Comparative Costs and Profits of Cable, Electric and Horse Railway Operation in New York City

Through the generous kindness of H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, we are enabled to give to the street railway world a transcript of the private cost sheets and other records of this great company, by means of which, for the first time in the history of street railroading, a true comparison of the relative cost of operation of cable, electric and horse railways in a single city and under substantially the same conditions can become generally known. We need not point out how important will be these comparisons to railways, particularly in foreign countries, whose managers are contemplating a change of motive power, and who are anxiously seeking all the light possible on the question of the best one to select. In the honesty of these figures and the accuracy of their distribution among the several branches of the service we have entire confidence, based on a somewhat intimate knowledge of the careful methods of administration and of bookkeeping pursued by this company in the management of the local transportation of over 250,000,000 passengers per annum.

Disregarding details for the moment, we may say on broad lines that the company's experience points unmistakably to the great superiority of electricity over both horses and cable not only in traffic handling capacity but in economy. This will come as a surprise to many who have believed that the cable system, certainly in its own peculiar sphere of great traffic density, is the cheapest and best motive power extant. The rapid disappearance of the cable system in America has been attributed by most foreign engineers and not a few Americans to a desire for unification of motive power or to the greater popularity and traffic-earning capacity of electric cars in competition with cable lines. Few have ventured to assert, in the absence of definite figures, that electric cars replacing cable over heavy traffic routes could be operated at a less cost per car mile, but the figures here given show conclusively that from economical considerations alone there is no place for the cable in modern street railroading.

Before considering these figures in detail, the present condition of surface railway transportation in New York

City should be clearly understood. On Jan. 1, 1893, the entire street railway system of New York City was operated by horses. In the spring of that year the Broadway cable line from Fifty-ninth Street to the Battery, 10.2 (track) miles in length, was put in operation. In 1895 15 (track) miles additional on Columbus, Ninth and Lexington Avenues were opened through streets most of which had previously had no horse railway service except for a short time preceding the actual starting of the cable lines. Cable construction then stopped and electric began. The company had several times attempted to install the overhead electric system in the city, but owing to extreme popular prejudice against all overhead wires, due largely to an unusual and indefensible abuse of their privileges by a number of electric light corporations, which had, in previous years, stretched their wires in New York City to such an extent as to be a positive menace to its safety as well as an intolerable eyesore, permission to adopt this system was refused. The importance of doing away with horse traction, in the interests of both the city and the company, became so great, however, that it was at last determined to try the underground conduit electric system, which had previously been a failure in this country wherever installed, owing partly to climatic conditions and partly to an attempt to use too shallow and cheap a conduit. The experiment was first made on the Lenox Avenue line in the northern part of the city, and a conduit was constructed which in point of size and cost was practically equal to that necessary for a cable system, the intention being, should electricity prove a failure, to change to the cable. After some experimenting with insulators this line proved to be an entire success and has been steadily and regularly operating ever since, with a rapidly increasing traffic and a quite remarkable economy. Encouraged by this experiment, the company's engineers devised a form of conduit which, while considerably cheaper to build, possessed, it was believed, all the necessary qualifications for success on a large scale, and during the last fifteen months nearly 35 miles of double track have been converted from horse to underground electric traction on Second, Madison, Sixth, Eighth and Amsterdam Avenues—all great through north and south routes paralleling the Broadway cable line, and intended to relieve it to a large extent of its enormously congested traffic—and on Fifty-ninth Street.

Now construction work of this kind means, of course, great interruption to traffic and a temporary diminution of receipts during the construction period, together with an increase in the operating expenses over what would be required were the roads in their final condition. Moreover, in this particular case, power for the new electric lines has been obtained from temporary power stations, and, although these have been fairly large and the production has been reasonably economical, it is certain that the new 70,000 h.p. station now being constructed on Ninety-sixth street for the service of the entire city through high tension primary lines and low tension secondary circuits, will greatly reduce the cost of power.

