

Government {1899} of Madras.
PUBLIC WORKS.

Spare copies

G.O., Nos. 692, 693 Ry., 23rd June 1899.

JUNE.

Forwarding a copy of the Proceedings embodying the report and correspondence on the subject of the opening of the — for passenger traffic on June 15th, 1899.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read again the following papers :—

From—The Senior Government Inspector of Railways.
To—The Secretary to the Government of India, Public Works Department.
Dated—21st October 1898, No. 2903.

I have the honour to enclose a copy of my report, dated 14th October 1898, on an inspection made of the Nilgiri Railway with a view to ascertaining whether it is fit to be opened for passenger traffic.

I recommend that the line be permitted to be opened for all traffic when the Agent, Madras Railway Company, shall have certified that the matters referred to in paragraph 29 of the report have been completed, and shall have promised that the matters referred to in paragraph 30 will be attended to at an early date.

I beg to enclose the usual certificates, plans, &c.

[Copy of the above forwarded to the Agent and Manager, Madras Railway, and to the Agent and Chief Engineer, Nilgiri Railway, under endorsement No. 2904, dated 21st October 1898.]

From—The Secretary to the Government of India, Public Works Dept.
To—The Joint Secretary to the Government of Madras, P.W. Dept., Ry. Branch.
Dated—Simla, 15th November 1898, No. 1772 R.C.

With reference to letter No. 2903, dated 21st October 1898, from the Senior Government Inspector of Railways, Madras, submitting a copy of his report on an inspection made of the Nilgiri Railway with a view to ascertaining whether it is fit to be opened for passenger traffic, I am directed to say that His Excellency the Governor-General in Council is pleased, under sections 18 and 19 of the Indian Railways Act of 1890, to sanction the opening of the Nilgiri Railway for the public carriage of passengers on the conditions stated in paragraph 31 of the Senior Government Inspector's report and for stock fully braked as described in paragraph 15 of the report, when (after further inspection) the Senior Government Inspector has satisfied himself that the details to which he refers have been put right, and that the damages done by

No. 40 B., dated 31st October 1898.

the late rains and falling rocks, reported in your telegram noted in the margin, have been repaired and made safe.

2. I am to request that a report may be made of the actual date of opening the railway.

Read—

G.O., No. 1521 Ry., dated 10th December 1898.

„ No. 463-64 Ry., „ 24th April 1899.

Read also the following Report :—

NILGIRI RAILWAY.

METRE GAUGE, 16.90 MILES.

Report of an Inspection, prior to opening for passenger traffic, by the Senior Government Inspector of Railways, Madras, on the 7th of June 1899.

Under an agreement which has been entered into between the Madras Railway Company and the Nilgiri Railway Company the latter Co.'s rack line is to be worked by the former Company at an agreed percentage under all revenue account heads, except maintenance for which actuals will be charged. The Government of India guarantee gross earnings up to Rs. 2,00,000 per annum.

2. *Gradients and Curves.*—The Nilgiri Railway starts from Mettupalaiyam terminus of the Podanur-Mettupalaiyam branch of the Madras Railway, at a height of 1,071.00 above mean sea level. Then, after dropping to 987.00 at the Bhavani river at the 1st mile, it rises to 1,250.28 at Kullar, mile $4\frac{2}{3}$, the actual foot of the rack ascent. Up to here the line is an ordinary adhesion railroad. From Kullar the next 12 miles to Coonoor, 5,613.33 feet above sea level, is a continuous rack ascent, with short level bits at the three intermediate stations. The mean gradient from Kullar to Coonoor is about 1 in $14\frac{1}{2}$ for 12 miles; but the gradients vary a good deal, there being nearly 7 miles of 1 in $12\frac{1}{2}$, or 8 per cent. gradient. About 9 out of the 17 miles consist of curves, and $5\frac{1}{4}$ miles of these curves have a radius of only 328 feet. Throughout the greater part of the ascent the work is of a very heavy character, the railway clinging to the precipitous side of the same valley through which, for many years past, the Nilgiris have been ascended by means of an excellent metalled road. There are no reversing stations.

3. *Stations.*—Mettupalaiyam is a Madras Railway Company's station, and having for years formed the terminus of that Company's system in the direction of the Nilgiris, it is supplied with very ample accommodation. Much of this will now fall out of use, especially if the gauge of the Podanur-Mettupalaiyam branch is changed to the metre, as strongly recommended by the Government of Madras and as it most certainly ought to be. The village of Mettupalaiyam owes its existence to the carting trade on the hill road, and it is reasonable to suppose that, when the chief occupation of its inhabitants shall have ceased owing to railway competition, it will become a place of very small importance. Kullar is, and probably always will be, little more than a name; it will do no traffic; it merely marks the foot of the mountain ascent, is a crossing station, and is of course an important watering station. Adderley, Hillgrove, and Runnymede, the intermediate stations, are all of great importance as watering and crossing stations. They will all do some traffic for the neighbouring coffee estates. Coonoor, the terminus of the section of the Nilgiri Railway which has so far been brought to completion, is a station of great importance, not only in itself, for Coonoor is a thriving European and native settlement and Wellington cantonment is close by, but also because for the present, pending further extension, it is the terminus where goods and passengers take the road to Ootacamund, a large European and native settlement, 11 miles further up the hill, at a height of between 7,000 and 8,000 feet above sea level and the summer head-quarters of the Madras Government.

4. *Formation.*—Some very heavy work has been done, since the severe slips of the north-west monsoon of 1898, in flattening the slopes of the cuttings. I do not venture to say that there will no longer be slips; indeed there will almost certainly be heavy slips whenever rain falls for a few hours continuously at the rate of over half an inch per hour. Slips will doubtless go on more or less for some years to come until all weak places have been found out. But the money that has recently been spent will, in my opinion, have greatly reduced the risk of lengthy obstruction of running. The actual road bed is everywhere now in good order. There are nowhere any signs of slipping or settlement of road bed. Of the three troublesome cuttings mentioned in last April's inspection report, that at Glenmore, chain 97 to 100, seems at last to be about as safe as it can be made, a new and very heavy retaining wall with

well drained backing having been built at great expense. The original cutting through the land slide at chain 264 is now full of debris, but the diversion round the outside of it seems likely to be permanently safe. The three great boulders sticking out of the clay hill side at chains 410—412 seem safe enough at present, a very heavy retaining wall having been built beneath them; this retaining wall will form one side of a cut-and-cover tunnel, of which the foundation of the outer wall is now up to rail level; the remainder of the work will go on without interruption of traffic.

5. *Tunnels.*—These seem everywhere in very good order now, lining having been added where necessary. In the Adderley tunnel concrete lining over bent rails is still in progress. Everywhere doubtful places in the tunnel roofs have been made as sound as seemed necessary.

6. *Bridges.*—The girders have been designed in accordance with the Government of India's conditions, viz., double moving load added to dead load and wind pressure, with a unit stress intensity of 9 tons per square inch. The only exception is the 100 ft. girders of the Bhavani bridge which were designed, under the Rules of 1892, for a dead and a non-doubled moving load, and with a unit stress intensity of six instead of nine tons. All girders are, I consider, sufficiently strong for the present 33-ton engines and 28-ton loaded vehicles, with over-all lengths of 24 and 34 ft., respectively. When I inspected in October last the girders on the lower part of the line were generally well finished off in detail, well bedded, anchored and braced; but on the upper few miles where work had been somewhat rushed at the end, less careful finish was observable; girders were still unanchored, and no provision had been made to prevent their creeping down hill under the stress of the pull on the rack. Then again curve superelevation, instead of being given in the girder bedding, had been effected in many cases by small packing pieces under the sleepers. These little details if left unfinished on an ordinary railway do not much matter, but on a rack line it is impossible to make such things too good. All this has now been made good and great attention has been paid to every little detail.

7. *Ballast.*—This is everywhere very good and plentiful. I was assured in October last that there are everywhere 12 inches of ballast beneath the sleepers and 6 inches between them. It is everywhere held in between dry stone ballast walls, 12 feet wide over all. The ballast is all clean broken granite, the lower 6 inches being 4 inch cube, and the rest 2 inch cube.

8. *Permanent-way.*—Rails are 50 lb. steel, flat footed, 28.14 feet long on the straight, held down by single spiking except at joints where the outer spikes are double. The rails are fastened with deep angle iron six bolted fish-plates weighing 40 lb. per pair. The sleepers are Pyngadu, spaced 2 feet $6\frac{3}{8}$ inches apart. Size $6' \times 8' \times 6"$. The rack is a double plate Abt steel rack, on cast iron chairs, weighing 90 lb. per yard. The length of the rack bars is that of 4 sleeper spaces; the bars break joint.

9. *Vertical curves.*—All gradient junctions have been rounded off by vertical curves of such a radius that their tangents are 200 feet long, that is the curves have generally a radius of 4,000 to 5,000 feet. This is less necessary on an ordinary adhesion line than on a rack railway where a sudden change of grade might cause the pinion either to jam or to ride the rack.

10. *Break in continuity of the rack.*—There is no rack on the short piece of level at the stations, and as speeds are necessarily slow on leaving a station, there will usually be no difficulty in the pinion putting itself in gear when entering the rack, with the aid of the spring tongue-piece. If however the rack brake is on when the pinion is trying to gear itself, the pinion will ride and may do mischief. When I inspected in October last there was a short piece of about 400 or 500 feet of 1 in 94, near the Karteri bridge two miles below Coonoor, where the provision of a rack had, unwisely I think, been considered superfluous; the result was that drivers were obliged to look out for the place and to slow down and to go through all the manipulations for disengaging and engaging the rack and for synchronising the rack adhesion engines, precisely as at a station. This was a very great nuisance, and might conceivably be productive of accident. The missing length of rack has now been filled in.

11. *Station lay-byes and sidings.*—The terminal stations, Mettupalaiyam and Coonoor, have all they require in the shape of through sidings and dead ends. Kullar has a run round and a dead end. The intermediate stations, Adderley, Hillgrove and Runnymede, have short sidings to allow trains to pass, and short dead ends off these, furnished with a slip switch, for a standing vehicle.

12. *Creep.*—I am informed that though trains have been running on the steep parts of the road for more than a year, no creep has as yet been detected. The deep fish-plates butt against the sleepers and these being, in turn, firmly bedded in the ballast make creep seem impossible; for if rails are to creep they must drag with them not only sleepers but six inches of ballast also.

13. *Buffer stops, &c.*—I saw none anywhere on the line except at Mettupalaiyam. They might, with advantage, be supplied at the dead end sidings and so save damage to rolling-stock. Scotch-blocks, safety chains, and point-locking bolts have I believe been everywhere supplied.

14. *Safety sidings.*—These have all been cut out, and very properly, for they were only smashing sidings, and most dangerous.

15. *Brakes.*—The engines are furnished with the Chatelier brake on both rack and adhesion cylinders. All engines and all rolling-stock, both passenger and goods, are fitted with the vacuum automatic brake acting on all six engine wheels and on all eight wheels of each vehicle, and applicable at will by either the driver or the guard. The rack pinions of both engines and vehicles are also very powerfully braked, the former by a band and the latter by blocks. The engine adhesion wheels are also fitted with ordinary hand brakes. Appliances have been added for actuating by hand the adhesion brakes of the vehicles also. Thus the whole of the rolling-stock is braked in an eminently efficient manner. A little consideration will make it evident that if a certain engine with a certain steam pressure can haul a certain load up a grade, on a return journey down the grade with a similar load the back pressure in the cylinders when the Chatelier brake is acting can never be as great as the working pressure in the cylinders on the up journey. As a fact trains are worked down the descent almost entirely by the Chatelier brake, the driver keeping one hand on that, and the other on the handle of the vacuum. Thus in an instant he can apply the former on the engine and the latter throughout the whole length of the train, and a blast of the whistle ensures the application of the hand-worked rack brake on every vehicle within the next moment or two. At appendix A of last October's report will be found an account of some brake experiments. It is quite possible in many places throughout the line for the driver or guard to be within 150 feet of a fall of rock or other obstruction before he can see it. On the ascending journey this does not matter, as the stop can be made in one-third of this distance. On the descent, however, at 7 or 8 miles per hour with a heavy train, the available stopping space infringes very nearly on this distance. It is therefore essential that the driver or his mate, on the offside of a sharp curve, should lean well out and see as far as he can. In places it may be necessary to flatten the slopes on the inner sides of curves, to keep jungle cleared, and in every way to facilitate the look-out; the recent flattening of the slopes of cuttings has improved things a good deal in this respect. There is nothing, however, in all this which need in my opinion cause the opening of the line to be delayed. The management must impress vigilance on all look-out men and must keep up an efficient patrol system.

