This road is an admirable dry weather road, but it can never be good at all seasons unless it is metalled.

No. 5 The steeply descending and partly metalled ghaut road down to Godaloor.

This road was opened to traffic 5 years ago. It was not fully completed, and would require an expenditure of Rs 2000 per mile to finish it off. It descends by an uniform gradient of 1 in 18, averages 14 feet in width, and is fully bridged, drained and catch drained, having 9 timber bridges of spans varying from 10 up to 30 feet, and 140 dry stone drains. It has 7 zigzags. One half of the length of this ghaut is metalled with 4 inches in depth of broken stone of an inferior quality, the other half being composed of a hard binding soil. Its cost of construction was

Rs

Rs 8140 per mile, details of which are given in Appendix F. The annual traffic on this ghaut is the same as on No. 4 and its annual repair allowance is also identical and divided in a similar manner. Its small repair allowance combined with its in complete state only allow the road to be kept in fair repair. This road is exposed to the full force of the South West monsoon, and the annual rain fall upon it is as much as 200 inches.

Having thus described this trunk road in detail it will be well to add that no portion of its road surface is ever tamped or rolled, the broken metal is thrown down during rainy weather when required, that part being first well picked up with a pick axe, and we look to the traffic to consolidate it. Unless

then

the drainage is insufficient or the drains become choked and there be an overflow we never find the rains wash the loose material on the trunk road above detailed. On some of the other district roads where the gradients are steeper this does occur. Another point deserving of notice is that all the drains up to 6 feet span are built entirely of dry rubble stone, the stones being large and well bounded and the covering stones laying on each of the walls not less than 9 inches. No mortar is ever used. These drains answer admirably. My predecessor thus reported to Government in 1865 on the occasion of a violent storm of rain which had then visited these Hills. "I was very much struck on inspecting the line to find how

11
how well the dry rough stone drains did their work. In some cases these drains had upwards of 10 feet head of water on their inner sides which was discharged without the slightest injury to the drains."

The geological formation of the Kailgharris is of the primitive igneous order, the mass of the mountains being granite frequently passing into sienite. Innumerable dykes or channels of basaltic rock, hornblende, quartz and other minerals intersect the granite. Hornblende rock is also found to occur in various parts of the Hills. This rock is highly ferruginous. It intersects the granite and sienite in deep dykes which
having

12
H. Hubert
having a greater tendency to decomposition than
these rocks frequently occasion chasms in
which water lodging and wearing away the sides
causes the disruption of large masses which
are continually parting from the parent rock
especially after heavy rains. Laterite is also
found in many parts of the hills generally
in an advanced stage of decomposition. No
stratified rocks make their appearance in
any part of the District except at the little
frequented N. E. angle of the plateau. Nor
does any limestone exist anywhere on these
hills in any form or shape. The road metal
is obtained from the granite, sienite, horn-
blende and laterite. The granite and sienite
if broken small enough to pass every way
through a one and a quarter inch ring form
a

a hard and durable road surface for heavy
traffic, but they take time to consolidate.
They are difficult to break and the rock has
generally to be blasted with powder for the purpose.
Marsden's stone breaking machines
(of which 2 have lately been imported into
this District) are very useful in breaking up
these hard tough rocks. Each machine is
worked by 4 pairs of bullocks, weighs nearly
2 Tons occupies a space of 2500 or 3000 square
feet and breaks the metal at a cost of from
1½ to 2½ Rupees per cubic yard, turning out
12 cubic yards per diem. The same metal
broken by hand costs from Rupees 3 to 4
per cubic yard. When broken by coolies it
is almost impossible to ensure the metal
being

of uniform hardness and size. The Machine travels on wheels and can be dragged from one place to another by a pair of bullocks. It costs Rs 1200 delivered in the District. It is called Blake's Patent Stone breaker and is manufactured by H. R. Marsden, who is a Foundry, Leeds. The following table shows the sizes of the Machines, the product per hour of each size of road metal from hard rock when run with a speed of 250 revolutions per minute - the power required to perform this duty, the whole weight of each sized Machine and the weight of the heaviest piece when separated for transportation.

Size of stone admitted	Product of broken stone per hour	Power required to obtain given quantity	Total weight of Machine	Weight of frame at wheels	Price of wheels at Leeds
inches	cubic yards	H.P.	Cwt.	Qts.	Rs. to £
6 x 4 —	1½	2	36.0.0	18.0.0	80
10 x 7 —	3	4	78.0.0	37.0.0	147
15 x 7 —	4½	6	120.0.0	54.0.0	190
15 x 9 —	—	—	130.0.0	66.0.0	—
20 x 9 —	6	8	156.0.0	74.0.0	255
24 x 12 —	8	10	220.0.0	110.0.0	370

The Machines may be driven by any power less than that given in the table, yielding a product per hour smaller in proportion.

The Hornblende forms a very good road coating for moderate traffic. It is obtained without blasting, is readily broken and binds together quickly. The Lignite is only suited for light carriage traffic, and should only be used on those parts of the road where the drainage is good and the soil dry. Moisture tends to disintegrate it. It differs much in quality and hardens very much.

mined by being dug up and exposed to the weather for a year before it is broken and laid on the road. It is generally found in reefs and the stone has usually to be carted from the quarries.

The cost of these 3 descriptions of rock is generally as follows:-

	Granite and Siennite	Horn-blende	Laticite
Cost per cubic yard broken into road metal to pass through a $1\frac{1}{4}$ ", $1\frac{1}{2}$ " or 2" ring and stacked near road side, stone being found pretty close to the road.	2.40	1.40	1.00
Cost per cubic yard broken into road metal to pass through $1\frac{1}{4}$ ", $1\frac{1}{2}$ " or 2" ring and stacked near road side, stone being found pretty close to the road including the blasting of the rock.	3.00	2.00	1.50
Cost per 100 square yards of spreading metal over road to a depth of 2 inches or nearly annas three per cubic yard.	Rupur. 1.00.0		

On the above data the cost per mile of laying on

* The European Prisoners break this stone at the Olatacammund tail and it is delivered to us there at Rs 3 per cubic yard including the blasting of the rock.

14
a road, granite metal 6 inches thick and 14" wide without rolling &c would be from Rupur 3337 to Rupur 6075. With the exception of the Olatacammund station roads none of the metal in this District is carted. The stone is generally found near enough to the road side not to require carting. The carting of granite and laticite costs from annas 12 to 14 per cubic yard conveyed upto one mile and Rupur 1 to $1\frac{1}{4}$ per cubic yard conveyed upto 2 miles including the loading and unloading of the cart. It depends on state of road over which the metal is conveyed and whether the carts can or cannot go right upto where the metal is broken or quarried. The distance from which the metal may be carted does not make so great a difference as might at first sight be supposed. The loading of the cart takes a long time and is done by the cartmen themselves. If the distance is short the number of trips is not

8. The following Table of work exacted from the work people and others on the different parts of the above trunk road will probably of Service.

Breaking granite or diorite
already blasted. 1 man in
5 being allowed for sledge
hammering the large blocks $\frac{5}{27}$ $\frac{1}{6}$ $\frac{1}{6}$ $\frac{1}{6}$

Breaking Hornblende picked
up and collected. 1 man in
5 being allowed for sledge
hammering the large stones $\frac{8}{27}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{3}$

Breaking up laterite into
road metal after being dug
out of the earth. —————

Digging up the Limestones only
out of the quarry

one cooly one cooly one cooly one cooly
will collect will collect will collect will collect
and stack and stack and stack and stack
per diem per diem per diem per diem
10 of Feb yd 10 of Feb yd 10 of Feb yd 10 of Feb yd

Rough Rubble stone not blasted brought to site and stacked	2 1 1/2 1/2	2 1 1/2 1/2	2 1 1/2 1/2	2 1 1/2 1/2
--	-------------------	-------------------	-------------------	-------------------

Boring granite or sienite with
steel pumps

One sinew One sinew One sinew One sinew
 will bore will bore will bore will bore
 per diem per diem per diem per diem
 $\frac{1}{2}$ of Run ft $\frac{1}{2}$ of Run ft $\frac{1}{2}$ of Run ft $\frac{1}{2}$ of Run ft

a. b. of your a. b. of your a. b. of your a. b. of your
 to be done by to be done by to be done by to be done by
 one man by one by one man by one man
 a. b. of your a. b. of your a. b. of your a. b. of your
 to be done by to be done by to be done by to be done by
 one man by one by one man by one man

clearing both sides of the
road and opening water
tables at intervals of yards 30 30 30 30

The accompanying General Table marked *D.* will perhaps also be of service.

