OBS TIONS

ON

COLONEL COTTON'S PROPOSED SYSTEM

OF

CHEAP RAILROADS

FOR INDIA.

BY

A MADRAS OFFICER.

Ago quod agis—

Nec timido nec temero.

MADRAS:

PRINTED BY MESSRS. PHAROAH AND CO.

ATHENÆUM PRESS, MOUNT ROAD.

1854.

In the following pages reference is made to the London Edition of Colonel COTTON's book upon "Public Works in India."

CONTENTS.

INTRODUCTION.

Mr. Norton, in a Work* lately published in Madras, observes :—"Our mission, here, really is, to teach the Natives to govern themselves; and, whether that shall be sooner or later; our policy, I take it, (to put it upon no nobler motive) is, so to arrange the interim, that when the separation takes place, it may leave upon the minds and recollections of the respective parties, a sense of obligations and benefits conferred, on the one hand; and of duty performed on the other."

I concur entirely in these sentiments;—I think, and indeed I presume we all think, that we have been placed here to educate the people; applying the word in its largest and most liberal sense.

With these views, it has always appeared to me, that men in authority in India, from the highest to the lowest, should regulate all their public acts, with reference to this great object; the leading on the Native population to a higher and more honorable position, among the great family of man.

Many complaints have been made during the late discussion, of evil that has been done; still more, of good that has been left undone. We hear of bad law—oppressive taxation—neglect of public works—and similar neglect in the establishment of Schools. Among these and many other important questions, which have been lately discussed; unquestionably, one of the most important is that of the "Communications:" the means of transport, whether for internal traffic, or for foreign commerce.

* Letter to Robert Lowe, Esq.

In evidence before Parliament—in official reports—in pamphlets and newspapers—much has been said, and much written upon this subject; but the time and circumstances have not been favorable to a calm, dispassionate consideration of this; or any other subject, connected with the "Indian question."

The writers and talkers have, as usual, ranged themselves in two parties. The one exaggerates the virtues and good deeds of the Government; the other pronounces nothing *done, and the whole country going to the dogs. The truth,* as usual, lies between the two. The country is advancing, not so fast as it ought—the Government have done much; but left more undone.

A book lately published upon "Public Works in India," by Colonel Cotton, professes to treat chiefly of roads, and other means of communication in India: as they have been,—as they are,—as they ought to be. The writer disapproves of the proposed railroads, "as worse than useless," and puts forth a scheme for providing the country with 15,000 miles of "low speed" railroads (anglicé, "tramways") "at once."

Colonel Cotton is an officer of experience and of well earned reputation: and his opinions upon this, or upon any other professional question, are not to be lightly disputed.

The subject is one, however, of vital importance to the interests of the people of India. It demands, therefore, the most careful and dispassionate consideration; and the mere fact of a writer giving, to this or that view of the matter, the stamp of high professional character, should put us on our guard; lest, in coming to a decision upon a subject of such importance, we accept assertion in lieu of argument; and take upon trust, facts and opinions, which it is our duty carefully and impartially to investigate, for ourselves.

I differ from Colonel Cotton; and consider that the construction of the trunk lines of railways, as now sanctioned,

is not only one of the boldest, but one of the wisest measures that the Government of this country ever undertook: that it especially marks the commencement of a new state of things among the people—new principles of government among their rulers.

I believe that any thing short of these works—such for example as these tramways, or low-speed railways—would fail to answer the same purpose: that, beneficial to some extent, they would be wanting in the very characteristics most essential to us here: that they would ultimately rather retard than promote, the dissemination among the people, of that moral and intellectual light, upon which, and which alone, their advance in material wealth must depend.

It is not my intention to enter into any discussion of the various topics introduced by Colonel Cotton, in connection with the public work question. In fact, I find "one idea" enough for any ordinary man of business to deal with at a time.

My business is not now with the important question of irrigation, nor making of salt, nor even the general value of water to a thirsty people—but the roads, or rather the railroads, as they ought to be, and, as I hope and believe, they are about to be.

I propose, therefore, to consider some of the arguments which Colonel Cotton has advanced in favor of his own views, and in objection to the present undertakings.

That officer proposes a system of tramways* in preference to railways on the score of economy—economy in time—economy in first cost—resulting, according to his calculations, in the saving of enormous sums of money within a few years.

* I use the term, as conveying to the general reader a more correct notion of the question at issue, than that of low speed railway as applied to the one, and high speed to the other. The works proposed for India are railways as generally understood—not "high speed" railways.

In attempting to prove this Colonel Cotton has, as I shall show,

1st. Overstated the cost of railways.

2nd. Underestimated the cost of tramways.

3rd. Greatly overestimated the time required to lay down the railways.

4th. Almost as much exaggerated the facility with which the tramways might be constructed.

5th. His calculations are vitiated throughout by his claiming for this cheap, and inferior description of railway, not merely an equality, but generally absolute superiority, over the more perfect and expensive work, in respect to cost of traction* and working expenses. Thus, in fact, begging the whole question—since it is solely, and entirely, with a view of reducing to a minimum these very costs, that greater outlay is recommended in the construction of the "railway."

It is not necessary that I should take the Colonel's calculations page by page, for the above errors lie at the bottom of them all.

There are, however, other points, in which Colonel Cotton's arguments are seriously defective. He omits, or makes only an occasional passing allusion to, the superior *capacity* for creating traffic, possessed by the railway. In his calculations it is ignored wholly.

While pointing out one line in India (the Bengal) which will have more traffic upon it than it can carry; and highly estimating the probable traffic on other lines; he recommends tramways for all: and seems to overlook the fact, that their capacity for performing any amount of work is far below that of railways.

Further, Colonel Cotton assumes an arbitrary and variable,

* In one place (page 140) the Colonel assumes, that whatever difference there may be in the cost of traction on the two lines, would be made up by the greater speed of the railways; which cannot be allowed.

though generally much too large, amount of traffic; confounding traffic that is, or may be supposed to exist, with that yet to be created by the very works in question.

He thus exhibits enormous sums of money "lost" while the railways are being laid down. The fact, as applied to this country at large, being, that the traffic at present is light; and that we must look to the railway as the instrument best calculated to stimulate and extend it.

The object of constructing a perfect railway is, to facilitate the most economical application of steam, as the motive power. The one great object in view in the construction of, and other arrangements connected with, this or that particular line of railway is, or ought to be, the most economical, most effectual, and therefore most beneficial, employment of that power.

This is the problem, on the solution of which depends the gauge, the weight of rails, the curves, the gradients, &c.

It is not quite clear whether Colonel Cotton has an idea of working his lines by steam. From the system on which he proposes to construct them, I conclude that he does not; though steam power is in one place alluded to, as cheaper than that of bullocks.

If it had been clearly stated, that the application of steam was an essential feature in his system; I should have left what I conceive to be the defects in that system to work their own cure.

If his calculations were received, and his views adopted, doubtless disappointment and loss would follow the attempt to carry out 15,000 miles of railway at once; but in carrying on the works thus begun, through the agency of practical men, acquainted with the working and power of steam; sharp curves would be got rid of, steep gradients levelled, screw piles would give place to solid, cheap, and durable embankments—a permanent way, adapted to the profitable employ-

ment of the locomotive engine, would be substituted for flange rails of 40 lbs. to the yard, without sleepers or ballast; and we should then have the railways we desire.

I conclude, however, from several passages in the book, and from the description given of the proposed tramway, that steam could not possibly be applied; that cattle are to furnish the motive power;* but I must observe, that it is very difficult for a reader to assure himself of Colonel Cotton's real views, or intentions, upon this point.

At page 184, among the "conclusions," we read of these cheap railways giving us a speed of 200 miles a day—while at page 186, they are spoken of as worked by cattle.

I do not believe we could, under any circumstances, travel 200 miles a day with cattle on such roads; or, if we could, it would be at a cost far beyond that at which a railroad would carry us 400. The climate of India is not favorable to the economical application of animal power; while, in all countries, the maximum of useful effect, obtained by the labour of a horse, is at a pace of between two or three miles an hour; and the cost increases rapidly, beyond that.

The line of argument which Colonel Cotton adopts, in favor of these cheap and inferior railroads, is this. He assumes that the better class of railroads will cost more in time, and much more in money; that, in the time required for the construction of the latter, millions will be lost on the now existing traffic of the country.

I shall show that Colonel Cotton has made the important mistake of reasoning, as if the cheap railroad was, when executed, to be as valuable an instrument in the hands of the people as the other; and I shall also show that, in fact, upon all those trunk lines in India where the traffic is likely to be heavy—apart from its infinitely superior value and importance in a

* It is not easy to see how even these are to get over the "screw piles."

social and political point of view—the better class of railway will furnish cheaper transport than the other—that £6,000 a mile, laid out upon such lines is a better investment than £2,000 on the inferior ones.

It is impossible to read this book, without arriving at the conviction, that its author has brought to its composition much earnest zeal, but little of the spirit of patient enquiry; that there is a total absence of that fairness and impartiality, which is essential to the profitable discussion of questions of this nature.

The book abounds in hypotheses; in statements and arguments built upon a "suppose," a "probably," or a "perhaps;" and these hypotheses are always in favor of one and the same view of the question at issue. Illustrations of this bias, in the author's mind, will be found at every page, and in every calculation. The following will suffice as an example, at pages 121, 122 and 123.

EXPENDITURE.

20 years at 100 *lacs.*	£20 *millions.*	
Extent of railway opened.....	2,000 *miles*	The railways may be executed for little more than half of this.
Main lines required.	20,000 ,,	
Remaining unexecuted.....	18,000 ,,	

ESTIMATE OF RESULTS.

5,000 *miles of road leading*	This is unintelligible—the traffic on the *road* talked of; and the saving by *river*. If there is no saving on river transit, whether in actual money charge, interest on goods

out of Calcutta —traffic on—500,000 *tons a year.*	
Saving on ditto, as compared with river transit.....	*Nothing.*
150 *miles on other lines — average traffic.....*	50,000 *tons.*
Saving on ditto, as compared with land carriage, at 2 Annas per ton per mile, per annum.....	90 *lacs.*
Ditto in 20 years, allowing half that amount for the whole period.....	900 *lacs.*
5,000 *miles of river navigation improved, at* 2,000 *Rupees .....*	100 *lacs.*

value, or in time, which is money,—there will be no traffic on the railway. Will Col. Cotton prognosticate this? At page 76, Col. Cotton estimates the saving by railway *against* the river at 2 Pice per ton per mile.

Colonel Cotton has assumed elsewhere, page 196, that the cost of transit, by railway, is 4 Pice, and by unmade roads, 3 Annas—but here the saving, instead of being rated 2 Annas 8 Pice, is taken at 2 Annas. The difference in the total would be 180 lacs.

Colonel Cotton has had much experience in these matters; and certainly ought to know the probable cost of such works; but it is remarkable, that, what he here estimates at 2,000 Rs. a mile, is calculated at page 197 of the same book, to cost Rupees 7,500 per mile.

2,000 miles of coast canals at 3,000 Rupees..... 60 lacs.

300 miles canal, on other favorable lines at 5,000 Rs. 150 *lacs.*

14,000 *miles of cheap single railways, at* 12,000 *Rupees a mile...* 1,680 *lacs.*

A portion of the coast canal in Madras has just been sanctioned, at an estimated cost of 35,000 Rupees for less than 2 miles, including 4 bridges, for which 6,000 Rupees only are allowed. There are no locks; but the canal averages 30 yards in width.

Colonel Cotton elsewhere proposes cheap railways at 20,000 Rupees the mile; which would increase this item from 1,680 to 2,800 lacs.

In the above calculation, the railways are estimated to cost Rupees 100,000 per mile; and it is given, as an argument against them, that 18,000 miles, out of 20,000 required, will remain unexecuted. Why should they—if it can be shown to be desirable, that the whole 20,000 should be laid down? The very question is, not, whether it is better to lay down 2,000 miles of railway against 6,000, or any other amount, of tramway; but whether, on this or that particular line or lines, whatever their extent may be, a railway, at 60,000 Rupees, is preferable to a tramway, at 20,000.

In the estimate of "results," 500 unfortunate miles of railway are knocked off, at once, as having "no effects;" though *this very railway, which is to be substituted for a common road*, now carrying a large amount of traffic, in competition with the river, has been declared by Colonel Cotton, in another part of his book, to be likely to work cheaper than the river, by 2 Pice a ton. Even this estimated saving is reduced, by a

summary dealing with the official statements of the Bengal people themselves, who make "evident mistakes" (page 65,) because they state the present river charge, at 9 Pice per ton: and if this were taken as the fact, and I believe it to be near the mark, and the railway charge taken (as everywhere assumed by Colonel Cotton) at 4 Pice, the saving, upon this 500,000 tons, would be 60 or 70 lacs annually, instead of "nothing."

Then the rivers are to be improved at a very cheap* rate, and 50,000 tons of traffic is assumed to be in existence upon 2,700 miles of "other rivers."

Coast canals are to be executed at 3,000 Rupees; which is rather too cheap. Under the most favorable circumstances, I do not believe these coast canals, supposing them to be not above 15 yards in width, could be executed, furnished with towing paths, occupation bridges, waste weirs and provision for the natural drainage of the country, under double the sum mentioned by Colonel Cotton.

Other canals to the extent of 3,000 miles, are estimated at 5,000 Rupees: these are to be "favorable lines." Where are these favorable lines? In this part of India, there are no favorable lines, except those on the coast. The Ganges canal is expected to cost 20,000 Rupees a mile, according to Colonel Cotton (page 216); and has very few locks, but some heavy works near its head; which do not perhaps materially affect the average cost on 850 miles.

One of Colonel Cotton's proposed canals, for the south of India, is that across the Peninsula, and through the Coimbatore district; which would require a lock every mile (page 217). How could this be executed at 5,000 Rupees a mile? *One lock*, of the simplest construction, on the canal near Madras, having been lately estimated at Rupees 9,000.

Colonel Cotton assumes a traffic of 20,000 tons on his

* The improvement of the St. Lawrence, over about 250 miles of river, was estimated some years back at Rupees 40,000 a mile.

14,000 miles of railway; but, with that amount of traffic, even at a cost of 12,500 Rupees, still more at that of 20,000 Rupees a mile (according to his more detailed estimate), they would offer a sorry investment, as I shall show hereafter.

II.

ON THE RELATIVE COST OF TRAMWAYS, AND RAILWAYS— AND PRESENT TRAFFIC.

Before entering upon a discussion of the relative cost of the two descriptions of railway; it may be as well to acquaint ourselves, distinctly, with their several natures, and characteristics.

The railways, now proposed, for the grand trunk lines in India, are similar to those known in England. The guage selected, lying between those known at home, as the "broad" and "narrow"—being in fact, five feet six inches.

The gradients, curves, weight of rails, are such as facilitate the employment of steam power, in the most economical manner; while the breadth of guage, and the power of engine available, lead to the employment of capacious waggons, suited to the conveyance of cheap and bulky goods.

The above characteristics, which give evidence of a power to move heavy loads, with the least possible exercise of force, give, also, the means of moving suitable loads with great speed, when necessary.

The style of road, which Colonel Cotton wishes to substitute, is described by himself, as having "sharp curves," "steep gradients," and "light rails," &c., the whole projected with a view, upon which the Author particularly insists, that the "loads should not the least affect the road."

The loads must be, then, very light—the waggons small; and, for a heavy, and bulky traffic very numerous; a condition, which all practical men know, must in the case of heavy goods traffic, add greatly to the working expenses. Moreover, it does not seem possible, that steam power could be applied on these roads. The traffic would be broken up into numerous trains, and drawn by cattle.

Colonel Cotton assumes, in his calculations, sometimes that the railways will cost eight—at others ten—and, more frequently, twelve thousand pounds the mile; while his tramways would cost £2,000.