16. *Patrols.*—Half way between stations there are patrol houses and two patrols. These men carry books and constantly traverse the $1\frac{1}{2}$ mile between their huts and the stations on either side of them. I gave the patrol rules as appendix B of last October's report. If this system is carefully worked it ought to ensure all warning that is practically possible of the occurrence of rock-falls or of slips between the running of trains. Permanent-way gangs working between stations can be concentrated very quickly on a slip.

17. *Train formation.*—The engine is invariably at the down-hill end of the train and the open-ended brake-van at the up-hill end. On the descent the driver and his mate have a full view of the road from the footplate of the engine, while the guard and the brakesman have an equally good view on the ascent. As already stated, the guard or brakesman, equally with the driver or his mate, can in an instant apply the

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vacuum brake throughout the train, while the whistle ensures the application of hand brakes. Under the working rules an engine must be kept below any and every vehicle removed from a lay-bye on the ghât. These precautions as well as the provision at lay-byes of scotch-blocks, wheel chains and slip switches, are calculated to make it next door to an impossibility that a vehicle should escape down the hill. If, owing to the derailment of its engine, a vehicle is being hauled instead of being pushed up the hill by another engine and if, owing to the fracture of its coupling, it starts to run away, it cannot run many yards if manned in accordance with the rules, for its brakeman can always stop it instantly by applying his hand rack-brake.

18. *Road-crossings*.—Wherever cart traffic exists on a cross road the level-crossing is gated and manned. The railway is not crossed by a carriage road except at Coonoor itself and at one place below Kullar, both places on adhesion parts of the road. At small paths from the coffee estates suitable ramps have been made between rail and rack, and overhead foot-bridges have been made at three or four places.

19. *Fencing*.—Except at Coonoor station the line is nowhere fenced. Fencing is not necessary anywhere above Kullar. I, however, am certainly of opinion that it will be desirable to fence the Mettupalaiyam-Kullar section as soon as funds are available, for cattle constantly stray over it, and there is danger of derailment of trains, with brakevan, or with engines devoid of cow-catchers, running foremost. There is a sort of a pretence at present of an aloe fence, but that is no use; a five wire fence should be provided. This, however, need not delay opening. Mile and quarter mile-posts are completed, and every chain is marked with painted figures on the ballast walls. The mileage runs up from Mettupalaiyam and the chainage (100 ft. chains) runs down from Coonoor.

20. *Rolling Stock*.—This at present consists of the following: 4 engines, 4 first-class cars, 4 composite second and third class cars, 4 brake-vans, 16 low-sided waggons. All cars are on bogies. The first-class tares 11t. 5c. and carries 27 passengers. The composite tares 10t. 12c. and carries 11 second-class and 36 third-class passengers. Mean tare about 6 cwt. per passenger, or about 3 cwt. for 3rd class only. The brake-van tares 10t. 7c. The waggon tares 6 tons and carries a paying load of 22 tons. Nets are wanted in the carriage racks. The engines are said to burn about 30 cwt. of patent fuel per trip; but the fuel has been 20 or 30 years in India and has probably lost many of its virtues; 1,500 tons of new patent fuel has now been got out from England. The engines which have only 750 square feet of heating surface, and which I consider ought to have 900 to 1,000, do not make steam fast enough and have not yet hauled a full load of three loaded vehicles up the ghât. They may perhaps do so when the rack and rails have been more run over and when all is working smoothly and with best-fuel and very intelligent driving: but still the margin is too small, and they ought to make more steam. With the best of the four engines in October last I took two fully-loaded vehicles and a brake-van, in all 67 tons 14 cwt. or with the engine about 100 tons, up 500 feet vertical height on the 8 per cent. gradient, at about 4 miles per hour. This was the very utmost the engine could do at 175 to 180 lb. pressure. The application of the injector knocked the steam pressure hopelessly down. Experiments are being tried with re-spacing the fire-bars, road resistance will improve, men will learn to fire better, and the new fuel, and oil fuel which has now been laid on, will improve the steaming, and perhaps better loads may be hauled; but at present on a three-mile ascent of 1 in 12½, with 328 feet curves and with fairly good driving, the engines can in practice do only about two-thirds of the work that they were expected to do. Indeed I learn that, since the present inspection, on the 14th June, the Locomotive officers of the Madras Railway Company found on a careful trial that only 45 tons or two loaded goods cars would be hauled up to Coonoor.

21. *Signals*.—At Mettupalaiyam the signals have now been satisfactorily arranged, and there is an electric starter.

At Coonoor entrance to the yard is governed by a square-armed outer main (so-called "distant") signal. This is 700 feet from centre of platform. On the platform is a "calling on" semaphore; but a train length beyond the outermost facing points is a stop notice board. When the outer main is lowered trains may come up to this notice board, but may not pass it until the platform, or "calling on"

signal is lowered; the object of this is to allow of shunting being done if necessary out on the main line while trains are approaching. There is also an electric starter.

At Kullar, Adderley, Hillgrove and Runnymede stations the only signal, besides the two electric starters, is a double-armed platform semaphore; but at a train length outside each end of the unracked part of the yard, or in the case of Kullar at a train length outside the facing points at both ends of the yard, stop notice boards have been erected. Every train must by order stop dead at these notice boards until admitted into the yard by the platform semaphore. At every point of entry on the rack there are notice boards to ensure that pinions shall not be braked, as a heavily braked pinion may mount and injure the rack on entry. Drivers will soon get into the trick of this, but rack entries have already been a little knocked about. All semaphore arms have been designed to fly to danger on the breakage of any connection.

22. *Passenger booking*.—At Mettupalaiyam, Kullar, Adderley, Hillgrove, Runnymede and Coonoor all necessary facilities and conveniences have been supplied. Indeed the conveniences at Coonoor are quite super-excellent; waiting-rooms, lavatories, kitchen, dining-room, &c., having all been arranged to afford a fitting welcome in the English climate to the fagged traveller from the plains below. The stairs at Coonoor leading up to the waiting-room are shaky and unfinished; they might be tidied up a bit. At the minor stations it will be necessary to level up the ballast with cinders to rail top for passengers to walk about on.

23. *System of working*.—The line will be worked on the absolute block system with Winter's telegraph instruments, electric starters, and the manuscript line-clear ticket. Under the Madras Railway Company's customary manner of working, where the station limits are not included in the block, the block will consist of the section lying between outer main semaphores, or between stop notice boards, or between outer main semaphore and stop notice board, as the case may be, outside the stations.

There is a certain confusion in the use of the terms *up* and *down* trains on this mountain line, for the public naturally attach to these terms the idea of *uphill* or *downhill*, whereas trains towards Madras are in the Railway Company's time-table called *up* and those from Madras *down* trains. In the working rules, therefore, the mountain trains are spoken of as A, or *ascending*, and D, or *descending*, trains. At passing stations descending trains are timed to arrive three minutes before ascending trains, so as to leave time for backing the former into the lay-bye. The ascending train keeps the main line. I do not like this arrangement for two reasons: (a) because it is hard on an ascending train to stop her within 50 yards of her goal, when, presumably, she has barely enough steam left to carry her through; and (b) because there is a certain risk in letting a descending train come 50 yards downhill from the station in the face of an ascending train. It might be preferable that the ascending train should be given free precedence into the siding, and only be let out when the descending train shall have cleared the station by one or two minutes. But it is the ascending and not the descending train that wants to water, and therefore if my suggestion is found workable, water should be obtainable on the train siding. This suggested change of system deserves in my opinion, careful consideration.

The brakemen on all vehicles are servants of the Locomotive Department and not of the Traffic Department. The guards have orders to assist the brakemen when called on by them to do so. I have approved of the rules proposed by the Madras Railway Company for the working of trolleys.

24. *Engine and goods sheds*.—The engine sheds at Mettupalaiyam and Coonoor are amply large enough for two engines each, but can accommodate four at a pinch. Accommodation for goods at both termini also is ample and excellent.

25. *The rack and pinion*.—Each of the two steel bars forming the rack has a section of 110 × 22 mm. The pitch of the teeth is 120 mm. and the pitch line is about 20 mm. below top of bar. The two bars have a space of 1¼ inches between them. The slope with the vertical of the rack tooth at pitch line is 1 in 4. The radius of pitch circle of pinion is 286.48 mm. There is a pair of pinions keyed on to the rack shaft to correspond with the pair of rack bars. The rack teeth break pitch. The rack is entered by a piece 10' 10" long, hinged at the inner end and floating on springs throughout, the top of the teeth at the entrance end being gradually sloped off to nothing.

26. *Size of waggons.*—Waggons are 19 feet between bogie centres. Bogie wheel-base 4 ft. 3 in. Inside dimensions of floor 7 ft. $\times$ 30 ft. Height of floor about 2 ft. 8 in. unloaded. Length over buffers about 34 feet. The sides of the waggons are 12 inches above floor; the ends are 3 ft. 5 in. above floor. Wheels are 2 ft. 4 in. in diameter. The maximum load on a pair of wheels is 7 tons. This information is given chiefly for the use of the Military authorities. Journals are $7\frac{1}{2}$ in. $\times$ $3\frac{1}{2}$ in. The coupling at one end of a vehicle has a hook, and at the other end a screw as in Jones's system; couplings are single-ended, not reversible. The unworn radius of journal fillets is $\frac{5}{8}$ inch. Wheels are shrunk without key or fillet on the full diameter $4\frac{5}{8}$ inch axle. Tires are held on by six square-headed $\frac{3}{4}$ -inch bolts, and when unworn are 2 inches thick on the tread.

With a view to relieving goods trains of having to carry a brake-van little cabooses have been erected on the forward end of four of the waggons, for use by a brakesman and guard, and a vacuum brake release handle has been given in the caboose. This will greatly improve the carrying capacity of the goods trains.

27. *Locomotives.*—The locomotives are six wheeled; the two lower, or down-hill, pairs being coupled. The wheel base is 10 feet, of which 3' 6" is between the coupled wheels. Length over buffers 24 feet. The loads on the wheels are $11\frac{1}{2}$ tons on each pair of coupled and 10 tons on the pair of uncoupled wheels, total 33 tons in steam and coal. Wheels are 2' 8" diameter. Midway between the non-coupled and the inner pair of coupled wheels are two pairs of rack pinions in tandem, 2' $5\frac{1}{2}$ " apart, driven by a third pinion keyed on a crank axle. This crank axle is driven by a pair of cylinders, $10\frac{3}{4}$ " diameter $\times$ 14" stroke, inside the main frames of the engine. Outside the main frames and in line with the rack cylinders is a second pair of cylinders 13" diameter $\times$ 16" stroke which drive the adhesion wheels. The boiler, which is 8' 4" long in the barrel, has a tilt of 1 in 20. There are tanks and coal bunkers. The over-all breadth of the engine is 8' 6" and its height over chimney 10' 6". The heating surface is, I am informed, 750 square feet, which in my opinion is insufficient, as even with the best fuel and the best firing there ought to be a larger margin of steaming power for the grades, curves and loads for which the locomotives were designed. The grate area is, I am told, about 16 square feet.

28. *Coaching stock.*—These are all built on similar under-frames, 22' 6" between centres of bogies, and 4' 2" wheel base. Wheels are 2' $3\frac{1}{2}$ " diameter. Length over buffers $37\frac{1}{2}$ feet. Over-all breadth of cars at sun-shades 7' 10", and at floor level 7' 4"; height 11' 2". The first-class cars seat 27 passengers; the composites 11 second and 36 third class; the guard's van has 14 lineal feet of seating and 24 square feet of flooring for native servants. The height of all buffer centres, unloaded, is 1' 11". Journals in all stock are 5' 1" centres. All passenger cars are of the vestibule sort, entered at the end, with steps about 1' 2" and 2' 2" above rail level. The luggage compartment in centre of guard's van is 15' 7" $\times$ 6' 4", and is about 7' 3" high.