With regard to the whole District the following abstract of all its Roads and the amounts allotted for their Repairs per annum, will probably be useful.

Description of Road	Total Use of Miles	Sufficient		Total	
		Repair Ratio per Mile	Annual allowance	Repair Ratio per Mile	Annual allowance
Coonoor Ghaut installed road	16	.605	9680		
Ootacamund Roads - installed with granite, broken small and rolled & well looked after	9	330	2970		
Ootacamund to Coonoor. Installed	12	275	3300		
Ootacamund Roads - installed with laterite, rolled and well looked after	7	220	1540		
Kotagharri Station Roads very steep, much wash - special allowance - installed	2½	13½	340		
Roads - chiefly uninstalled of earth but well drained - worst parts here and there. Covered with broken stone	153	110	16830		
Roads chiefly good bridle paths - 9 feet wide or very little used cart roads 12 feet wide drained, of earth	62½	55	2890		
Bridle paths. 4 or 6 feet wide - rough and - steep indifferently drained	13	27½	357½		
Total		265	37907		

The whole of the roads lumped together and divided according to their natures will be as follows

Metalled with granite or with Sienite	180 1/2
Metalled with Stoneblende	45 1/2
Metalled with Laterite	58 1/2
Barthen Roads	79
Brick Paths	118 1/2
<u>Total No of Miles</u>	<u>265</u>

The only roads in this District which are rolled are those in the Cantonment of Potaammud and it is only within the last 3 or 4 years that this has been done. These roads have been better constructed in the first instance than the District Roads and more care is taken with their annual repairs. For granited roads Rs 30 per mile are annually expended on repairs as follows—

	Per mile Rs	Percentage of whole
Metalling	210	65
Rolling	50	15
Cleaning sides, catch & cross drains	57	16
Cutting hedges &c	13	4
<u>Sundries</u>	<u>13</u>	<u>4</u>
	<u>330</u>	<u>100</u>

In future years as the roads become more completely covered with metal the cost of metalling will decrease while that of rolling increase.

For those roads coated with Laterite Rs 220 are annually expended per mile as follows—

	Rs per mile	Percentage of whole
Metalling	136	62
Rolling	20	9
Cleaning sides, catch & cross drains Cutting hedges &c	56	25
<u>Sundries</u>	<u>8</u>	<u>4</u>
	<u>220</u>	<u>100</u>

Large sums have also from time to time been expended in effecting improvements. Both the above kinds of road are rolled with heavy rollers each weighing from 2 to 3 tons and drawn by 2 pairs of bullocks. The granited roads require more rolling than those covered with laterite, but when once consolidated last much longer. The laterite wears and washes and requires more frequent renewal. On the whole the roads are in very good order. The metal is spread thinly and the traffic is light.

There

There is not much wear from the traffic. On some of these roads an under layer of large blocks of laterite from 6 to 12 inches thick has been laid and over the centre part of this lower layer small broken granite 2 or 3 inches thick has been spread. In this way the granite is never worked down into the under soil and is lost. Nor does the laterite the blocks of which adhere to each other ever work up through the granite to the surface. The lower soil is first sectioned and prepared for the laterite blocks. The blocks are rammed in and partly rolled, and then the granite is laid on in two or three thin layers. There is no doubt that where the granite is laid directly on the soil it often sinks into and is lost particularly where the traffic is heavy, the soil soft, or the rain falls large. In digging up old metalled roads for new drains the metal has been found at a depth of 2 feet below the road

road surface. The cross section is made to vary with the gradient, being flatter as the gradient is easier.

With regard to the labor on these roads I beg first to quote a paragraph of a letter addressed by the Commissioner of the Nilgiris to Government. He says a planter of great experience informs me that owing to the difficulty of procuring labor each acre of open land only uses at present the labor of half a cooly, that is to say an estate of 100 acres only employs a standing body of 50 coolies. The proper quantity of labor is one cooly per acre. The full complement would probably be procurable if there was a rail. These are facts indicating the accuracy of this presumption. A male cooly emigrating from the Madras Presidency to Ceylon receives on the estate in that island 22s. per month and his food costs him 15s. His savings are therefore 7s. per month.

On

On these hills he receives 7 Pipers per month, and his food costs him 4 Pipers. He saves therefore 3 Pipers or 6 shillings. A woman cooly in Ceylon receives 18s. She therefore saves 6s. A woman here gets 4 Pipers and her food costs 3 Pipers. Her savings are 1 Rs or 2s. The following tabular statement will supply further information.

Statement showing prices of food grain per on the Nilgiris and at Coimbatore.

	Rice	Rice	Cholam	Coimbatore	Salt	Wheat
Nilgiri Hills	17.42	19.76	24.57	38.22	19.05	21.62
At Coimbatore	22.26	23.36	41.43	53.43	37.38	28.07
Per Ton on Nilgiris	125.5	114.7	64.4	63.2	114.4	103.6
Per Ton at Coimbatore	100.6	96.8	54.0	41.6	65.1	77.6

The Price of labor on these Hills is as follows—

Skilled Labor			Common coolies		
Description of labor	Rate per diem	Description of labor	Rate per diem	Description of labor	Rate per diem
Maistry	1/4	Carpenter 1st class	1	Head cooly or gang	1/4
Stone cutter 1st class	1/4	Carpenter 2nd class	1/4	Cooly man	1/4
Stone cutter 2nd class	1/4	Carpenter 3rd class	1/4	Cooly woman	1/4
Bricklayer 1st class	1/4	Painter 1st class	1/4	Cooly woman	1/4
Bricklayer 2nd class	1/4	Painter 2nd class	1/4	Cooly boy	1/4
Smith 1st class	1/4	Smith 2nd class	1/4	Cooly boy	1/4

Quite one half of the labor on our Hill Roads is imported. The indigenous population which for the most part consists of Agriculturalists work fitfully and only at certain periods of the year. The demand for labor is greater than its supply. Hence as much work is not obtained out of the workmen as in more favored Districts. The climate also is often against the work, full pay having to be sometimes given for part of a day's labor. I append a Statement of our District work Rates which may be of service. vide Appendix E.

In conclusion it may be stated generally that the roads in this District are with few exceptions not of that first rate class which more populous countries with a large traffic enjoy, nor are they attempted to be kept up in really first rate order. But they suffice for the wants of the people. Economy rather

6 rather than efficiency has been studied.
h The making of new roads has been pushed
3 on with great rapidity, and the traffic has
t been too small to justify a large expenditure.
C The roads have in the first place been
made only barely to suffice for wheeled
traffic, and thus a portion of the annual
repair allowance is wasted from deficient
drainage, and other causes. It is a question
whether it would not have been better to spend
the same amount of money on a more
restricted number of roads and thus have
obtained a fewer number of miles of a more
perfect character. For the cost of the annual
upkeep of roads is very materially enhan-
ced by bad gradients, imperfect drainage,
irregular widths, tortuousness, and generally
poor construction.

I have the honor to be
Your most obedient servant
J. Morant. Captain &c
District Engineer, Nilgiris

Ex-16-9-75 Oct 20 1875
 12. Sub-13 1875

No 457 B.

457B

for a comparison between
 the roads on the Nilgiris
 and those in Mysore

For much information

Enclosure. 7

Subd 20th
 Dec 22 1875

No 207

16. 29. 11. 20-3-75

to Genl D. W. S.

of the Madras Government
 P. W. 1875-80
 No 5071

Statement showing the average cost per mile of roads in the Nilgiris, Malabar & Mysore

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
District	Name of road	Cost of work, materials, & cartage	Cost of land	Cost of water	Cost of bridges and drains	Cost of metalling	Cost of graveling	Cost of felling & clearing	Cost of drainage	Cost of fencing	Cost of other works	Cost of maintenance	Cost of repair	Cost of other
Coorg	Coorg - Ghant	Rs 11077	Rs 5504	Rs 3443	Rs 533									
	Aracaman to Keddur	Rs 447	Rs 88	Rs 888										
	Keddur to Keddur	Rs 888	Rs 404	Rs 538										
	Coorg to Mysore	Rs 1100												
	Coorg to Coorg	Rs 1273												
	Coorg to Coorg	Rs 1345												
	Coorg to Coorg	Rs 530												
	Coorg to Coorg													
	Coorg to Coorg													
	Coorg to Coorg													
Malabar	Malabar - Ghant	Rs 1100												
	Malabar - Ghant	Rs 1100												
Mysore	Mysore - Ghant	Rs 1100												
	Mysore - Ghant	Rs 1100												

or Metalling. Under allowance stated to be insufficient
 This road is incomplete and would require Rs 2000 per mile additional
 * Exclusive of Metalling
 + Stated by Captain Selous to be the average cost of a 14' road and line of bridges

Statements showing the cost of maintenance of certain roads in the Adirondack and Malone Counties compared with that current in Cayuse.