The estimate he has given, in support of the latter opinion, exhibits sundry grave omissions; while no notice is taken of the effect on prices, due to the extraordinary expedition, with which they are to be laid down. Here Colonel Cotton *would have "speed;" but without paying for it.*

Of the probable cost of railways, we have, now, some experience.

The *first section* of the Bengal railway, *estimated*, originally, at £6,000, will be completed, and furnished, with rolling stock for £9,000 the mile: notoriously much more than it ought to have cost.

The Bombay line, of which about 22 miles are opened, cost (to the best of my recollection; I have no means of reference,) about the same.

The first 47 miles of the Madras line (of which the whole are to have bridges for double way—and half, earthwork for the same,) are estimated to cost without the stations, or the materials of the permanent way, Rupees 607,464, including one stone bridge 900 feet in length—or, Rupees 12,712 (£1,270) per mile.

The materials of the permanent way, assuming Colonel Cotton's data for iron, would be :—

Sleepers or blocks, at 3¼ Rupees, 2,000 to a mile	6,500
Rails, at 65 lbs. the yard, including sidings, 104 tons	10,400
Chairs, 30 tons, at £8	2,400
Ballast	4,000
While the stations may be taken	4,000
	27,300

The total cost, per mile, thus becomes Rupees 40,000 or £4,000 : and there are no signs, yet, of this being exceeded ; except in the matter of iron, which, for the purpose of comparison, I have, of course, taken in the above calculation, at Colonel Cotton's own price.

Thus, it seems, the "superior article" can be laid down for Rupees 40,000 the mile, instead of Rupees 120,000.

I do not feel the slightest doubt of any extent, of substantial railway, being laid down in India, with rails at 65 or 70 lbs. the yard, for £6,000 the mile, of single line ; supposing iron to stand at a moderate average price.

Let us now look at Colonel Cotton's estimate for his rails.

The description of railroad intended, if I understand the calculation right, consists throughout a portion of its course, of cutting, in which broad flanged rails are to be laid without ballast. These rails are to weigh 40 lbs. to the yard ; and their section, flange, and all, will, consequently, be about 4 square inches.

On the other portion of the line, parallel girders are to be laid, in lengths of 20 feet, upon cast iron columns—these girders, weighing 80 lbs. to the lineal yard, and having a breadth of 1¼ inch, will be 6¾ inches deep. As far as we can judge, from the estimate, this is, literally, the whole affair. We see no framing, no cross girders, struts, or braces—and, though a passing allusion is made, in a previous page, to the

beams being "stayed across" at intervals, no notice is taken of this in the estimate, which is as follows :

	Rs.
176 cast iron posts, averaging 8 feet in length, and weighing 4 cwt. 35 tons, at £8.....	2,800
176 rolled iron beams,* 20 feet long, 80 lbs. per yard, at 5 cwt. each, 44 tons, at £10 a ton.....	4,400
2,400 yards of broad flanged rail, at £40, 44 tons at £10.....	4,400
Excavation, 16,000 cubic yards, at 1 Anna	1,000
Sundries.....	3,140
	15,740
Rupees....	20,000

Well may Colonel Cotton admit, that, with a railway so constructed with "sharp curves, and steep gradients," there would be "some little additional danger" to the travellers.

In this estimate, we see no notice of the usual preliminary expenses, of surveying and tracing; and even the important item of labour, in putting together this contrivance, is altogether omitted. The estimate is, however, brought up to Rupees 20,000 a mile.

It will be observed, moreover, that Colonel Cotton overlooks the probability of having to encounter enhanced prices, in attempting to carry out 15,000 miles of railway "at once." He estimates at something enormous, the additional cost of speed in travelling; but takes no notice of its effects in the execution of his works. But does it, therefore, cost nothing?

* These longitudinal girders would bear with safety, not above one ton (gross) in movement; and a road so constructed, would be, therefore, quite unequal to the demands of a heavy traffic: utterly unsuited to the passage of locomotives.

It is proposed to supply 100,000 tons of cast iron, and 130,000 tons of rolled iron, per annum. The total quantity of iron, of every kind, exported from Great Britain, in 1851, was 1,296,873 tons; of which 539,877 tons, only, were in the form of bar, bolt, and rod.

The total amount of tonnage, which arrived at Madras from England, during the last three years, was as follows.

	Tons.
1851	24,929
1852	25,591
1853	19,248

Total in three years 69,768—making an annual average of 23,256 tons.

If we allow one-fourth the total amount, demanded for India, by Colonel Cotton, to be called for at Madras: and, taking the highest annual amount, 25,591 tons, give up *one-third* to dead weight, it will give us about 8,000 tons available, to the exclusion of coals, and all other dead weight; and, consequently, with a certain rise in freight for our iron from England. We should require 45 years to bring out the iron for the tramways in this Presidency, supposing its share to be 3,000 out of these 15,000 miles, which are to be laid down "at once."

The cheapest way of bringing out these 230,000 tons in one year, if money could buy such a quantity in England, would be to build ships for the purpose—and they must be large, and numerous; and do not appear in Colonel Cotton's estimate.

I am satisfied, from the experience we have already acquired,—£5 per ton having been demanded for freight for rails already—that iron could not be landed at Madras, to the extend proposed by Colonel Cotton, under a cost of £20 per

ton ; if it could be effected, which I think doubtful, at any price.*

We have now to consider the saving of *time*, anticipated from the substitution of tramways for the railroads now projected.

The latter it is argued will be completed at the rate of 10 miles per annum.

The Colonel arrives at this conclusion—which, it must be remembered, holds a very prominent, and important place, in all his calculations, in the following manner.

At page 120, we read that "*high speed railways are crawling across the country at the rate of* 10 *miles a year*," giving the reader to understand that such *is*, and *is to be*, the rate of progress. And in another place he informs the public that "*it will take* 200 *years to provide it with railways.*" A statement for which he shows no authority ; and, I believe, has none.

In another place, we read (page 132) of the rate the Bombay railroad is going on—about 12 miles a year—and a calculation is made, from thence, as to the time that a given line, of 760 miles, will take to execute.

The Liverpool and Manchester line took four years to complete—its length is about 30 miles. What would have been said, if one, standing in 1830 at the Liverpool station, had gravely predicted that it would take 1,000 years to lay 7,000 miles of railroad ?

And yet, this is exactly the argument that Colonel Cotton uses : and it must be remembered, that it runs through the whole book ; though in some of his calculations 20, or even, 50 miles per annum, are granted, evidently as an extreme

* In carrying on those railways gradually their effect will be felt upon the commerce of the country ; the annual tonnage arriving from England will increase ; and thus, though the price of iron may range high, the charge for freight will not be affected to the extent, it must be, by the large and sudden demand contemplated by Colonel Cotton.

supposition. Strange that the Colonel should have over looked the obvious fact; that the time, which it takes to lay 25 miles in one part of India, might be fairly taken as the measure of the time it would take to lay the same length in another, carried on *at the same time!*

The fact is, as I shall presently show, that the rate at which we can procure the iron, is that, at which we can complete our railways in India.

We must, in considering this question of the time that it will take to execute these works, carefully distinguish, between those causes of delay—of loss, and expenditure, of time, common to all great undertakings; and those, which attach to works of this, or that, particular description.

We have some great facilities for executing works of this nature here; and some great difficulties:—

The facilities are:—

1st. The position and power of Government.

2nd. The peculiar character of a great portion of the country, through which our trunk lines would pass.

3rd. Cheapness of simple labour as far as it is to be had.

The difficulties are:—

1st. The necessity of getting all scientific superintendence from Europe.

2nd. The deficiency in the amount of available labour in the several districts.*

* Paradoxical as it may appear, I believe, simple manual labour to be, in this part of India, cheap, where you can get it—though not to be had in great abundance. The demand for "Navvies" in England, soon increased the number of available labourers of that class—but there is in the social habits of the people of this country, much to interfere with the ready adjustment of the supply to the demand; much to puzzle your political economist. The present state of the labour market is perhaps, in a measure, attributable to the circumstance of all works of any importance being carried on under one authority—the Government. There is no competition in the demand; and little scope, therefore, for competition in the supply. The introduction of private companies* here, will have the effect of raising wages, and increasing the amount of available labour.

3rd. The necessity of procuring all the iron for the permanent way, and rolling stock, &c., from England.

It is evident, that as we press the works forward to completion; the cost, in money, upon all these things will rise—the time saved must be paid for.

Now, there is not one of these, except the second difficulty, that does not apply, as well to the tramways, as to the railroads. By "*sharp curves and steep gradients*," increasing greatly, the cost of working the line, some amount of simple manual labour may be saved; but while the other difficulties remain, this will create no ultimate saving of time, as I shall presently show.

Entering suddenly upon such large undertakings, our chief difficulty seems to be, how to procure qualified men to direct the works.

Colonel Cotton has a curious way of measuring the expedition, with which works may be executed, by the amount of money that can be spent. This is however an unsound, and, at the same time, a dangerous kind of test.

If, by spending money, we mean spending it judiciously—advantageously—it is evident that the amount of work done, and consequently of money spent, under a given amount of superintendence, will depend upon the quality, the position, the general character of the work in hand. Contractors would readily be found to undertake to spend a million upon a palace in England, in a shorter time, than they would undertake to lay out half that sum, on a line of railway, between Bombay and Hydrabad.

One other point only need be mentioned, viz., that the greatest loss of time is commonly experienced in *commencing* great undertakings, such as these. Such loss of time, like

general expenses in money, distributed hereafter over a work of 1,000 miles, however it may create dissatisfaction, in the first year, will be found not materially to affect the time in which the whole has been carried out. The people of England were four years in opening their first thirty miles; but had 7,000 miles in operation, within twenty-three years from that time.

With all these early sources of delay, what has been our Indian experience? The lines in Bengal and Bombay have experienced the full effect of these several difficulties; added to which, the general question, while they struggled on, was not finally determined; and they were working, only, upon fragments of lines, not even yet, in both cases, finally determined on.

In Madras they had the advantage of the others experience, and of a more decided state of things to begin with; and how have they got on?

Of the lines now sanctioned (about 500 miles)—50 miles only were sanctioned in March 1853. On the 9th of June, in that year, the first turf was turned; while very much of the necessary surveying, levelling, and staking out, on the line, yet remained to be done. To begin this work was to begin, indeed, from the beginning—establishments had to be organized, and servants instructed: the Engineers, being themselves perfect strangers to the country, to the people, and the language.

Moreover it was determined, from the first, that, whereas all great public works, hitherto, had been dependent for the supply of labour and materials, upon the Police Officers and other public servants; this should proceed wholly dependent upon itself; a fair day's wages for a fair day's work should be the motto.

The introduction of such a system involved an improvement on the one hand, and a difficulty on the other; which can only be appreciated by those, who know the country.

The estimated amount of work on those 47 miles was—in earthwork 2,034,536 cubic yards; in Masonry, 22,944 cubic yards.

On the 31st December, the work had so far advanced, that the Chief Engineer considered that the whole, with the exception of the laying permanent way, would be completed in four months from that date.*

The price of labour has not been raised; and the earthwork has been executed at a cost, quite as low as that performed by Government servants, with all their apparent advantages.

Up to the present time, about 622 tons of rails† have been received; and no chairs. I do not attribute this to any want of activity on the part of the Directors at home; but, I consider it an established fact that the expedition, with which we can lay down railways in India, is only limited by the speed with which they can supply us with iron from home.

It is to be observed, that in executing these first few miles, no labourers have been drawn from other districts; while they have been laying these 47 miles, they might precisely, in a similar manner, have laid any number of "47 miles" all over the country.

Let the sanction be given, the money forthcoming, and the iron; and we shall, at this rate, cover the country with rail-

* These expectations have not been realized, the season having been singularly unfavorable to work of this kind; but enough has been done, to show that, under ordinary circumstances, a work of this nature, in this part of India, might be completed in twelve months, without any extraordinary efforts.

† Enough for about 5 miles of single lines.

roads, in a *twelve month;* finishing the occasional large bridges in two years.

Colonel Cotton states, vaguely, that iron could be got in any quantity, and that thousands of Europeans and Natives want employment as Superintendents;* and we find it is only the iron, and the superintendence, that interferes with our laying any extent of railroad in two years. If we can get the iron thus readily, what becomes of "crawling nuisances" the "ten miles a year" railroad? If we cannot, what becomes of a cheap railroad, that is to be laid down at the rate of 15,000 miles in two years, or "at once;" requiring, however 123 tons of iron per mile, without any allowance for cross girders, struts or braces?

Of the traffic, actually existing, in India, at the present time, I think Colonel Cotton's book conveys a very exaggerated idea.

On the line of the Ganges, no doubt, it is very large; it could not be otherwise, considering the extent and fertility of the country, drained of its products, by the port of Calcutta.

On the western road of Madras, the traffic is stated (in page 23) at 300 tons daily; exactly twice what it was estimated at in 1851, by an officer called upon specially to report† upon the subject, and furnished with all the returns available for the purpose.

At page 131, Colonel Cotton calculates the average traffic upon the whole line, between Madras and Bombay, by taking the accumulated traffic at each end, and adopting the mean of the two for the average traffic, upon the whole 760 miles:‡ manifestly a most erroneous mode of calculation.

* Page 15.

† Madras Railway Reports.

‡ This a most curious calculation, and worth looking at; the traffic is thus erroneously stated, then doubled—a saving is calculated, from this—and this saving is then doubled.

But this is too often the character of *averages*—not only is the traffic near Madras made up, in great part, of local supplies, brought from the immediate neighbourhood, for the accommodation of a large town, numbering 700,000 inhabitants—not only does the traffic passing down the ghaut near Bombay—made thus the measure of the traffic to Madras—*consist of an accumulated trade, passing down from all parts* of the Deccan:—but the Thull Ghaut, the traffic upon which, is thus made to contribute to the estimated traffic on the Madras line, lies north of Bombay; and has no connection, whatever, that I can see with the question.*

I am *only now considering* what the *traffic is*—not what it *may*, and will *become*, under the influence of railroads; but what it is, at *present*. The estimated amount of loss, arising from our delay, in laying down the railways, being calculated from the traffic that may be supposed now to exist.

The greatest amount of traffic, on any road in the Madras Presidency, is unquestionably to be found on the western road, leading from Madras toward Vellore, &c. Here it certainly does not exceed 50,000 tons annually, on the first 125 miles.

The following table shows the traffic on other lines, carefully observed under instructions from the several Collectors of the districts.

* The reader will hardly believe, that the traffic on the road, in which a saving to the tune of 21,000 Rupees a mile is to be effected, is not, at the present moment, at a point 120 miles from Madras, above from 16 to *20 thousand tons per mile per annum.*

Average daily Traffic, during eight months, on five different high roads in the Madras Presidency.

No. of Roads.	Traffic daily.		Total per Annum.		Locality.
	Goods.	Passengers.	Goods.	Passengers.	
	Tons.				
1	248 19/20	370	90,848 1/3*	138,335	Between Salem & Trichinopoly.
2	*85 1/3	1,414	31,207 1/3	516,110	Between Negapatam & Tanjore.
3	30 1/3	324	11,071 2/3	118,260	Between Trichinopoly & Tanjore.
4	14 1/3*	28	5,292 1/3	10,220	Between Coimbatore and Carocr.
5	9 1/3	168	3,330 5/6	61,320	Between Darapooram & Palghaut.
	388 17/20	2,313	141,750 3/4	844,245	
Average.	* 77 1/3	462 3/5	28,350 3/4	168,845	

In short, we must bear in mind, that, throughout India, with occasional and rare exceptions, commerce is at present inactive, and the amount of traffic very small; and, "what we want," is a stimulus to the energies of the people; which the mere cheap carriage of their agricultural produce, will not of itself afford.