29. *Derailments.*—The inspection report prior to opening affords a very suitable opportunity for a reference to the subject of derailments, a subject of somewhat serious importance on a steep mountain railway. About a year ago Mr. Weightman spoke to me rather anxiously about a derailment of an engine; he attributed it to the entire engine having moved so far towards the outside of a curve that the inner of the two pinions mounted the teeth of the outer of the two racks whose teeth alternate. Some experiments were suggested for measuring the outward movement of the pinions on a curve, and we came to the conclusion, as the result of the experiments, that the outward movement is not, and cannot be, nearly enough to cause mounting. Further inspection satisfied us that as the derailment had occurred just off the abutment of a bridge where there were a few yards of bank, there must have been some slight irregularity of the roadway which sufficed to cause derailment. The next derailment I heard of, which occurred on August 20th, 1898, was undoubtedly caused by the unevenness of the road bed, near the end of the section then being plate-laid, where ballast was deficient. This particular derailment occurring as it did to His Excellency the Governor's special train attracted some public attention. Mr. Weightman then admitted to me that there had been several similar derailments since the first one mentioned above, all in his belief ascribable to insufficient packing of road, and all if I recollect right to ascending trains, and none of them productive of any damage.

On the day of this inspection, 7th June 1899, on the return or ascending journey, a precisely similar derailment occurred a couple of miles below Coonoor, at a place where a few yards of bank filled in the gap between a bridge abutment and a cutting. A few months ago in the north-east monsoon a retaining wall at this spot had given way, so the bit of bank was new, and the road was undoubtedly slightly, though very slightly, irregular; the outer engine fore-wheel mounted at a rail joint in a sharp curve. In all previous cases too it was, I understand, the outer engine fore-wheel that mounted on a curve. Another derailment of a leading engine wheel of an ascending train occurred on the 16th instant.

A little consideration will show that a descending engine, below a train and propelled forward by that train's weight, is in a very different position in regard to the probability of the mounting of its outer fore-wheel on a curve than is an ascending train pushing its load in front of it. The transmission of the thrust through the central buffer will in the former case tend to push the pair of fore-wheels *central* to the rails, while in the latter case the tendency will be quite the other way, viz., to make the outer fore-wheel mount the outer rail of the curve. An experiment with a toy train or with a couple of books on the table will show what I mean.

The conclusions to which I have come are, (a) that the derailment of a descending train is extremely unlikely to happen; (b) that derailments are less likely to occur on a bridge than anywhere else, owing to the perfection of the road-bed; (c) that derailments in cuttings also are very unlikely, as the road-bed will usually be good; (d) that derailments are most likely to occur on the few short bits of bank intervening between bridges and cuttings where earthwork may have settled a little, and especially where curves exist, and almost always to ascending trains.

Therefore maintenance gangs should pay special attention to these places, and moreover I would recommend that rails should be made to *break joint* at these places and that their curvature should be specially attended to, and that the joints of outer curve rails at such places should be made specially unyielding and unangular. I do not believe that occasionally greasing the inner edge of these few places would appreciably affect hauling power, for the rack portion of the engine does most of the work.

30. *Conclusion.*—I recommend that permission be granted for the railway to be opened for passengers at a speed not exceeding 8 miles per hour on the Kullar-Coonoor rack section, and 20 miles per hour on the Kullar-Mettupalaiyam adhesion section. When fencing is completed on this latter section speed can be increased if desired. This recommendation is for daylight running only.

OOTACAMUND,
7th June 1899.

FRANCIS J. E. SPRING,
Senior Govt. Inspector of Rys., Madras.

Telegram from—The Joint Secy. to the Govt. of Madras, P.W.D., Ry. Branch.
To—The Secretary to the Government of India, Public Works Dept., Simla.
Dated—Mettupalaiyam, 7th June 1899, No. 12 A.

Please read Madras Senior Inspector's report inspection Nilgiri Railway prior to opening for passengers dated 14th October 1898, also report accompanying this Government's proceedings 463 Ry. April 24th 1899. Senior Inspector has now completed inspection and finds all matters stipulated for in paragraph 29 and all essential in paragraph 30 of report of October 14th 1898, also matters referred to in paragraph 7, Report dated April 6th 1899, have been done and recommends immediate opening for all traffic on condition laid down paragraph 31 of report October 14th. This Government recommends permission be accorded by wire for immediate opening.

Telegram from—The Secretary to the Government of India, Public Works Dept.
To—The Joint Secretary to the Government of Madras, P.W. Dept., Ry. Branch.
Dated—Simla, 9th June 1899, No. 1099 R.C.

Your telegram of 8th instant. Opening of Nilgiri Railway for public carriage of passengers sanctioned on conditions stated in Government of India letter 1772 R.C. 15th November last and on understanding set forth in paragraph 16 of inspection report accompanying your 464 Ry. of 24th April last. Please telegraph actual date of opening.

From—The Senior Government Inspector of Railways, Madras.
To—The Agent and Manager, Madras Railway.
Dated—Ootacamund, 10th June 1899, No. 87/O.

You are hereby authorized to open the Nilgiri Railway for all traffic during daylight only at speeds not exceeding 20 miles per hour on the Mettupalayam-Kullar section and 8 miles per hour on the Kullar-Coonoor section. Stock on the Kullar-Coonoor section must be fully braked as described in paragraph 15 of my report, dated 14th October 1898.

2. The sanction for opening for all traffic hereby conveyed to you is subject to the understanding that the Nilgiri Railway Company's guarantee holds good only during so many days in each half-year as through booking between Mettupalayam and Coonoor is maintained for all traffic in spite of breaks and interruptions. The guarantee will be in abeyance during so many days in each half-year as through booking is not maintained. In this connection your perusal is invited of paragraphs 13 to 16, inclusive, of my report, dated 6th April 1899, which went to you with endorsement No. 464 Ry., dated 24th April 1899.

3. I have the honour to request that you will intimate to me by wire the actual date of opening.

Telegram from—The Joint Secy. to the Govt. of Madras, P.W. Dept., Ry. Branch.
To—The Secretary to the Government of India, P.W. Dept., Simla.
Dated—Ootacamund, 16th June 1899, No. 13 A.

Nilgiri Railway opened for traffic 15th instant.

ORDER—No. 692 Ry., dated 23rd June 1899.

Recorded. A copy of these Proceedings will be forwarded to the Government of India.

FRANCIS J. E. SPRING,
Joint Secretary.

To the Agent and Manager, Madras Railway.
" the Secretary to the Board of Directors,
Nilgiri Railway Company, 18 St. Helen's place, London.
" the Postmaster-General.
" the Examiner, Public Works Accounts.
" the " Guaranteed Railway Accounts.
" the Consulting Engineer for Railways.
Editors' Table.

ENDORSEMENT—No. 693 Ry., dated 23rd June 1899.

Forwarded.

(By order.)

FRANCIS J. E. SPRING,
Joint Secretary.

Exd. T. K. Narayana Aiyangar.

Form No. 24.

Reminders.

Reply No. _____

dated _____

SERIAL
No. 40

No. 2903
2904

Madras, 21st Oct 1898.

From

THE SENIOR GOVERNMENT INSPECTOR OF RAILWAYS,

MADRAS,

To

THE AGENT AND MANAGER, M. Ry. — copy with copy of report
to 10 pages.

" " S. I. Ry.

" " H. H. THE N. G. S. Ry.

" " AND CHIEF ENGR., N. Ry. — copy with copy of report
to 6 pages.

" " S. M. Ry.

" " ENGR. IN CHIEF, D. M. Ry.

" " MANAGER, E. C. Ry.

7. " SECRETARY TO THE GOVT. OF INDIA. P.W. Dept.

SIR,

I have the honour to enclose a copy of my report on
an inspection made of the Nilgiri Railway with a view to
ascertaining whether it is fit to be opened for passenger traffic.

I recommend that the line be permitted to be opened for
all traffic when the Agent and Manager of the N. G. S. Ry. shall have certified
that the matters referred to in para 29 of the Report have been
completed. and shall have promised that the matters referred to
in para 30 will be attended to at an early date.

I beg to enclose the usual certificate plans for the

I have & 7/8 19/10/98

Document accompanying: —
(1) Inspection Report
(2) Tabulated Details 1 to VII.
Referred to 30/9/99
(3) S. I. Ry. Plan & Section and list
of bridge curves & grades.
(4) Bridges & Culverts.
(5) Book of Drawings of Bridges
(6) Certificate 1 to 5.

SERIAL
No. 51

Public Works (189^D) Department.

Railway

CURRENT No. 1382

From *The Govt. of India*

Order

File
J.H.
for ER
28/11/90

No. 1772 R.C.

Dated 15 November 189^D

Received }
Registered } 22-11-90

Enclosures

Spare copies

SUBJECT.

Nilgiri Railway

*Sanctioning the opening
of the — for the public car-
riage of passengers & requesting
that a report may be made
of the actual date of opening
the Railway*

BACK PAPERS.

FURTHER PAPERS.

No. 1772.R.C.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY CONSTRUCTIONS.

*All communications
should be addressed
to the Secretary.*

PLEASE REPLY
TO **BIMLA**
CALCUTTA

actual date of opening the railway.

I have the honour to be,

Sir,

Your most obedient Servant,

C. O. A. H.

Offg. Under Secretary.

Documents accompanying:-

Nil.

C. O. A. H.

Int. of Railways
O. W. D.
Railway

Print

Read again the following papers:-

Letter to the Govt. of Madras from the Govt. of India, dated 4.10.1898. (Print in file.)
Int. of Railways, dated 5.1.1899. (Print in file.)
G.O. 1511. R. 10.12.98. } Do not print
" 463. R. 24.12.99. }

Please see the following:-

NILGIRI RAILWAY.

METRE GAUGE, 16.90 MILES.

Report of an Inspection, prior to opening for passenger traffic; by the Senior Government Inspector of Railways, Madras, on the 7th of June 1899.

Under an agreement which has been entered into between the Madras Railway Company and the Nilgiri Railway Company the mountain line is to be worked by the former at an agreed percentage under all revenue account heads except maintenance for which actuals will be charged. The Government of India guarantee gross earnings up to Rs. 2,00,000 per annum.

2. *Gradients and Curves.*—The Nilgiri Railway starts from Mettupalaiyam terminus of the Podanur-Mettupalaiyam branch of the Madras Railway, at a height of 1,071.00 above mean sea level. Then, after dropping to 987.00 at the Bhavani river at the 1st mile, it rises to 1,250.28 at Kullar, mile $4\frac{2}{3}$, the actual foot of the rack ascent. Up to here the line is an ordinary adhesion line. From Kullar the next 12 miles to Coonoor, 5,613.33 feet above sea level, is a continuous rack ascent, with short level bits at the three intermediate stations. The mean gradient from Kullar to Coonoor is about 1 in $14\frac{1}{2}$ for 12 miles; but the gradients vary a good deal, there being nearly 7 miles of 1 in $12\frac{1}{2}$, or 8 per cent. About 9 out of the 17 miles consist of curves, and $5\frac{1}{4}$ miles of these curves have a radius of only 328 feet. Throughout the greater part of the ascent the work is of a very heavy character, the railway clinging to the precipitous side of the same valley by which for many years past the Nilgiris have been ascended by means of an excellent metalled road. There are no reversing stations.

3. *Stations.*—Mettupalaiyam is a Madras Railway Company's station, and having for years formed the terminus of that Company's system in the direction of the Nilgiris, it is supplied with very ample accommodation. Much of this will now fall out of use, especially if the gauge of the Podanur-Mettupalaiyam branch is changed to the metre, as strongly recommended by the Government of Madras and as it most certainly ought to be. The village of Mettupalaiyam owes its existence to the carting trade on the hill road, and it is reasonable to suppose that, when the chief occupation of its inhabitants shall have ceased owing to railway competition, it will become a place of very small importance. Kullar is, and probably always will be, little more than a name; it will do no traffic; it merely marks the foot of the mountain ascent, is a crossing station, and is of course an important watering station. Adderley, Hillgrove and Runnymede, the intermediate stations, are all of great importance as watering and crossing stations. They will all do some traffic for the neighbouring coffee estates. Coonoor, the terminus of the section of the Nilgiri Railway which has so far been brought to completion, is a station of great importance, not only in itself, for Coonoor is a thriving European and native settlement and Wellington cantonment is close by, but also because for the present, pending further extension, it is the terminus where goods and passengers take the road to Ootacamund, a large European and native settlement, 11 miles further up the hill, at a height of between 7,000 and 8,000 feet above sea level and the summer head-quarters of the Madras Government.