During the fifteen months covered by the annual and quarterly statements presented herewith the company's cable lines have not been interfered with in any way, and their receipts and expenses are normal. On June 30, 1898, there were about sixty (track) miles of electric railway actually running, but nearly all of this had gone into operation during the year. The Fourth Avenue line was opened in successive stages from Nov. 1 to Dec. 16, 1897; the Second Avenue line from March 22 to April 3, 1898; the Fifty-ninth Street line from March 20 to May 21, 1898; the Amsterdam Avenue line from Feb. 3 to March 20, 1898, and the Eighth Avenue line, on May 7, 1898, from 155th Street to Fifty-ninth Street. During the last quarter, ending Sept. 30, the Sixth and Eighth Avenue lines from Fifty-ninth Street south have been torn up and traffic discontinued, a portion only being put in service in August and September over the new construction by horses and electricity. It is evident that the company's total earnings for the year and quarter, though considerably larger than the last year and quarter respectively, should be greatly exceeded in 1898-9, when the conditions on the lines at present converted are more settled, and that not until the conversion of the system is completed will the full earning power of the property be anywhere near in sight, both because of the increases due to the introduction of new motive power, and because of the doing away with the loss of traffic coming with reconstruction.

We will now take up the figures of the accompanying annual and quarterly reports. It will be seen that during the twelve months period the company operated 34.2 per cent of its car mileage by the cable system, 20.2 per cent by the electric system and 45.6 per cent by horses. During the last quarter, however, the proportions were greatly changed, the cable mileage being only 27.4 per cent of the total, the horse 33.7 per cent, while the electric had risen to 39.1 per cent.

The relative traffic densities measured by the receipts per mile of track and per car mile as shown in the quarter's report are as follows: cable, $39,000 per mile of track and $.333 per car mile; electric, $17,000 per mile of track and $.260 per car mile; and horse, $8,000 per mile of track and $.288 per car mile. The average earning power of the entire system was about $14,000 per mile of track and $.29 per car mile. These figures per track mile are for the quarter only—annual figures would be somewhat more than four times as large. Henceforth the cable and horse lines will undoubtedly show a decreasing traffic density, owing to the competition of the electric roads parallel to them, the electric lines will show an increasing density, while the earnings per mile of track for the entire system will increase with a growing disposition of the public to ride upon clean and rapidly moving cars and by diversion of traffic from the elevated lines in competition. For a time the earnings per car mile of the entire system may not increase rapidly as new electric lines are put in operation, for the public will not respond immediately to the improved service. Eventually, however, the earnings per car mile will be much greater than at present as population increases.

Another gage of traffic density is found in the statement that the 11 per cent. of the company's entire mileage which is operated by the cable system is earning 28 per cent of the total passenger receipts; the 28 per cent which is operated by the electric system is earning 32 per cent of the total passenger receipts; and the 61 per cent which is operated by horses is earning but 30 per cent of the total passenger receipts.

For the year, the operating expenses of the cable lines were 16.42 cents per car-mile, of the horse lines 17.87 cents, and of the electric lines 10.23 cents. For the three months period, which is more favorable to electric operation for reasons already stated, the cable lines cost 17.55 cents, the horse 17.89 cents, and the electric 10.06 cents.

The electric lines during the twelve months period earned 16.76 cents net per car mile, or but 1.25 cents less than the cable system, in spite of the fact that the latter has 7.43 cents per car mile greater receipts; while for the three months period the net earnings of the electric lines per car mile were actually greater than the cable lines by .25 cents, and greater than those of the horse lines by 5.04 cents.

How have these surprising results been achieved, and are they a true measure of the permanent relative earning powers of the different systems?

From a careful study of these figures, we believe that were all the lines in New York City to be equipped with a single motive power, electricity would have a permanent advantage over the cable of at least 3.5 cents per car-mile in maintenance of way; a slight disadvantage in maintenance of equipment; and an advantage of at least 1.25 cents in power, of 1.5 cents in transportation, and of .5 cents in general expenses; a total of nearly 6.75 cents per car-mile. In comparison with horse traction, electricity would be at a disadvantage of perhaps .5 cents per car-mile in maintenance of way, and .5 cents in maintenance of equipment; while it would have an advantage of at least 6 cents in motive power, 1.5 cents in transportation, and 5 cents in general expenses; a net difference of 7 cents. Besides this, electric cars would earn more than either horse or cable cars with equivalent mileage.