Having now shown that Colonel Cotton has:—

1st. Overstated the cost of railways.

2nd. Underestimated the cost of tramways.

3rd. Greatly overestimated the time required to lay down the railways.

* Whether we consider the probable trade of Salem itself, (25,000 inhabitants) or the traffic on the other side of it (known to be very light); the amount here shown, as far as goods are concerned, appears much too heavy to be correct. It is likely to have many *travellers* on it. The traffic in carts both ways on two roads *east* of Salem has been lately reported to be 10,000 tons per annum.

4th. Almost as much exaggerated the facility, with which the tramways might be constructed.

What becomes of the following alarming calculation? (page 144.)

760 *miles, at* 20,000 *Rupees*..... 152 *lacs* .. *A.*
Cost of transit, at $\frac{1}{4}$ *present rate, or* 4,000
Rupees a mile..... 456 *lacs* .. *B.*

Total expense.... 508 *lacs* .. *C.*

760 *miles, at* 100,000..... 760 *lacs* .. *D.*
Cost of working half, at $\frac{1}{4}$ *present rate,*
for 15 *years*..... 228 *lacs* .. *E.*
Ditto for one-half at present rate..... 912 *lacs* .. *F.*

19,000 *lacs* .. *G.*

Loss by waiting for the complete road. 1,392 *lacs !!!* *H.*
Or, 14 *millions sterling nearly.*

I have marked these seven items for more distinct criticism.

A. The estimate for a tramroad is probably enough; but not for such as the Colonel proposes. Many necessary items are omitted.

B. Calculated as it appears for steam power, which could not be worked on such a line—also, from an assumed traffic, it is impossible to say what, larger than exists on any line in India but the Ganges, and which if it did exist, could not be worked by such a line, (single) as Colonel Cotton proposes.

The "cost of transit" (meaning "working expenses,") is here taken at a rate per ton equal to that on the superior railway; which cannot be.

C. The total, as thus obtained, is diminished, by an error of calculation, by *one hundred* lacs of Rupees.

D. The railways are here estimated at Rupees 100,000

per mile. The Madras line of 500 miles should not, and as far as our present experience enable us to judge, will not cost above Rupees 60,000, on the average of the whole length; if the Directors are content with rails of 65lbs., and if iron keeps down to Colonel Cotton's assumed price; this will bring down the total cost from 760 lacs to 342 lacs.

E. This is calculated on the supposition that it would take 15 years to execute the railway; the tramway being laid in "no time." I have shown that if we can have the iron, as the Colonel assumes we can have it, to "any extent;" or at 230,000 tons per annum; we could do the whole within two years.

I must add though, that in order to do this, we must not only get iron; we must get also qualified men, in sufficient number, to conduct the works.

I should anticipate some difficulty in this respect—though it does not appear to have occurred to Colonel Cotton; who thinks there are thousands of Europeans and Natives, who want employment as superintendents of work, &c.

Where are they?

F. This amount is also obtained by the same assumption, viz., that while the tramway could be executed "at once" the railway would take 15 years; which I have shown to be a mistake.

But this calculation calls for more particular remark. There is a question regarding the expediency of providing a very complete, though comparatively expensive, machine for the performance of certain work; in preference to a cheaper, and less efficient apparatus.

Colonel Cotton discusses this question by taking the original cost of the one—setting it off against that of the other—and calling the difference á "loss": a short cut to a settlement of the question—a mode of calculation that may, with equal propriety, be applied to every case; wherein time,

and money are expended, upon the provision of the best description of instrument, for the performance of a given work. He then condemns the one to be 15 years in executing—7,000 miles of railway having been executed in England, under many hinderances unknown to us here, in 23 years:—the other to be executed literally in "no time"—not a day—not an hour. He sets down all the difference, between the cost of transit on the present roads, and that on the railroad during the (assumed) time, the latter is under execution, as *loss*—implying, that this would be saved by the adoption of his cheaper road; which, by some indescribable process, are to be laid down in the twinkling of an eye: and throughout these calculations, as indeed throughout the book; he treats of the cheap railway as of a work equal in value to the other; a great and important error.

Indeed the calculation now referred to is the most extraordinary I ever saw. These railways, of which we treat, are constructed, or supposed to be constructed, for many ages; perhaps for all time. Their money results are here compared for the time, and that time only, during which the railway is assumed to be under construction.

It is, as if a man, engaged in navigation, were to recommend, upon some line of heavy traffic, a barge, in opposition to a projected steamer of 2,000 tons burden, calculating thus.

Cost of large steamer.....	£70,000
Ditto of barge.....	30
Total loss.....	£69,970!!

To which is to be added the cost of transit, while the big ship is building.

The proper way, to view these investments of money, is to consider the interest on first cost as a debt upon the line; and then to calculate the capacity of each for promoting, and

augmenting the trade; meeting its requirements, and bearing that debt.

Colonel Cotton has occasionally quoted "Lardner," but has I think, overlooked the following passage.

"Practical evidence of the economy arising from this increase of power and dimensions, is supplied by the fact, that the proprietors of the Hudson steam-boats reduced their tariff for passengers, as well as for freight, as they increased the size of their vessels."*

III.

ROADS—TRAMWAYS—RAILWAYS.

We shall find, every where, that the highways of a country naturally divide themselves into two great classes—the trunks and the feeders.

A country is drained, in fact, of its traffic, as it is of its surface water; by rivers, and tributary streams.

The greater the extent to be drained, in both cases; the larger the rivers, the greater the number of streams.

In India, the raw produce of the country has to be conveyed, in large quantities, for exportation, to the coasts. The "light" from Europe has to pass from the coast into the interior. The chief commercial towns, the capitals, also, of three Presidencies, are on the coast.

The trunk lines, therefore, may be described as those, which terminate on the coast. The feeders and branches are those, whose termini are, the one inland, and the other at some point on the trunk—a second class of feeders would similarly fall on to the first, &c.

It is perfectly clear, that there must be, as indeed there

* Railway Economy, page 377.

always are, different descriptions of highways, for these different portions of a general system.

In England, we have substantial doubled lined railways for all the trunks; while most of the branches have either lighter rails, or single lines: the ordinary macadamized roads filling up the intervals; and contributing to the volume of traffic on the trunk lines, through hundreds, and thousands of lesser channels.

It may be as well to say a few words, here, on the distinctive characteristics of the rail, and the common road; characteristics which adapt them to their relative positions, as trunks—branches, and feeders.

The cost of transit upon any road is made up of

1st. Interest on first cost of construction.

2nd. Wear and tear due to traffic, and to the atmosphere.

3rd. Management.

4th. Draft—Interest and Insurance on goods might be added; but I exclude them to simplify matters.

The ratio, which these several elements of cost bear to each other, varies very considerably upon different descriptions of road.

On the common road, the cost of draft is the most important. The wear and tear of road the next. The interest on first cost is comparatively small. On a tramway, the interest on first cost is increased—the draft diminished, the wear and tear diminished also.

On a railway, the same increase on the one hand, and diminution on the other, is carried further. "Management" is an element of cost peculiar to the two latter. In each case *the actual cost of draft is a constant quantity; not varying* with the amount of traffic on the road, in any given time; the same may be said of the "wear and tear" due to the unit of traffic; while the proportion of the other charges ("interest upon prime cost," "management," and "repairs of da-

mage due to atmospheric causes") decreases on the unit of *traffic*, as the total amount of that traffic increases.

It results from these facts, that, to arrive at a minimum charge upon either the rail, or the tramway, we must increase the traffic to the amount which they can respectively bear; while, on a common road, our aim should be to bring to perfection our measures for economizing power, and for reducing the resistance.

Moreover of the several description of railway, the cheapest to travel on will be that, which has the greatest capacity for the performance of work, in proportion to its prime cost; and is, at the same, worked up to that capacity.

I will further explain this argument by hypothesis:—

We have a railway which cost £5,000 per mile; the working expenses on which, are ¼*d.* the ton: and we have one, which cost £2,500, working expenses on which are ½*d.* a ton —the interest to be met in the one case is.... £ 250

In the other..... „ 125

If the charge is to be the same on both, we should require (on the first) at 1*d.* the ton per mile,

An annual traffic per mile ..... 80,000 tons.

The receipts being .... $£\frac{80,000}{12\times20}$ = £333 6 8

The expenses would be $£\frac{80,000}{4\times12+20}$ = £ 83 6 8

Interest..... £250 0 0

£333 6 8

In the case of the cheaper railway, we should have, with the same data, a required traffic of only....60,000 tons.

The receipts are ..... $\frac{60,000}{12\times20}$ = £250 0 0

The expenses... $\frac{60,000}{3\times12\times20}$ = £125 0 0

Interest..... £125 0 0

£250 0 0

Independent, therefore, of any peculiar advantage, that it may otherwise offer to the public—it is necessary, in order that the more expensive railway should offer as cheap transport as the other, that it should possess a greater capacity for work; and, that there should be work for it to do, within that capacity, sufficient to reduce the cost of transport to a level with the cheaper line.

The cost of construction of the one is, in the above assumed case, double that of the other. Let the capacity for creating, and performing work, be also double.

If 60,000 tons per annum were the limit of the cheaper railway's capacity; the charge *must* be one penny per ton to yield interest.

Let us give to the more perfect railway a traffic of 120,000 tons; and the calculation will show, that we might reduce the charge at once to ¾*d.* the ton per mile.

It may be said, in a few words, that, in the most perfect description of road, the more work you have the cheaper you do it; and the better and more efficient the road, the greater its capacity for creating, as well as for meeting, a demand for transport.

A very important distinction between a railroad, or tramway, (which is an inferior description of railway) and a common road, is to be found in the necessity of working the former by one uniform organized system; while the latter lies open to every description of passenger, and vehicle at any and all times. These circumstances adapt the railway to lines, whereon the traffic is considerable; and render it necessary that such lines should exceed a certain length: in order that the saving thereon should counterbalance the loss in time and labour occasioned by the necessity of transfer. On the other hand the common road is better suited to the numberless ramifications—feeders,—which, penetrating into the fields, and

villages, collect the general produce, and transport it to the railway station.

A question now arises, whether, after it has been shown, that the trunk lines in such a country as this, with a heavy and increasing traffic, and with distant provinces to unite together, must be railways; while the minor branches must be common roads; whether, the intermediate portion—the main branches—might not be tramways—an inferior description of railway—worked by cattle.

The only advantage of such a system would be, in the employment of very light rails at first; until the increasing traffic justified the use of heavier, and the introduction of the steam engine: but it will be seen how important it will ever be to keep the rails—railways or tramways—upon the same guage; to prevent a double break in the general system of communication.

In all cases of such "light rail" branches, the line should be prepared, as much as possible, for the superior class of railway—suitable curves adopted from the beginning; though the gradients might be left, if desirable, to be modified hereafter.

This, then, should be, and, if we may judge from the beginning, will be, the growth and progress of railways in India.

The trunks are now being laid down on the most important lines; traversing a vast extent of country; connecting remote districts; drawing into them a large amount of trade.

Existing roads will be made use of, and improved, as branches—new ones provided. As the traffic develops itself, and the effect of the railway on the energies of the people begins to be felt; the amount of business on the larger branches will render necessary the laying of rails upon them also. The whole system will be made up of common roads,

and railroads. The relative amount of each changing, as the country advances in wealth.

One among many evils attendant on the adoption of Colonel Cotton's system of railroads would be the absolute necessity of beginning, *de novo*, on the same line; whenever a better kind of rail was needed. It would be necessary to take up a new line to avoid "sharp curves;" and the whole system of screw piles, &c., would be unsuitable. The necessity of doing this, 20 (or "say" 30) thousand Rupees per mile having been sunk in the original line, would tend greatly to discourage this change for the better—or if carried out, it would be at thus much additional cost. We may observe, on the other hand, that nothing is lost in superseding a common road by a railway. The former lies open to the country through which it passes; a great and necessary convenience for its local and varied traffic, connected or unconnected with the railway. A tramway could not answer this end. *It must either compete with the railway; or*, being bought up, add so much to the capital, the interest of which has to be earned on the line.

It will be seen, that in considering a system of communications for India, there should be no difficulty in determining, where we should have good efficient railways; and where common roads. Knowing by experience the cost of *actual traction, &c., on a good railway—estimating carefully* its probable cost; the anticipated amount of traffic will show whether a railway would or would not cheapen, in every sense, as well as expedite, the traffic. In the same manner, the substitution of a railroad hereafter for a common road, on an important branch, might be from time to time proposed, and carried out, upon sound intelligible principles.

If it were found expedient to have an intermediate description of branch line—a light rail line with steeper gradients, but in all other respects adapted to the higher class of

railway; there would be no difficulty in laying down general rules, by which it might be known, when the time had arrived, with reference to the traffic, for the conversion of a road into a light rail—or a light railroad into a trunk line: and it must be remembered, as a very important point, which Colonel Cotton has overlooked, that whether an expensive, that is a superior, class of railway, or a cheap and inferior one, shall carry a ton of goods (allowing for interest on first cost, &c.), the cheapest, depends, not solely upon the first cost in either case; but upon the nature, and amount of the traffic—of the work to be done.

Colonel Cotton appears to have lost sight of the fact; that in any system of highways, there must be roads of different capacities.

In his several calculations, he assumes an "average" amount of traffic, over a great extent of country; and, having assumed one insufficient to make a railway pay, proves his case in favor of a tramway.

Men, who deal largely in averages, are apt to fall into these kinds of error. In this case, it is, as if one were about to provide for the drainage of a country; and, knowing that, for some miles near the sea, a column of water equal to 50,000 cubic feet would be flowing onward at a rate of 6 feet a second; while, 1,000 miles higher up, the largest stream we could find would yield only 10 at the same velocity, were to cut a channel the whole length, to an average section of 25,000 feet. This would not do.

The chief point of difference between the railways, and the roads proposed by Colonel Cotton are these.

The railways, being worked by steam, their capacity for work is much enlarged; and the cost of traction on the unit of work much reduced.

In the railway, the quick and cheap transmission of travellers, troops, and mails, would be provided for throughout the

length and breadth of this benighted land—while on the tramways, the pace is greatly diminished, and the cost increased, by the necessity of employing cattle ; no less than by the imperfect construction of the road itself, &c.*

The capacity of the railway both for creating work, and for performing it, far exceeds that of the tramway ; and is, in the former respect, especially important in this country; where the people stand chiefly in need of that moral and intellectual " light, and air," which quick and cheap transport for men and intelligence, can alone give them.

Colonel Cotton is quite right in attaching importance to cheap transport; but he makes the mistake of thinking that the line of cheapest construction must necessarily involve the cheapest charge on the unit of traffic. Does the manufactory, in which the largest amount of capital is sunk, necessarily—does it *ever*—turn out a costlier article than one of less capacity, established with less capital ? Do the men, who propose to invest their capital in steamers of 10 and 12 thousand tons, do so with the view of increasing the charges on the unit of traffic? Certainly not.

In undertaking, in right earnest, to establish a general system of communications for India, the Government have determined upon laying down about 4,000 miles of superior railway upon the great trunk lines; the framing of the whole system. The effect of these will be to knit together the distant provinces; to establish a degree of social and political oneness throughout the empire; to stimulate trade and manufactures; not only by conveying the great amount of traffic, which will drain on to these trunks, with regularity and economy ; but by the diffusion of light and knowledge.

* Colonel Cotton proposes ruling gradients of 1 in 70—1 in 80 and 1 in 100 which would add 32—28—22 lbs. to the draft of each ton. Thus, supposing this draft to be on such a road 10 lbs., expending 3 and 4 times the amount of force required on a level.

Every mile of these opened will tend to increase the traffic, which, even now, the roads upon these lines collect from the immense extent of country drained by them. The railways will not only carry the present amount in such a manner as to invite more; but they possess a capacity for conveying, up to a very large amount, the traffic thus augmented.

