

Carolina Conductor



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Preserving the Past Active in the Present Planning for the Future

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Articles can be submitted anytime.

Blue Ridge RR

A REPORT OF THE CHIEF ENGINEER OF THE BLUE RIDGE RAILROAD 1871

Continued from September 2026. Ed.

Here we observe that these figures give the total amounts transported upon the trains, both local and through traffic; so that, if we provide trains capable of taking these amounts through, we shall really have accommodations for a business exceeding, probably by one-third, the amount assumed. What trains, then, are required for a daily tonnage of 563 tons, and 446 passengers? Three passenger trains each way daily, carrying 75 passengers each, would answer the purpose; and, referring to the conclusions reached in considering motive power, trains of 100 passengers would not overtask our engines. Loading our freight trains for the 100 feet grades and using auxiliary power to ascend the 150 feet per mile mountain grade, it is necessary to provide for moving 563 tons net, and, say, 360 tons dead load, or 923 tons gross. Four trains each way daily would then give 115 tons to each

train. And, again, referring to our remarks on motive power, we find that the locomotive is capable of taking 115 tons under the conditions specified. The conclusion reached, then, is this: that seven trains each way, daily, are capable of handling a traffic that, at usual rates, will pay 7 percent on the estimated capital employed.

How far the number of trains mentioned is from over-tasking the powers of the road may readily be conceived; only fourteen, daily, have to pass any given point on the line. Double that number might be handled without the least inconvenience. It must be acknowledged, then, that the 3 feet road will answer the requirements of our business for: First—The motive power is sufficient. Second—The cars are of capacity to carry passengers with comfort, and freight to advantage. And finally—The line would not be overcrowded or encumbered, even by a traffic far in excess of that which is anticipated.

COST OF CONSTRUCTION

This discussion having thus far, given results favorable to the new system, you will, doubtless desire to know what the probable saving

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in cost of construction will be, should the narrow gauge be adopted for the Blue Ridge Road.

This point is to be considered, first, as influenced by the relative dimensions of the roadbed and structures ; and, secondly, as affected by the comparative flexibility of the gauge, or its adaptability to high grades and sharp curves.

If we suppose that the small gauge road is constructed with the same rate of grade and curvature as the common gauge, the saving in cost of building the roadbed and structures will be confined to that amount which results from the decreased width of excavations and embankments, and the reduced size and weight of bridges and other structures.

I find, from comparison, that the areas of the cross sections of cuts and fills are 20 per cent. less on the 3 feet gauge.

For the heavy engines of the common gauge, all bridges and structures must be proportioned to carry a load of one and a half tons (3,360 pounds) per running foot, while 1,500 pounds per foot is the maximum load which can be put on to a narrow gauge bridge, by covering the track with a train of locomotives. It will not, then, be an excessive estimate to call the saving made in the cost of all structures which form a part of the roadbed 20 per cent. on account of reduced dimensions.

Here is presented a comparison between my last estimate for track and the cost of the narrow gauge track:

Five Feet Gauge.

2,640 ties, 8 feet x8x6, at 40c.....	\$ 1,056 00
6,000 lbs. spikes, at 6c.....	360 00
450 joint fastenings, at \$1.10.....	495 00
88 tons 56 lb. rails, at \$90.00.....	7,920 00
Laying and distribution.....	800 00
Total.....	\$10,631 00

Three Feet Gauge.

2,640 ties, 6 feet x4x6, at 25c.....	\$ 660 00
5,000 lbs. spikes, at 6c.....	300 00
352 joint fastenings, at \$1.00	352 00
47 tons 30 lb. rails, at \$92.00	4,324 00
Laying and distribution.....	500 00
Total	\$6,136 00

This is a reduction of the original estimate for track of \$4,495 per mile, or a saving of 42 per cent.