The Broadway cable line has now been in operation for five years and the Lexington and Columbus Avenue lines for nearly three and four years respectively. In that time the track has, of course, deteriorated and repairs have been necessary. We find that $58,715, or .49 cents per car mile have been spent on track repairs during the year. The electric lines, which are, of course, almost entirely new, have cost for repairs only $10,278, or .14 cents per car mile. The horse railway track has cost $89,053, or .56 cents per car mile. Now the cost of maintenance of electric track in this current year is obviously far too small, while that of the cable and horse railway track is probably smaller than average renewal and repairs for a long period of time, since there has been practically no renewal so far of the cable track, and horse railway track repairs have naturally been reduced to a minimum in the expectation that the railway would be converted to electricity. Electric traction will be harder on rails than cable traction, and far harder than horse traction, the reason being, of course, that electric cars do not, as in the last two systems, simply roll over the track, but actually grind it out in exerting tractive effort, while the electric motor cars are, moreover, heavier than either horse or cable cars and deliver a more severe hammer blow to the joints. An expenditure of .75 cents per car mile for 40,000,000 car miles would be equal to $300,000 per annum, or $1,400 per mile of track per annum for the complete system, and this should be an ample figure for repairs and renewal of track were the whole system electric. The electric figures on the accompanying statement are therefore too small by perhaps .6 cents.

Repairs of underground and overhead construction show a great difference in favor of electric traction over cable, and this is quite reasonable, since the amount of moving mechanism in the cable conduits is enormous, while the electric has none. Nevertheless, .08 cents for this account in the electric column is possibly too small and may be slightly raised as the system grows older.

Accounts number 7, 9 and 10 for renewals of cable, wages of oilers, gearsmen and splicers, amount in the aggregate to 2.10 cents per car mile, and are found only in the cable system with no corresponding charge in the electric. This is a very important saving indeed. The renewals of cables alone cost much more per car mile than will be the entire cost of electric power under final conditions!

Cleaning the tubes will cost slightly less for the electric system than for the cable, but repairs of buildings, removal of snow and ice, and street cleaning should be, under normal conditions, approximately the same.

The repairs of cable cars exclusive of equipment will probably be greater per car mile than the repairs of electric cars, owing not only to the greater speeds possible with electric cars, which increases the service divisor, but also because of the greater jerking which the cable gives to its cars than is the case in electric traction. The repairs of the electric car equipment should be, on the contrary, greater, as there is much more mechanism in the electric equipment than in cable. The expenditure of .42 cents per car mile for this item in the electric column, though very large for a new road because of inexperienced motormen rapidly put into service during the last year, is probably smaller than the permanent average, but the latter should not exceed .60 to .75 cents.

It certainly overturns all our established ideas to find that two temporary electric power stations can actually produce power for heavy electric cars 22 to 28 feet in length at a cost less by 30 per cent (in the quarterly statement) than can be done in two cable power stations which operate cables so heavily loaded as to make the proportion of live to dead weight greater probably than that of any cable railway system in the country with the possible exception of the State Street line of the Chicago City Railway Company. The new electric power station will do much better than this, and it is obvious on examination of the different items in power account that while repairs of plant will undoubtedly be greater per car mile on an average in the electric stations than they have been this year, when equipment is new, there are other items temporary in character in the electric account which will disappear in the final plant, so that the total cost of motive power will be reduced, perhaps even to .75 cents per car mile.

The large expenditures for provender and care of horses in the electric column are not properly chargeable to electricity at all, being due to a short horse line, feeding the Madison Avenue electric line.

But 1.38 cents per car mile looks small in comparison with the 6.90 cents charged to motive power on the horse system (in the quarterly statement), and those of our foreign friends who still cling to horse power may well examine these figures with interest to see wherein lies the enormous saving in electricity over horses, upon the claims for which they have looked for so many years with suspicion.