As a necessary consequence of the operation of these lines, promoting the development of the resources of the country, and giving us an acquaintance with the nature and requirements of its commerce; other lines of railways or roads must shoot out in connection with them; dependent, probably, as the branches are in England, upon the parent stem for a while; but sure, in course of time, to earn their own support, and promote the growth of other lines, in connection with themselves, at their proper times, and in their proper places.

Colonel Cotton's plan, however is entirely different. He disapproves of the "crawling plan"—feeling our way and letting one portion of railway—as it certainly will if judiciously selected—lead on to, and facilitate the construction of another. He would have 15,000 miles of cheap railroad "at once"—a railroad of "average" capacity to suit an "average" amount of traffic.

Having seen how these cheap railways are to be constructed—how large the amount of traffic is likely to become, on some of the main lines—it is manifest that such railways would be wholly inadequate in those places—while upon other portions of these 15,000 miles, if the *average* upon the whole is only 20 or even 50 thousand tons annually, the traffic must be very small; too small to pay even these cheap railways.

Where the business is heavy, they could not perform it either so well, or so cheaply as the better railway; and from their inferior capacity could not derive full benefit from it: and, where the traffic is light, they would not pay.

But let us grant that they could carry all the traffic, however heavy, at the charge Colonel Cotton proposes. Let us see what kind of investment it would be. I suppose we must come to this after all, though Colonel Cotton considers this a comparatively insignificant view of the subject.

At page 123, Colonel Cotton makes his calculations of a traffic of 20,000 tons, annually, on 14,000 miles of railway—*estimating the cost of the railways at 12,500 the mile.* This must be a clerical error; as in another place a detailed estimate is given of these cheap railways, amounting to 20,000 Rupees the mile.

Now I want to see what return this would give. I meet with some difficulty, at the outset, because, at page 182, we are told that the "working expenses" on these railways would be 2 Pice the ton; and at page 196, the "cost of transit" is the same; and therefore leaves no profit at all. Assuming this to be a mistake; and that the Colonel would not wish the cheap railway to charge 4 Pice, which he gives as the cost by the "high speeds;" we will take 3 Pice as the "cost of transit" or "charge" per ton per mile. The "working expenses" being 2 Pice, we should have a net profit of 1 Pice on each ton: then $\frac{20,000 \times 1}{12 \times 10} = 104$ Rupees "net profit."

This would be, upon a capital of 20,000 Rupees, about $\frac{1}{2}$ per cent. dividend. If the Government, on the security of the land revenue, guaranteed 4½ per cent. they would lose

900—104 = (say) 800 Rupees

upon every mile, annually; so that, upon 14,000 miles, there would be an annual deficit of 112,00,000, one hundred and twelve lacs of Rupees; which, calculated for 20 years, would bear comparison with some of the Colonel's own "results."

We may view this question in another light. The "average traffic" is taken at 20,000 tons on 14,000 miles or a mileage of 280,000,000—but of this, supposing we have, over a

thousand miles, an average traffic of 200,000; which gives, on those 1,000, a mileage of 200,000,000: there remain only 80 millions upon the remaining 13,000 miles

If one of these cheap railways, calculated as they are for an average traffic, were laid upon these 1,000 miles; it would neither be so useful, so economical, or so profitable, as the superior class of railway; while laid on the remaining 13,000 miles, where the traffic is small, it would be attended with great loss.

The results would be something of this kind:

Capital cost on 14,000 miles, at Rupees		
20,000 per mile.....	= Rs. 280,000,000	
Mileage on 13,000 miles..	= Rs. 80,000,000	
Net profit on 80 millions at		
one Pic.....	= „	417,000
Mileage on 1,000 miles,		
1,000 × 150,000, (assuming this to be all the tramway could carry) =		
150,000,000 which × by		
one Pic.....	= Rs.	781,250
Total profit..	Rs.	1,198,250
Interest on capital as above.. ...	„	12,600,000
Annual loss.....	Rs.	11,401,750 or 114 lacs of Rupees.

IV.

SPEED.

In a report* made to the Madras Government upon the proposed railways in that Presidency, I find the following observations:

* Railway Reports, 1851.

"The question of speed has also led to some discussion. There can be but one opinion, as to the propriety of our adopting the higher rates of speed; which have been introduced (and it is believed at a positive loss) on many of the principal lines in England; but we need not run into the opposite extreme; or propose to construct our lines, upon such a refined system of economy, as to render them unsuited to a higher speed than 10 or 12 miles an hour. Kept within the limits of safety, speed is a mere question of expense; and up to 20 or 25 miles not one of much importance: but the railway, once constructed, should be capable of bearing any speed required, and paid for, within the first mentioned limits. My own impression is that it will be chiefly as an improvement on the means of personal communication, that railways will affect this country; whether in its social progress, its commercial and manufacturing prosperity, or in the development of its agricultural resources."

A reduction of 10 Pice per ton per mile in the carriage of goods will doubtless do much; the provision made for their safe and speedy transport will do perhaps more; but it will be, by inducing the inhabitants of the several districts and provinces to mix freely and become acquainted with each other; by their operation in fact, upon the national mind, that railways will realize our highest expectations."

Colonel Cotton evidently thinks that, even at this rate, we are pursuing our "idol speed" to the prejudice of the best interests of the people; not seeing, I think, how intimately and necessarily associated, are the power of working quickly, and that of working cheaply.

At page 241 we find the following passage: "*Canals, as at present worked, even when steam is not used are the cheapest of all communications, but railways afford the highest speed.*" "*There is not the slighest probability of railways ever beat-*

ing canals in cheapness ; nor of canals beating railways in speed."

Now we all know that motion, the thing aimed at, whether on railroads or canals is compounded necessarily of both matter, and velocity, or "speed." For all practical purposes, the element of time must be introduced; and we speak of the dynamical power of an agent, as of an horse power, being the *amount of work done in a given time.*

There may be an infinite number of instruments; each of which may produce an equal quantity of motion, and yet each be only suited to a special purpose. One instrument may raise 33,000 pounds, one foot in a minute; but not be able to raise 16,500 the same height in half a minute—though the quantity of motion would be the same. Another may be one of an opposite kind; raising or propelling small weights at great velocities; and thus making up an equal measure of momentum.

The railway, with its locomotive, is in this respect one of the most perfect instruments we have. It will take its load of 3 or 4 hundred tons at 10 miles an hour; or fly with its lighter load, of 50 or 60 tons, at 60 miles an hour. The dynamical result the same.

We may illustrate the absolute necessity of time forming an element of the work done, by supposing a merchant to have the offer of conveyance for his goods at a certain price. Can any description of goods be thought of, regarding which he would not enquire, how long it would take ?

The owner of the property, whether that property be a bale of cotton, or his own person, pays in its transport, for the expenditure of a certain force, producing a result composed of two varying elements—mass—velocity.

The relative value of these two elements varies with almost every conceivable description of property.

A ton of cotton is moved at 6 miles an hour ; ⅓ a ton of sugar at 12 miles an hour ; ¼ of a ton of men is moved at 24 miles an hour.

The work done is the same in each case ; and the expenditure of dynamical power only varies against the quicker motion ; to an extent inconsiderable within certain limits, and from extraneous or accidental causes.

In each case the relative value (to the proprietor of the article to be moved) of the mere transport and of the velocity, vary. The traveller pays for speed chiefly—the cotton owner pays chiefly for the weight moved. The manager of the railway says to both—I'll work for you at so much for every ton moved one mile, in any proportion you like. The passenger chooses ⅓ a ton 20 miles an hour—the merchant takes one ton at 10 miles—both pay the same, or nearly so ; the additional expenditure due to the velocity being, within certain limits, unimportant. It is this capacity for doing, within a given time, the same amount of *work* with a light load, that it can with a heavy one ; that distinguishes the railway from the canal or tramway ; fitting it for the performance of the infinite variety of work required in the social and commercial pursuits of every community.

I shall now consider the several arguments, or assertions, made by Colonel Cotton, as they appear in this chapter, on "speed."

"*One thing is certain—that increase of speed, whether by land or by water, by railways or roads, involves an increase of expense, much more than proportioned to the gain of time.*"

Here, as elsewhere, Colonel Cotton misleads his readers, by applying this rule to speed, or velocity, considered in the abstract; without reference to the description of motive force.

It is true that the expenses increase with animal power applied at a speed beyond 3 miles an hour—true perhaps, that it increases with a locomotive engine, though at first not mate-

rially, at a speed beyond 20 miles an hour; but it is not true, as every day's experience shows, and as every coachman, whose vocation is gone, knows, that the cost of travelling 20 miles an hour by steam is higher than that of travelling six by horses—But more than this.

There is known to be a certain speed, at which men, animals, and machines are worked with the greatest economical effect; up to this point then, there is clear and obvious *gain* in increase of speed.

How shall we ascertain this point, viz., the rate at which every animal or machine works to the greatest advantage?

Herapath, in his "Mathematical Physics" says, the dynamical force of horse or man is the greatest when his velocity is $\frac{r}{3}$; one-third the maximum velocity, at which they can move unloaded.

After giving examples in the case of horses, this accomplished writer says, (page 40) "One sees, from the observations above, the great cost of speed, owing to the limited velo*city of horses. In locomotive engines, the expense does not in*crease so much with a given mileage increase of speed; because the maximum unloaded velocity of an engine is so far beyond any small speed, as to render a considerable increase of trifling import. There is reason to believe that some of the engines, if they had no resistance from the atmosphere, would go nearly or quite 100 miles an hour unloaded. Therefore their best working velocity would be 33 miles an hour. That best velocity, however, is found to be much less, on ac*count of the great resistance of the atmosphere.* Engineers appear to think that the maximum of economy is about 12 to 15 miles an hour, for locomotives. We are much in want of experiments on this subject; but unless they are undertaken by some scientific man; we have not much chance of them from Engineers, who are all too much engaged in other matters, and take too little interest in such subjects."

Colonel Cotton, however, differs from Mr. Herapath and others whom I shall mention; and states that the increase of cost on high speed is *enormous*. The Colonel uses indefinite terms—"high" and "enormous." What is high?

If he means 100 miles an hour; we will grant, that *that* is beyond the economical application of the railway's dynamical power.

We read, further,* that "*in land transit it is now clearly ascertained that the increase of cost on increased speeds follow much the same law as afloat,*" viz., that a man can travel at 5 miles an hour at *one-sixth* the cost at which he can travel at 10.

Monsieur De Pambour proves by calculations, in which his facts are carefully drawn from experiment—that the greatest amount of useful effect is produced by an engine—of which the description—pressure, &c., are given—travelling at nearly 16·2 miles an hour. With an engine of different character, the maximum useful effect was obtained at the rate of 25·55 miles an hour; that is, at this rate of working, the dynamical result—the mass moved over a certain space—was attained in the most economical manner, for that engine.

Since, however, the charges arising from interest, management, &c., are charges against time, and are not noticed in the above calculation; it follows, that the most profitable rate of working, on all roads called upon to meet those charges, will be something above the rate of maximum useful effect, as above given.

If we turn to the valuable work of Mr. Belpaire; we find —after most careful analysis of the expenses on the Belgian railways—that the cost of traction of the quick and slow trains varied—for a passenger of the 1st class—as 8 to 5—for

* Page 155—166.

a ton of goods—as 27 to 16—being, as near as possible, as the *work done*.*

After speaking of the loss of power in horses at increased speeds, Colonel Cotton says, the same is the case with railroads.

We have seen Herapath's conclusion about locomotive engines. But the main fact with which we have to do now is; that in whatever degree the expenditure of power is increased at very high velocities—the velocity depending upon the degree of rapidity with which the water can be converted into steam of the given elasticity—the speed at which the engine produces its maximum useful effect is from 15 to 25 miles an hour, according to the build of the engine—while with a horse it is 2½.

Much stress, however, is laid upon the atmospheric resistance—What is this?

Speaking in general terms, we may consider the total resistance to be overcome by a locomotive engine as made up of two elements. The one—*friction*—bearing a proportion to the load, constant† at all velocities. The other due to the resistance of the air; and increasing rapidly with the speed: in fact as the square of the velocity. It appears from Herapath, that were it not for this resistance, the most economical pace, for a locomotive engine, would be 30 or 40 miles an hour; and we learn from Pambour that *in fact* it is from 15 to 25.

The resistance arising from friction, then, which with large loads at moderate velocities is the most important, does not vary with the velocity—the atmospheric resistance rises with the velocity; and is the main element in the cost of "speed."

* From what appears in "Lardner" their relative speed may be taken to be 22 and 15.

† Or nearly so.

The expenditure of power demanded at high speeds arises from the increase of "wear and tear," and of fuel consumed.

Of the latter, Mr. Whewell, in his "Mechanics of Engineering," says that the fuel consumed is very nearly proportioned to the "work done" by locomotive engines, at whatever rate they travel; and I find, in a table given in Monsieur De Pambour's work on the locomotive engine, the following results of two experiments, being the pair best suited for comparison; the pressure of steam, and expenditure of fuel, being the same, nearly.

	Load.	Speed.	Fuel per ton per mile.
	Tons.		
1	92·75	17·25	0·34
2	198	8·99	0·30

The expenditure of fuel is nearly
equal, being as..... 0·3 : 0·34

The speed of the one, double that of the other.

The paying work done is as..... 1609 : 1700 or as 3 : 3·6

Showing how small the effect—at these velocities—of atmospheric resistance on the expenditure of power.

If an engine is drawing a load of 100 tons on 16 waggons; the resistance which it will have to overcome at 10 miles an hour, supposing the effective surface of the train to be 220 feet, will be—

100 × 7 = lb. 700 friction.
„ 59 atmospheric resistance.*

Total.. 759

At 20 miles it will be—

100 × 7 = lb. 700 friction.
„ 236 atmospheric resistance.

Total.. 936

* Pambour.

At 40 miles—

$100 \times 7 =$ lb. 700 friction.

,, 946 atmospheric resistance.

Total.. 1646

The work—paying work—done will be, in the 3 cases, as

1—2 and 4.

The expenditure of power to meet the increasing resistance will be, as

1—2·5—7·2.

But while the power expended upon the unit of work does thus increase; two-thirds of the ordinary "working expenses," upon the same unit, are diminished.

Wages of engine men—general charges—management—police—interest—are all diminished, as the amount of work done increases. It is, thus, clear, that if atmospheric resistance were the only thing to be encountered in an increase of speed; our trains might travel much faster than they do, at present, provided they had sufficient work.

There is no doubt, however, that with railways constructed and worked as at present—there is a limit to the speed (depending very much on the several characteristics of each particular railway) beyond which the wear and tear increases rapidly.

I do not, however, agree with Colonel Cotton in the view he takes of the cost of speed, considered in the abstract. He says, "*for high speeds a most perfect apparatus is required, enormously heavy engines and consequently rails of immense weight, secure fastenings, &c., and also gentle slopes and easy curves at a cost of excavation almost incalculable in some instances.*" (p. 156.)

Now let us look through this—enormously heavy engines*

* Mr. Stephenson states (guage commission) that he made several journeys on a narrow guage line in Belgium, with a small engine, a "very beautiful little thing," carrying 40 tons, at the rate of upwards of 30 miles an hour.

are not required for high speeds; but for great and rapid "work" compounded of load and speed. The heavy rails operate, in every way, beneficially; by reducing the resistance; by enabling us to attain to high speeds; and—if the quantity of work render it expedient—to employ heavy and powerful engines. The resistance to traction of each unit is thus reduced to a minimum, by the expenditure of large sums upon the "perfect apparatus;" and, as a result of the same perfection of structure, the wear and tear of rails,* and other portions of the road, is reduced also in the railway. As to "easy curves" and "gentle slopes" they are calculated for railways exactly as they ought to be for tramways and roads; they are reduced not at an "incalculable cost;" but at one calculated to bear an amount of interest less than the difference saved in the working expenses; this saving in working expenses being found not only in the diminished resistance to traction, but also in the reduced amount of wear and tear of road, consequent on a reduction of gradients and curves. Colonel Cotton would find it, in his tramways, cheap to reduce the gradients considerably below 1 in 100.