Over a moderately difficult country, where it is not necessary to resort to maximum grades or very sharp curvatures in constructing a road of either gauge, the saving in first cost is, as shown in the preceding

paragraphs, 20 per cent. on grading and bridging, and 42 per cent. on track—a result very near the usual estimate of engineers who have written on this subject, and who are accustomed to fix the cost of the narrow at two-thirds the cost of the common gauge roads. But there are portions of our line where savings will be made by the adoption of the high grades and sharp curves practicable on the 3 feet gauge ; savings so great that, without surveys, I can venture to estimate the amount only in the most general way.

Over about one-half the length of the road yet to be built, the work is of such character that the use of grades of 150 feet per mile one way, and 100 feet per mile in the direction of the heaviest traffic, with curves of 100 to 200 feet radius, will be of immense advantage in reducing the quantities. This is the flexibility of the narrow gauge, by which the line, in plan and profile, may be laid much closer to the natural face of the country than has heretofore been possible. Through the mountains, from Walhalla to Rabun Gap, near Franklin, in North Carolina, and at some points on the Tennessee River, the maximum grade may be resorted to with great economy in work and in distance.

There are many points in the Tennessee Valley, where the tunnels, now necessary, will be no longer required, as, by the use of the sharper curves, the short bends of the river may be followed, where now the line pierces the projecting spurs of the mountains, which rise abruptly from the river bank.

Notwithstanding a natural reluctance to estimate without a survey, I shall, probably, be safe in expressing the opinion that, over one-half the line, this flexibility of the gauge will save one-half the work, and reduce the length of the line to not far from 130 miles yet to build, instead of 147 miles.

Using, then, these data as a basis for a rough calculation, viz First—That twenty per cent. of the cost of grading and bridging is saved by the diminished size of the works Second—That the track will cost 42 per cent. less; Third—That, on the mountain divisions, one-half the work may be saved, and the line greatly reduced in length, say from 147 to 130 miles to build; I venture to reduce my estimate of November 17, 1870, from \$6,800,000 to \$4,000,000, as the probable cost of completing the road ready for the rolling stock.

Your attention is now invited to a comparative estimate of the cost of supplying the road with rolling stock. The number of locomotives and cars is estimat-

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ed for the traffic assumed in a former paragraph as sufficient to pay 7 per cent. on a capital of \$6,000,000:

Three Feet Gauge.

30 locomotives, at \$7,500.....	\$225,000
12 first class passenger cars, at \$2,200.....	26,400
6 second class passenger cars, at \$1,500.....	9,000
6 baggage cars, at \$1,000.....	6,000
100 box cars, at \$350.....	35,000
50 flat cars, at \$250.....	12,500
25 gravel cars, at \$125.....	3,125
20 hand cars, at \$75.....	1,500
Total.....	\$318,525

Five Feet Gauge.

30 locomotives, at \$15,000.....	\$450,000
10 first class passenger cars, at \$5,000.....	50,000
5 second class passenger cars, at \$4,000.....	20,000
5 baggage cars, at \$2,500.....	12,500
85 box cars, at \$850.....	72,250
40 flat cars, at \$700.....	28,000
25 gravel cars, at \$175.....	4,375
20 hand cars, at \$100.....	2,000
Total.....	\$639,125

OPERATING EXPENSES

We must now consider, briefly, what will be the cost of operating the narrow, as compared with the wide gauge road.

A glance at the table appended to the paragraph on rolling stock reveals a great and sufficient cause for the superior economy of working which is claimed for the narrow' gauge. It is the vast advantage which it has in the proportion of paying to dead load.

It will be seen, for instance, by reference to the table, that when the cars of the two systems are loaded to their full capacity, the wide gauge passenger car carries 560 pounds dead load per passenger, and the narrow car but 353 pounds ; that the wide freight car carries 2,000 pounds of dead weight to a ton of freight, and the narrow but 1,100 pounds. It must be understood that this comparison is made under conditions most advantageous to the wide gauge. The weights of the wide cars are rather under than over estimated, while the weights which I have given to the narrow gauge cars exceed the statements of the manufacturers and of writers on the subject.

To show you more clearly that, in transporting less quantities than full loads, the small cars still have the advantage, I prepare the following table. Cars carrying through freights may be loaded very generally to their capacity, but the average net car loads are brought down by the necessity for dropping cars from the trains at turnouts along the route with local freights, sometimes very small in proportion

to the full car load.