In the transportation expenses we find again that electric traction is the cheapest of the three motive powers, and the reason for this is found chiefly in the greater speeds of car possible with electric traction, which, as above stated, increases the service divisor. The part which this speed element cuts in transportation expenses is indicated by the difference between the cost per car mile of conductors, drivers, gripmen and motormen in the electric system against the corresponding charges for the horse

RECEIPTS AND EXPENSES OF THE METROPOLITAN STREET RAILWAY COMPANY, OF NEW YORK.

For the Year Ending June 30, 1898.

SHOWING THE RELATIVE COSTS AND PROFITS OF CABLE, ELECTRIC AND HORSE RAILWAY OPERATION.

ITEMS.	CABLE.		ELECTRIC.		HORSE.		TOTAL.	
	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount	Per Car Mile.
GENERAL EXHIBIT.	$	Cents.	$	Cents.	$	Cents.	$	Cents.
Total passenger receipts	4,130,225	34.42	1,918,873	26.99	4,375,597	27.35	10,424,695	29.70
Operating expenses	1,970,486	16.42	727,406	10.23	2,858,235	17.87	5,556,127	15.83
Earnings from operation	2,159,739	18.00	1,191,467	16.76	1,517,362	9.48	4,868,568	13.87
OPERATING EXPENSES IN DETAIL.								
MAINTENANCE OF WAY.								
1 Repairs roadbed—track, labor	41,447	.35	6,153	.09	72,928	.46	120,528	.34
2 " " material	6,673	.06	*105	....	7,549	.05	14,117	.04
3 " " steel rails	200	....	954	.01	705	....	1,859	....
4 " " switches, estgs., spikes, etc.	10,108	.08	3,128	.04	5,567	.03	18,804	.05
5 " " ties and timber	287	....	148	...	2,304	.01	2,739	....
6 Repairs overhead and underground construction	80,787	.67	5,779	.08	165	...	86,731	.25
7 " and renewals of cable	189,391	1.58	.....	....	.....	...	189,391	.54
8 " tube cleaners	11,758	.10	4,230	.06	.....	....	15,988	.05
9 " oilers	40,708	.34	12	....	.....	...	40,720	.12
10 " gearsmen and splicers	21,240	.18	.....	....	.....	....	21,240	.06
11 Repairs of buildings	4,099	.03	821	.01	17,262	.10	22,182	.06
12 Removal of snow and ice, and street cleaning	15,328	.13	2,731	.04	9,666	.06	27,725	.08
Total	422,027	3.54	23,851	.33	116,145	.72	562,024	1.60
MAINTENANCE OF EQUIPMENT.								
13 Repairs of cars and vehicles	68,768	.57	28,687	.40	61,449	.38	158,904	.45
14 " " electrical or cable equipment of cars	42,287	.35	29,952	.42	8	....	72,247	.21
17 " " tools and machinery	1,714	.01	152	....	328	...	2,195	....
Total	112,770	.94	58,792	.83	61,784	.39	233,345	.66
POWER.								
15 Repairs of steam plant	15,147	.13	2,042	.03	9	...	17,197	.05
16 " " electrical or cable plant	12,395	.10	824	.01	3	....	13,221	.04
18 " " harness	458	....	584	....	15,361	.10	16,404	.05
19 Stable equipment supplies, etc	174	....	424	...	12,706	.08	12,805	.04
20 Renewals of horses	550	....	3,030	.04	62,440	.39	66,020	.19
21 Horse shoeing	571	....	2,477	.03	80,933	.51	83,981	.24
22 Cost of provender	3,432	.03	14,010	.20	445,183	2.78	462,624	1.32
23 " " feedmen—wages	92	...	1,687	.02	40,419	.25	42,198	.12
24 " " removing manure	60	....	*85	...	7,109	.04	7,084	.02
27 Hostlers, hitchers and stable help	2,485	.02	12,795	.18	347,855	2.18	363,134	1.07
28 Engineers, firemen and power service	65,262	.54	20,662	.29	240	....	86,163	.25
32 Fuel, power houses	104,912	.88	51,015	.72	455	....	156,381	.45
33 Light and other supplies at power house	15,471	.13	5,370	.08	59	...	20,900	.06
34 Water tax	21,775	.18	5,842	.08	11,138	.07	38,754	.11
Total	242,784	2.02	120,675	1.70	1,023,408	6.40	1,386,867	3.95
TRANSPORTATION.								
25 Conductors, drivers, gripmen and motormen	711,630	5.93	353,127	4.97	1,156,395	7.23	2,221,151	6.33
26 Inspectors, starters, switchmen, etc	143,512	1.20	50,292	.71	119,400	.74	313,204	.89
29 Car house exp. watchmen, car cleaners, oilers, etc.	36,820	.31	27,392	.39	63,245	.40	127,457	.36
30 Car service—car lighting	39,227	.33	1,142	.02	11,690	.07	52,059	.14
31 " " oil, waste, etc	12,932	.11	5,158	.07	7,191	.04	25,281	.07
Total	944,120	7.87	437,111	6.15	1,357,921	8.49	2,739,153	7.81
GENERAL EXPENSES.								
35 Salaries of officers and clerks	30,359	.25	11,051	.16	41,938	.26	83,348	.24
36–40 Injuries and damages	150,325	1.25	43,829	.61	79,076	.49	273,229	.78
41–48 Other general expenses	68,099	.57	32,100	.45	177,962	1.11	278,162	.79
Total	248,784	2.07	86,978	1.22	298,976	1.87	634,738	1.81
Total Operating Expenses	1,970,486	16.42	727,406	10.23	2,858,235	17.87	5,556,127	15.83
Car mileage	11,991,404		7,110,090		15,994,912		35,096,406	