Colonel Cotton then speaks of the effect of a blow on the rails being as the square of the velocity; and goes on to conclude thence, that an engine of double weight, moving at double speed, strikes the rail with eight times the force. I doubt the correctness of this theory; though it is certain that at high velocities the wear and tear increases rapidly. Experiment has shown that in cases of "impact" the deflexion of an iron bar is proportional to the *velocity* of the falling body; but experience has not yet enabled us to lay down any precise rule for determining the limit of a "paying" speed under every conceivable variety of circumstances.

* All writers agree that the wear of rails from ordinary usage is very small; and one writer stated in "Herapath's Journal," not many months since, that a worn out rail was a thing not yet known.

Colonel Cotton then says "if a high speed is required, when the traffic is considerable, a double line is unavoidable," &c.

This is a most strange view to take of the matter; and it is one upon which the same writer had already determined; that, if the Bengal railway has a very great amount of traffic—the way to get over it would be to travel slower.

The fact is that one of the great advantages of the railway —its stout rails and powerful steam engine—is, that *its* most economical pace of working is—compared to trams and canals—a *fast* pace: and therefore it does more work, and earns more money, in a given time.

Regarding these *extravagant estimates of higher cost of* speed, I need only add the evidence of a man, whose practical acquaintance with the subject will not be disputed.

Before the guage commissioners, Mr. Locke says, "I think it would cost about *one-third* more to work trains at 40 miles an hour than at 16"—and this without reference to weight. If he meant trains of the same weight, there is of course clear gain in working them at the higher speed—40 miles the hour is, however, much beyond any thing I should contemplate for India, at present.

There is a passage further on—"*Let us now suppose the railway worked at low speed such as 8 miles an hour in which case all the trains would travel the same speed, so that a single line of rail would be sufficient.*" Here we have the same extraordinary conclusion!! And then with these vague data of light rails, light engines and single line—the cost of construction is brought down at once from £12,500 the mile to £1,250. This is for the Bengal line, with 2,000 tons a day. While the Colonel's tramways for all India are to cost £2,000 per mile. Really we can prove any thing, if we are thus permitted to make our own data.

The subject of the value of time; and its bearing upon the railway question, does not seem to be fully understood by Colonel Cotton. He speaks of the 1st, 2nd, and 3rd class travellers, at home, as if they travelled at different speeds; whereas, the two first always travel at the same speed; and the last frequently in the same train: the difference of charge is not owing to any difference in speed; but to the size and fitting of carriages chiefly.

We speak of the value of time; and the rich are spoken of as those to whom time is of most value. Time, like every thing else, is worth what it will fetch; but while it is, on this account, of greater value to many of the first class than to any other; there are more, in that class, to whom it fetches nothing, than there are in any other class.*

The value of railways in promoting saving of time, is not to be measured by this or that passenger's day's wages; and to argue that these people can value 5 miles an hour but cannot value 20, is to say, a shilling possesses some value to them, but they are not yet rich enough to make any use of half a crown.

When, from tramways and common roads, we pass to the finished substantial railway; and convey goods and passengers, at a higher rate of speed, with safety and regularity; the value of time rises throughout the country: every man becomes so much the richer, as his time becomes more valuable to him.

All these statements and arguments are based upon these erroneous views.

* Speaking of the advantages offered by the railway to the Weavers near Manchester, Mr. Francis (History of the English railway) says "Before the railway was formed, one day in six was spent in procuring and in carrying back their work. When the trains enabled them to ride, they walked four miles to the station with their twenty-eight pounds of work, travelled by the third class, and unable to pay for another ride, walked back the whole of the way, with the silk or cotton which was to occupy the next week's labour."

1st. That persons and goods must of *necessity* travel at high speeds, on railroads.

2nd. That that speed necessarily costs more money, than slower speeds upon inferior roads.

3rd. That cost of construction regulates the charge for transport; whereas one great distinguishing feature in railways, and all similar instruments, is, that the actual cost of traction being very small, the charge for transport is regulated by the amount of business—the number of units to be conveyed in a given time.

Throughout the whole of his book, Colonel Cotton expresses his belief that this will be very great, both in passengers and goods. This granted, it follows, that the railways, with their infinitely superior capacity, with the resistance reduced to a minimum, and the power of adapting themselves to the traffic of the country to any amount, and in any kind, will provide the means of locomotion to the people, and their posterity, cheaper, as well as better, than the tramways.

In this chapter on speed, it is only necessary that I should notice one of the calculations, to show how entirely, though unconsciously, Colonel Cotton leans towards his own conclusions, by the assumption of the data necessary to their demonstration. At page 169 we read the following—

Present cost of transit	
60,000 tons per annum, 24 miles, at	
3 Annas, ... Rupees.	270,000
Present cost of transit on a *good* common road.	
60,000 tons, 24 miles, at 9 Pice. . . .	67,500
10 per cent. at 120,000 Rupees	12,000
Say. . . .	80,000
Repairs and management, at 500 Rupees per mile.	12,000
	92,000
Annual saving by common road. . . .	178,000

Cost of transit upon one mile of railway, 23 of unmade track.

60,000 tons, one mile, at 1 Pice. . . .	1,250
60,000 tons, 23 miles, at 3 Annas. .	258,750
10 per cent., at 120,000 Rupees . . .	12,000
	2,721,000 *

The object here is to show, that, by such an expenditure of money, there would be a loss annually—*i. e.*, by making upon 24 miles of road, one mile into a railway, and leaving 23 "unmade tracks:" while there would be a large gain in spending the same amount upon a good road—who can doubt it?

But let us see the data upon which Colonel Cotton arrives at this conclusion.

1st. That the railway costs £120,000 per mile.

2nd. That the traffic experiences no increase in consequence of its construction.

3rd. That the cost of working a common road would not exceed twice that of working the railroad—all errors.

The calculations made in this place are such as are entered into daily by every projector of a railroad, and might be put into the following words;—"given a high road with a traffic of 60,000 tons annually (which is to remain the same under all circumstances) required to know—supposing a railway to cost £12,000 per mile, the working expenses on it being one-half those on a common road, while the latter will cost in construction, *one twenty-fourth* part of the former—which would be the safest investment—the road, or the railroad?" any man of business could answer this.

The expediency of investing a large sum in the "perfect apparatus" depends on the probable amount of traffic; or the

* *This is the way it is printed, but there is an error in one figure.*

extent to which the existing traffic is susceptible of increase. Let us try, in the above case, as a railway would not do, how a tramway would.

60,000* tons per annum 4 miles, at 3 Annas..... 45,000

Present cost of transit on good common road.

60,000 tons 4 miles, at 9 Pice.....	11,250
10 per cent. on 20,000.....	2,000
Repairs, &c., on 500.....	2,000
	15,250

Cost of transit on *one* mile of tramway, 3 of unmade track:

60,000 tons on 1 mile, at 6 Pice †....	1,875
60,000 tons 3 miles, at 3 Annas.....	33,750
10 per cent. on 20,000.....	2,000
	37,625

Here then is a saving to the extent of Rupees 7,375 in favor of the tramway—the interest of money expended on it being small—but that on the common road is still far greater; and the Colonel's calculations, if worth any thing, bring us to the conclusion, that a common road, costing £500 per mile, and admitting of traffic being carried on, at a cost of 9 Pice per ton, is *the thing*, when you can get it.

It is not, however, intended to make one mile of railway; but several thousands—and the anticipated results are not, that they will carry a traffic limited to the present amount, cheaper than the common road; but they will create a much

* This is the rate assumed by Colonel Cotton, but I know of no road in India, upon which a ton of goods is carried one mile for 9 Pice (or a Penny nearly.)

† I have of course made the expense of traction greater on a tramway, than on a railway; though I have here made the difference much less than it would be with such roads as Colonel Cotton proposes.

larger traffic, and carry that cheaper, when created, than roads or any other means could.

Of the effect of speed, on the social and commercial condition of a people, we have sufficient evidence in the extraordinary influence it has exercised in England. There we had the best roads in the world; and we had many hundred miles of canal before railroads were introduced; but great as were the benefits which the public derived from those works; much as the canals contributed, in the form of cheap transport, to the development of the resources of the country, and the promotion of its general prosperity; it was reserved for the railway to exhibit those effects to an extent unparalleled in the domestic history of our own, or of any other country.

What was this? cheap transport? The canals were cheap in one sense; heavy goods of small value were dragged at the cheapest possible rate along them; but no travellers ever thought of this cheap kind of locomotion; while a large portion of the general traffic of the country, in goods valuable enough to pay for speed, were moved upon the common roads. If the canals produced comparatively little effect upon the manufacturing interests of the country, they produced still less upon the social and intellectual condition of the people.

The following statement, taken from Herapath's journal,* is sufficient to convey some idea of the effect produced by the superior power of a railway upon the country at large, as well as upon the interests of its own proprietors. In this case it not only increases enormously the amount of traffic, and the demand for transport; but while it threatens to destroy a neighbouring canal by a monopoly of the whole of the general traffic, it makes compensation, by creating an increased demand for the peculiar description of work, best adapted to the canal.

* April 30th, 1853.

The Grand Junction Canal in 1833, when the London and North-Western (railway) act was obtained, carried annually 703,257 tons of merchandize local and through: and in the year 1852, no less than 1,144,579 tons. In the same year (1852) the London and North-Western carried 3,398,622, including coal.*

It would be an error, in the very outset of the discussion, to talk of the value of speed as the thing for which we construct expensive and substantial railways. The question is what are the advantages of the solid rail, and the locomotive engine? These—Characterized by a power as readily displayed in the slow draught of heavy loads, as in the rapid movement of lighter ones; they perform their work cheaper than any other kind of agent, and at a higher speed: cheaper, in part, *because* quicker.† The necessity of sinking a larger sum in their construction, than in that of other descriptions of road, is a disadvantage met, and more than counterbalanced, by their immense capacity for creating a traffic, and for performing a very large amount of work.

One thing must be mentioned as essential to the economical application of a railway; as indeed it is in all similar cases. There must be work, or a promise of a speedy supply of work, up to its capacity. A man will not buy a horse to do the work, that a boy could do in the same time with a wheelbarrow. That the trunk lines in this country are likely to afford sufficient work for these mighty labourers, few, I think, are disposed to doubt.

The "wear and tear," and other expenditure attributed to high speeds in England, is explicable, not upon the theore-

* There is a difference in the extent of each; but the fact shows remarkably enough, the vast power of the railway.

† Before a Committee of the House of Commons, Mr. Seymour Clarke says (1606) "the great object in the coal business is to carry quickly and at a low price; in order to carry at a low price we must get the waggons out and home in the shortest possible time." 6th Report Railways and Canals.

tical principles advanced by Colonel Cotton, against high velocities, but to accidental circumstances involved in the working arrangements of a railway; such as, the frequent stoppages involving use of the breaks; and, on the other hand, the rapid passage of the express trains over crossings, and round curves, &c. Indeed, for all practical purposes, a limit is placed to the speed of trains by the frequent stoppages, without which the railways could not perform the part assigned to them. It is evident that, with stations every 6 or 8 miles, there must be a great loss of power in attempting to use a speed, so high, as to be scarcely attainable before it must be again slackened.

Moreover, the higher rate of speed has been hitherto applied to passengers only; and the necessity of meeting the convenience of the public by punctuality and frequency of trains, renders it impossible in this case, as is done with goods, to make up trains with the maximum of profitable load. I have more than once travelled a hundred miles, in England, the only passenger in a carriage, arranged for eight.

Lastly, I cannot believe, that with the urgent demands, of late years, for economy and judicious management, on the part of Railway Directors, the rates of speed would have gone on increasing, while the charges have decreased; did they not find, that, up to those rates, at all events, the higher velocity was more than counterbalanced, by the value of the additional work done.

V.

TRAFFIC—WORKING EXPENSES—TARIFF.

It has been seen, that the actual charge, per ton per mile, upon a railroad, does not depend solely, nor even principally, upon the original cost of the line although this

is the impression that is conveyed by Colonel Cotton's mode of arguing the subject.

The unit charge depends—

1st. On the cost of traction which decreases as the road is brought nearer perfection..... *A*.

2nd. On the capital invested..... *B*.

3rd. On the amount of traffic..... *C*.

It is in fact, directly as the two former—inversely as the latter—or, more strictly, as $A + \frac{B^*}{C}$—and I have shown not only that it *may* be; but that, if the work has a sufficient field for its operations, it *will* be, less on the more expensive line than on the cheaper one.

We may, however, illustrate this by some observations upon a line now under construction in this part of India.

We will look at a common trunk road, like that now running westward into this part of the country from Madras. What—introduced as it is into a network of bad roads—"unmade tracks"—what have been its effects?

Assuming that traffic can be carried on, upon this new trunk line, at twice the pace, and half the cost of the older lines; it will draw into it all the traffic, destined for Madras, of every kind, included within a space, represented by a triangle, of which, the apex being at Madras, the height being equal to the length of that road, the base is equal to one and a half times its height.

Let us now substitute a railway for the trunk road—a railway, by which traffic can be carried at *six times* the speed and *one-sixth* of the charge of that on the "unmade tracks." The space, over which the influence of the railway is extended, the traffic upon which it would monopo-

* Of these *A* will always be less on the better railway, while $\frac{B}{C}$ will depend upon the capacity of each, and the amount of work they have to do.

lize, becomes a triangle of which, the apex being at Madras, the height the length of the railway, the base is nearly *six times* that length.

Thus, if the railway is extended 240 miles westward from Madras, it must draw upon it, besides intermediate traffic, all, destined for that town, embraced between two lines meeting at Madras at an angle of 140 degrees. The area of the space contributing to the traffic, on the present common road, would be to that contributing to the traffic on the railroad as 1 to 4 nearly.

Now Colonel Cotton thinks the present traffic on our western road is 100,000 tons annually. I put it down at 50,000. Bearing in mind, that, upon the above calculations, the present trunk road drains an extent of country, *one-fourth* of that which a railway would drain; is it too much to estimate the traffic, on such a railway, at 200,000 tons annually, exclusive of passengers, and without reference to the increase, that would arise from such an improved system of transport?

Acknowledging the railway to possess power of a higher order than the tramway—that, in its speed—in its capacity for work—exhibited both in the road and the engines, we see not merely sources of expense at the outset, but means, peculiar to itself, for awakening the people of the country, and stimulating them into life and energy; we must, before we look to the other side of the picture, and pronounce it all very fine, but too expensive! enquire whether the *charge per ton* for transport on it, must necessarily be, or is likely to be, higher than on a tramroad, costing 20,000 Rupees the mile.

I have shown that, on the trunk line now under construction at Madras, the traffic drawn into a railway, may be estimated at 200,000 tons annually—say, in round numbers, 700 tons a day. This, in the existing state of things: and, if effect follows cause in the usual manner, this must increase:

since every ton, except those drawn from the very verge of the space so drained, comes cheaper and quicker than it ever did before.

Now I think, whatever Colonel Cotton's opinion may be as to the necessity of going slow to get over a great amount of work, most men will agree with me, that the capacity for performing any amount of work will be greater in a machine whose maximum useful effect is attained at 12 or 14 miles an hour, than in one whose maximum useful effect is at $2\frac{1}{2}$ or 3.