The table shows the amount of dead load, per ton, in pounds, by the two systems, when the shipment of freight to a locality is not an even car load. The figures in the heading show the amount of supposed shipment to a way station, in tons:

Gauge.	Number of cars to carry shipment....	1	2	3	4	5	6	7	8	9	10	11
5 feet	1 2	16,000	8,000	5,333	4,000	3,200	2,666	2,285	2,000	3,555	3,200	2,982
3 feet	1 2 3	5,500	2,750	1,833	1,375	1,100	1,833	1,575	1,375	1,222	1,100	1,500

It is here seen that, if it is necessary to drop cars with, say, six tons of freight, at a station—this being an amount which is one ton over a car load for the narrow gauge, and which renders necessary the use of two cars at the utmost disadvantage—the dead weight is even then, but 1833 pounds per ton, or less than it is, under any circumstances, on the other gauge.

Notice, too, an important fact, that the table sets forth plainly. The dead weight carried with a five ton load, in the wide gauge freight car, is 3,200 pounds. Now, by, reference to the previous table, it is seen, that the number of pounds, dead load, to a ton of freight, from an average of all the New York roads, is 3,091 ; and from the average of five Massachusetts roads, is 3,136 ; clearly indicating that the average car load of freight, in actual practice, is very close to five tons. Therefore, if we desired to have cars that would, on the average, best fit the loads, with least waste of room or weight, we should build them to carry five tons ; and this is almost precisely the capacity which the narrow rolling stock has.

A table, similar to the above, made for passenger travel, gives similar results. It seems unnecessary to introduce it here. I give only two items. Suppose it necessary to accommodate forty passengers, which is a number too large, by six, for the small car, so that a second must be added to the train, while it requires but one wide ear ; the dead weight is even then 840 pounds per passenger on the wide, and 600 pounds per passenger on the small gauge.

Or take seventy passengers, two more than two small cars will take, requiring three small cars, or two large. The dead weight is then 960 pounds per passenger on the five feet, and 514 pounds per passenger on the three feet gauge.

It is proven, then, that, under any circumstances which can be imagined, there will be an immense economy in the transportation of non-paying load on the narrow gauge. But we wish to know something about the probable amount of this saving; in what de-

partments of expenditure it is to be most apparent; and, if possible, to what extent it will affect the net income of the Blue Ridge road.

First, let us estimate, as nearly as possible, the relation which will obtain between the dead and non-paying load, in *actual practice*, on the 3 feet gauge. We have taken the statistics which give us this information for the 5 feet gauge, from official reports, and we have the relations between full loads; but the new cars are not going to run *full*, although they will come much nearer to it than on the old lines.

We have seen that the freight cars of all existing roads carry an average of 5 tons, and that; therefore, they run with an average of ft of a full load, calling 8 tons a fair full load. To keep within safe limits, I estimate, then, that the peculiar adaptability of the narrow car to the average load of five tons, has no greater effect than to raise the average load one-eighth, and say that the usual load of the narrow gauge car will be 3/4 of five tons, or 3 3/4 tons. It is more difficult to estimate the probable number of pas-sengers per car. Still, deducing our results from such statistics as are at hand, it appears that 2,748 pounds dead load of passenger cars, exclusive of baggage, was moved for each passenger over the New York roads. This indicates about thirteen passengers per car, which seems a small number for Northern trains, but answers well to experience here. The passenger cars, then, run about one-fourth full. I think we shall not overestimate if we assume that the nar-row car will run one-third full.

On this basis, the table of dead weights and paying loads is rearranged thus:

Showing the actual relations between dead and paying load, in practice, on the common gauge, and the probable results to be expected on the narrow gauge.

The average charge for transporting one ton or one passenger, per mile, is about 2½ cents.

On the wide gauge, 5,331 lbs. of freight and cars one mile; or 2,878 lbs. of passengers and cars one mile. On the narrow gauge, 3,706 lbs. of freight and cars one mile; or 1,350 lbs. of passengers and cars one mile.