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CONFIDENTIAL

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 八、
 九、
 十、

Statement showing the cost of main lines of certain roads in the Adirondack and Malone Counties compared with that current in Cayuse.

District	Name of Road.	Metalling	General Repairs	Blacking	Building	Repairs	Land	Gravel	Gravel
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Coimbatore	Coimbatore - Coimbatore.	-	-	-	-	-	-	-	-
Coimbatore	Coimbatore - Coimbatore.	242	247	39	26	8	13	3005	9024
Coimbatore	Coimbatore - Coimbatore.	187	62	7	-	8	11	245	6386
Coimbatore	Coimbatore - Coimbatore.	478	67	-	-	10	-	110	1000
Coimbatore	Coimbatore - Coimbatore.	30	64	-	-	10	-	110	1000
Coimbatore	Coimbatore - Coimbatore.	152	60	16	-	-	20	248	3600
Coimbatore	Coimbatore - Coimbatore.	220	82	-	-	28	-	330	4800
Coimbatore	Coimbatore - Coimbatore.	37	13	-	-	8	-	55	4200
Coimbatore	Coimbatore - Coimbatore.	-	50	-	-	5	-	53	7200
Coimbatore	Coimbatore - Coimbatore.	1500	400	-	-	-	-	2000	-
Coimbatore	Coimbatore - Coimbatore.	-	-	-	-	-	-	1100	-
Coimbatore	Coimbatore - Coimbatore.	-	-	-	-	-	-	820	-
Coimbatore	Coimbatore - Coimbatore.	-	-	-	-	-	-	98	-

* This outlay is insufficient and ought to be increased to Rs. 2500.
 Only one fourth of the length is metalled.
 Only one half of this road is metalled.
 And half this will suffice when the road has been fully metalled.

The metalled roads in Malabar are stated to require a general repair every four years in addition, so that probably the annual charge under each head should be doubled.

1900

Appendix B

21

Expenditure in constructing the Road from Ootacamund to Addi-vattum

Quantity	Particulars	Rate	Per amount	Total
144,122	Subyards 1 st & 2 nd class cart tracks / .. 8 yds 18015 4 "			
70,621	— 3 rd & 4 th class — 1 .. 6 .. 11,770 2 8			
24,422	— 1 st class filling — " 2 .. Sub 3052 0 "			
5080	— 1 st class blasting & removing rocks } 2 .. " 10160 ..			
14	Miles Check Channel 150 .. mile 2000 ..		45098 2 8	2147 8 "

1375	Subyards Reclamation of Canapeto 1 .. 8 yds 1375 ..		1375 ..	65 8 "
------	---	--	---------	--------

1	Timber bridge 36' span — 715 .. each 1715 ..			
2	— 1 st — 20' — 1 st — 430 .. 1 st 3260 ..			
4	— 1 st — 15' — 1 st — 725 .. 1 st 2900 ..			
4	— 1 st — 12' — 1 st — 575 .. 1 st 2300 ..			
1	— 1 st — 8' — 1 st — 385 .. 1 st 385 ..			
161	Rough stone drain 1 st class 50 .. 1 st 8150 ..			
2	— 1 st — 2 nd — 1 st — 25 .. 1 st 50 ..			

		18660 ..	888 8 "
Sundries		1628 13 4	77 8 "

Total length 21 Miles Grand Total Rs 67,762 13 4 = 3179 ..

Distt Engineer's Office
Ootacamund
20th July 1875

J. S. Morant Captain
District Engineer

Appendix C.

Expenditure in constructing the Road from Kaddiattun to Goodaloor

Quantity	Particulars	Rate Per	Amount Total
38183	Cubic yards earthwork 1 st class	4.00	152732.00
31881	— 2 nd — 2 nd — 2 nd — 2 nd	5.00	159405.00
45873	— 3 rd — 3 rd — 3 rd — 3 rd	6.00	275238.00
17515	— 4 th — 4 th — 4 th — 4 th	8.00	140120.00
9526	— 5 th — 5 th filling & raising embankments	4.60	43819.60
4796	— 6 th — 6 th blasting & removing rocks	3.00	14388.00
7	Miles check channel	150.00	1050.00
10 1/2	— 7 th — 7 th levelling the road	300.00	3150.00
			66485.10
3098	Cubic yards structure	1.50	4647.00
4	— 8 th — 8 th — 8 th — 8 th	5.00	20.00
1	Timber bridge 20' span	800.00	800.00
2	— 9 th — 9 th — 9 th — 9 th	400.00	800.00
146	Rough stone drains	30.00	4380.00
4	— 10 th — 10 th — 10 th — 10 th	100.00	400.00
			6380.00
	Sundries		3887.60
	Total length 10 miles		81400.00
			8140.00

W. B. Engineer's Office
 Ootacamund
 20th July 1875

J. S. Morant Captain R.E.
 District Engineer

26/10/97

Appendix. D

Description of Work	One Brick layer with filling of mortar solid.	Sides of foot requires men	Description of work	Quantity of work	Description of work
Brick and mud with 2 feet thick with Common Dagon Bricks	500	15	Plastering Common Road work 1 yard out of solid bank. 4 feet high, completing work fully smooth	8	Road widening, easy soil in good weather. 3 yards out of the solid.
Brick and mud walls 2 feet thick with good stable bricks	400	2	Plastering 2 inch Road work 1 yard out thick, good quality of soil, bank 1 1/2 feet high completing work to full and smoothing	15	Road widening, easy soil, in good weather. including distance 30 yards
Brick and mortar 1 1/2 feet thick with Common Dagon Bricks	400	4	Plastering one inch Road work 1 yard with hydraulic mortar out of solid bank 1 foot high, the one photo completing work fully	6	Road widening, easy soil, in good weather including distance 50 yards.
Brick and mortar walls 1 1/2 feet thick with good stable bricks	350	5	Plastering 3 inch thick Road work, 1 yard out of solid, bank 1 1/2 feet high fairly polished with completing work fully thorough photo	10	Digging foundations for buildings in average soil.
Plastering brick on edges with common Dagon Bricks	600	6	Plastering 3 inch Catech drains 2' x 2' in thick, very wet soil wet weather and easy ed with shell lime soil including cleaning roots & mounds to roots.	9	Digging foundations for buildings in average soil including distance 30 yards.
	2	4	Common whitewash. Catech drains 2' x 2' in ing. one foot in dry weather and hard soil.	6	Digging foundations for under average, common targets.

16. m. 1. 71

Description of Work	Qty. or Part	Square feet or quantity required	Description of Work
Metal for Roads	Public yard 5 1/2	1/2 of new	Painting with mortar Common Ordinary
Bricks	Amenity 200	As per new 3	Painting with mortar
Plaster Ligne	Public yard 6 6	As per new 4	Painting with mortar
Sand	Public yard 5 1/2	As per new 4	Painting with mortar
Broken Bricks	Public yard 7 1/4	As per new 24	Painting with mortar
In wood	Public yard 11 1/2	As per new 4	Painting with mortar

with this office
at July 1875

John Morant
Captain Rtd
District Engineer

Statement showing the average cost of construction and maintenance of roads and rates of labor and road material

Names of Roads

Average cost of construction of roads per mile	Average cost of maintaining roads per mile per annum										Cost of Daily rate of hire for skilled labor									
	Earth work i.e. Raveling, leveling, and embankment	Revetment Bridges	cutting and filling	Gravel and sand	cutting and filling	Gravel and sand	cutting and filling	Gravel and sand	cutting and filling	Gravel and sand	General repairs i.e. Metal Bridges, drains, etc.	Repairs to drains	Blasting and removal of rock	Superstructure	Cost of labor	Carpen	Stone	Brick	Masons	cutters
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