4. *Formation.*—Some very heavy work has been done, since the severe slips of the north-west monsoon of 1898, in flattening the slopes of the cuttings, I do not venture to say that there will no longer be slips; indeed there will almost certainly be heavy slips whenever rain falls for a few hours continuously at the rate of over half an inch per hour. Slips will doubtless go on more or less for some years to come until all weak places have been found out. But the money that has recently been

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17. *Train formation.*—The engine is invariably at the down-hill end of the train and the open-ended brake-van at the up-hill end. On the descent the driver and his mate have a full view of the road from the footplate of the engine, while the guard and the brakeman have an equally good view on the ascent. As already stated, the vacuum brake throughout the train, while the whistle ensures the application of hand brakes. Under the working rules an engine must be kept below any and every vehicle removed from a lay-by on the ghât. These precautions as well as the provision at lay-byes of Scotch blocks, wheel chains and slip switches, are calculated to make it next door to an impossibility that a vehicle should escape down the hill. If, owing to the derailment of its engine, a vehicle is being hauled instead of being pushed up the hill by another engine and if, owing to the fracture of its coupling, it starts to run away, it cannot run many yards if manned in accordance with the rules, for its brakeman can always stop it instantly by applying his hand rack-brake.

18. *Road-crossings.*—Wherever cart traffic exists on a cross road the level-crossing is gated and manned. Except at Coonoor itself and at one place below Kullar, both on adhesion parts of the road, the railway is not crossed by a carriage road. At small paths from the coffee estates suitable ramps have been made between rail and rack, and overhead foot-bridges have been made at three or four places.

19. *Fencing.*—Except at Coonoor station the line is nowhere fenced. Fencing is not necessary anywhere above Kullar. I, however, am certainly of opinion that it will be desirable to fence the Mettupalaiyam-Kullar section as soon as funds are available, for cattle constantly stray over it, and there is danger of derailment of trains with brakevan/or with engines devoid of cow-catchers/running foremost. There is a sort of a pretence at present of an alloy fence, but that is no use; a five wire fence should be provided. This, however, need not delay opening. Mile and quarter mile-posts are completed, and every chain is marked with painted figures on the ballast walls. The mileages run up from Mettupalaiyam and the chainage (100 ft. chains) runs down from Coonoor.

20. *Rolling Stock.*—This at present consists of the following: 4 engines, 4 first class cars, 4 composite second and third class cars, 4 brake-vans, 16 low-sided waggons. All cars are on bogies. The first-class tares 11t. 5c. and carries 27 passengers. The composite tares 10t. 12c. and carries 11 second-class and 36 third-class passengers. Mean tare under 6 cwt per passenger. The brake-van tares 10t. 7c. The waggon tares 6 tons and carries a paying load of 22 tons. Nets are wanted in the carriage racks. The engines are said to burn about 30 cwt. of patent fuel per trip; but the fuel has been 20 or 30 years in India and has probably lost many of its virtues; 1,500 tons of new patent fuel has now been got out from England. The engines which have only 750 square feet of heating surface, and which I consider ought to have 900 to 1,000, do not make steam fast enough and have not yet hauled a full load of three loaded vehicles up the ghât. They may perhaps do so when the rack and rails have been more run over and when all is working smoothly and with best-best fuel and very intelligent driving: but still the margin is too small, and they ought to make more steam. With the best of the four engines in October last I took two fully-loaded vehicles and a brake-van, in all 67 tons 14 cwt. or with the engine about 100 tons, up 500 feet vertical height on the 8 per cent. gradient at about 4 miles per hour. This was the very utmost the engine could do at 175 to 180 lb. pressure. The application of the injector knocked the steam pressure hopelessly down. Experiments are being tried with re-spacing the fire-bars, road resistance will improve, men will learn to fire better, and the new fuel, and oil fuel which have now been laid on, will improve the steaming, and perhaps better loads may be hauled; but at present on a three-mile ascent of 1 in 12½ with 328 feet curves and with fairly good driving, the engines can in practice do only about two-thirds of the work that they were expected to do.

21. *Signals.*—At Mettupalaiyam the signals have now been satisfactorily arranged, and there is an electric starter.

At Coonoor entrance to the yard is governed by a squarearmed outer main (so-called "distant") signal. This is 700 feet from centre of platform. On the platform is a "calling on" semaphore. But a train length beyond the outermost facing points is a stop notice board. When the outer main is lowered trains may

come up to this notice board, but may not pass it until the platform, or "calling on" signal is lowered. The object of this is to allow of shunting being done if necessary out on the main line while trains are approaching. There is also an electric starter.

At Kullar, Adderley, Hillgrove and Runnymede stations the only signal, besides the two electric starters, is a double-armed platform semaphore; but at a train length outside each end of the unracked part of the yard, or in the case of Kullar at a train length outside the facing points at both ends of yard, stop notice boards have been erected. Every train must by order stop dead at these notice boards until admitted into the yard by the platform semaphore. At every point of entry on the rack there are notice boards to ensure that pinions shall not be braked, as a heavily braked pinion may mount and injure the rack on entry. Drivers will soon get into the trick of this, but rack entries have already been a little knocked about. All semaphore arms have been designed to fly to danger on the breakage of any connection.

22. *Passenger booking.*—At Mettupalaiyam, Kullar, Adderley, Hillgrove, Runnymede and Coonoor all necessary facilities and conveniences have been supplied. Indeed the conveniences at Coonoor are quite super-excellent; waiting-rooms, lavatories, kitchen, dining-room, &c., having all been arranged to afford a fitting welcome in the English climate to the fagged traveller from the plains below. The stairs at Coonoor leading up to the waiting-room are shaky and unfinished; they might be tidied up a bit. At the minor stations it will be necessary to level up the ballast with cinders to rail top for passengers to walk about.

23. *System of working.*—The line will be worked on the absolute block system with Winter's telegraph instruments and electric starter and the manuscript line-clear ticket. Under the Madras Railway Company's customary manner of working, where the station limits are not included in the block, the block will consist of the section lying between outer main semaphores, or between stop notice boards, or between outer main semaphore and stop notice board, as the case may be, outside the stations.

There is a certain confusion in the use of the terms *up* and *down* trains on this mountain line, for the public naturally attach to these terms the idea of *uphill* or *downhill*, whereas trains towards Madras are in the Railway Company's time-table called *up* and those from Madras *down* trains. In the working rules, therefore, the mountain trains are spoken of as *A*, or *ascending*, and *D*, or *descending*, trains. At passing stations descending trains are timed to arrive three minutes before ascending trains, so as to leave time for backing the ~~latter~~ into the lay-by. The ascending train keeps the main line. I do not like this arrangement for two reasons: (a) because it is hard on an ascending train to stop her within 50 yards of her goal, when, presumably, she has barely enough steam left to carry her through; and (b) because there is a certain risk in letting a descending train come 50 yards downhill from the station in the face of an ascending train. It might be preferable that the ascending train should be given free precedence into the siding, and only be let out of it when the descending train has cleared the station by, say, one or two minutes. But it is the ascending and not the descending train that wants to water, and therefore water should be obtainable on the train siding. This suggested change of system is, in my opinion, deserving of careful consideration.

The brakemen on all vehicles are servants of the Locomotive Department and not of the Traffic Department. The guards have orders to assist the brakemen when called on by them to do so. I have approved of the rules proposed by the Madras Railway Company for the working of trollies.

24. *Engine and goods sheds.*—The engine sheds at Mettupalaiyam and Coonoor are amply large enough for two engines each, but can accommodate four at a pinch. Accommodation for goods at both termini also is ample and excellent.

25. *The rack and pinion.*—Each of the two steel bars forming the rack has a section of 110 × 22 mm. The pitch of the teeth is 120 mm. and the pitch line is about 20 mm. below top of bar. The two bars have a space of 1½ inches between them. The slope with the vertical of the rack tooth at pitch line is 1 in 4. The radius of pitch circle of pinion is 286.48 mm. There is a pair of pinions keyed on to the rack shaft to correspond with the pair of rack bars. The rack teeth break pitch. The rack is entered by a piece 40 ft. 10 in. long, hinged at the inner end and floating on springs throughout, the top of the teeth at the entrance end being gradually sloped off to nothing.

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18. *Road-crossings.*—Wherever cart traffic exists on a cross road the level-crossing is gated and manned. Except at Coonoor itself and at one place below Kullar, both on adhesion parts of the road, the railway is not crossed by a carriage road. At small paths from the coffee estates suitable ramps have been made between rail and rack, and overhead foot-bridges have been made at three or four places.

19. *Fencing.*—Except at Coonoor station the line is nowhere fenced. Fencing is not necessary anywhere above Kullar. I, however, am certainly of opinion that it will be desirable to fence the Mettupalaiyam-Kullar section as soon as funds are available, for cattle constantly stray over it, and there is danger of derailment of trains with brakevan or with engines devoid of cow-catchers running foremost. There is a sort of a pretence at present of an alga fence, but that is no use; a five wire fence should be provided. This, however, need not delay opening. Mile and quarter mile-posts are completed, and every chain is marked with painted figures on the ballast walls. The mileages run up from Mettupalaiyam and the chainage (100 ft. chains) runs down from Coonoor.

20. *Rolling Stock.*—This at present consists of the following: 4 engines, 4 first class cars, 4 composite second and third class cars, 4 brake-vans, 16 low-sided waggons. All cars are on bogies. The first-class tares 11t. 5c. and carries 27 passengers. The composite tares 10t. 12c. and carries 11 second-class and 36 third-class passengers. Mean tare under 6 cwt per passenger. The brake-van tares 10t. 7c. The waggon tares 6 tons and carries a paying load of 22 tons. Nets are wanted in the carriage racks. The engines are said to burn about 30 cwt. of patent fuel per trip; but the fuel has been 20 or 30 years in India and has probably lost many of its virtues; 1,500 tons of new patent fuel has now been got out from England. The engines which have only 750 square feet of heating surface, and which I consider ought to have 900 to 1,000, do not make steam fast enough and have not yet hauled a full load of three loaded vehicles up the ghât. They may perhaps do so when the rack and rails have been more run over and when all is working smoothly and with best-best fuel and very intelligent driving: but still the margin is too small, and they ought to make more steam. With the best of the four engines in October last I took two fully-loaded vehicles and a brake-van, in all 67 tons 14 cwt. or with the engine about 100 tons, up 500 feet vertical height on the 8 per cent. gradient at about 4 miles per hour. This was the very utmost the engine could do at 175 to 180 lb. pressure. The application of the injector knocked the steam pressure hopelessly down. Experiments are being tried with re-spacing the fire-bars, road resistance will improve, men will learn to fire better, and the new fuel, and oil fuel which have now been laid on, will improve the steaming, and perhaps better loads may be hauled; but at present on a three-mile ascent of 1 in 12½ with 328 feet curves and with fairly good driving, the engines can in practice do only about two-thirds of the work that they were expected to do.

21. *Signals.*—At Mettupalaiyam the signals have now been satisfactorily arranged, and there is an electric starter.

At Coonoor entrance to the yard is governed by a squarearmed outer main (so-called "distant") signal. This is 700 feet from centre of platform. On the platform is a "calling on" semaphore. But a train length beyond the outermost facing points is a stop notice board. When the outer main is lowered trains may

come up to this notice board, but may not pass it until the platform, or "calling on" signal is lowered. The object of this is to allow of shunting being done if necessary out on the main line while trains are approaching. There is also an electric starter.

At Kullar, Adderley, Hillgrove and Runnymede stations the only signal, besides the two electric starters, is a double-armed platform semaphore; but at a train length outside each end of the unracked part of the yard, or in the case of Kullar at a train length outside the facing points at both ends of yard, stop notice boards have been erected. Every train must by order stop dead at these notice boards until admitted into the yard by the platform semaphore. At every point of entry on the rack there are notice boards to ensure that pinions shall not be braked, as a heavily braked pinion may mount and injure the rack on entry. Drivers will soon get into the trick of this, but rack entries have already been a little knocked about. All semaphore arms have been designed to fly to danger on the breakage of any connection.

22. *Passenger booking.*—At Mettupalaiyam, Kullar, Adderley, Hillgrove, Runnymede and Coonoor all necessary facilities and conveniences have been supplied. Indeed the conveniences at Coonoor are quite super-excellent; waiting-rooms, lavatories, kitchen, dining-room, &c., having all been arranged to afford a fitting welcome in the English climate to the fagged traveller from the plains below. The stairs at Coonoor leading up to the waiting-room are shaky and unfinished; they might be tidied up a bit. At the minor stations it will be necessary to level up the ballast with cinders to rail top for passengers to walk about.