This is a comparison, not at all exaggerated, between the two systems. The expenditure of power stands in the relation of 37 to 53 in freight, and 13 to 28 in passenger traffic. When the freight traffic stands to the passenger traffic in the proportion of 4 to

1, the difference on the whole power expended is 33 per cent. in favor of the narrow gauge. Does it, then, actually cost 33 percent less to conduct traffic when done on the narrow gauge? The mechanical forces expended certainly stand in this proportion. But that may not be a true measure of the money cost, because all parts of the expense account may not be equally affected.

I estimate the probable saving in operating the road on the narrow gauge system as follows:

For maintaining roadway....	37 per cent.
For repairs of machinery and cars.....	20 " "
For operating.....	43 " "
	100 " "
These headings may be sub-divided, as follows:	
Maintenance of roadway:	
Repairs road-bed.....	.166
Cost of iron for renewals.....	.129
Repairs buildings, fences, &c.....	.037
Taxes.....	.038
	.37
Repairs of machinery and cars.....	
	.20
Operating:	
Office expenses, agencies and employees on trains and at stations.....	.223
Fuel, oil and waste.....	.125
Loss and damage to goods and persons, general superintendence, &c.....	.030
Contingencies.....	.052
	.43
Total.....	100

The repairs of roadbed, whether considered by their relation to first cost or by the diminished wear and tear from the reduction of weights upon each wheel, and the smaller dead load hauled, cannot be reduced less than one-third. The exposed surfaces of earthworks on a line, over so rough a country as the Blue Ridge Road traverses, must be reduced more than a third; and the waste of these work's is proportioned to their surface. The weight and amount of materials in bridges, masonry, and all timber structures, would also be greatly less, probably one-third, and they would be correspondingly less costly to keep in repair.

The labor of track repairing would be, also, lighter, as the rails and crossties to be handled are nearly one-half less in weight ; the track itself, under the diminished weight of trains, being much more easily and cheaply kept up.

I diminish the cost of iron for renewals by one-half, the rails being, in weight, in the ratio of 30 to 56. Besides this, the lighter rails will always be

found of better quality and will have a much longer life. Considering weight and quality, the iron will show, proportionally, much greater durability, under the narrow gauge locomotives, than the 56 pound rail, under the wide gauge engines.

Charges for repairs of buildings and for taxes I leave untouched ; the latter, of course, will be reduced, so far as they are laid upon our property, in proportion to its diminished cost. If we should say that the repairs of rolling stock were in direct ratio to the cost of the stock, the reduction for the small gauge would be 50 per cent., as we remember that to be the difference in the cost of the equipment by our former estimate.

But the repairs of machinery and cars I reduce only one-third, in equal ratio with the motive power expended. This expenditure of power, and the ordinary repairs, must be held to be strictly correlative. And yet, I believe that all the parts of the narrow gauge rolling stock, being relatively stronger, and the shocks to which they are exposed being so much less, both the cars and engines will run with less repairs even than have been estimated.

Here let me ask a moment's attention to a matter that bears directly upon the wear of iron and cross-ties, the labor of keeping up the track, and the wear and tear of machinery: introducing a table showing the weight on each wheel of ordinary trains on the two gauges, and the momentum with which the wheels will strike any irregularity in the track :

Passenger Trains—Speed Twenty-five Miles Per Hour.

	Five Feet Gauge.		Three Feet Gauge.	
	Weight on Single Wheel.	Momentum.	Weight on Single Wheel.	Momentum.
	Pounds	Pounds.	Pounds.	Pounds.
Engine driver.....	8,000	288,000	6,250	225,000
Engine truck.....	5,000	180,000	2,500	90,000
Tender.....	7,050	171,000	3,500	125,000
Baggage car.....	4,000	144,000	3,000	108,000
Passenger car.....	4,700	171,300	1,780	64,080

The ends of the rails are beaten to pieces and the surface abraded, the ties splintered, and the fiber of the wood cut under the iron, weak joints quickly made worse, so that each succeeding wheel falls with an increasing force upon the ends of the yielding rails, by the tremendous forces developed by the passage of these enormous weights

at high velocities. It does not pay to preserve the wood of cross-ties from decay by any of the simple methods which are now known, only because the tie seldom has time to rot, but is shattered before decay commences under the hard usage to which it is exposed.

