REPORT

By

State of New York

STATE OF NEW-YORK.

No. 296.

IN ASSEMBLY,

March 14, 1835.

REPORT

Of the Canal Commissioners on a resolution of the Assembly of the 23d February, relative to the cost of canals and rail-roads.

The Canal Commissioners, in obedience to a resolution of the Assembly, under date of the 23d ultimo, requesting them to report "at as early a day as conveniently may be, a statement shewing the average relative cost per mile of canals and rail-roads, the average relative expense annually of repairs and superintendence, and the average relative charges per ton, or other given quantity for transportation; and also, whether in their opinion, any, and what articles of produce, merchandize, or manufacture, can or cannot, having a due regard to the saving of time, as well as other circumstances, be more advantageously conveyed on rail-roads than by canals, with the reasons for their opinion, and such observations on the general subject of this resolution, as they may deem appropriate to guide the action of the Legislature in reference thereto," respectfully submit the following

REPORT:

The subject submitted to the consideration of the Commissioners, is interesting in its character, and of some public importance. The comparative cost of constructing rail-roads and canals, the comparative cost of transportation, and the comparative expense of superintendence and repairs, are subjects which have occupied a large share of public attention; and respecting which, many speculative opinions have been advanced. At one period, the public were assured with some degree of apparent confidence, that rail-roads would supersede canals; and it will no doubt, be recollected by many, that inquiries were made as to the probability of converting the Erie canal into a rail-road.

Experience has gradually developed the relative utility of canals an drail-roads for the transportation of property. We think the period is not distant, if it has not already arrived, when the superior advantages of a canal over a rail-road, as a means of conveying property, will be indisputably demonstrated.

It is believed that it will not be difficult to shew, that the expense of transportation on rail-roads, is very materially greater than on canals. In addition to this, there are other important considerations in favor of canals.

A canal may be compared to a common highway, upon which every man can be the carrier of his own property, and therefore creates the most active competition, which serves to reduce the expense of transportation to the lowest rates. The farmer, the merchant, and the manufacturer can avail themselves of the advantage of carrying their property to market, in a manner which will best comport with their interest.

Much of the property which passes on the canals is carried by transportation companies; but the largest portion is carried by individuals and small associations. The individual who becomes the carrier of his own property, has the advantage of paying nearly one half of the expense of transportation, in the regular course of his business; and the cash disbursements often do not much exceed the payment of tolls. To the farmer, the profits on return freight in many instances gives a full indemnity for the expense of taking his cargo to market.

On rail-roads the proprietors must necessarily be the carriers; and this is the general practice.

It appears that in the State of Pennsylvania an attempt has been made to permit an indiscriminate use of rail-roads. On this subject the Canal Commissioners of that State, in their last annual report, remark as follows: "Before quitting the subject of railways the Canal Commissioners take occasion to remark, that the experience of the past season has convinced them that these roads, either as it regards revenue, facilities to trade or general accommodation, will not answer public expectation, if thrown open like public highways, to be used indiscriminately. Every person who has paid the least attention to the transportation upon them since they were opened, must be convinced that an unrestrained and indiscriminate application of motive power is attended with danger, delays and interruptions. Safety, regularity and punctuality must first be secured, before those important links in our great chain of improvements can fully answer the purpose for which they were designed, and the board are decidedly of opinion that this desideratum is only to be obtained by the Commonwealth furnishing all the motive power, and directing its application."

There is some difficulty in furnishing an accurate comparative statement of the cost of constructing canals and rail-roads. The character of the country in which a canal, or rail-road is situated, and the manner in which they are constructed, have an important influence in determining their cost; and unless the prominent circumstances which have a bearing on this question are understood, it would be difficult to do more, than furnish an approximate estimate.

To furnish a statement of the actual cost of several canals, and rail-roads, with a brief allusion to the prominent features which have a bearing on the question of cost, is the best evidence which can now be furnished, in answer to that branch of the inquiry.

The relative annual expense of superintendence and repairs, is not the subject of estimate on any fixed data; but must rest on experience. This expense would depend on circumstances which are hardly similar in any two cases. The character of the country, the permanency which is given to the work in its first construction, and the amount of business, governs this question to a great extent.