23. *System of working.*—The line will be worked on the absolute block system with Winter's telegraph instruments and electric starter and the manuscript line-clear ticket. Under the Madras Railway Company's customary manner of working, where the station limits are not included in the block, the block will consist of the section lying between outer main semaphores, or between stop notice boards, or between outer main semaphore and stop notice board, as the case may be, outside the stations.

There is a certain confusion in the use of the terms *up* and *down* trains on this mountain line, for the public naturally attach to these terms the idea of *uphill* or *downhill*, whereas trains towards Madras are in the Railway Company's time-table called *up* and those from Madras *down* trains. In the working rules, therefore, the mountain trains are spoken of as A, or *ascending*, and D, or *descending*, trains. At passing stations descending trains are timed to arrive three minutes before ascending trains, so as to leave time for backing the latter into the lay-bye. The ascending train keeps the main line. I do not like this arrangement for two reasons: (a) because it is hard on an ascending train to stop her within 50 yards of her goal, when, presumably, she has barely enough steam left to carry her through; and (b) because there is a certain risk in letting a descending train come 50 yards downhill from the station in the face of an ascending train. It might be preferable that the ascending train should be given free precedence into the siding, and only be let out of it when the descending train has cleared the station by, say, one or two minutes. But it is the ascending and not the descending train that wants to water, and therefore water should be obtainable on the train siding. This suggested change of system is, in my opinion, deserving of careful consideration.

The brakemen on all vehicles are servants of the Locomotive Department and not of the Traffic Department. The guards have orders to assist the brakemen when called on by them to do so. I have approved of the rules proposed by the Madras Railway Company for the working of trolleys.

24. *Engine and goods sheds.*—The engine sheds at Mettupalaiyam and Coonoor are amply large enough for two engines each, but can accommodate four at a pinch. Accommodation for goods at both termini also is ample and excellent.

25. *The rack and pinion.*—Each of the two steel bars forming the rack has a section of 110 × 22 mm. The pitch of the teeth is 120 mm. and the pitch line is about 20 mm. below top of bar. The two bars have a space of 1¼ inches between them. The slope with the vertical of the rack tooth at pitch line is 1 in 4. The radius of pitch circle of pinion is 286.48 mm. There is a pair of pinions keyed on to the rack shaft to correspond with the pair of rack bars. The rack teeth break pitch. The rack is entered by a piece 10 ft. 10 in. long, hinged at the inner end and floating on springs throughout, the top of the teeth at the entrance end being gradually sloped off to nothing.

With a view to relieving goods trains of having to carry a brake-van little cabooses have been erected on the forward end of four of the waggons, for use by a brakeman and guard, and a vacuum brake release handle has been given in the caboose. This will greatly improve the carrying capacity of the goods trains.

27. *Locomotives*.—The locomotives are six wheeled, the lower, or down-hill two pairs being coupled. The wheel base is 10 feet, of which 3' 6" is between the coupled wheels. Length over buffers 24 feet. The loads on the wheels are $11\frac{1}{2}$ tons on each pair of coupled and 10 tons on the pair of uncoupled wheels, total 33 tons in steam and coal. Wheels are 2' 8" diameter. Midway between the non-coupled and the inner pair of coupled wheels are two pairs of rack pinions in tandem, 2' $5\frac{1}{2}$ " apart, driven by a third pinion keyed on a crank axle. This crank axle is driven by a pair of cylinders $10\frac{3}{4}$ " diameter $\times$ 14" stroke inside the main frames of the engine. Outside the main frames and in line with the rack cylinders is a second pair of cylinders 13" diameter $\times$ 16" stroke which drive the adhesion wheels. The boiler, which is 8' 4" long in the barrel, has a tilt of 1 in 20. There are tanks and coal bunkers. The over-all breadth of the engine is 8' 6" and its height over chimney 10' 6". The heating surface is, I am informed, 750 square feet, which in my opinion is insufficient, as even with the best fuel and the best firing there ought to be a larger margin of steaming power for the grades, curves and loads for which the locomotives were designed. The grate area is, I am told, about 16 square feet.

28. *Coaching stock*.—These are all built on similar under-frames, 22' 6" between centres of bogies, 4' 2" wheel base. Wheels 2' 3½" diameter. Length over buffers 37½ feet. Over-all breadth of cars at sun-shades 7' 10", and at floor level 7' 4"; height 11' 2". The first-class cars seat 27 passengers; the composites seat 11 second class and 36 third; the guard's van has 14 lineal feet of seating and 24 square feet of flooring for native servants. The height of all buffer centres, unloaded, is 1' 11". Journals of all stock are 5' 1" centres. All passenger cars are of the vestibule sort, entered at the end, with steps about 1' 2" and 2' 2" above rail level. The luggage compartment in centre of guard's van is 15' 7" × 6' 4", and about 7' 3" high.

29. *Conclusion.*—I recommend that permission be granted for the railway to be opened for passengers at a speed not exceeding 8 miles per hour on the Kullar-Coonoor section, and 20 miles per hour on the Kullar-Mettupalaiyam section. When fencing is completed on this latter section speed can be increased if desired. This recommendation is for daylight running only.

OOTACAMUND,
7th June 1899.

FRANCIS J. E. SPRING,
Senior Govt. Inspector of Rys., Madras.

Drailments. —

29. ^{He} The inspection report given to ^{Hicks} giving, a very suitable opportunity for a reference to ^{the subject of discharge} ~~the subject of discharge~~.

^{Subject of}
A somewhat serious importance in a mountain valley, ~~the~~ ^{step} ~~valley~~, about a year ago I

Wrightman spoke to me ^{rather} ~~anxious~~ ^{answering} about a derelict of an engine; he attributed it to the entire engine having moved so far toward the outside of a curve that the ^{of the two} inner ^{where teeth alternate} pinions mounted the teeth of the outer of the two racks. Some experiments were suggested for measuring the actual movement of the pinions on a curve, and we came to the conclusion, ~~on~~ the result of the experiment, that the ~~actual~~ ^{not,} movement is ^{not,} and cannot be, nearly enough to cause mounting. Further investigation satisfied us that as the

derailment had occurred just off the abutment of a bridge where there was a few yards of bank. There must have been some slight misalignment of the running wheel sufficient to cause derailment.

The next derailment I heard of, which occurred on Aug 20th 98, was undoubtedly caused by the unevenness of the road bed ^{near} the end of the section then being plate-laid, where ballast was deficient. This particular derailment occurring as it did to H. R. the Governor's special train attracted some public attention. In Wightman's ^{then} admission to me that there had been ^{since the first one mentioned above,} several similar ones.

On the day of this inspection, 7th June 99, on the return or ascending journey, a serious
 similar derailment occurred a couple of miles below Coomoo, at a place where a few yards of
 bank filled in the gap between a bridge abutment and a cutting. A few months ago in the N.E. monsoon
 a retaining wall at this spot had given way, so the bit of bank was new, and the road was
 undoubtedly slightly, though very slightly, irregular; ~~and~~ the outer engine fore-wheel ^{mounted} ~~rested~~ at
 in a sharp curve. In all previous cases too it was, I understand, the outer engine fore-wheel that
 mounted on a curve.

A little consideration will show that a descending engine, before a train, and propelled forward by that train's weight, is in a very different position in regard to the probability of the mounting of its outer fore-wheel on a curve than is an ascending train pushing its load in front of it. The transmission of the thrust through the central buffer will in the former case tend to push the pair of fore-wheels central to the rails, while in the latter case the tendency will be quite the other way, viz. to make the outer fore-wheel mount the outer rail of the curve. An experiment with a toy train on a table, or with a couple of books on the table will show what I mean.

The conclusions to which I have come are, (a) that the derailment of a descending train is extremely unlikely to happen; (b) that derailments are less likely to occur on a bridge than anywhere else, owing to the perfection of the roadbed; (c) that derailments in cuttings also are very unlikely, as the roadbed will usually be good; (d) that ^{derailments are} the most likely ^{to occur on} ~~the~~ ^{the} short bits of track intervening between bridges and cuttings where earthworks ^{may} ~~intervene~~ have settled a little, and especially where curves exist, and almost always to ascending trains.

Therefore maintenance gangs should pay special attention to these places, and moreover I would recommend that rails should be made to break joint at these places - that their ~~ends~~ ^{curves} should be specially attended to, and that the joints of outer curve rails at such places should be made especially unyielding and unangular. I do not believe that occasionally greasing the inner edge of these few places would appreciably affect adhesion for the whole engine does most of the work.

To

Sinla
works

From

Mittapallin
Madras works Railway

1 Please	2 read	3 madras	4 Sinor
5 Ensuper's	6 report	7 inspection	8 Nilgiri
9 railway	10 prior	11 15	12 opening
13 for	14 Passengers	15 Dated	16 fourteenth
17 October	18 1898	19 also	20 report
21 accompanying	22 this	23 Government's	24 proceedings
25 463	26 railway	27 Sender's signature	28 Date
29 1899	30 Senior	31 Inspector	32 Has
33 now	34 completed	35 inspection	36 and
37 finds	38 all	39 matters	40 stipulated
41 for	42 in	43 the	44 Paragraphs
45 29	46 and	47 all	48 essential
49 in	50 Para	51 30	52 of
53 report	54 of	55 Sender's signature	56 Date
57 October	58 fourteenth		

1 1898	2 also	3 matters	4 referred
5 to	6 in	7 Paragraph	8 Seven
9 report	10 dated	11 April	12 Sixth
13 1899	14 have	15 been	16 done
17 and	18 recommends	19 immediate	20 opening
21 for	22 all	23 Traffic	24 on
25 Condition	26 laid	27 Sender's signature	28 Date
29 down	30 Paragraph		

1 31	2 of	3 report	4 October
5 fourteenth	6 this	7 government	8 recommends
9 permission	10 be	11 accorded	12 up
13 wire	14 for	15 immediate	16 opening
17	18	19	20
21	22	23	24
25	26	27 Sender's signature	28 Date
29	30	31	32

Received from

Sent to

7/6/99

7/6/99

7/6/99

89

Public Works (1897) Department.

P.W.R.
CURRENT No. 763

Order

From The Govt of India

Vol No. 1099 R-c

Dated 9th June 1899

Received 10th do

Registered do

Enclosures

Spare copies

SUBJECT.

Milgiri Railway

Sanctioning the opening of
— for public carriage
of passengers on certain
conditions & requesting to
intimate by wire the actual
date of opening

100. 25. INDIAN JOURNAL OF TELEGRAPHS. Monthly
Class. Number. }

To Madras From Shimla
(Office) (Office)

Words	Day	Hour	Minute	Official
56. 13.	9	17	47	offd

To From
(Person) works. Railway works.
To be deposited.

Wm. No. 24.

No

SERIAL

No.

Madras, Dec 10 - June 189

From

THE SENIOR GOVERNMENT INSPECTOR OF RAILWAYS,
MADRAS.

To

THE AGENT AND MANAGER, M. Ry

~~S. I. Rx.~~

H. H. THE N. G. S. Ry.

AND CHIEF ENGR., N. Ry.

S. M. Ry.

ENGR-IN-CHIEF, B. M. Ry.

~~MANAGER, E. C. Ry.~~

SECRETARY TO THE GOVT. OF INDIA.

Reply No.

dated

SIR,

SIR,

You are hereby authorized to open the Nilgiri Railway for all Traffic ^{during absence of} at speeds
not exceeding ²⁰ ~~3~~ miles per hour on the Portapollin-Kuller section ~~to~~ 8 miles
per hour on the Kuller-Cooman section. ~~W~~ Stock on the Kuller Cooman section
must be fully broken in described in para 15 of my Report dated 14th Oct. 98

2 - The sanction for opening for all traffic hereby conveyed to you is subject to the understanding that the Nilgiri Railway Company's guarantee holds good only during so many days in each half year ^{as} though looking ^{after} between Metropolitan and Common in maintenance for all traffic in spite of breaks and interruptions. ~~and that the railway is not to be held responsible for the~~
~~any of the breaks and interruptions in the traffic.~~ The guarantee will be in abeyance during so many days in each half year as though looking is not maintained. In this connection you proposed in invoice of June 13 & 16 enclosing of my Report dated 6th April 99, which went to you with ^{and without} S.D. No. 464-3.
dated 24th April 99

3. I have the honor to request that you will intimate to me
 the actual date of opening.

I have &

7/15

9/6/99

Despatched on 16/6/99
 Wm. J. Smith

To be registered

Code
 Class.