And the action upon the rolling stock is the same as upon the track. The wheel receives a blow of precisely the same weight as that which it administers to the rail at a low joint, and the shock is transmitted to the axle, save what is taken up by the springs, and the yielding of the parts of the whole structure of the engine or car. Now the saving of dead weight transported is so much saved from the grand total of this destructive agency; and, by the reduced weight upon each wheel, it comes to pass that no single blow of such enormous force can be given on the narrower road. I leave this point with a single illustration, showing the total of the forces expended upon a defective joint on one side of the track, by the passage of a train of 50 passengers, on either gauge. The joint is supposed to have yielded, so that the wheels fall into it with a perceptible shock. In an example, selected for calculation, it results that the wide gauge train will have inflicted a series of blows, amounting, in the aggregate, to 6,891,840 pounds, while the narrow train will have expended a force amounting to but 3,248,640 pounds.

Fuel, oil and waste are also reduced in cost, in proportion to the power developed—say one-third. The list of employees, cost of general superintendence, office expenses, losses and damages to persons and goods, are left untouched. We state, then, the per centage of saving in the different departments of expenditure, as follows:

Classification of Expenses.	Per centage of whole operating Expenses.	Per centage Saved by Narrow Gauge.
Maintenance of roadway :		
Repairs road-bed.....	.166	.055
Cost of iron for renewals.....	.129	.065
Repairs buildings, fences, &c.....	.037	
Taxes.....	.038	
Repairs of machinery and cars..	.20	.070
Operating :		
Office expenses, agencies and employees on trains and at stations.....	.123	
Fuel, oil, and waste.....	.125	.041
Loss and damages to goods and persons, General Superintendence, &c.....	.030	
Contingencies.....	.052	.017
Total		.248 per cent.

The result is that the narrow gauge line may be operated for 25 percent less than the wide; and, as the usual proportion of ex-penses to gross receipts is 70 percent, the ratio of small gauge expenses to receipts would be 52f percent, so that we were not so far out of the way in the assumption upon which we calculated our traffic in a former paragraph.

With one additional remark, I leave this branch of the subject. In my calculation of the comparative cost of working the two gauges, I have been solicitous in no particular to exaggerate the advantages of the narrow system. I have given the narrow gauge a proportion of dead load greater, and, to the wide, a less amount than you will find stated in any of the numerous reports, and other publications, on the subject.

In round numbers, I have made the wide gauge to carry, in freight traffic, one and a half rounds dead, to one pound paying weight, and, in passenger traffic, eighteen pounds dead, to one pound paying load ; and the narrow gauge one pound dead, to one and a half pounds paying load of freight traffic, and eight pounds dead, to one pound paying load, passenger traffic.

Now, Mr. Fairlie, speaking of the English roads, remarks: "It is known, and everywhere admitted, that the proportion of non-paying to paying weight, in passenger trains, is as much as 29:1, and, in goods trains, exclusive of minerals, as much as 7:1. This terrible disproportion is partly due to the system of management pursued, but, in a far greater degree, to the gauge" and in speak-ing of the London and North Western railway, he demonstrates, in a calculation, which has been so frequently republished here, that I will not quote it in detail: "that, if its gauge were 3 feet, instead of 4 feet 8½ inches, its goods traffic could be hauled at half the present cost, and in such a way as to reduce the present tonnage on the road by one-half."