* Surplus Account.

PASSENGER RECEIPTS AND EXPENSES FOR THREE MONTHS ENDING SEPTEMBER 30, 1898.

	CABLE.		ELECTRIC.		HORSE.		TOTAL.	
GENERAL EXHIBIT.								
Total passenger receipts	944,985	33.27	1,056,866	26.03	1,009,100	28.82	3,010,951	28.95
Operating expenses	498,318	17.55	408,250	10.06	626,521	17.89	1,533,089	14.74
Earnings from operation	446,667	15.72	648,616	15.97	382,579	10.93	1,477,862	14.21
OPERATING EXPENSES BY DIVISIONS								
Maintenance of way	136,704	4.81	13,553	.34	24,036	.69	174,294	1.68
" " equipment	36,689	1.29	38,420	.95	14,280	.40	89,389	.86
Power	58,085	2.04	56,203	1.38	241,686	6.90	355,974	3.42
Transportation	226,225	7.98	262,889	6.47	288,701	8.25	777,816	7.48
General expenses	40,614	1.44	37,184	.91	57,818	1.65	135,616	1.30
Total	498,318	17.55	408,250	10.06	626,521	17.89	1,533,089	14.74
Car mileage	2,840,383		4,059,756		3,501,088		10,401,227	

system, these differences amounting to 2.26 cents per car mile in spite of the fact that motormen are paid 25 cents more per day than horse car drivers.

In the department of general expenses everything possible has been charged directly to the different motive powers affected, but salaries of general officers and other similar charges impossible to handle directly have been pro rated on the basis of passenger earnings. The only item here which has special interest is that of injuries and damages, which can be, of course, directly charged to the motive powers which cause them. We find that, as is natural, horse traction has cost the company the least for injuries, while the cable appears to have cost more than twice as much as electric traction. It is probable that the charge of 1.25 cents per car mile on the cable system, amounting as it does to 3.6 per cent of the passenger receipts, is a fair average for a carefully operated line in Broadway, and, considering the greater safety of the electric car through its better means of control in emergencies, the average cost for injuries and damages on the electric lines will certainly be much less than with the cable system.

In the quarterly statement it will be seen that, in every grand division of operating expenses, electricity has a decided advantage over the cable system, and in every division except maintenance of equipment it has an advantage over the horse system.