1. Road from Calicut to Mysore
Frontier via Tumhacherry

Calicut 27 miles	800	"	1100	2640	"	120	200	100	880	4640	60	152	"	16	20	248	3	6	8	10	6	10	10
Do do portion gravelled	800	"	1100	"	1320	120	200	100	"		"	"	"	16	20	248	3	12	16	14	12	12	1

2. Road from Cannanore to Coorg
Frontier 35 miles

Coorg 35 miles	1098	"	1500	2640	"	120	100	75	880	5313	82	220	28	"	"	330	34	4	4	8	5	6	8
Do do portion gravelled	1098	"	1500	"	1320	120	100	75	"		"	"	"	"	"	330	34	16	12	12	10	1	1

3. Road from Panditand via Wandoor to Chempoye
14 miles

Chempoye 14 miles	556	"	400	"	115	115	57	33	1276	13	87	5	"	"	55	3	8	6	4	6	6	8
																		8	12	12	12	1

4. Road from 10 mile of Tumhacherry road to Tumhacherry 11 miles

Tumhacherry 11 miles	430	537	57	75	25	1124	13	37	5	55	3	$\frac{7}{12}$	$\frac{8}{12}$	$\frac{10}{14}$	$\frac{6}{12}$	$\frac{10}{12}$	$\frac{10}{16}$
												12	1	14	12	12	1

Malabar District Engineer's Office,
Calicut 4th September 1895

Recd. by return to Calicut

In a letter from
the Dy. District
Engineer Malabar
to the Under Secy.
Secretary to Govt.
D. D. Madras.

No 86 dated 4
September 1876

Statement showing
the average cost
of construction
of main roads in the
Malabar Dis-
-trict.

Description of work	Quantity	Unit	Remarks
One part square feet	100		Requisite
Public yard	5	12	Painting with mortar
Metals for Roads	1 1/2		Common: Ordinary
Bricks	200		Painting with mortar
Slaked Lime	5	6	Painting with mortar
Sand	5	12	Painting with mortar
Broken Bricks	7	4	Painting with mortar
Firewood	750	1000	Painting with mortar

Dist. Officer
 Captain 1875

John Warrant
 Captain 1875
 District Engineer

Flat tiles for roofing 5" x 5" x 1/2",
 average weight of every 10 tiles, 1000

Pan tiles 1 1/2" quality, found, well
 burnt, very when struck, about
 10 lbs. or 12 lbs. weight, average weight 1000
 of every 10 tiles 12 1/2 lbs.

Pan tiles 2 1/2" quality, made of
 porous clay and not so good as above,
 not used if the first can be got,
 average weight of every 10 tiles 11 1/2 lbs 1000

Rough stone quarried and stacked,
 granite or breccia, not less than 10 ft
 and not exceeding 2 cft.

6-10-10 3-8-10 Camidge in addition

8-10-10 3-8-10 Camidge in addition

6-10-10 3-8-10 Camidge in addition

10 1/2 17 1/2 18 1/2

to be delivered

Flat-tiles for roofing $5 \times 5 \times \frac{1}{2}$,
average weight of every 10 tiles,
 $82\frac{2}{3}$ lbs.

Can tiles 1st quality, sound, well
burnt, very when stuck, about
little or no moisture, average size for
Germany 10" tiles 12 1/2" tiles

Can take 2 ^{and}/₂ " quality, made of
poor clay and not so good as above,
not used if the first can be got,
average weight pereny 10 lbs 11 ¹/₂ lbs

Rough stone, quarried and stacked
 Paved a granite & hot-lyls than 10 ft
 and not exceeding 2 cft. C. 422

Stone hammer chipped (roughly squared) granite a decade, the stone so very hard and difficult to work!

Stone Grants or Granite, Squared
and Chopped to size, labor only

Latipis cut into blacker stones
roughly squared, not less than
1 cft. each

Flaming Stones 12" x 12", wt. less than
6 inches thick, fair defect on
face and sides

three slabs, rough split, they
average 2 cft each, size 6 x 12 x 3

10

1

[illegible]

1

1

100

100

This image shows a blank white page. At the very bottom, there is a dark, irregular horizontal band that appears to be a scan artifact or the edge of the paper. The rest of the page is completely empty and white.

100

100

1000 6-1-10 3-8-11 Receipt in addition

8-11-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-104

[Faint handwritten notes, possibly "L. 10-11"]

~~no~~ ~~6-0-0-0~~ 38- Carriage in addition

100

C. 92 182 182

100 Apr 15 1891

hot-ward

100 times 30 --- 30 --- not used by this department in the 5th, but Private Persons sometimes employ it -

The stone is chiefly found at Connor, where it is cheaper than at Potomac, Brookfield place
from \$7 to 65 or 68 it is carted

The stone plates are laid to 1 ft. on 11 ft.

no off-100---100---cost-1 paper the off-1, used almost solely
for 18 years for 1822-Deimos---in 1906, last known visit

[illegible]

Completed Jan Bygote 7x2'-3", thickness 5'-4" - 5'-4" -
2 packages 20' in length 21 the pin block sheet 4'-8" - 4'-8" -

Comparted Jan Shute 8 x 2-3, thickness
12, length 20, weighing 22 1/2 lbs. from
shute by

Sheet 5-4-5-

Continuous Steel Bars 2 1/4" dia,
thickness 2 1/8" to 1", weighing
11 lb the running ft.