FINANCIAL PROSPECTS

I now apply the conclusions which have been reached to the commercial or financial prospects of the road. To complete the road, and furnish it with rolling stock, will require, for the 5 feet gauge, in cash:

For grading, track, depots, and engineering.....	\$6,800,000
For rolling stock.....	640,000
For repair shops.....	100,000
	\$7,540,000

Brought forward.....	\$7,540,000
To which must be added, for retiring the old debt, and paying the floating debt.....	800,000
	\$8,340,000
Toward this, will be realized, from the four millions endorsed bonds, at, say 80 cents.....	\$3,200,000
Leaving a cash capital, to be raised, of.....	\$5,140,000
To complete the road, and furnish it with rolling stock, will require, for the 3 feet gauge, in cash :	
For grading, track, depots, and engineering.....	\$4,000,000
For rolling stock.....	320,000
For repair shops.....	80,000
	\$4,400,000
For old and floating debt, as above.....	800,000
	\$5,200,000
Proceeds of the four millions of bonds, above	3,200,000
Leaving to be raised, in cash.....	\$2,000,000

This calculation of capital presupposes that the present capital stock is virtually destroyed by the preference of the new, and that the old first mortgage bonds are retired, as provided in the esti-mate.

Now, to pay interest at 7 per cent. on the capital necessary for a 3 feet gauge, (\$6,000,000,) requires a net income of \$420,000; and, at 521 percent expenses, the gross receipts must reach \$880,000. Such traffic (as before stated in this report, 86 percent of that of the South Carolina Railroad for the year 1870) yields perfectly satisfactory results, paying 7 percent interest on the capital invested. If, however, we suppose the road to be built on the com-mon gauge, requiring a capital of \$9,140,000, this gross traffic of \$880,000 would pay less than 3 percent interest on the capital invested for, in such a case, there must be deducted from the gross earnings 70 per cent. for ex-penses, leaving but \$264,000 for the net earnings.

Is there any doubt which of these two projects would receive the preference in any money market? For it must not be forgotten that the capital necessary to complete this road has to be procured outside our own resources; and when I look at these figures, and contemplate the chances of obtaining, upon such a showing of traffic as we can make, \$5,000,000 for the one plan, or \$2,000,000 for the other, I confess to a feeling that our choice is between the narrow gauge railroad and no road at all.

BREAK OF CONNECTIONS

As we look back upon the information which we

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have collected, and gather up the results of our inquiry, the question before us seems to take a new shape, and we are tempted to ask, " If all this be true, why should we think of building a wide gauge ; what pos-sible reason can be given in its favor?" And but one answer can be found, which is this: " There is, in fact, no reason for building roads wider than three feet, for such speed as is required for the traffic of the South, except, that all the other existing lines are of another and wider gauge, and at every break of gauge freight and passengers must change cars."

This is a real and weighty objection to the introduction into our system of a new gauge, and it must not be pushed out of the way without examination. Certainly, I am not disposed to do so, for it has long hindered my own mind in advancing to a conclusion as to, not the merits of the system, but the policy of its introduction. When I was prepared to recommend it for branches, I could not feel satisfied to approve it for main lines, connected at both termini with a general railroad system of a different gauge. That the ob-jection may lose none of its proper force to your minds, I quote the most forcible statement of it that I remember to have seen. The writer speaks of English roads:

"The evils resulting from the break of gauge, are by no means unimportant. The inconvenience to passengers is great, but the difficulties, as respects the goods traffic, are still greater. The re-moval involves loss, pilferage, detention, beside a money tax, esti-mated at from 1s. 6d. to 2s. 6d. per ton. It is found at Gloucester that it occupies about one hour to remove the contents of a wagon, full of miscellaneous merchandise, from one gauge to another, with all the force of porters that can be brought to act upon it. An ordinary train, laden with promiscuous goods, may contain loose commodities, such as bricks, slate, lime, or limestone and chalk, flags, clay, manure, salt, coal or coke, timber and deals, dye woods, iron, iron ore, lead and metals, cast iron pots, grates and ovens, grindstones, brimstone, bones and hoofs, bark, bides and seal skins, oil cake, potatoes, onions and other vegetables, cheese, chairs and furniture, hardware, earthenware, dry salteries, groceries, provi-sions, cotton, wool, oils, wines, spirits and other liquors, man-ufactured goods, fish and eggs, ripe fruit, and etc. In the hurry the bricks are miscounted, the slates chipped at the edges, the cheeses cracked, the ripe fruit and vegetables crushed and spoiled, the chairs, furniture and oil