If the special charge of transit, at its most profitable pace, ($2\frac{1}{2}$ or 3 miles an hour) be, on the tramway $\frac{1}{3}d.$ per ton, and that on the railway, at 12 miles an hour, is $\frac{1}{4}d.$, (I am confident that this is not too great a difference to make between the expenses of draft on two such roads,) it is not too much to assume that the capacity of the railway is double that of the tramway. How does this effect the charge on the unit of traffic?

Assuming the original cost

In the one to be..... £6,000

In the other..... £2,000

The special charges on each ton of goods charged one mile.

In the one case..... $\frac{1}{3}d.$

In the other..... $\frac{1}{4}d.$

Interest with other general charges.

In the one case..... £100

In the other £300

The total charge for each ton per mile will be

In the tramway..... $\frac{1}{3}d. + \frac{100}{C}$

In the railway..... $\frac{1}{4}d. + \frac{300}{C}$

Let C the traffic be equal to 200,000 tons.

The $\frac{1}{3}d. + £\frac{100}{200,000} = 2{\cdot}48$ farthings the charge for *tramway*.

And $\frac{1}{4}d. + £\frac{300}{200,000} = 1{\cdot}70$ farthings the charge for *railway*.

In the above calculation, I have, for simplicity sake, divided the whole expenditure into two kinds, the special indistributable costs, and the general charges (including interest), the proportion of which, allotted to each ton or other unit of work, of course varies with the amount of that work. In doing this, I have given, under the first head, as invariable, much* that ought to have been placed in the other category; and have thus given the advantage to the tramway.

Monsieur Belpaire, in his valuable work on the Belgian Railways, shows that, in the movement of a ton of goods one mile, the actual fixed cost is only about (0·07*d.*) the seven hundredth part of a penny; while the total expenditure (on the Belgian lines) upon that amount of work is (exclusive of interest,) 1·2 penny. The difference shows the proportion of the "working expenses" which (as is the case with the interest on first cost) is reduced by an increase in the amount of traffic. The same writer gives, subsequently, a table to show how the actual charge on each ton is reduced by the increase of traffic, and by judicious arrangements of trains; and he brings down the cost of moving one ton a mile, from something above 4 pence, when the traffic is light and the trains worked at a disadvantage, to about *seven-tenths* of a penny, when the traffic amounts to 100,000 waggons a year over each mile, and the railway and rolling stock are judiciously worked. In fact, while the expenses which depend upon the resistance would certainly be higher, on the inferior railway, than they would upon the other; a portion of these very charges, being distributable, would fall heavier upon each unit, as being divisible among a smaller amount of traffic.

I have said nothing of canals hitherto—but the same mode of reasoning will be found to apply to these also. There is,

* Much, even of the locomotive expense, will be found to vary inversely with the "work done," in the charge upon the unit.

however, this marked difference between a "slow speed" canal and a tramway; that in the former, the expense of "draft" is at those slow speeds much below that on a railroad; while on the tramway (which is a bad railway,) this cost of draft is much greater. It may not be out of place here to allude to certain statements and arguments, exhibited at page 241.

We are first told that every body who had previously written upon the subject of railways and canals had shown "a fundamental misapprehension of this subject." "*Universally railways are spoken of as substitutes for canals, though nothing can be more false than this idea.*" The meaning of this sentence is not quite clear. If a man proposes to substitute a railway for a canal; I cannot see that he is guilty of any "false idea." When another with, perhaps, equally good reasons, proposes, in some other locality, to substitute a canal for a projected railway—there is not, necessarily, a "false idea." Both together may be recommended, at one and the same time, and yet the idea be a very just one.

Among those, who have been lately called upon to write upon this subject in India, one officer gave his opinion in a report to the Governor General, dated 1st February 1853, and since printed, as follows.

"In the case of navigable rivers and such as the Godavery, which it appears probable might at no great cost be rendered navigable, that part of the country to which they already furnish a cheap and ready means of transport, may, as a general rule, be left without railways till the more pressing necessities of other portions of the country have been provided for.

I have only further to remark that the line proposed* on the eastern coast of Madras lies over a country singularly favorable for the construction and supply of canals. The

* A line proposed for a trunk line of railway by Major Kennedy.

construction and working of a canal near Madras, so short as to produce little effect on the development of traffic, has been attended with very favorable results. A proposition has been made, and I believe sanctioned, for extending it a few miles; and there is no doubt that communication by canal might be opened along the coast between the now fertile deltas of the Godavery and Cauvery at a far less cost than a railway, and far more capable of competing with the present coasting traffic."

The argument proceeds on the form of a very "simple calculation to show that, making allowance for the loss of interest on the value of goods carried, a canal at 3 miles an hour may carry grain 1,000 miles cheaper than a railway at 14—possibly—probably, in most cases—but not *necessarily*.

Colonel Cotton, to show this, takes the cost of draft, arbitrarily, at 4 Pice in the one case and 1 Pice in the other—against the railway: but he leaves out of the question the interest on first cost and the general expenses of management, &c.

Now I freely admit that it is not likely that a railway will ever (taking interest on first cost, management, and all expenses into consideration) beat a canal in the carriage of cheap goods—but there are circumstances under which it might do so—and it is under these very circumstances that, in some cases, the railways have pressed competing canals so hard in England.*

At page 250 Colonel Cotton introduces some trite observations on the effects of profits, on the value of shares; and shows that the mere fact of a shareholder in a canal, who bought shares of a nominal value of £200 for £2,000, los-

* In the *Economist* (March 11,) I find in a notice of a work by Mr. Whitworth, in America, the following passage, "yet the railroad system for the western trade is said to have superseded the canal system—we should say rather it has come to its aid." Again, "the rails are carrying such increasing quantities of goods and carrying so cheaply as to compel the state of New York to lower its canal tolls."

ing by competition with a railway, does not prove that the latter is working cheaper than the former. I do not see, however, that he has taken any notice of the fact that, of the canals now quoted as paying (in spite of the railways) a certain dividend, few if any are paying that dividend on the original cost of the canal; a considerable portion of that cost having been, in their palmy days, paid off. How a railway may compete with a canal may be seen from the statement already made regarding the quantity of heavy traffic upon the north-western Railway and Grand Junction Canal: that they do so compete with them is clear, from the evidence of men intimately associated with the canal interests.

From its superior power, from its cheapest working rate of speed being a high speed, comparatively, the railway monopolises all the fast traffic of every kind. Indeed there is nothing, as I have observed before, on which speed does not tell to some extent.*

Having thus withdrawn from the canal all the lighter traffic of every kind, passengers, mails, bullion, and goods of value, manufactured or others, the railway has still stomach for more work; and picks up raw produce, minerals, &c., carrying them at the smallest fraction of profit; such small fraction still adding to their dividend.

The charge for transport in each case may be found thus, taking our former mode of calculation.

Special cost of locomotion in the canal....1 Piec.
In the railway.....4 Piec.

To each of these must be added a proportion of interest on capital. The railway clears 5 per cent. already by its

* The great northern railway now carries beside passenger traffic 17,000 tons of coals per week along its line at ½*d.* a ton. Does it manage this large amount of work by slackening speed on traffic of all kinds? I suspect not.

passenger traffic, and is satisfied to have ½ a Pie profit on each ton of coals—the canal having a capital invested of 20,000 Rupees and 50,000 tons of annual traffic, in heavy goods, must put 4 Pice, on each ton, in order to gain a similar dividend.

It is thus that the railways in England do press upon the canals, by their superior capacity for work, which capacity depends mainly upon their going quick at low prices, quicker than canals, roads or trams, however worked, can manage.*

It is clear from the above, that while, as Colonel Cotton remarks, the question is still open, what kind of communication is best for this country; That question is to be considered with a little more care than he has bestowed upon it.

I look upon his proposed tramway as an inferior description of railroad; not likely to be adopted with advantage in any general system of highways; though very useful in mineral districts and other special cases.

In determining whether, in any particular case, we should have a railway—a canal—or common road—we have to consider,

1st. The character of the country.

2nd. The probable cost of construction in each case.

3rd. The probable cost of maintenance and working in each case.

4th. The amount of traffic to be anticipated.

5th. The nature of that traffic.

Lastly—the results, social and political as well as commercial to be desired and anticipated from the highway in question.

* The following is an extract from the official "census Report" for the united States, December 1st, 1852, after stating that before 1860, there will be completed 35,000 miles of railway, the writer says, "The usefulness and comparative economy of railroads as channels of commerce and travel have become so evident that they have in some measure superseded canals and are likely to detract seriously from the importance of navigable rivers for like purposes.

If it were possible that any country could be in such a condition as to furnish an enormous amount of heavy cheap goods, upon any given trunk line; without their being at the same time a large demand for passenger traffic, and the quicker transport of costlier goods; and if local circumstances were not opposed to it; I should say, this is a case for a canal—but such a case is without an example.

If—as will be found in some cases in this country, there were circumstances peculiarly favorable to the construction of a canal, while the development of a mixed traffic did not promise to be sufficiently rapid to encourage the construction of a railway, I should say, "lay down the canal, let it do its best towards the general traffic of the country; and let the railway follow: as the business of the country increases a railway and canal may well work together."

In this part of India, I agree with Colonel Cotton in thinking, the construction of a coast canal would be a measure, wise, simple and benefical. But I should look upon his proposed canal across the Coimbatore district, with a lock every mile, and a summit level on a district, more scantily provided with water, than any in India, as a grievous mistake.

I am by no means disposed to enter upon so unprofitable a discussion as that of the general merits of a canal *versus* those of a railway; but I cannot avoid noticing the manner in which Colonel Cotton has treated the subject in quoting the American works. He does not take into consideration, how remarkably in that case the natural features of the country promote water communication*; their magnificent rivers and lakes feeding and supporting artificial, connecting channels.

* Of 587 miles of inland navigation in North America 62½ only are by artificial canal.

One thing however is clear from these statements, assuming that they are derived from good authority, viz., that the cost of transit on the "Erie canal" is $\frac{9}{10}$ of a penny per ton per mile; while on railways in England it is only $\frac{1}{3}d.$ or $\frac{8}{10}$ of a penny, at this moment.

We observe another fact too from these statements, viz., that to effect this—to create an instrument, in the shape of a canal, that should transport goods at $\frac{9}{10}$ of a penny per ton, it was necessary to expend in construction no less than £13,700 per mile. This, taken with the fact that, in England, upon lines of railway which cost £35,000 to £50,000 the mile, coals are now carried at $\frac{1}{3}$ or $\frac{4}{10}d.$ per mile, is very encouraging to the promoters of railways here, where we can complete them for *one-sixth* of that sum.*

I have, I think, said enough of Colonel Cotton's arguments against what he terms "high speed" (that is, well constructed) railways, on which, at considerable first cost, the operation of carrying goods and passengers is facilitated and cheapened; but it may be as well in concluding this part of our subject to say a few words on the capacity of these railways for the performance of a given amount of work.

Nothing more clearly shows the very narrow and imperfect view which Colonel Cotton takes of this subject than such a passage as this, at page 247: "*We might as well say, that because my Lord and Lady found a carriage sufficient to carry their own persons, therefore all the farmers on the state ought to carry their hundreds of tons of goods in Gentlemen's carriages instead of waggons*"—as if the capital invested in reducing the inequalities of the earth's surface, in purchasing rails, and fixing them securely, thus

* Speaking of the Huddersfield Canal Captain Laws says before the Committee (6th Report railway and canal), "How can a penny a ton pay upon a canal which hardly even paid a dividend with a very much higher tariff and a greater traffic"?

reducing the resistance as much as possible, was simply intended and calculated to enable Lords and Ladies to travel quick; and had no effect on the conveyance of such vulgar things, as turnips and barley. This, too, with the fact already mentioned, that one railway in England has been lately carrying 17,000 tons of coal, a week, over its line at ½*d.* the ton per mile.

Might we not, with as much justice, point to the palaces in Manchester, the splendid buildings, the expensive fittings, arrangements perfect on all sides, and contemplating, with awe, the amount of capital sunk, exclaim, "such an employment of capital may do well in a country where Court dresses and costly manufactures are required; but for the poor people of India and *their* clothing, commend us to the cheaper handloom!!"

The fact is, that, in the best description of railway, we see nothing more than the operation of a system which is daily being applied more and more extensively in Europe: the economical employment of capital, in the concentration of power; by which the most minute and contemptible unit of work, a button, or a doll's eye, is executed at the cheapest possible rate.

I have before alluded to the errors into which men are apt to fall by a too great dependence upon averages. It will be not out of place, if I again illustrate this, by an allusion to Colonel Cotton's mode of applying the average in calculating the relative cost of traffic upon a railway, and one of his tramways; by throwing the whole of the traffic into a lump, and assuming one rate for all. He thus deprives the railway of one of its most remarkable and characteristic advantages, the power of creating a demand for a large amount and great variety of work; and adjusting its tariff to the several description of traffic, so as to make great profit out of some, carrying on the rest at the cheapest possible rate.

As an example of this and other errors into which Colonel Cotton has fallen throughout his book, I will take the following calculation at page 182.

High Speed Railway.

Cost of 100 miles, at 80,000 Rs. . . . 80 lacs.
Working half of the 100 miles for five years, at 80,000 Rs. a mile. . . 75 lacs.
Ditto half at 4 Pice per ton, or *one-ninth* of the present rate. . . . . 8 lacs.
——— 163 lacs.

Cheap Railway.

Cost of 100 miles, at 20,000 Rs. . . . 20 lacs.
Cost of working for five years, at 2 Pice $\frac{1}{1}$ of the present rate . . . . 4 lacs.
——— 24 lacs.

Saving on the cheap railway. . . . 139 lacs.

Now one fundamental mistake which the Colonel makes in this and other similar calculations, is in assuming first, an amount of traffic; and then a cost of working without any reference to that amount.

In the above calculation the cost of the railway is stated at too high a figure; but I need not dwell upon this. The time required to execute it is exaggerated greatly. The cheap railway is assumed in the calculation to have been executed in "no time;" the "working" is assumed in the one case to be 4 Pice, in the other 2 Pice; so that, in the one line made expensively to ensure cheap working, the "working" cost is double that on a tramway worked by cattle with "steep gradients, sharp curves, &c." This is an easy way of proving anything.

Now let us proceed in the ordinary way to see what the cost of transport, (which is the very thing we want to arrive

at) would be—fortunately Colonel Cotton has given us his hypothetical traffic—160,000 tons.

Working expenses include all expenses properly so called, "management" "locomotive," &c., but in getting at the probable "charge" per ton, we must include interest on capital, say five per cent.

Now we will start, if we can get hold of such a thing, with a fact.

The locomotive expenses on the Manchester and Leeds railway have been stated before the Guage Committee to amount to *four hundredths* of a Penny per ton per mile—double this for the cheap railway and we have *eight hundredths* per ton. Let the other elements of working expenses in both cases amount to 0·8. Then the total becomes

In the good railway.....0·12*d.* per ton.
In the bad railway.....0·16*d.* „

The expenses per ton per mile on 160,000 tons will be

On the good railway....160,000 × 0·12*d.* = £ 80
On the cheap railway....160,000 × 0·16*d.* = £106

The charge for interest, assuming according to our experience, that the railway cost £6,000 per mile, will be

On the good railway.....£300
On the cheap railway.....£100

The additional charge on each ton per mile to meet this will be

In the former case .... £ $\frac{300}{160,000}$ = 0·45*d.*
In the latter case ..... £ $\frac{100}{100,000}$ = 0·15*d.*

The charge must therefore be

In the first case . .0·12*d.* + 0·45*d.* = 0·57*d.* per ton.
In the second case.0·16*d.* + 0·15*d.* = 0·31*d.* „

By this mode of calculation, we should find that when the traffic reached 1,200,000 tons per annum, the mileage charge upon each of these, to enable them to pay alike 5

per cent. upon capital, would be the same, viz. 0·18*d.* per ton per mile. This is however, taking the worst case against the better class of railway; giving it nothing but slow speed traffic, none of the advantages of the higher and more profitable description of work: and wholly putting out of sight its surpassing power to stimulate commerce and create traffic as well as the impossibility of the cheap railway ever carrying 1,200,000 tons, or even so much of it as the better railway could.*

But now let us suppose that out of this 1,200,000 tons, a portion represented by 100,000 tons, consisted of that fast traffic of passengers and light, valuable, and perishable goods, much of which the cheap railway could not carry at all.