1881-1882-1883-1884-1885-1886-1887-1888-1889-1890-1891-1892-1893-1894-1895-1896-1897-1898-1899-1900-1901-1902-1903-1904-1905-1906-1907-1908-1909-1910-1911-1912-1913-1914-1915-1916-1917-1918-1919-1920-1921-1922-1923-1924-1925-1926-1927-1928-1929-1930-1931-1932-1933-1934-1935-1936-1937-1938-1939-1940-1941-1942-1943-1944-1945-1946-1947-1948-1949-1950-1951-1952-1953-1954-1955-1956-1957-1958-1959-1960-1961-1962-1963-1964-1965-1966-1967-1968-1969-1970-1971-1972-1973-1974-1975-1976-1977-1978-1979-1980-1981-1982-1983-1984-1985-1986-1987-1988-1989-1990-1991-1992-1993-1994-1995-1996-1997-1998-1999-2000-2001-2002-2003-2004-2005-2006-2007-2008-2009-2010-2011-2012-2013-2014-2015-2016-2017-2018-2019-2020-2021-2022-2023-2024-2025-2026-2027-2028-2029-2030-2031-2032-2033-2034-2035-2036-2037-2038-2039-2040-2041-2042-2043-2044-2045-2046-2047-2048-2049-2050-2051-2052-2053-2054-2055-2056-2057-2058-2059-2060-2061-2062-2063-2064-2065-2066-2067-2068-2069-2070-2071-2072-2073-2074-2075-2076-2077-2078-2079-2080-2081-2082-2083-2084-2085-2086-2087-2088-2089-2090-2091-2092-2093-2094-2095-2096-2097-2098-2099-2100-2101-2102-2103-2104-2105-2106-2107-2108-2109-2110-2111-2112-2113-2114-2115-2116-2117-2118-2119-2120-2121-2122-2123-2124-2125-2126-2127-2128-2129-2130-2131-2132-2133-2134-2135-2136-2137-2138-2139-2140-2141-2142-2143-2144-2145-2146-2147-2148-2149-2150-2151-2152-2153-2154-2155-2156-2157-2158-2159-2160-2161-2162-2163-2164-2165-2166-2167-2168-2169-2170-2171-2172-2173-2174-2175-2176-2177-2178-2179-2180-2181-2182-2183-2184-2185-2186-2187-2188-2189-2190-2191-2192-2193-2194-2195-2196-2197-2198-2199-2200-2201-2202-2203-2204-2205-2206-2207-2208-2209-2210-2211-2212-2213-2214-2215-2216-2217-2218-2219-2220-2221-2222-2223-2224-2225-2226-2227-2228-2229-2230-2231-2232-2233-2234-2235-2236-2237-2238-2239-2240-2241-2242-2243-2244-2245-2246-2247-2248-2249-2250-2251-2252-2253-2254-2255-2256-2257-2258-2259-2260-2261-2262-2263-2264-2265-2266-2267-2268-2269-2270-2271-2272-2273-2274-2275-2276-2277-2278-2279-2280-2281-2282-2283-2284-2285-2286-2287-2288-2289-2290-2291-2292-2293-2294-2295-2296-2297-2298-2299-2300-2301-2302-2303-2304-2305-2306-2307-2308-2309-2310-2311-2312-2313-2314-2315-2316-2317-2318-2319-2320-2321-2322-2323-2324-2325-2326-2327-2328-2329-2330-2331-2332-2333-2334-2335-2336-2337-2338-2339-2340-2341-2342-2343-2344-2345-2346-2347-2348-2349-2350-2351-2352-2353-2354-2355-2356-2357-2358-2359-2360-2361-2362-2363-2364-2365-2366-2367-2368-2369-2370-2371-2372-2373-2374-2375-2376-2377-2378-2379-2380-2381-2382-2383-2384-2385-2386-2387-2388-2389-2390-2391-2392-2393-2394-2395-2396-2397-2398-2399-2400-2401-2402-2403-2404-2405-2406-2407-2408-2409-2410-2411-2412-2413-2414-2415-2416-2417-2418-2419-2420-2421-2422-2423-2424-2425-2426-2427-2428-2429-2430-2431-2432-2433-2434-2435-2436-2437-2438-2439-2440-2441-2442-2443-2444-2445-2446-2447-2448-2449-2450-2451-2452-2453-2454-2455-2456-2457-2458-2459-2460-2461-2462-2463-2464-2465-2466-2467-2468-2469-2470-2471-2472-2473-2474-2475-2476-2477-2478-2479-2480-2481-2482-2483-2484-2485-2486-2487-2488-2489-2490-2491-2492-2493-2494-2495-2496-2497-2498-2499-2500-2501-2502-2503-2504-2505-2506-2507-2508-2509-2510-2511-2512-2513-2514-2515-2516-2517-2518-2519-2520-2521-2522-2523-2524-2525-2526-2527-2528-2529-2530-2531-2532-2533-2534-2535-2536-2537-2538-2539-2540-2541-2542-2543-2544-2545-2546-2547-2548-2549-2550-2551-2552-2553-2554-2555-2556-2557-2558-2559-2560-2561-2562-2563-2564-2565-2566-2567-2568-2569-2570-2571-2572-2573-2574-2575-2576-2577-2578-2579-2580-2581-2582-2583-2584-2585-2586-2587-2588-2589-2590-2591-2592-2593-2594-2595-2596-2597-2598-2599-2600-2601-2602-2603-2604-2605-2606-2607-2608-2609-2610-2611-2612-2613-2614-2615-2616-2617-2618-2619-2620-2621-2622-2623-2624-2625-2626-2627-2628-2629-2630-2631-2632-2633-2634-2635-2636-2637-2638-2639-2640-2641-2642-2643-2644-2645-2646-2647-2648-2649-2650-2651-2652-2653-2654-2655-2656-2657-2658-2659-2660-2661-2662-2663-2664-2665-2666-2667-2668-2669-2670-2671-2672-2673-2674-2675-2676-2677-2678-2679-2680-2681-2682-2683-2684-2685-2686-2687-2688-2689-2690-2691-2692-2693-2694-2695-2696-2697-2698-2699

Hand made a dense one,
broken small enough to pass every
way through a 1¹/₄ "net", without
blasting, & packed them as and where

C. 42
2-8-2-8-

Had found a double line, broken well
enough to go every way through a
 $1\frac{1}{4}$ " knot, including knotting.
Stacked now on side

C. M.

The Canton Pioneer at Westborough breakfasts up
for \$1.3 per copy at the full including mailing

Boards 2 $\frac{1}{2}$ class 10 to 12 ft. long
 average painted 3 to 4 inches 100 50-- 50--

Boards 3 $\frac{1}{2}$ class 10 to 12 ft. long
 average painted 3 to 4 inches 100 30-- 30--

Boards 4 stacked 3 ft. with
 4 feet long each 4 to 6 in 4 to 6 in

Couple 13 in long, straight
 the 3-5-3-8-

Couple steel bar for pump and
 chisel, cast steel drill have
 from 1 $\frac{1}{8}$ to 1 $\frac{1}{4}$ in diameter the 8-8-8-

Compared 8 in steel 6 x 2-3
 the 20, weighing 20 the 20 the 20
 the 20 the 20 the 20 the 20 the 20

Compared 8 in steel 7 x 2-3, the 20
 a couple 20, weighing 21 the 20 the 20
 the 20 the 20 the 20 the 20 the 20

Compared 8 in steel 8 x 2-3, the 20
 a couple 20, weighing 22 the 20 the 20
 the 20 the 20 the 20 the 20 the 20

Compared 8 in steel 9 x 2-3, the 20
 the 20 a couple 20, weighing 23 the 20
 the 20 the 20 the 20 the 20 the 20

Hand made a device there,
 broken small enough to pass every
 way through a 1 $\frac{1}{4}$ in, without
 blocking, stacked them on side C. 2-2-2-2-2-2-

Hand made a device there,
 broken small enough to pass every
 way through a 1 $\frac{1}{4}$ in, without
 blocking, stacked them on side C. 2-2-2-2-2-2-

The Canyon Prison at Ocala was built up
 for the 3 in C. 2-2-2-2-2-2-2-2-2-2-

Some of the 3 in C. 2-2-2-2-2-2-2-2-2-2-

Some fine broken small, delivered at place, 1/2 to particular size.

These stones are brought from the low country about 10 miles from the port of the plant

Some burnt and delivered, some stacked, delivered at building site, some which is not subsequently back, delivered

C. 47 25-8-25-8-

Some burnt and delivered already stacked, fresh clean lime, well burnt

C. 47 13-4-13-4-

Five bags, cut and stacked, obtained from the old trees, to be used, average size 8 ft long

C. 47 2-8-2-8-

Five were cut and stacked, obtained from the old trees, average size 8 ft long

C. 47 2-4-2-4-

Some clean, sharp and delivered at the work site, washed in river before brought

C. 47 3-0-3-0-

Some were full of holes and cracks in top, but well returned

C. 47 2-0-2-0- Caviage in addition

Some were down with some things C. 47 3-8-3-8- Caviage in addition

Some were rough and pitted C. 47 4-0-4-0- Caviage extra

Some were in the rough, averaging 20 ft in the top, insufficiently seasoned C. 47 1-8-1-8- Below used

Bamboo 1st class 25 to 30 ft long average diameter 3 to 4 inches 100 75-75-

First class 13rick with table
huddled 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with

1170ft 45750 45750

First class 13rick with table
huddled 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with

1170ft 45750 45750

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1170ft 45750 45750

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1170ft 45750 45750

First class 13rick with table
huddled 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with
chase 13icks at in basket, with

1170ft 45750 45750

Plating with best white shell
lime, 13 cents and, for a half, two
under each, 10 of lime for 1 of sand
by measure, 14 for each of 1 lime

Take the stone broken small

enough to hold through a winter and
thickened at evening with a soft
frost.

15 x 15
 Put out of burning
 outside the big
 you large lamp at burning

C. 47-1-2--1-2--
10-10-10

Preserving, volumes of Binding the 1000th 1000th 1000th

Concrete configuration 19 1/2 in. to 3 ft broken brick bats well rammed in 3 inch layers

mod 32-... 32-...
54-... 54-...

Public in Boston, there not less
than 12,000, Boston 19 June to 2
of each, 13 and 14 of each at entry,
6000, 13 and 14 of each at entry,
6000, 13 and 14 of each at entry,

The Granite in this district is generally so hard and breaks into such awkward shaped stones that a great deal of work has to be consumed in filling up irregularities; the work is expensive and hardly ever gives

Feasible, dry in measurement, with
stones not less than 3 cft. with br
stones not less than 4 ft. in diameter. Stone
delivered in 1873.

100ft 5m-5m-

First class Buckram with my
machine shoulded 30000 lbs in two
English bond, broken 17 June 1891
bond by measure.