INDIAN



TELEGRAPHS

Monthly
 Number.

To
 (Office)

Botacamund

From
 (Office)

Rangapuram

Words.

Day.

Hour.

Minute.

Official
 Instructions.

To
 (Person)

Consulting

From
 (Person)

St. And

Madras Railway

m.

Engineer for Rly

32 Word Form.

Nilgiri railway opened for
 traffic today.

Recd. from

LN.

Sent to

LN.

At

Hrs.

Mis. by

At

Hrs.

Mis. by

Telegraph Master.

CCP- No. 201 T-17 9 97-2000000

Telegram State 8/4

From R

to works Simla

No 13.A - Nilus (Nilgiri R) opened for traffic
 anserine (15th instant)

Despatched on 16/6/99

Note

After dispatch of the telegram to
 India the paper will be sent to
 Madras to be enclosed in the
 f.o. embodying the instruction
 re: sent to Press on the 14th inst.

16.6.99

On outer cover of the f.o.

Opening ~~the~~ the Valparaiso Railway for all traffic.

preceding report and correspondence on the subject of _____,
and forwarding a copy of the proceedings to the Govt. of India.

and they were 2 & 2.

No. Ditt.

Order Records. A copy of these Proceedings will be forwarded to the
Govt of India.

Files

N. Dutcher

Forward.

7th

L. N. Agre & Son R.C.

Secretary & the Board of
" ~~Massachusetts~~ Insurance, Niagara B. C. 18. St. Helen's place. London.

" " Port Hunter Island.

th " " Examined P. W. Coats.

Proceedings of the Madras Government
Read again the following

Print

1. Letter to the Government of India from the Senior Govt Inspector of Ry. No. 2903 dt 21.10.98

Copy to the Agent & Managers, In Ry

" " " " Ch. Engr. Nilgiri Ry

under Enst. No. 2904 dt 21.10.98

Print

2. Letter from India No. 1772 R.C. dt 15.11.98

Print 3. Inspection Report dt 7.6.99

Print 4. Telegram to India No. 12A dt 7.6.99

Print 5. " from India No. 1099 R.C. dt 7.6.99

Print 6. Letter from the Senior Govt Inspector of Ry. to the Agent & Managers, In Ry. No. 87 dt 10.6.99

7. Leave Small Space

Order No. Ry dt June 1899

Recorded. A copy of these Proceedings will be forwarded to the Govt of India.

Sd/ Francis J.E. Spring
Joint Secretary

Enst. No. Ry dt June 1899

Forwarded

Sd/ Francis J.E. Spring
Joint Secretary

- The Agent & Managers, In Ry
- " Secy to the Bd of Directors, Nilgiri Ry Co., 18, St. Helen's place, London.
- " Postmaster General
- " Examiner, P.W. accounts
- " " Ld Ry accts.
- " Consulting Engineer for Ry
- " Editor's table

Go No. 1521 R.C. dt 10.12.98.
463-64 R.C. dt 24.4.99.

No. 692. Ry. 23? JUNE 1899.

Proof for approval.
The known officials have not returned the originals.
Issue urgent.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read again the following papers :—

From—The Senior Government Inspector of Railways.
To—The Secretary to the Government of India, Public Works Department.
Dated—21st October 1898, No. 2903.

[Copy to the Agent and Manager, Madras Railway, to the Agent and Chief Engineer, Nilgiri Railway, under endorsement No. 2904, dated 21st October 1898.]

I have the honour to enclose a copy of my report, dated 14th October 1898, on an inspection made of the Nilgiri Railway with a view to ascertaining whether it is fit to be opened for passenger traffic.

I recommend that the line be permitted to be opened for all traffic when the Agent, Madras Railway Company, shall have certified that the matters referred to in paragraph 29 of the report have been completed, and shall have promised that the matters referred to in paragraph 30 will be attended to at an early date.

I beg to enclose the usual certificates, plans, &c.

From—The Secretary to the Government of India, Public Works Dept.
To—The Joint Secretary to the Government of Madras, P.W. Dept., Ry. Branch.
Dated—Simla, 15th November 1898, No. 1772 R.C.

With reference to letter No. 2903, dated 21st October 1898, from the Senior Government Inspector of Railways, Madras, submitting a copy of his report on an inspection made of the Nilgiri Railway with a view to ascertaining whether it is fit to be opened for passenger traffic, I am directed to say that His Excellency the Governor-General in Council is pleased, under sections 18 and 19 of the Indian Railways Act of 1890, to sanction the opening of the Nilgiri Railway for the public carriage of passengers on the conditions stated in paragraph 31 of the Senior Government Inspector's report and for stock fully braked as described in paragraph 15 of the report, when (after further inspection) the Senior Government Inspector has satisfied himself that the details to which he refers have been put right, and that the damages done by the late rains and falling rocks, reported in your telegram noted in the margin, have been repaired and made safe.

No. 40 B., dated 31st October 1898.

2. I am to request that a report may be made of the actual date of opening the railway.

G.O., No. 1521 Ry., dated 10th December 1898.

No. 463-64 Ry., 24th April 1899.

NILGIRI RAILWAY.

METRE GAUGE, 16.90 MILES.

Report of an Inspection, prior to opening for passenger traffic, by the Senior Government Inspector of Railways, Madras, on the 7th of June 1899.

Under an agreement which has been entered into between the Madras Railway Company and the Nilgiri Railway Company the latter Co.'s rack line is to be worked by the former Company at an agreed percentage under all revenue account heads, except maintenance for which actuals will be charged. The Government of India guarantee gross earnings up to Rs. 2,00,000 per annum.

2. *Gradients and Curves.*—The Nilgiri Railway starts from Mettupalaiyam terminus of the Podanur-Mettupalaiyam branch of the Madras Railway, at a height of 1,071.00 above mean sea level. Then, after dropping to 987.00 at the Bhavani river at the 1st mile, it rises to 1,250.28 at Kullar, mile $4\frac{2}{3}$, the actual foot of the rack ascent. Up to here the line is an ordinary adhesion railroad. From Kullar the next 12 miles to Coonoor, 5,613.33 feet above sea level, is a continuous rack ascent, with short level bits at the three intermediate stations. The mean gradient from Kullar to Coonoor is about 1 in $14\frac{1}{2}$ for 12 miles; but the gradients vary a good deal, there being nearly 7 miles of 1 in $12\frac{1}{2}$, or 8 per cent. gradient. About 9 out of the 17 miles consist of curves, and $5\frac{1}{2}$ miles of these curves have a radius of only 328 feet. Throughout the greater part of the ascent the work is of a very heavy character, the railway clinging to the precipitous side of the same valley through which, for many years past, the Nilgiris have been ascended by means of an excellent metalled road. There are no reversing stations.

3. *Stations.*—Mettupalaiyam is a Madras Railway Company's station, and having for years formed the terminus of that Company's system in the direction of the Nilgiris, it is supplied with very ample accommodation. Much of this will now fall out of use, especially if the gauge of the Podanur-Mettupalaiyam branch is changed to the metre, as strongly recommended by the Government of Madras and as it most certainly ought to be. The village of Mettupalaiyam owes its existence to the carting trade on the hill road, and it is reasonable to suppose that, when the chief occupation of its inhabitants shall have ceased owing to railway competition, it will become a place of very small importance. Kullar is, and probably always will be, little more than a name; it will do no traffic; it merely marks the foot of the mountain ascent, is a crossing station, and is of course an important watering station. Adderley, Hillgrove, and Runnymede, the intermediate stations, are all of great importance as watering and crossing stations. They will all do some traffic for the neighbouring coffee estates. Coonoor, the terminus of the section of the Nilgiri Railway which has so far been brought to completion, is a station of great importance, not only in itself, for Coonoor is a thriving European and native settlement and Wellington cantonment is close by, but also because for the present, pending further extension, it is the terminus where goods and passengers take the road to Ootacamund, a large European and native settlement, 11 miles further up the hill, at a height of between 7,000 and 8,000 feet above sea level and the summer head-quarters of the Madras Government.

4. *Formation.*—Some very heavy work has been done, since the severe slips of the north-west monsoon of 1898, in flattening the slopes of the cuttings. I do not venture to say that there will no longer be slips; indeed there will almost certainly be heavy slips whenever rain falls for a few hours continuously at the rate of over half an inch per hour. Slips will doubtless go on more or less for some years to come until all weak places have been found out. But the money that has recently been spent will, in my opinion, have greatly reduced the risk of lengthy obstruction of running. The actual road bed is everywhere now in good order. There are nowhere any signs of slipping or settlement of road bed. Of the three troublesome cuttings

mentioned in last April's inspection report, that at Glenmore, chain 97 to 100, seems at last to be about as safe as it can be made, a new and very heavy retaining wall with well drained backing having been built at great expense. The original cutting through the land slide at chain 264 is now full of debris, but the diversion round the outside of it seems likely to be permanently safe. The three great boulders sticking out of the clay hill side at chains 410—412 seem safe enough at present, a very heavy retaining wall having been built beneath them; this retaining wall will form one side of a cut-and-cover tunnel, of which the foundation of the outer wall is now up to rail level; the remainder of the work will go on without interruption of traffic.

5. *Tunnels.*—These seem everywhere in very good order now, lining having been added when necessary. In the Adderley tunnel concrete lining over bent rails is still in progress. Everywhere doubtful places in the tunnel roofs have been made as sound as seemed necessary.

6. *Bridges.*—The girders have been designed in accordance with the Government of India's conditions, viz., double moving load added to dead load and wind pressure, with a unit stress intensity of 9 tons per square inch. The only exception is the 100 ft. girders of the Bhavani bridge which were designed, under the Rules of 1892, for a dead and a non-doubled moving load, and with a unit stress intensity of six instead of nine tons. All girders are, I consider, sufficiently strong for the present 33-ton engines and 28-ton loaded vehicles, with over-all lengths of 24 and 34 ft., respectively. When I inspected in October last the girders on the lower part of the line were generally well finished off in detail, well bedded, anchored and braced; but on the upper few miles where work had been somewhat rushed at the end, less careful finish was observable; girders were still unanchored, and no provision had been made to prevent their creeping down hill under the stress of the pull on the rack. Then again curve superelevation, instead of being given in the girder bedding, had been effected in many cases by small packing pieces under the sleepers. These little details if left unfinished on an ordinary railway do not much matter, but on a rack line it is impossible to make such things too good. All this has now been made good and great attention has been paid to every little detail.

7. *Ballast.*—This is everywhere very good and plentiful. I was assured in October last that there are everywhere 12 inches of ballast beneath the sleepers and 6 inches between them. It is everywhere held in between dry stone ballast walls, 12 feet wide over all. The ballast is all clean broken granite, the lower 6 inches being 4 inch cube, and the rest 2 inch cube.

8. *Permanent-way.*—Rails are 50 lb. steel, flat footed, 28.14 feet long on the straight, held down by single spiking except at joints where the outer spikes are double. The rails are fastened with deep angle iron six bolted fish-plates weighing 40 lb. per pair. The sleepers are Pyngadu, spaced 2 feet $6\frac{1}{8}$ inches apart. Size $8\frac{1}{2} \times 8 \times 6$. The rack is a double plate Abt steel rack, on cast iron chairs, weighing 90 lb. per yard. The length of the rack bars is that of 4 sleeper spaces; the bars break joint.

9. *Vertical curves.*—All gradient junctions have been rounded off by vertical curves of such a radius that their tangents are 200 feet long, that is the curves have generally a radius of 4,000 to 5,000 feet. This is less necessary on an ordinary adhesion line than on a rack railway where a sudden change of grade might cause the pinion either to jam or to ride the rack.

10. *Break in continuity of the rack.*—There is no rack on the short piece of level at the stations, and as speeds are necessarily slow on leaving a station, there will usually be no difficulty in the pinion putting itself in gear when entering the rack, with the aid of the spring tongue-piece. If however the rack brake is on when the pinion is trying to gear itself, the pinion will ride and may do mischief; indeed some of the rack entrances have been a bit knocked about by inexperienced drivers. When I inspected in October last there was a short piece of about 400 or 500 feet of rack at 94, near the Karteri bridge two miles below Coonoor, where the provision of a rack had, unwisely I think, been considered superfluous. The result was that drivers were obliged to look out for the place and to slow down and to go through all the manipulations for disengaging and engaging the rack and for synchronising the rack and

adhesion engines, precisely as at a station. This was a very great nuisance, and might conceivably be productive of accident. The missing length of rack has now been filled in.