The total amount of interest on the £6,000 is £300. To the working expenses on these 100,000 tons we may add a handsome profit—say—a half penny a ton—then $\frac{1}{2}d. \times 100{,}000 = £208$ profit on this portion of the traffic; leaving £300—£208 = £92 to be earned by the goods—$£\frac{92}{1{,}100{,}000} = 0{\cdot}02d.$ ($\frac{2}{100}$ of a penny) to be added to the "working expenses" for the cost of transit, which then becomes $0{\cdot}12d. + 0{\cdot}02d. = 0{\cdot}14d.$

Colonel Colton seems to entertain some singular apprehensions regarding the amount of traffic, on such a line as that of the Bengal railway; which he thinks will be more than the line can conveniently carry. Is this a grievance? Do men generally complain they have too much grist coming to their mill? What do we with a common road when it becomes thronged to an inconvenient extent? We widen it—so do we with a railroad. The "Great Northern" of England are actually laying down or proposing to lay down

* The above calculation is intended to show that viewing the subject under the worst possible aspect for a railway—it would yet, when the traffic reached a certain amount, work cheaper than the tramway—purposely taking an extreme case, I have assumed that the tramway would carry as much as the railway which it would not.

an additional line of rails to accommodate their increasing and remunerating coal traffic.

This is however an anxious moment for so large and expensive an apparatus as a railway. The traffic coming in must be beyond its capacity in the first place—and then sufficiently beyond it, or having sufficient promise of so great an augmentation, as shall give employment to the additional amount of roadway proposed.

The traffic advances on a railway in this manner. There is a speed at which the engines do their work with the best possible effect—say 15 miles an hour. The traffic increases until, at that speed, there is a risk of choking. The speed is increased to (say) 17; but the profit on the additional traffic, thus mastered, more than compensates for the expenses of the increased speed: traffic pours in; but if they increase the speed further, the additional profits, at the present charge, will *not* make up for the additional expenditure due to the additional speed. The railway is saturated: then comes the question of a general rise in the tariff, to keep off further increase in traffic; or additional accommodation with the same or even a reduced tariff.

Now a single line of good railway, with its speed, will do far more work in a given time than a tramway. The former would accomplish with one engine a mileage of 40 or 50 thousand tons in 12 hours at the cheapest possible rate. The latter would require 200 horses to do the same amount of work. To make the cheap railroad as accommodating as the other, it would be necessary to add more lines of rails. This would bring the total cost up to that of the better railway. We might then have accommodation for all, in tonnage; but not one step should we have advanced towards improvement in the character of the highway: more of it, but still of inferior character. We might add 20 parallel lines, but we should still have light girders to bear very light weights so light as

" not in the least to affect the rails," " sharp curves," " steep gradients,"—travellers, troops and mails would still be limited to 5 and 6 miles an hour. Moreover, add as many lines of rails as you choose, the superior railway if worked up to its capacity must work cheaper than the other.

On the railway, supposing there to be a single line, and stations every 10 miles, 6 trains might run during the 12 hours each way; and the character of the road facilitating the economical application of steam power, each of these trains would take without difficulty 200 tons (nett.) It is thus not too much to assume that such a line might manage, at its most economical rate, 1,000 tons each way, or 2,000 tons a day—700,000 tons per annum. On the tramway, with the same number of stations, 2 (through) trains, each way, at 3 miles an hour would be the utmost that could be managed: if there were 250 tons each way each train would consist of 250 tons gross. This would require upon such a line, with steep gradients 50 good, horses at least: allowing each horse with his load to occupy 15 yards—and it would not be an economical application of the horse to have more than one to the same load—would give a length of train of about 900 yards; something more than ½ a mile. Such a train would in the course of the day's journey—40 miles—meet two others and no little time would be expended on these occasions.

If the stations were more frequent, more trains might start, but more time would be lost. I do not think it possible therefore that such a line could accommodate above 250 tons each way daily, or just *one-fourth* of that which the railway could perform; and the passage of any quicker trains would be utterly impossible.

In order therefore to give the tramway a capacity for the performance of very heavy traffic equal to that possessed by the railway we must give the former 4 lines of way to one of the

latter. But this would cost £2,000 × 4 = £8,000, whereas the latter only to cost £6,000.

If however we are content with a single line in either case, what would be their respective merits as investments, worked up to their capacity!

Railway working expenses.....	0·2*d.* per ton.
Tramway do.	0·3*d.* per ton.
Railway charge (say).....	¼*d.* per ton.
Tramway do. (the same).....	¾*d.* per ton.

Profit in each ton.

Railway.....	0·55*d.* per ton.
Tramway.....	0·45*d.* per ton.

Aggregate profit in railway.

$$\frac{700,000 \times .55}{12 \times 20} = £1,600.$$

which is on a capital of £6,000 = 26 per cent

Aggregate profit on tramway.

$$\frac{180,000 \times 45}{12 \times 20} = £837$$

which is on a capital of £2,000 = 16 per cent.

We have here argued from a fixed charge, on two such railways, to a resulting dividend—but let us now take a fixed dividend, and see how the country would be affected—what the tariff would be.

Let the dividend be five per cent. This on the railway would be £300 per mile, which divided among 700,000 tons gives

$$0{\cdot}1d. = \tfrac{1}{10} \text{ of a penny.}$$

Then 0·2 + 0·1 = 0·3*d.* of a penny per ton per mile is the charge for the *railway*.

In the other case we have interest on first cost £100.

Then $£\frac{100}{180,000} = 0{\cdot}13d.$ and 0·3 + 0·13 = 0·43 or $\frac{43}{100}$ of a penny, as the charge per ton for the tramway.

There is yet one observation to be made regarding the traffic to be expected in India.

With trunk lines extending many hundred miles and draining such a vast extent of country as these will, there cannot be a doubt, that the traffic will be greatly increased; or that, being chiefly raw produce, it will Be very bulky; neither can we doubt that there will be a great amount of passenger traffic, though there is little to be seen now.

It is well to remark, however, that the increase in the traffic on any particular line will be of two sorts; due to two distinct causes—the one will arise from the tendency of the improved road to draw into it existing traffic from each side—far and wide—the other will depend upon the effect produced by the railway on the means—the habits—the minds of the people.

The former increase will show itself very soon; the latter will be much more gradual, as regards goods—the passenger traffic will develop itself, I think, very soon. In the latter case we have the materials ready—the men, women and children. In the former, the produce has to be raised—an increased amount of sugar and cotton can only be obtained from a greater breadth of land being brought under cultivation; or from an improved system of agriculture being followed upon the land already cultivated. Both these causes will be at work; and the effect, though gradual, will be sure.

Colonel Cotton speaks of the country, as already full of population, and yet with an unlimited extent of suitable soil still available; which sounds somewhat paradoxical. Not so full, in my opinion, but that the effect of the railways will be to fill it fuller; and to furnish men to raise an additional amount of raw produce, upon this unlimited extent of suitable soil.

Colonel Cotton has stated (page 184) certain conclusions to which he has arrived, upon this subject, which it is not necessary, I should notice further; as they are chiefly built upon the foundations which I have now laid bare.

There is one para. however, (the 55th) page 196, which appears to call for remark, as indicative of a disposition to assume data somewhat hastily.

In this para. the cost of transit upon different descriptions of roads and canals is stated. Now, as before observed, the interest on first cost is a very important item in "cost of transit;" especially on roads which cost £6,000 or even £2,000 the mile.

Here we have the cost of transit on a common road, stated at 8 Pice per ton—upon what authority?

On the Madras western road the charge at present is about 1 Anna 6 Pice, or 18 Pice per ton; exclusive of wear and tear of road, and interest on first cost—manngement, &c.

The late Captain Best—a man of rare ability, experience, and judgment—estimated the interest on first cost on the western road, and wear and tear together, at from 25 to 45 per cent. on the present charge for traffic. This would bring the cost of transit up to 24 or 25 Pice per ton.

Again, in this table the cost of transit on a railway is stated at 4 Pice—on a cheap railway at 2 Pice. Now the Colonel cannot believe that the *traction* on the former would be more expensive than on the latter: if there be this difference, it must arise from the interest on first cost forming an important element in the "cost of transit." But what do we see at page 182? there the "working expenses," which do not include interest, are stated to be 2 Pice; then at page 196, the "cost of transit," which *must* include interest on capital, is also 2 Pice! Further we have here, cost of transit.

On first class railways.....	4 Pice.
On cheap railway.....	2 Pice.
On canal (with towing paths) page 228...	½ Pice.

i. e. The cost of transit on the railway is double that on the cheap railroad, and eight times that on the canals; and yet we find railways in England which cost 30 to 50 thousand

pounds a mile, carrying coals for less than ½d. a ton per mile, and pressing upon these canals very hard. I think this is quite sufficient of itself to show that Colonel Cotton has not fully considered this question; that thinking only of the well known relative value of the resistance, at certain speeds, on railways and canals, he has forgotten how the mighty power of the locomotive engine enables the proprietors of the former to regulate this "cost of transit," by ringing an indefinite number of changes on the proportions in which each description of traffic shall be made to contribute to the required dividend.

We may see, from what has been stated, both the light in which railway projects should be viewed, and their progressive effects on the commerce of a country.

Colonel Cotton makes it a matter of complaint against the various gentlemen who have hitherto discussed these projects in India, that they have confined their attention, to the "comparatively insignificant" question of their remunerative character.

Having in view the execution of these works by private companies, I consider that they would have been guilty of an absolute breach of faith, towards the public, had they considered them in any other light than that of money speculations. It was their business to state plain facts; not to indulge themselves in flights of imagination: to show how, with existing traffic, and that which might fairly be expected, and with a charge sufficiently low to defy competition, the work might be expected to pay.

In another place* the Colonel says, that nothing will be done unless India has "*cheap transit—really cheap transit at rates one-tenth or one-twentieth of those at present prevailing,*" And he then finds fault with those who talk of 1*d.* to 3*d.* per ton per mile, as men who do not consider, &c.

* Page 76.

Now the most perfect apparatus yet known for the purposes of transport is the railway. I have shown that the rate at which goods can be conveyed by this instrument depends upon the amount of traffic—and I need not say, that this amount of traffic depends, on the other hand, on the operations of the railway. The consequence is, that the fall in the charge for transport must be progressive. The only thing we have to secure at first for the railways in India—positively the only point of any serious consequence—is this; that they should be able to support themselves while they benefit the people. They may probably begin with what Colonel Cotton would consider a high charge; and yet it may be low enough to be a decided improvement on the present rate. The effect of this decided improvement is to stimulate trade, and increase the traffic; and the effect of this increase in the traffic, is to enable the railway to work at a lower charge.

Let us apply this in practice, taking the Madras railway. Suppose the annual traffic now to be 50,000 tons—the working expenses 2 Pice per ton—the interest on first cost Rupees 3,000 per mile. Let us assume that of the interest, passengers, parcels, &c. pay Rs. 1,000, leaving 2,000 to be met by the goods, Rs. $\frac{2,000}{50,000}$ = 8 Pice nearly as the interest to be earned upon each ton. Then this added to the working expenses gives 2 + 8 = 10 Pice for the charge.

This is an improvement; and we cannot doubt of its operation upon the trade. The traffic becomes 100,000 tons the variable charge for interest becomes 4 Pice per ton and the tariff may be reduced from 10 Pice to 6 Pice per ton. Thus the fall in the charge for transport keeps pace with the increase in the amount of traffic; until the railway is saturated with work. In this case it appears that, for an average, something like 6 Pice per ton would be a reasonable charge to begin with.

Lastly the above considerations show us the immense importance of keeping the cost of traction, the locomotive expenses, low. These are fixed and invariable; and when they are relatively high, the beneficial effect produced by any increase in the amount of traffic will be relatively small. I have elsewhere observed that Colonel Cotton generally assumes that the working expenses of his tramways are less than those in the railways; a palpable and most important error.

VI.

WHAT WE WANT IN INDIA.

Before determining what description of communications we should provide for India—upon what system they should be constructed—at what rate it is desirable to lay them down—it will be well to reflect upon the present condition of the people—the character and relative position of the Government.

I speak of that part of India with which I have some acquaintance. The population is almost entirely agricultural; scattered over the face of the land, chiefly in small villages. The distinctive characteristics of the people are, poverty, and ignorance—their actual wants are few, their habits simple—their virtues are chiefly of a negative kind, contentment, sobriety, patience: industrious they are not (though often said to be so); if industry means to work when not compelled; to make the best use of time. Their defects, compared with the more distinguished races of men are want of energy, of ambition and self-reliance. I do not speak of those moral virtues which neither they nor any other men can display, until brought under the influence, direct or reflected, of religion.

Not only is this people broken upon into different castes, among whom are no social relations, and little sympathy, either in public or private life: they are divided even into nations—speaking different languages—wearing different costumes—cultivating different soils—consuming different products—all ignorant and all poor.

As a remedy for this ignorance and this poverty, one man proposes a general system of government education; another reform of the law; another revenue surveys, and regulation of the assessment: others look to the abolition of ryotwaric; *while some talk of good highways as the grand* specific.

Each of these measures may be good in itself, but none, not even the roads, would do alone. As calculated to shed abroad "light and air"—these would probably lead on, of necessity, to the other reforms, but we want reform in every department—we want clear heads and unfettered hands to carry them out, studying to take the people, as fast as may be, along with us in our progress.

We are placed here as the representatives of a nation, among the foremost of all in the world, to educate a people far behind in every thing. We know that our own national character has been in a great measure formed during a long struggle up to national manhood; can we hope to see this people spring at once into that state?

We talk of our roads—canals—docks—manufactories—and brag not a little of the Anglo-Saxon in these days; do these make the men, or the men these?

The kind of difficulty we have to contend with, under present circumstances, may be illustrated by a look at the "road" question.

We take our ideas of roads from England—and we are told, perhaps, as a great grievance that there are not 50 miles

of road one could drive a gig upon! possibly—but then, if there were, no gig would be driven on them.

The people are very slow to take advantage, and certainly never have yet taken full advantage, of any works of this nature. They take no interest in them before hand; and when presented to them, only make that use of them that instinct forces upon them. Under these circumstances a common macadamized road is one of the most unsatisfactory and expensive works that could be constructed for them; at least if made up to our English notion. The people take the least possible advantage of it; and the expenditure (upon such as are made up to an English standard), necessary to repair decay due to atmospheric influence, probably far exceeds that fairly expended in the facilitating and cheapening of traffic.*

Considering the ordinary character of this people's mode of working and of travelling, the additional expenses, necessary to complete a road up to the "gig driving" mark, would far outweigh the additional advantages gained by a common bullock cart; while at the same time the habits of the people are such, that no gig appears.

On one road we have now a mail cart, the proprietors of which horse carriages for travellers—the road is 200 miles long, and lying between large European stations is wholly supported by that section of the community. The advantages gained by bullock drivers from the finishing expenditure would never be sufficient to pay for it—while the proprietor of, or travellers by, these carriages are perhaps the only people on the road who do not, in some shape or other, contribute to its maintennnce. Here we depend upon the indirect effects, and are obviously applying a principle, that would not be allowed to stand in England.

* The late Captain Best ascertained from careful observation, that the wear of the road near Poonamallee from the effects of weather during eight months, was eqtial to that which would be effected by about 270,000 loaded carts passing over it, or 135,000 tons nett.