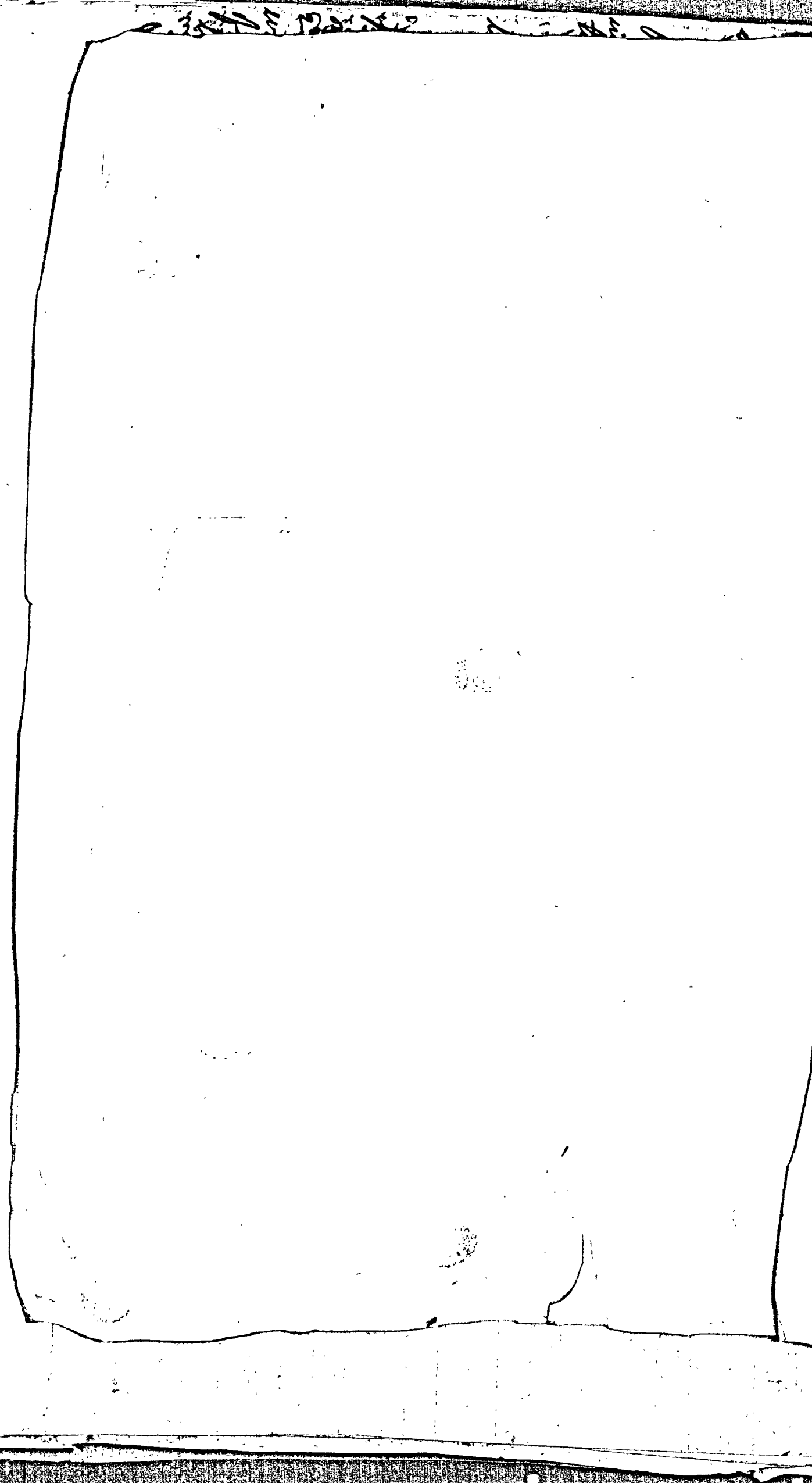
2000 1000 1000

First - Claps bricks with table
knights bricks set in mortar, with
lime & sand joints, up to 20 ft. in
English bond, mortar 1/2 stone &
1/2 sand by measure

1000000 40 745 40 745

Twit-claps Knickknack, with to
huddled backs set in button
ground stone, dulcet land's har-
monies to a soft band by him-

[illegible]



Just clay bricks with table
huddled bricks set in mud in
open fields and fields

Brickwork; burnt bricks table
huddled in clay, English mud,
clay carefully selected

100 cft 10 x 12 10 x 12 in 10 x 12 in
100 cft 45- 45- 45- 45- 45- 45- 45- 45- 45- 45-
100 cft 24- 24- 24- 24- 24- 24- 24- 24- 24- 24-
100 cft 35- 35- 35- 35- 35- 35- 35- 35- 35- 35-

the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the
the bricks are made in the

Flaming with granite paving stones
laid in concrete and mostly joints
stone mosaic in tile, 12" square;
concrete 4" thick laid in 2 layers and
compacted 4" 1st time to 2" of the
brick laid; stone laid before on
sand and tiles

100 cft 100- 100- 100- 100- 100- 100- 100- 100- 100- 100-
100 cft 15- 15- 15- 15- 15- 15- 15- 15- 15- 15-

Flaming with paving bricks 12 x 12
x 1 3/4 laid in concrete 2" thick on

limestone with 1" concrete compacted
1" 1/2 of stone to 2" of brick brick laid 100 cft 35- 35- 35- 35- 35- 35- 35- 35- 35- 35-

100 cft 100- 100- 100- 100- 100- 100- 100- 100- 100- 100-

Red Paint 1 coat
more ground

Red Paint 2 coats
more

Green Paint 1 coat
more

Green Paint 2 coats
more

But used oiling one coat
more

But used oiling 2 coats
more

But used oiling 3 coats
more

Painting with heavy seal tan
including brush

Greening (exclusion of burning)
Held 1st year in light and

more than 20 yds
in light drill

Greening (exclusion of burning)
1st year in light and depicting on
hand up to 2 yards high with a
lid of hot-broth 20 yards
in hard clay or shale

Greening (exclusion of burning)
Held 1st year in light and depicting on
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Greening (exclusion of burning)
Held 1st year in light and depicting on
hand up to 2 yards high with a
lid of hot-broth 20 yards
in hard clay or shale

more 1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

3-12-0 3-12-0 6th of paint, 2 bottles of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
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3-12-0 3-12-0 6th of paint, 2 bottles of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-8-0 1-8-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

3-12-0 3-12-0 6th of paint, 2 bottles of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-8-0 1-8-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

3-12-0 3-12-0 6th of paint, 2 bottles of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-14-0 1-14-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

1-8-0 1-8-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

3-12-0 3-12-0 6th of paint, 2 bottles of stain oil, 1/2 bottle of
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1-8-0 1-8-0 3rd of paint, 1 bottle of stain oil, 1/2 bottle of
suspension, 5 pints of stain oil, 1/2 bottle of

Swimming and Sinking Sticks 100 yds? 5--...5--...
 Surplus Sticks including waterway
 in 3 months " 85 to 100 Sticks. Confound I will select half 85 to 12 x 12 x 3,
 laid and named -

Swimming and Sinking Sticks when
 the Sticks can be removed with
 ease, distance where the
 obtained, not greater than
 100 yards C. 42 85 to 100

Swimming and Sinking Sticks when
 floating is required " 3-4--3-4--

Sinking Sticks 1 1/4" in diameter,
 including floating of Sticks
 100 yds " 3-4--3-4--

St. Ignace Office
 Neil Sherrin
 20th July 1875

Restaurant.
 Captain R. B.
 District Engineer

No. 266.

District Engineer's Office
Cotacambund 18 August 1875

From

The District Engineer
Philippines

S

Major A. L. Scott R.E.
Under Secretary to Govt.
P.W. Department

With reference to your
Memo No. 23^d of the 7th Inst.
I have the honor to inform
you, that ^{the} reply to the Memo.
-random therein alluded to,
was made in this office letter
No. 207, of 20th July 1875, to
your address, which I trust you
have received.

Have the honor to be
Sir
Yours most obed^t & serv^t
J. M. Morant Capt. R.E.
District Engineer.

Atokacarrind
26 May 1875

No 23
Permitted 1st
5 & July 11

The District Engineer { Malabar } is requested to be good enough to furnish a report regarding the cost of the construction & maintenance of the roads in his District which will enable a comparison to be made between the expenditure in this kind in this country & England & the results obtained in each case.

It is necessary for the purpose of such comparison that the cost of living of an able bodied coolie & the rate of hire of bullocks & carts in each District should be stated. The former in connection with the rate of wages will give an index to the physical condition of the labourer & the rate of daily hire for skilled & unskilled labour will of course establish the cost of every description of work.

A special line of road should be selected

1875 Sept
The District Engineer

to the District Engineer
to Govt. Secy.