11. *Station lay-byes and sidings.*—The terminal stations, Mettupalaiyam and Coonoor, have all they require in the shape of through sidings and dead ends. Kullar has a run round and a dead end. The intermediate stations, Adderley, Hillgrove and Runnymede, have short sidings to allow trains to pass, and short dead ends off these, furnished with a slip switch, for a standing vehicle.

12. *Creep.*—I am informed that though trains have been running on the steep parts of the road for more than a year, no creep has as yet been detected. The deep fish-plates butt against the sleepers and these being, in turn, firmly bedded in the ballast make creep seem impossible; for if rails are to creep they must drag with them not only sleepers but six inches of ballast also.

13. *Buffer stops, &c.*—I saw none anywhere on the line except at Mettupalaiyam. They might, with advantage, be supplied at the dead end sidings and so save damage to rolling-stock. Scotch-blocks, safety chains, and point-locking bolts have I believe been everywhere supplied.

14. *Safety sidings.*—These have all been cut out, and very properly, for they were only smashing sidings, and most dangerous.

15. *Brakes.*—The engines are furnished with the Chatelier brake on both rack and adhesion cylinders. All engines and all rolling-stock, both passenger and goods, are fitted with the vacuum automatic brake acting on all six engine wheels and on all eight wheels of each vehicle, and applicable at will by either the driver or the guard. The rack pinions of both engines and vehicles are also very powerfully braked, the former by a band and the latter by blocks. The engine adhesion wheels are also fitted with ordinary hand brakes. Appliances have been added for actuating by hand the adhesion brakes of the vehicles also. Thus the whole of the rolling-stock is braked in an eminently efficient manner. A little consideration will make it evident that if a certain engine with a certain steam pressure can haul a certain load up a grade, on a return journey down the grade with a similar load the back pressure in the cylinders when the Chatelier brake is acting can never be as great as the working pressure in the cylinders on the up journey. As a fact trains are worked down the descent almost entirely by the Chatelier brake, the driver keeping one hand on that, and the other on the handle of the vacuum. Thus in an instant he can apply the former on the engine and the latter throughout the whole length of the train, and a blast of the whistle ensures the application of the hand-worked rack brake on every vehicle within the next moment or two. At appendix A of last October's report will be found an account of some brake experiments. It is quite possible in many places throughout the line for the driver or guard to be within 150 feet of a fall of rock or other obstruction before he can see it. On the ascending journey this does not matter, as the stop can be made in one-third of this distance. On the descent, however, at 7 or 8 miles per hour with a heavy train, the available stopping space infringes very offside of a sharp curve, should lean well out and see as far as he can. In places it may be necessary to flatten the slopes on the inner sides of curves, to keep jungle cleared, and in every way to facilitate the look-out; the recent flattening of the slopes of cuttings has improved things a good deal in this respect. There is nothing, however, in all this which need in my opinion cause the opening of the line to be delayed. The management must impress vigilance on all look-out men and must keep up an efficient patrol system.

16. *Patrols.*—Half way between stations there are patrol houses and two patrols. These men carry books and constantly traverse the $1\frac{1}{2}$ mile between their huts and the stations on either side of them. I gave the patrol rules as appendix B of last October's report. If this system is carefully worked it ought to ensure all warning that is practically possible of the occurrence of rock-falls or of slips between the running of trains. Permanent-way gangs working between stations can be concentrated very quickly on a slip.

17. *Train formation.*—The engine is invariably at the down-hill end of the train and the open-ended brake-van at the up-hill end. On the descent the driver and his mate have a full view of the road from the footplate of the engine, while the guard and the brakesman have an equally good view on the ascent. As already stated, the guard or brakesman, equally with the driver or his mate, can in an instant apply the vacuum brake throughout the train, while the whistle ensures the application of hand brakes. Under the working rules an engine must be kept below any and every vehicle removed from a lay-bye on the ghât. These precautions as well as the provision at lay-byes of scotch-blocks, wheel chains and slip switches, are calculated to make it next door to an impossibility that a vehicle should escape down the hill. If, owing to the derailment of its engine, a vehicle is being hauled instead of being pushed up the hill by another engine and if, owing to the fracture of its coupling, it starts to run away, it cannot run many yards if manned in accordance with the rules, for its brakesman can always stop it instantly by applying his hand rack-brake.

18. *Road-crossings.*—Wherever cart traffic exists on a cross road the level-crossing is gated and manned. Except at Coonoor itself and at one place below Kullar, both on adhesion parts of the road, the railway is not crossed by a carriage road. At small paths from the coffee estates suitable ramps have been made between rail and rack, and overhead foot-bridges have been made at three or four places.

19. *Fencing.*—Except at Coonoor station the line is nowhere fenced. Fencing is not necessary anywhere above Kullar. I, however, am certainly of opinion that it will be desirable to fence the Mettupalaiyam-Kullar section as soon as funds are available, for cattle constantly stray over it, and there is danger of derailment of trains with brakevan, or with engines devoid of cow-catchers, running foremost. There is a sort of a pretence at present of an aloe fence, but that is no use; a five wire fence should be provided. This, however, need not delay opening. Mile and quarter mile-posts are completed, and every chain is marked with painted figures on the ballast walls. The mileage runs up from Mettupalaiyam and the chainage (100 ft. chains) runs down from Coonoor.

20. *Rolling Stock.*—This at present consists of the following: 4 engines, 4 first class cars, 4 composite second and third class cars, 4 brake-vans, 16 low-sided waggons. All cars are on bogies. The first-class tares 11t. 5c. and carries 27 passengers. The composite tares 10t. 12c. and carries 11 second-class and 36 third-class passengers. Mean tare about 6 cwt. per passenger for 3rd class only, about 3 cwt. The brake-van tares 10t. 7c. The waggon tares 6 tons and carries a paying load of 22 tons. Nets are wanted in the carriage racks. The engines are said to burn about 30 cwt. of patent fuel per trip; but the fuel has been 20 or 30 years in India and has probably lost many of its virtues; 1,500 tons of new patent fuel has now been got out from England. The engines which have only 750 square feet of heating surface, and which I consider ought to have 900 to 1,000, do not make steam fast enough and have not yet hauled a full load of three loaded vehicles up the ghât. They may perhaps do so when the rack and rails have been more run over and when all is working smoothly and with best-best fuel and very intelligent driving: but still the margin is too small, and they ought to make more steam. With the best of the four engines in October last I took two fully-loaded vehicles and a brake-van, in all 67 tons 14 cwt. or with the engine about 100 tons, up 500 feet vertical height on the 8 per cent. gradient, at about 4 miles per hour. This was the very utmost the engine could do at 175 to 180 lb. pressure. The application of the injector knocked the steam pressure hopelessly down. Experiments are being tried with re-spacing the fire-bars, road resistance will improve, men will learn to fire better, and the new fuel, and oil fuel which has now been laid on, will improve the steaming, and perhaps better loads may be hauled; but at present on a three-mile ascent of 1 in 12 $\frac{1}{2}$, with 328 feet curves and with fairly good driving, the engines can in practice do only about two-thirds of the work that they were expected to do. Indeed, I learn that, since the present inspection, on the 19th June, the locomotive *Office of the Superintendent of the Southern Ry. Co. found on a careful test that only 45 tons on the loaded goods cars could be hauled up to Coonoor.*

21. *Signals.*—At Mettupalaiyam the signals have now been satisfactorily arranged, and there is an electric starter.

At Coonoor entrance to the yard is governed by a square-armed outer main (so-called "distant") signal. This is 700 feet from centre of platform. On the platform is a "calling on" semaphore; but a train length beyond the outermost facing points is a stop notice board. When the outer main is lowered trains may

come up to this notice board, but may not pass it until the platform, or "calling on" signal is lowered; the object of this is to allow of shunting being done if necessary out on the main line while trains are approaching. There is also an electric starter.

At Kullar, Adderley, Hillgrove and Runnymede stations the only signal, besides the two electric starters, is a double-armed platform semaphore; but at a train length outside each end of the unracked part of the yard, or in the case of Kullar at a train length outside the facing points at both ends of yard, stop notice boards have been erected. Every train must by order stop dead at these notice boards until admitted into the yard by the platform semaphore. At every point of entry on the rack there are notice boards to ensure that pinions shall not be braked, as a heavily braked pinion may mount and injure the rack on entry. Drivers will soon get into the trick of this, but rack entries have already been a little knocked about. All semaphore arms have been designed to fly to danger on the breakage of any connection.

22. *Passenger booking.*—At Mettupalaiyam, Kullar, Adderley, Hillgrove, Runnymede and Coonoor all necessary facilities and conveniences have been supplied. Indeed the conveniences at Coonoor are quite super-excellent; waiting-rooms, lavatories, kitchen, dining-room, &c., having all been arranged to afford a fitting welcome in the English climate to the fagged traveller from the plains below. The stairs at Coonoor leading up to the waiting-room are shaky and unfinished; they might be tidied up a bit. At the minor stations it will be necessary to level up the ballast with cinders to rail top for passengers to walk about on.

23. *System of working.*—The line will be worked on the absolute block system with Winter's telegraph instruments, electric starters and the manuscript line-clear ticket. Under the Madras Railway Company's customary manner of working, where the station limits are not included in the block, the block will consist of the section lying between outer main semaphores, or between stop notice boards, or between outer main semaphore and stop notice board, as the case may be, outside the stations.

There is a certain confusion in the use of the terms *up* and *down* trains on this mountain line, for the public naturally attach to these terms the idea of *uphill* or *downhill*, whereas trains towards Madras are in the Railway Company's time-table called *up* and those from Madras *down* trains. In the working rules, therefore, the mountain trains are spoken of as *A*, or *ascending*, and *D*, or *descending*, trains. At passing stations descending trains are timed to arrive three minutes before ascending trains, so as to leave time for backing the former into the lay-bye. The ascending train keeps the main line. I do not like this arrangement for two reasons: (a) because it is hard on an ascending train to stop her within 50 yards of her goal, when, presumably, she has barely enough steam left to carry her through; and (b) because there is a certain risk in letting a descending train come 50 yards downhill from the station in the face of an ascending train. It might be preferable that the ascending train should be given free precedence into the siding, and only be let out of it when the descending train has cleared the station by, say, one or two minutes. But it is the ascending and not the descending train that wants to water, and therefore if my suggestion is found workable, water should be obtainable on the train siding. This suggested change of system deserves in my opinion, careful consideration.

The brakemen on all vehicles are servants of the Locomotive Department and not of the Traffic Department. The guards have orders to assist the brakemen when called on by them to do so. I have approved of the rules proposed by the Madras Railway Company for the working of trolleys.

24. *Engine and goods sheds.*—The engine sheds at Mettupalaiyam and Coonoor are amply large enough for two engines each, but can accommodate four at a pinch. Accommodation for goods at both termini also is ample and excellent.

25. *The rack and pinion.*—Each of the two steel bars forming the rack has a section of 110 × 22 mm. The pitch of the teeth is 120 mm. and the pitch line is about 20 mm. below top of bar. The two bars have a space of 1 $\frac{3}{4}$ inches between them. The slope with the vertical of the rack tooth at pitch line is 1 in 4. The radius of pitch circle of pinion is 286.48 mm. There is a pair of pinions keyed on to the rack shaft to correspond with the pair of rack bars. The rack teeth break pitch. The rack is entered by a piece 10' 10" long, hinged at the inner end and floating on springs throughout, the top of the teeth at the entrance end being gradually sloped off to nothing.

26. *Size of waggons.*—Waggons are 19 feet between bogie centres. Bogie wheel-base 4 ft. 3 in. Inside dimensions of floor 7 ft. × 30 ft. Height of floor about 2 ft. 8 in. unloaded. Length over buffers about 34 feet. The sides of the waggons are 12 inches above floor; the ends are 3 ft. 5 in. above floor. Wheels are 2 ft. 4 in. in diameter. The maximum load on a pair of wheels is 7 tons. This information is given chiefly for the use of the Military authorities. Journals are 7 $\frac{1}{2}$ in. × 3 $\frac{1}{2}$ in. The coupling at one end of a vehicle has a hook, and at the other end a screw as in Jones's system; couplings are single-ended, not reversible. The unworn radius of journal fillets is $\frac{5}{8}$ inch. Wheels are shrunk without key or fillet on the full diameter 4 $\frac{5}{8}$ inch axle. Tires are held on by six square-headed $\frac{3}{4}$ -inch bolts, and when unworn are 2 inches thick on the tread.