I have lately travelled over an extent of about 700 miles of road in this Presidency. I travelled 400 by carriage, and, with the exception of one mile of ghaut, there was not an inch upon which I should have hesitated to take a carriage or a gig. They were certainly not all in the highest order for these kind of conveyances; but had they been made so, it is certain, with the present habits of the people, the wind and the rain would have done their work on the macadamized surface before any gig appeared. A year before, I travelled in a pair horse carriage (established on speculation) upon 80 miles of this road. This time it had disappeared; the road was good enough; but there is yet no field, except in special cases, for such speculations.

One great advantage of railroads, then, is, that they are not only constructed for the people, but worked for them in the most judicious and economical manner: but this should make us pause. Are we not guilty of the very error that Colonel Cotton condemns, doing a thing for the people instead of giving them the means, strength and knowledge to do it for themselves? We certainly are; and were it not that the same railways, which carry their cotton and grain for them, would bring back the schoolmaster and the newspaper, I should hope little from it.

The effect of ages of servitude is, that the elasticity of the people is destroyed or grievously impaired. They are not only poor in material wealth, they are poorer still in spirit and knowledge. Every man who has moved much among them has felt his heart fail him at the apparent impossibility of rousing them, under any encouragement, or in view of any prospective advantages, to energetic and continued action. You might carry their goods free: they would still be slaves to ignorance and indolence. Merchants and money lenders would grow rich—there would be doubtless a gradual extension of the benefit of cheap carriage throughout the

country; but if "light and air" were not freely admitted among the people, at the same time, the change in the habits and character of the agricultural population would be slight and tardy. Whatever money they saved would be buried, as now, instead of going to complete the docks, railways, &c., spoken of by Colonel Cotton.

It is with this view of the character and present condition of the people that I consider there should be a limit put to the rapidity with which expensive public works are thrown over the land. I am satisfied that if it were possible to throw down 15,000 miles of railway, during two years, at £2,000 the mile, there would be a great loss of money—a heavy accumulating debt.

I think one of Colonel Cotton's "fundamental errors" is, that of looking to the time in which the communications can be improved as the all-important point. It would be as reasonable for a supporter of "high speed" railways to consider the time in which coals can be carried a certain distance as the one point of importance.

With an extent of works, involving an expenditure of thirty millions, laying on the country a burden £1,500,000 annual interest—it is no joke going ahead of the requirements of the people. It is moreover peculiarly characteristic of railways that the operations of the part greatly facilitate the construction of the whole—500 miles of railway, laid down on the now most prosperous portion of the country, in operation for a couple of years, would facilitate the construction of another 500; while the effect produced by the former, on the habits and circumstances of the people, would render the latter at once a profitable undertaking, and a necessity.

Our object is to keep the people moving; and, under present circumstances, we must no doubt take the lead. We should consider the "fundamental point in the whole ques-

tion" to be the promotion of steady, healthy progress, in all respects, among the people of India, according to their day and generation.

We are told of England and the Anglo-Saxon, and asked what would they be without their railway and canal and dock, &c.? The only answer to this is another question; what would the docks and railways be without them?

To throw down 30 millions of money on the land, in these public works, with the expectation that the Natives would spring at once into national maturity—to calculate at the same time and deplore the loss of money, which in the lapse of years, would accrue from the people wanting this invested capital—these evidences of natural strength—would be about as wise as to reproach a child with the prospective wants of the next 20 years, and buy him a full suit of man's clothes for the purpose of hastening his growth. If he did not sink altogether, smothered under the weight thus thrown upon him, he might live to realize, in process of time, the fact of a tailor's bill with accumulated interest, as the only inheritance derived from a fond but somewhat impatient parent.

There is, therefore, a limit somewhere to the "speed" at which these works would be carried out—how to determine that limit?

Perhaps it will be as well, before we attempt to answer this question, to put another—viz., by what agency shall they be carried out?

In England, at the present time, there are few things at which the Anglo-Saxon so readily turns up his nose, as at the idea of the Government doing any thing of this kind. While, however, it is considered altogether opposed to common sense to look to the Government there for the execution of public works—here the cry is all against the Government, for not spending the revenues of the country in this very manner.

If we enquire why a fundamental rule, in one land, is so utterly ignored in another, the governing power being the same in both cases; we are told, no doubt, that the case is different—here the people wont do them for themselves. But suppose such an argument was advanced by the Government in England—and doubtless there are many things which the people there wont do which they might do with advantage—would the people's representatives open their purse to the Government?

In one part of his book (page 113), Colonel Cotton talks of indirect returns in the shape of taxes. In another place (page 81), he says that the Engineers, and others concerned in projecting the great railways, had views naturally contracted to this comparatively insignificant part of the subject, viz. will such a railway pay to the shareholders?

His opinion is that a work should be undertaken by the Government without reference to the probability of its paying, by the work it performs, the interest on first cost; that the indirect returns in the shape of additional taxes may be *safely looked to as ample remuneration. This may be true,* and no doubt to a great extent is so; but greatly as the adoption of such a principle would smooth the path of railway *projectors and engineers, it is to be very cautiously applied.* These additional taxes fall in India wholly upon the agricultural classes. What would they say to such a doctrine among that class at home?

The people of England pride themselves upon helping themselves, doing everything for themselves. In the resolution with which they oppose all interference on the part of Government, there may be, and doubtless is often, simply a desire for profitable investment of money; but if there be, as I believe, a sounder principle at bottom, it is this; that the people are—instinctively perhaps—but yet certainly, the best judges of the thing wanted.

Another result of the system is that no work is ever undertaken without a good promise that it will pay. The "Anglo-Saxon" takes care of that.

Are we to adopt this principle here, or are we not? Are our principles here again to vary with our latitude and longitude?

I consider that in every work there should be a *promise* of its paying in a more direct and satisfactory manner than in its indirect effect on the taxes. In England, not to forget Wales, we have a way of making the man who uses a road pay for it, and pretty handsomely sometimes. We do not leave it to be paid by the additional taxes which it enables the agricultural classes to pay.

We cannot get the people here, unfortunately, to execute their own great works; and while the Government wisely steps in to promote (by direct interference) their execution, I do not see why they should not act upon precisely those principles which have been at the bottom of all the projects of public works in England—their direct remunerative *tendency*.

If we do this, we have a rule, a safe and rational rule, to go by. If we once throw this over, and set to work to squander money upon works, no matter how desirable in themselves, with merely a vague notion that Government will be repaid by benefits to be received through unforeseen and indirect channels; instead of laying on our posterity, as Colonel Cotton very justly proposes we should, a fair charge for the use of these works, we shall run the risk of bequeathing to them a national debt, which will make them wish they had been left to make their own roads.

In the active connection between an enterprising people and their works, in such a country as our own, we see, in a measure, cause and effect—the source, and the symptom of

national greatness. Both are wanting here; and this again should make us cautious in our proceedings.

The railways in India are now nominally constructed by Companies; and it is pleasing perhaps to Capitalists, at home, to have so safe an investment for their money: satisfactory to others to think, that we are introducing a great principle, by constructing these works by private enterprise. But the people here feel it not—they are not doing it—to them it is the work of Government—they care little for it—they lend no aid in their construction—when completed, they will pay for being carried about upon them; and, as heretofore, the profits will be spent in London.

I have made these observations for the purpose of showing how peculiar our position is here; and how desirable it is that in all we do, we should greatly and constantly endeavour to take the people along with us. In the execution of these works by English Companies there are, with some evils, some advantages; and among the latter perhaps the greatest is, that money will not readily be raised unless with the expectation of satisfactory results: and that, once subscribed for a specific purpose, the proposed work cannot be suspended by any difference of opinion among our rulers, or any supposed financial difficulties on the part of Government.

As regards the interest of the people here, so long as they are not in a position, or have little inclination, to invest money* in these undertakings, themselves, it is obviously of little im-

* It is to be regretted that so little care has been taken to induce the people of the country to interest themselves about these railways. It is difficult in some cases—in one it may be pronounced impossible, for any Native to hold shares. In Bengal and Bombay, the shares are obtainable, and dividends payable, at the capitals of those Presidencies, and there only. In the Madras railway the dividends are payable in London!! This is an unfortunate arrangement; unjust, and in more than one sense impolitic. Agencies should rather have been established throughout the country, and, if necessary, even some sacrifice should have been made to place the shares in these undertakings within easy reach of the people, as a secure investment for their money.

portance whether the Government execute the works by their own servants or through a private Company; but in either case the only safe rule to follow, in any project of this kind, is, that it should be proved likely at no distant period to pay the interest on its original cost.

I do not intend by this, that it should be proved by existing traffic thus likely to pay; but that the Government, while ready to risk something, as they do in guaranteeing interest upon the capital of these Companies, should remember that this risk is laid upon the people, and chiefly upon the agricultural classes; and should make as sure, as the circumstances will admit, that the projected work will ere long become self supporting; and that the revenues of the country will be, at an early day, entirely relieved from all charge on its account.

VII.

CONCLUSION.

The conclusions to which I arrive upon consideration of Colonel Cotton's views—are

1st. That, considering the vast extent of this country—the nature of the climate—the character and condition of the people—the peculiar relation in which we stand to them—railways worked by steam power, appear, under Providence, to be the instruments for effecting that great change among them, which we all desire to see, and which it seems to be our mission to effect.

2nd. That the mere conveyance of the material product of the soil is *not* the one most important want among this people—that it is the stirring up of mind, not the movement of matter, that is chiefly needed.

3rd. That tramways, to be worked at slow speed, with cattle, or even with some very light, and inferior engine, yet to be invented, are not instruments capable of effecting this.

4th. That, wherever, as on the trunk lines in India, the traffic is sufficiently extensive and varied, to render the application of steam power profitable, the question becomes reduced to the simple enquiry as to the most economical application of that agent; and in determining this, the whole apparatus comes to be considered as one—the gradients, curves, rails, engines, &c.

5th. That in this view of the case the cheapest and most profitable application of steam power is in the *railway*, as generally known in Europe—that the weight of rail, and size of engine are questions open to difference of opinion—fair subjects for discussion in each particular case—and the gradients and curves are, by every Engineer, determined without difficulty, upon known principles, and with the sole view to economy in working.

6th. That on any line of railway yet proposed for India, and many others yet to be examined, the charges upon each unit of traffic (allowing for interest upon cost of constructing) would be less, than it would be upon a tramway with light rails—"sharp curves" and "steep gradients," as proposed by *Colonel Cotton*; while the benefits conferred upon this country by their facilitating cheap and rapid personal intercourse, would be inconceivably greater.

7th. That as far as the people of this country are concerned the works at present must be carried out by Government.*

8th. That the only safe principle, by which to determine the selection and execution of works, is to be found in the probability of their "paying"; and that this principle, care-

* That is either by their own Agents or by Companies under supervision and guarantee.

fully applied, will lead us to a sufficiently rapid progress; while it, in some measure, ensures the people moving forward with us.

9th. That the highways should be considered as divided into trunks and branches, constructed and maintained by Government;* and that the proper mode of undertaking the construction of such a system of highways is by furnishing the trunks, at once, with that description of road, which is best calculated to carry a heavy amount of traffic, and to promote, and facilitate the subsequent extension of the system.

10th. That the feeders should be carefully made to keep pace with the trunks, and the main branches laid down with a view to ultimate conversion into railways. That an average kind of road for an average amount of traffic would never do.

11th. That in this part of India, the annual opening of 100 or 150 miles of railway, with due attention to the branches of each portion, would be probably found as much as the country could afford,† or the growing traffic keep pace with; as much as could be carried out, with a fair hope of each succeeding portion proving remunerative.‡

12th. That there would be the greatest danger in acting hastily, upon an assumption of the abstract value of a road, tramroad, or railway; and throwing down, at a vast expenditure of money, an extensive system of the one or the other, far in advance of the requirements of the people.

13th. That, fortunately, it is not likely that this will be attempted; or possible, that, if attempted, it could be effected in the time contemplated by Colonel Cotton.

* See note, page 86.

† I do not mean by this that there should be any interruption in the construction and extension of the ordinary roads. They are always valuable even after they may have been in a measure superseded by the railroad.

‡ The rate of progress will of course vary as the country advances in wealth and in commercial activity.

14th. Lastly, all Colonel Cotton's calculations of loss from delay are founded upon erroneous data—as to the rapidity with which his tramways could be constructed—the length of time, on the other hand, which it would take to lay down railways—the present traffic—and the cost of working such roads as he proposes.

I trust I have said enough to show, that, taking the lowest view of the case, we provide the cheapest description of traffic—no matter for what goods, by laying down a railway, suited to the most economical application of steam power, upon all trunk lines in India, whereon the traffic is likely to be large. Even in the case of goods, of raw produce, having shown that, mile for mile, upon all lines where the traffic is considerable, the actual cost of transport, per ton per mile, will be less upon the railway going at 10 or 15 miles an hour, than upon a tramway, with sharp curves, steep gradients, and horned cattle, I need not stop to prove the advantage of running over 2 or 3 hundred miles a day, with punctuality and certainty, in a country like this, instead of crawling along at 40 and 50. It is an advantage to every description of goods; an immense advantage in some cases—absolutely necessary to the very existence of many kinds of traffic.

But the most important consideration still remains. What shall we say to the political, social, moral effects of the two instruments?

There is much to be done in this country. A bare commencement is yet made. The struggle is commencing, in earnest, between truth and falsehood—light and darkness.

In this peaceful, social contest, our operations have hitherto been confined within very narrow limits—chiefly to the three Presidency Towns.

We may see in them, and in villages not ten miles out of them, the difference between a Hindoo, who has been touch-

d by the leaven of Christian civilization, and one who is yond its reach.

We want an extended base for our operations. The rail- will give us this. In a few years, streams of light will ass across the country from Calcutta to Lahore—from Bom- bay to Agra—from Madras to the central districts of the Peninsula; while rays, of varying magnitude, penetrate the adjacent districts, fraught with the moral and spiritual reno- vation of the people.

Travellers of every class, Europeans and Natives, will pass rapidly, freely, and in comfort, among the people; while the press will find access to multitudes, who are now igno- rant of its very existence.

It is to this *movement of mind and intelligence*, that we have to look for all our greatest results here.

It is this that the slow speed tramway can never accom- plish—can attempt even imperfectly. We want every in- ducement for people, of all classes, to move across the length and breadth of the land.

On the cheap tramway, this inducement would be confined to the proffer of a seat in a car, to be dragged along at five miles an hour; the passengers, European and Hindoo, Prince and Peasant, jumbled up with cotton and cocoanut oil—hides and horns—brattics and salt-fish. The transit *must* be slower; the expenditure of power to effect the tran- sit *must* be greater; while the actual *charge* per unit can only be less, while the amount of traffic of every kind re- mains small.

Happily, under the wise measures that have been at last adopted, the problem will be, in a few months, solved.

Let 100 miles of any one line of railway be open—suffi- cient in length to command the traffic of the country over which it lies—and all will be known—goods, passengers, expenses, tariffs—while every additional mile, brought into

operation, will furnish an additional stimulus to traffic—additional inducements and facilities to the extension of the railways themselves, as well as of other means of communication. I have myself no doubt of the result.*

Let improvement in other departments only keep pace with this; and we shall be in a fair way to fulfil our mission, by creating and maintaining, among the people of India, temporal happiness, and social progress, to the extent of their capacity.

The enlargement of that capacity will follow; but, under the most wise and liberal administration, will ever be a work requiring time and patience. Few men do any good in this world, who are not content to work for posterity—to sow now, that others may reap hereafter.

* The Bombay line of about 22 miles, is now paying almost wholly by Native passenger traffic. I hear that the very poorest appear to be able and willing to pay as much as five Annas for 20 miles.