Recd 18th Sept 1875
Recd 22 Sept 1875

Enclosure

Inform that
Happily to the
Governor
Recd 18th Sept 1875
Recd 22 Sept 1875

Can-18-9-75
Atokacarrind
26 May 1875

in which the physical conditions
 approximate more closely to
 those in the coffee districts of Ceylon
 & the amount of traffic as it should
 be given as influencing the expenditure
 on maintenance.

There should be a distinction made between
 roads impervious to the ground or metal,
 gravelled & metal roads or it would
 be impossible to fix the cost of construction
 & maintenance were given under distinct
 heads.

by order
 of the
 Chief Eng^r

Memo No. 23
 8/25th/75

By letter from Govt. No 143 A. C. 27
 25 April 75. & 1 Schedule of rates.
 sent to D. L. Kellyherries to be returned.
 26/5/75

Queen

85. Malabar. 1862.
 12th July 1862

In order to facilitate a
 comparison which it is
 desired to make between
 the cost of roads in the
 Presidency of Ceylon it is
 desirable that the outlay which
 is expended in the district highways
 should be divided if
 possible under sub heads

- It was also intended that
 a distinction should be made
 between
1. Gravelled roads
 2. Gravelled roads
 3. Metal roads

2 In the statement accompanying
 the W. L. letter the cost of con-
 struction & maintenance are

each
lumped together. And
from the heading given
of 'Roads Metalled & travelled' ^{needed}
it would seem that the two
species are combined.

It would be better if possible to
to separate them if possible
respective to each other.

3. The last heads under which
it would be most convenient
to record the cost of construction
is. ^{Part work is. {} ^{Mending up}
^{by excavation}

- 2. Repairs to parapet walls
- 3. Bridges & drains
- 4. Metalling.
- 5. Sundries, expenses also for travel

It may not be possible now to give
any information but it
is particularly important that
the cost of Metalling should
be kept distinct.

4. Under Maintenance the
expenditure should be classed

as well as the
of the road

under the sub heads of
1. General repairs i.e. { cleaning sides
slatch drains
filling ruts, opening
drains

- 2. Metalling
- 3. Repairs to bridges & drains.

The outlay for metalling is
particularly required and
it should be stated whether
that annual outlay is sufficient
to thoroughly maintain the
surface or whether at intervals
of some years
a general outlay for metal
would be required in
addition.

5. Some information ^{is desired} regarding
the nature of the stone used
& whether well or ill suited
for a road surface, is desired.
Also whether it is laid on
the earth (formation surface)
or whether a foundation
of rubble stone is ever adopted.
The degree of facility with
which road material is
obtained should be stated.
Whether close to or distant
from the road. In other respects the
information seems to be complete.

Handwritten notes in the top left corner of the left page, including "No. 293" and "24/7/13".

Handwritten notes in the middle left section of the left page.

Handwritten notes in the bottom left section of the left page.

Ch: Mr Memo
No 293 24/7/13

24/7/13

Malabar Dist. Engineer's Office
Calicut 17th July 1875

To
The Offg. District Engineer,
Malabar.

The Under Secretary to Government,
P. W. Department,
Madras.

Sir,

In obedience to the instructions conveyed in your Memo. No. 23 dated 26th May last, I have the honor to forward a Statement shewing the average cost of construction and maintenance for the two principal lines of Roads in this District, as also the cost of living of an able bodied cooly in the vicinity thereof, the rate of hire for skilled and unskilled labor and the amount of traffic on each line as near as could be ascertained.

2. It will be seen that in the first instance the cost of construction per mile of Road, Bridged, Metalled and gravelled is Rs 3000 on an average, and the cost of maintenance Rs 24 7/8 per mile. Many of the wooden Bridges on these lines are a constant source of expense in the way of upkeep, they are a mistake in a District like this where the rainfall is so heavy. I find in going over the records of this District that as much as 40 inches of rain was registered in three days at the foot of the Ghats on these lines of communication giving an average of 13 1/3 inches for three consecutive days and I may observe that

that hitherto no paint or protective agency was applied to save the timber work from such extremes as we find to exist in this District; but in any case the occasion for timber Bridges has gone by, neither should the soft laterite so abundant along this coast be used in arches, high abutments or piers without a most careful use of Cement in building and surface enamel painting afterwards, iron bridges are best suited to the climate here, they need only to be carefully painted as occasion requires.

3. The two roads selected are those on which heavy traffic is carried on in bringing down coffee from Wynnad and Coorg and the physical conditions are approximate to those in the upland districts of Ceylon. It will be seen that the traffic on the line from Calicut to Wynnad via the Tambacherry Ghaut is on an average estimated at about 36,000 carts per annum which gives a daily average of 98 and for the line from the Coorg frontier to the Coast the annual traffic in carts is estimated at 48,000 or an average daily of 131. for the present I can only say that I think this gives a near approach to the truth. I can only estimate as I have no reliable traffic returns; the Tahsildar's returns are not correct, and it does not appear that any traffic returns were ever registered in this Office. The amount of traffic by pack cattle was very great formerly, but it has declined since the opening of the roads and the

great

great improvement of the Ghauts for cart traffic, but a great deal of the salt still goes up into Wynnad and Coorg Provinces.

4. Both Roads run over very irregular ground but on the whole they have been well laid out and improved over the hilly parts so that the gradient is over all easy to the foot of the Ghauts, well drained with a good surface of not less than 18 feet in any part except at the Toll gates where the surface width is reduced to 10 feet by wretched stakes on the Road.

I found these Roads in what may be called in fact, excellent order and considerable ability is everywhere displayed in their alignment and construction with the exception of the Bridges, which in some cases are faulty as pointed out above and this defect is due to the materials which in the time of their construction had to be made use of.

I have the honor to be
Sir,

Your most obedt. Servant

J. Harris
Offg. District Engineer
Malabar

N^o 86. Matabar, Dist. Eng^rs Office 31.
Cahiers H. 4th September 1875

From
The Offg. District Engineer
Madras

To
The Under Secretary to
Government L.P.W.
Madras.

In obedience to the instructions contained in your Memo. No 293 dated 26th Ultima, I have the honor to forward a revised statement showing the average cost of construction and maintenance of roads in the Malabar District.

2. — Roads No 1 and 2. — the cost of the construction of these two roads under the several sub-heads has been furnished as near an approach as it could be possible to give, and I regret that I am unable to give this information from actuals of work done for want of records. There are no roads in this District which are metalled throughout but partly metalled and partly gravelled, about half in proportion to each other.

24th Nov. 1845 Delph.
 24th Nov. 1845 Delph.
 The Undersecretary
 to Govt. Genl. &
 Madras.
 No. 62.

Dec 17/33
Dec 17/33
E. 17/33

Departing for
the morning
the Knickerbocker
maintaining of
roads in the
about District.

4578

Ms. A. 9. 2. 11. 20-5-25
Meeting of the Q. R. M. A.
with memo No 298

3. Roads Nos 3 and 4. the cost of construction has been obtained from actuals of work done.

4. The annual maintenance allowance for the roads is not found adequate for properly maintaining them, as after intervals of 3 or 4 years an outlay for metalling and gravelling and for general improvements such as rebuilding tunnels and platform bridges and widening the road in places is necessary.

5. The stone generally used for metalling is granite and sienite, is well suited for the purpose here and wears well.

6. Road materials are in some places obtained with great facility being quite close to the road and in others they have to be brought from a distance of one to 2 miles. No good gravel can be found from the 18th mile of the Tambora Road to the foot of the plant and no good gravel can be had on the road from Cammermore to the Coorg frontier from the 27th mile to the foot of the plant. This road passes over very uneven ground but it has been improved from time to

time and continued round the hills till the gradient is made easy over the whole line and it is plain that great zeal and ability has been displayed on the work in various ways. The Tam. hercherry road is similar. The cost of plant work on both roads is excluded but it was very heavy and admirably executed. It must have been costly but I regret that I am unable to state the cost thereof. The wooden bridges on all Rivers of road are a mistake as also laterite masonry the occasion for wooden Bridges has gone by both the roads to the frontier are exceedingly feverish during a great part of the best working season and are shunned by all classes of work people, on the whole these roads with the exception of the bridges are in good order throughout the year. 330 Rs. a mile would be a sufficient maintenance allowance over the worst portion when properly made and bridged and Rs 220 is sufficient over the good sound laterite soil.