With a view to relieving goods trains of having to carry a brake-van little cabooses have been erected on the forward end of four of the waggons, for use by a brakeman and guard, and a vacuum brake release handle has been given in the caboose. This will greatly improve the carrying capacity of the goods trains.

27. *Locomotives.*—The locomotives are six wheeled; the two lower, or down-hill, pairs being coupled. The wheel base is 10 feet, of which 3' 6" is between the coupled wheels. Length over buffers 24 feet. The loads on the wheels are 11 $\frac{1}{2}$ tons on each pair of coupled and 10 tons on the pair of uncoupled wheels, total 33 tons in steam and coal. Wheels are 2' 8" diameter. Midway between the non-coupled and the inner pair of coupled wheels are two pairs of rack pinions in tandem, 2' 5 $\frac{1}{2}$ " apart, driven by a third pinion keyed on a crank axle. This crank axle is driven by a pair of cylinders, 10 $\frac{3}{4}$ " diameter × 14" stroke, inside the main frames of the engine. Outside the main frames and in line with the rack cylinders is a second pair of cylinders 13" diameter × 16" stroke which drive the adhesion wheels. The boiler, which is 8' 4" long in the barrel, has a tilt of 1 in 20. There are tanks and coal bunkers. The over-all breadth of the engine is 8' 6" and its height over chimney 10' 6". The heating surface is, I am informed, 750 square feet, which in my opinion is insufficient, as even with the best fuel and the best firing there ought to be a larger margin of steaming power for the grades, curves and loads for which the locomotives were designed. The grate area is, I am told, about 16 square feet.

28. *Couching stock.*—These are all built on similar under-frames, 22' 6" between centres of bogies, and 4' 2" wheel base. Wheels are 2' 3 $\frac{1}{2}$ " diameter. Length over buffers 37 $\frac{1}{2}$ feet. Over-all breadth of cars at sun-shades 7' 10", and at floor level 7' 4"; height 11' 2". The first-class cars seat 27 passengers; the composites 11 second and 36 third class; the guard's van has 14 lineal feet of seating and 24 square feet of flooring for native servants. The height of all buffer centres, unloaded, is 1' 11". Journals in all stock are 5' 1" centres. All passenger cars are of the vestibule sort, entered at the end, with steps about 1' 2" and 2' 2" above rail level. The luggage compartment in centre of guard's van is 15' 7" × 6' 4", and is about 7' 3" high.

29. *Derailments.*—The inspection report prior to opening affords a very suitable opportunity for a reference to the subject of derailments, a subject of somewhat serious importance on a steep mountain railway. About a year ago Mr. Weightman spoke to me rather anxiously about a derailment of an engine; he attributed it to the entire engine having moved so far towards the outside of a curve that the inner of the two pinions mounted the teeth of the outer of the two racks whose teeth alternate on a curve, and we came to the conclusion, as the result of the experiments, that the outward movement is not, and cannot be, nearly enough to cause mounting. Further inspection satisfied us that as the derailment had occurred just off the abutment of a bridge where there were a few yards of bank, there must have been some slight irregularity of the roadway which sufficed to cause derailment. The next derailment I heard of, which occurred on August 20th, 1898, was undoubtedly caused by the unevenness of the road bed, near the end of the section there being plate-laid, where the track was deficient. This particular derailment occurring as it did to His Excellency the Governor's special train attracted some public attention. Mr. Weightman then admitted to me that there had been several similar ones since the first one mentioned above, all in his belief ascribable to insufficient packing of road, and all if I recollect right to ascending trains, and none of them productive of any damage.

On the day of this inspection, 7th June 1899, on the return or ascending journey, a precisely similar derailment occurred a couple of miles below Coonoor, at a place where a few yards of bank filled in the gap between a bridge abutment and a cutting. A few months ago in the north-east monsoon a retaining wall at this spot had given way, so the bit of bank was new, and the road was undoubtedly slightly, though very slightly, irregular; the outer engine fore-wheel mounted at a rail joint in a sharp curve. In all previous cases too it was, I understand, the outer engine fore-wheel that mounted on a curve.

A little consideration will show that a descending engine, below a train, and propelled forward by that train's weight, is in a very different position in regard to the probability of the mounting of its outer fore-wheel on a curve than is an ascending train pushing its load in front of it. The transmission of the thrust through the central buffer will in the former case tend to push the pair of fore-wheels central to the rails, while in the latter case the tendency will be quite the other way, viz., to make the outer fore-wheel mount the outer rail of the curve. An experiment with a toy train or with a couple of books on the table will show what I mean.

The conclusions to which I have come are, (a) that the derailment of a descending train is extremely unlikely to happen; (b) that derailments are less likely to occur on a bridge than anywhere else, owing to the perfection of the road-bed; (c) that derailments in cuttings also are very unlikely, as the road-bed will usually be good; (d) that derailments are most likely to occur on the few short bits of bank intervening between bridge and cuttings where earthwork may have settled a little, and especially where curves exist, and almost always to ascending trains.

Therefore maintenance gangs should pay special attention to these places, and moreover I would recommend that rails should be made to break joint at these places and that their curvature should be specially attended to, and that the joints of outer curve rails at such places should be made specially unyielding and unangular. I do not believe that occasionally greasing the inner edge of these few places would appreciably affect adhesion, for the rack engine does most of the work.

30. Conclusion.—I recommend that permission be granted for the railway to be opened for passengers at a speed not exceeding 8 miles per hour on the Kullar-Coonoor rack section, and 20 miles per hour on the Kullar-Mettupalaiyam adhesion section. When fencing is completed on this latter section speed can be increased if desired. This recommendation is for daylight running only.

OOTACAMUND,
7th June 1899.

FRANCIS J. E. SPRING,
Senior Govt. Inspector of Rys., Madras.

Telegram from—The Joint Secy. to the Govt. of Madras, P.W.D., Ry. Branch.
To—The Secretary to the Government of India, Public Works Dept., Simla.
Dated—Mettupalaiyam, 7th June 1899, No. 12 A.

Please read Madras Senior Inspector's report inspection Nilgiri Railway prior to opening for passengers dated 14th October 1898, also report accompanying this Government's proceedings 463 Ry. April 24th 1899. Senior Inspector has now completed inspection and finds all matters stipulated for in paragraph 29 and all essential in paragraph 30 of report of October 14th 1898, also matters referred to in paragraph 7, Report dated April 6th 1899, have been done and recommends immediate opening for all traffic on condition laid down paragraph 31 of report October 14th. This Government recommends permission be accorded by wire for immediate opening.

Telegram from—The Secretary to the Government of India, Public Works Dept.
To—The Joint Secretary to the Government of Madras, P.W. Dept., Ry. Branch.
Dated—Simla, 9th June 1899, No. 1099 R.C.

Your telegram of 8th instant. Opening of Nilgiri Railway for public carriage of passengers sanctioned on conditions stated in Government of India letter 1772 R.C. 15th November last and on understanding set forth in paragraph 16 of inspection report accompanying your 464 Ry. of 24th April last. Please telegraph actual date of opening.

From—The Senior Government Inspector of Railways, Madras.
To—The Agent and Manager, Madras Railway.
Dated—Ootacamund, 10th June 1899, No. 87/O.

You are hereby authorized to open the Nilgiri Railway for all traffic during daylight only at speeds not exceeding 20 miles per hour on the Mettupalaiyam-Kullar section and 8 miles per hour on the Kullar-Coonoor section. Stock on the Kullar-Coonoor section must be fully braked as described in paragraph 15 of my report, dated 14th October 1898.

2. The sanction for opening for all traffic hereby conveyed to you is subject to the understanding that the Nilgiri Railway Company's guarantee holds good only during so many days in each half-year as through booking between Mettupalaiyam and Coonoor is maintained for all traffic in spite of breaks and interruptions. The guarantee will be in abeyance during so many days in each half-year as through booking is not maintained. In this connection your perusal is invited of paragraphs 13 to 16, inclusive, of my report, dated 6th April 1899, which went to you with endorsement No. 464 Ry., dated 24th April 1899.

3. I have the honour to request that you will intimate to me by wire the actual date of opening.

Telegram from—The Joint Secy. to the Govt. of Madras, P.W. Dept., Ry. Branch.
To—The Secretary to the Government of India, P.W. Dept., Simla.
Dated—Ootacamund, 16th June 1899, No. 13 A.

Nilgiri Railway opened for traffic 15th instant.

ORDER—No. 692. Ry., dated 23rd June 1899.

Recorded. A copy of these Proceedings will be forwarded to the Government of India.

[Here enter No. — Ry., dated — June 1899.]

(True Extract.)

FRANCIS J. E. SPRING,
Joint Secretary.

To the Agent and Manager, Madras Railway.
" the Secretary to the Board of Directors,
Nilgiri Railway Company, 18 St. Helen's place, London.
" the Postmaster-General.
" the Examiner, Public Works Accounts.
" the " Guaranteed Railway Accounts.
" the Consulting Engineer for Railways.
Editors' Table.

ENDORSEMENT—No. 693. Ry., dated 23rd June 1899.

Forwarded.

(By order.)

Joint Secretary.

Ed. T. K. Narayana Aiyangar.

RAILWAY.

Government {1899} of Madras.
PUBLIC WORKS.

Recd.

1899.

Enclosures

Regd.

Spare copies

G.O., Nos. 692, 693. Ry., 23^d June 1899.

JUNE.

Nilgiri Railway

Recording the report & correspondence on the subject of the
opening of the — for passenger traffic on June 15th 1899.

Forwarding a copy of the Prop. and the
report & correspondence on the subject of the opening of
the — for passenger traffic on June 15th 1899.

Form No. 7.

TELEGRAM ~~URGENT~~
~~ORDINARY~~
DEFERRED

SERIAL
No. 46

FROM

To

R.

W
Smith.

40 B. Nilgiri Railway. heavy monsoon caused numerous
ships and in one case 28 foot girders smashed by rocks
from above. Opening for traffic reported impossible before
first January. All ships seem to be debris from above
no subsidence of roadways reported.

7/11
31/10/98

Desd. R.
31/10

D1 For perusal

SKL
JH

Form No. 7.

TELEGRAM

URGENT
ORDINARY
DEFERRED

SERIAL

60

FROM

TO

R.

Madras

Work.
Sind.

Probably date opening Nilus June first

F/S.

6/4/99

No. 1093
6/4/99.

29 B x Post Coy & P.M. G. Madras. substituting
Nilgiri B. for Nilus.

F/S

6/4/99

Despd
6.4.99.

Despatched on 6/4/99

TELEGRAM

URGENT
ORDINARY
DEFERRED

SERIAL

No. 65

FROM

To

R.

Works Smt.

No. 9. A

Plen in para 16 of Inspector report accompanying my 464. Pys.
 dated April 24th 99 and be prepared to pass order on receipt of
 Inspector report Nilgiri Railway prior to opening which I hope to dispatch
 with instant with request for telegraphic permission to open for the traffic.

1/6/99

FWS

1/6/99

No. 20. C

From E.R.

A.M.

See paras 29 and 30 Nilgiri Inspector report October fourteen
 also para 7. Report April sixth. Also draw your Engineer's
 close attention to recommendations in both reports. I hope to
 write to Smt. with instant asking for telegraphic order to
 open if everything is right.

1/6/99

FWS

1/6/99

69214 8235-99

SERIAL
56a

Public Works (1899) Department.

Railway
CURRENT No. 243.

Telephone
From ER. To AM
From The Govt of India
Order India wires
begin. "Hence reports x x"
India office "Ends"
Hence reply urgently.

No. 284 R.C.

7/MS
EA.
18/1/99
desptd 8/11
18/2

Dated 17th February '99
Received }
Registered } 18. 2. 99.
Enclosures
Spare copies

SUBJECT.

Nilgiri Railway

Requesting to report.
by wire probable dates of
opening & completing
respectively of — also.
total average of work done
on the line for the quarter
ended 31st Decr last

13.2.99

FURTHER PAPERS.

Code 735-52 INDIAN  TELEGRAPHS. Monthly
Class. 1 Number.

To <i>Madras</i> (Office)		From <i>Simla</i> (Office)		10750 JOINT SECRETARY	
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To <i>Madras</i> (Person)				From <i>By</i> (Person)	

Recd. fr <u>LN.</u>		Sent to <u>LN.</u>	
At	Hrs. Mts. by	At	Hrs. Mts. by
		AS Telegraph Master	