During the twelve months period, the cable lines operated at 47.7 per cent of their passenger receipts, the electric lines at 37.9 per cent, the horse lines at 65.3 per cent, and the entire system at 53.3 per cent. During the three months period the cable lines operated at 52.7 per cent. of their passenger receipts, the electric lines at 38.6 per cent, the horse lines at 62.1 per cent, and the entire system at 50.9 per cent.

The Metropolitan Street Railway Company in 1893 controlled directly and through lease 122.82 miles of track. In each of the five succeeding years additions have been made to this system by the lease of other lines and by extensions, and the management has sometimes been criticised in financial circles for the large rentals which have been guaranteed in order to secure operating control of these properties, the fear having been expressed that the company was assuming too heavy burdens. The accompanying table has been prepared to show the influence upon gross and net earnings in toto and per mile of road operated of these successive acquisitions. It will be seen that the gross receipts have increased from $4,022,723 to $10,779,087 (excluding Second Avenue); the earnings from operation have increased from $1,326,396 to $5,289,982; and while the fixed charges have shown a large increase, the earnings over charges applicable to dividends on the Metropolitan Street Railway Company's stock have increased from $117,794 to $1,787,651, a figure in 1898 more than fifteen times as great as in 1893. Moreover, the gross receipts per mile of road, which is a good test of the wisdom of these purchases, has shown a regular and successive increase from $32,753 to $56,294; the earnings from operation per mile of track have fluctuated somewhat, owing in part without doubt to loss of traffic through reconstruction, but are now between two and three times the earnings per mile in 1893, while the net earnings per mile over charges have increased from $958 to $9,359.

It must not be hastily assumed from the remarkable showing in these statements that the underground electric system could be adopted with financial or engineering success by street railway companies in general. New York City and Washington, which have the only electric conduit roads of any size found in America, are peculiarly favored in the matter of climate and cleanliness of streets, the rainfall and snowfall during the year being extremely small. Moreover, the conduit system, even in its cheapest form, is enormously more expensive than the overhead electric system, costing from $50,000 to $100,000 per mile of single track, according to the pipes and other obstructions which have to be removed. Only the very largest cities of the world, where the traffic densities are extremely heavy, can afford such initial costs, and not only would the street railways of smaller cities, particularly those which have spent large sums for the overhead electric system, be financially ruined by the forced adoption of the underground conduit system, but extensions into and development of suburban areas would be greatly hampered, while, even if overhead rights should be conceded for suburban lines, the inconvenience to the public through transfers would be very great.

We feel that the thanks of all who are seeking light upon this complicated problem of motive power for our great city transportation systems are due to Mr. Vreeland for his generous and broad-minded action in allowing his brother managers to have, in so complete a form, the results of his experience.

Six Years' Statement Showing Increase of Earnings of the Metropolitan Street Railway Company, Due to both Consolidations and Traffic Increases.

	1893.	1894.	1895.	1896.	1897.	*1898.
Totals.						
Gross receipts	$4,022,723	$5,398,466	$6,432,933	$8,173,332	$9,706,598	$10,779,087
Operating expenses	2,696,326	3,223,956	3,389,814	4,189,145	5,090,016	5,489,104
Earnings from operation	1,326,396	2,174,510	3,043,119	3,984,186	4,616,581	5,289,982
Fixed charges	1,208,602	1,859,971	2,070,958	2,517,339	3,226,592	3,502,331
Net earnings	117,794	314,539	972,161	1,466,848	1,389,990	1,787,651
Dividends paid	None.	328,000	405,000	1,252,500	1,200,000	1,500,000
To surplus	117,794	† 13,461	567,161	214,348	189,990	287,651
Per Mile Road Operated.						
Gross receipts	32,753	41,229	46,032	47,555	50,692	56,294
Earnings from operation	10,784	16,599	24,213	23,163	24,171	27,696
Fixed charges	9,826	14,198	14,793	14,636	16,893	18,337
Net earnings	958	2,401	6,944	8,528	7,277	9,359

*Excluding Second Avenue earnings, which form a part of system for three months only in this year. † Deficit.