I would here give an estimate for the construction of roads at the present time including iron

3. Bridges with granite and Bricks
 - c. culverts
 paving with boulders 1 foot thick — Rs 1760
 4. metalling with broken stone
 8 inches thick — 2640
 gravel blind 6" — do. — 1320
 as 5720
 for Earthwork & Catch drain in
 clearing jungle — 1760
 Bridges and Drains — 100
 Compensation for land
 taken up — 2500
 5. Blasting rock — 275
 400
 70755
 @ 5 per cent — 557
 6. Total estimated cost for con-
 structing one mile of road
 at the present time — 11292

I have the honor to be
 Sir
 Your most obedient servant
 D. P. S. S. S.
 Off Dist. Engr Malabar

From 1895 Sept. 11
 The District Engineer
 Malabar
 To The Under Secretary
 to Govt. S. P. W.
 Madras
 No: 5916
 dated 4th September 1895
 Recd. 8.3
 N: 86
 Encls. 1

Forwarding a revised
 statement showing
 the average cost of
 construction and
 maintenance of
 roads in the
 Malabar District

No: 457 B
 Cir. 16.9.75 Pld. 20.9.75
 Recd. 25.9.75 R 18-9-75

S. B. 27/11/23-75

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 - c. culverts
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 8 inches thick — 2640
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 Recd. 25.9.75 R 18-9-75

S. B. 27/11/23-75

35
74
Memorandum
There has been
considerable delay in
obtaining the particulars
regarding the expenses
of road construction and
maintenance in this
Presidency which are
required by the letter
from the Govt of India
marginally noted but
it was considered that
unless specific details
were furnished which
would enable a direct
comparison to be made
with

N^o 143 A^m 20th April 1875.

Off Dist. Engr Malabar

with similar items
of expenditure in Ceylon,
the purpose of the re-
quisition would not
be attained and it
has been necessary to
refer to the Districts
more than once in order
to obtain the most com-
plete information.

2. Reports have now
been furnished from
Malabar and the
Nilgheries, two Districts
in which the conditions
under which roads are
constructed and main-
tained approximate
most closely to those
in Ceylon.

The

3. The District Engineer Nilgheries has given very clear and complete information of the kind required in reference to the main road from Mettupalayam to Gudalore via Brown and Ootacamund as well as the District roads generally and as his rates and estimates are based on records of actual work done they may apparently be fully relied on. The District Engineer Malabar has given details of the cost of construction

3. Construction and main-
tenance of four roads
aggregating 80 miles
in length viz, from
Calicut to the Mysore
frontier 24 miles from
Cananore to the Coorg
frontier 35 miles.
from Pandikhead to
Cherupogga 14 miles.
from the 10th mile on
the Gambercherry road
to Sirivembady 10 miles.

The particulars
regarding the two first
as regards total cost,
both of Maintenance
and construction are
apparently derived
from

76 37
from records such as
estimates but the dis-
tribution of the outlay
under the ^{several} sub heads has
been suggested by general
experience more than
from information derived
from accounts. All
the details given of the
two roads last mention-
ed are it is assumed
gleaned from the books
expenditure.

The roads above
referred to are of various
natures, metalled, gravel-
led, and both unmetal-
led and ungravelled.
The gradients vary also
from those suited to a

low

3. Construct low level country to
tenance those necessary for the
4. aggreg ascent of a mountain
chain.
9 in length

as balance 4. The information
of frontier regarding the cost of
the maintenance of the
roads in Ceylon given
from the Governor Gregory's
Chief letter which forms an
enclosure to the letter
of the Govt. of India
to Ceylon already quoted, is not

The sufficiently detailed
regarding to enable a close com-
parison to be made
both of here between the outlay
and cost in both localities and
appear the cost of construction

is

38
is merely alluded to
incidentally as regards
one item viz: that of
metalling. This
defect can no doubt
be easily remedied
by reference to the
accounts of expenditure
and as the outlay in
this Presidency has
been classified under
distinct sub heads
and the wages, cost of
food and tasks of
the labourers are speci-
fied in the appendix,
all the data necessary
for allotting to the
various causes of
increased

3. increased cost in Ceylon
4. their proper degree of
5. importance will apparently
6. be at hand.

7. 5. While summarising
8. here the results exhibited
9. of the cost of construction
10. and maintenance of
11. roads in Malabar &
12. the Malghernies, it will be
13. as well however to add to
14. the statements the Ceylon
15. data so far as they are
16. available and those adopt-
17. ed in the present correspon-
18. dence may be supplement-
19. ed by details furnished by
20. Captain Schaw R.E. and
21. printed in the 6th volume
22. of the professional papers
23. of the Corps of Royal
24. Engineers.

Statement A

39
78
8. The annexed state-
ment compares the cost
of construction of the
roads in the Malghernies
Malabar and Ceylon
so far as it is entered
on in the correspondence
or reports here available.
The charge for metalling
in Ceylon is manifestly
largely in excess of the
average cost of the same
work in this Presidency.
The charges per mile
for excavation and the
total for construction
as given by Captain
Schaw, exceed those
here current except in
the case of roads ascending
the

the Ghats. But in order to arrive at any definite conclusion the rates per cubic yard paid for excavation, blasting, stone breaking and carting, &c. in each locality must be compared, and the Schedules of rates current which have been furnished by the District Engineers will afford the means of doing so.

It is however the cost of maintenance of the Ceylon roads which is chiefly in question and this is compared with the results in Malabar

79 40

Malabar and the Nilgherries, in the annexed Statement B. The actual number of carts traversing the Ceylon roads referred, is not stated nor is the cost of metal per cubic yard given. A comparison of the quantity of metal per cart required for renewals in the Presidency and in Ceylon would be a rough test of the relative economy of management in that particular respect.

Ootacamund }
15th Sept 1875

Chief Secy

Major R.C.

Under Secy. to Govt.

Rd. Asst.

44
No 2712 Public Works Dept.
Daty 20 Sept/75

To The Secy. to the Govt. of India
Public Works Dept.

Sir,

N^o 1143 A $\frac{m}{c}$ dt 20th April/75
" 194 A $\frac{m}{c}$ " 19th June "
" 237 A $\frac{m}{c}$ " 23rd July "

With reference to
your letters marginally
noted I am directed to
forward the following
documents.

1. A report from the
District Engineer Nil-
gheries relative to the
cost of construction and
maintenance of roads in
that District with
enclosures.

2. A similar report
from the District Engineer
Malabar

P.W.
G.O. 2711-20th Sept/75

Malabar with enclosures.

3. A summary of the above.

2. I am also to state that the delay which has taken place in replying to the reference made to the Govt. has been caused by a desire to furnish the fullest information possible and the consequent necessity of several references to the District Officers.

7 B. Letter + 26
copy Bala Kovvur
no. Office 17
drpd -
12-10-75

12-456-457

Work 43
Public Works Dept.

No 2711
Proceedings of the Madras Government
Under date the 20 Sept 1875
Read the following

From
The Govt. of India (No. 143 A.C. of 20th April 75)
do (No. 194 A.C. of 19th June ")
do (No. 237 A.C. of 23rd July ")
Dist. Engr. Nilgernes (No. 207 of 20th July ")
do (No. 208 of 18th Sept ")
Dist. Engr. Malabar (No. 62 of 14th July ")
do (No. 86 of 4th Sept ")
Memo. by Under Secy. to Govt. P.W.D. (No. 415 of 15th Sept ")

Ordered that the following letter be sent

Dist. Engr. Nilgernes. 3 (No. 2712 of 20 Sept 75)
Dist. Engr. Malabar. 8
" " Malabar
S C drpd -
12-10-75

11/28/75
 11/29/75
 11/30/75
 12/1/75
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 12/30/75
 1875
 GOVT. OF INDIA
 PUBLIC WORKS
 S.

To
 D. R. Kulkarni
 Secy. to Govt.
 20/9

Sub. P. Indira
 Dated
 Issued
 Recd.
 Encl.

G. O. 20 Sept 1875, No. 2911.

Nos. 456(a) 459

Forwarding for perusal
 documents relative to the
 comparison between the
 cost of construction and main-
 tenance of roads in Ceylon
 with those in the Nilgerry
 and Malabar districts

instructions and
 list of maintenance of
 roads in Ceylon. - documents
 passing orders on papers
 submitted
 regarding the comparison
 between the — with those
 the Nilgerry and
 Malabar Districts.

22/9/75