cakes, cast iron pots, grates and ovens, all more or less broken, the coals turned into slack, the salt short of weight, sundry bottles of wine deficient, and the fish too late for market ; whereas, if there had not been any interrup-tion of gauge, the whole train would, in all probability, have been at its destination long before the transfer of the last article, and without damage or delay. Though this description is somewhat overdrawn, there is still much truth in it. It will readily be im-agined that the livestock frequently manifest decided objections to the change of train, and we are informed that pigs exhibit their usual peculiarities of disposition on these occasions, that cattle sometimes resist with great energy, and that two hours have been spent in effecting the removal of one of them."

We agree with the writer that his description is a little, or a good deal, overdrawn, but let it stand, without further remark, save on one point, that of the money cost of changing freights. This is excessively overstated, even for the time when the passage was written, twenty years ago. Experience has demonstrated that the cost of transferring freight in Great Britain to be about 2 pence per ton. The cost of handling at the break of lines on the Canada frontier has been found to be, from many year's experience, 5 cents per ton. Considering this, then, as only a question of additional cost, it will evidently bear hardest upon the through freight, which has to be changed at each end of our line, at a cost of 5 cents per ton, or a charge of 10 cents per ton total. The average cost of transporta-tion of freight may be taken at 11 cents per ton per mile on the existing roads; but on the narrow road, we have found that we can transport 25 percent cheaper in actual expenses. One ton transported 180 miles, at 1½ cents, would cost \$2.70, and a saving of 25 percent on this would be 67½ cents, so that an expense may be in-curred of 10 cents per ton in transferring freight and still leave a balance in favor of the narrow gauge of 57½ cents.

I might leave this topic here, but, in equal justice to the advo-cates of the narrow gauge, must add that it is claimed by them all that it is well worth paying the cost of transferring freight to keep the cars of each road on its own line. The system of inter-change of cars is prolific in losses and damages to the different companies. One does not gain what another loses, but all suffer alike; and from a common cause, namely, that when off its own line, no car receives that timely repair which, at home, would be the " stitch in time." However bad be its condi-

tion, if it can be got off the hands of the parties at present responsible, and, like Ginx's baby, put off. On the next parish, employees rejoice in a sense of duty performed. Around the great terminal stations are bone yards, filled with the remains of these victims of neglect, whose owners are too far away to care for them.

It is also probable that the cost of transferring freight may be materially diminished by special appliances for that purpose. For instance, all articles in bulk, as grain or coal, may be spouted from one car to another by an arrangement of tracks on a different level; and it is possible, by the use of cranes, to raise and transfer the smaller box car bodies to flats of the wider gauge. It will be sufficient for this argument to let the question rest on the comparative money cost of the two systems.

CONCLUSION

This discussion, then, leads me to these conclusions: First—That the three feet gauge will answer all the requirements of our prospective traffic. Second—That the saving in first cost will be immense, enough, in fact, to place the completion of the road within our reach, by raising \$2,000,000 of additional capital, while it seems impossible to obtain the large sum necessary for a 5 feet line. Third—That, being built, the narrow gauge will be much more economical in working, the expense being only 52k, instead of 70 percent, of the gross receipts. Fourth—

That the main, if not the only objection to be urged against the change of gauge, is that drawn from the necessity for transferring freight at the termini; but that, without seeking to diminish the force of this argument, it is greatly overborne by the weight of advantages, which must be counted in favor of the narrow gauge.

OPINIONS OF EXPERTS

However satisfactory to ourselves are the processes of our reasoning, and whatever confidence we may have in the soundness of our conclusions, yet, should they lead the managers of this enterprise to so important a step as the change of gauge, the public will be likely to inquire, and with propriety, whether the system adopted has the sanction of experience, and the approval of those professional men whose reputation and attainments command public confidence.

In addition, therefore, to the experimental details which have hereinbefore been given, I think it well to conclude this paper with a few brief memoranda of the results attained by such European narrow lines as have published statistics of business; and, also, to give the testimony of some professional authorities and experts. ✓

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