The Erie canal was commenced in 1817, and completed in 1825. Every part of it has been in use 10 years, and some parts of it 15 years. In this period many of the structures of wood have been twice renewed, and all of them once. Several important improvements have been made, such as the widening of aqueducts, &c.; and the banks on much the largest portion of the line, have been faced with stone and timber. The great facilities which are furnished to accommodate the large trade which is done upon it, by removing bars and deposites in the bottom of the canal, guarding against breaches, their prompt reparation when they occur, gravelling the towing path, attendance at the locks, &c. &c., exceed the expenses which ordinarily occur on canals, and is much greater than would be necessary where a limited amount of business is done.

A statement of the average annual expenses for superintendence and repairs, from 1828 to 1835, will furnish the most accurate information which can be given in regard to this expense.

The annual expense of repairing rail-roads has not yet been developed by experience.

The Manchester and Liverpool rail-road was completed in 1830. The Baltimore and Ohio rail-road, in 1831; and the Delaware and Hudson rail-road, in 1829. These companies have severally given a particular statement of the actual annual cost for superintendence and repairs. But this expense will fall short of a true average after the lapse of time within which the wood work of these roads must be renewed.

The proprietors of these roads have furnished a detailed statement of the actual cost of transportation, independent of tolls or profit to the company; which, compared with the actual cost of transportation on the Erie canal, will furnish the best data which can now be given, of the relative expense of transportation on canals and rail-roads.

The Commissioners have not had it in their power, since the receipt of the resolution, to which they are now replying, to investigate this subject with that care and attention which its importance demanded. One of the acting Commissioners is absent, on account of severe indisposition in his family, and another has been in feeble health. Under these circumstances, and with a view of giving the subject a speedy and careful examination, they called to their aid John B. Jervis, Holmes Hutchinson and Frederick C. Mills, Esqs., civil engineers, of experience in the construction of canals and rail-roads. Their report, accompanied by several interesting tables, is herewith submitted.

The Commissioners have examined this report, and believe the general results to be correctly stated. This report contains all the information which can now be given in answer to the several inquiries submitted to their consideration.

WM. C. BOUCK.
MICHAEL HOFFMAN,

March 17th, 1835.

DOCUMENTS.

REPORT

Of John B. Jervis, Holmes Hutchinson and Frederick C. Mills.

To the honorable the Canal Commissioners of the State of New-York:

GENTLEMEN—

We have examined the question you submitted to our consideration, in relation to the relative cost of construction and repairs of canals and rail-roads, and also the relative expense of transportation, and present in the follow report, the facts and views we have been able to obtain. The importance of the subject compels us to regret, that more time could not consistently have been taken, to obtain further facts, and allowed us to carry the investigation into greater detail. We have felt compelled in a great degree, to confine ourselves to an exposition of prominent features, in the two methods of facilitating internal communication. We believe, however, the facts presented, and the exposition of the bearing of those facts, will be found useful, in leading to correct conclusions in regard to the question under consideration.

RAIL-ROADS.

The utility of rail-roads is materially, and in some respects, peculiarly affected by the ascent and descent that is overcome, and the relative amount of trade requiring transport in opposite directions. For instance, a rail-road requiring transport only in one direction, would be most favorable with such a declivity in the direction of the freight, as would require the same power to move the loaded wagons, as would be necessary to return with the empty ones: and this declivity would decrease in cases requiring transport in both directions, and become level when the freight was equal.

In this country, it rarely occurs that freight is equal in both directions; more frequently it is 2, 3 and 4 to 1. To obtain the most favorable graduation to the trade to be accommodated, it is essential that it be uniform, or nearly so; which the route would not often admit without too great expense, and in some cases would be impracticable. On important lines for general trade that have any considerable extent, there will, from the character of the country, often require a level, and sometimes a small ascent in the direction of the greatest trade; and it would be a favorable compromise to exchange all acclivities and declivities for a level road. Though there would be exceptions, still, it is believed a level road would afford a fair standard, in determining the general question of utility.

Below will be found a statement of the cost of several rail-roads, and in some cases the cost of transportation.

It is to be regretted that more authentic information of a practical character is not in our possession. The authorities as well as the facts, are stated to show the weight which they are entitled too. In some important cases they are authentic; and these will be adopted as the basis of our conclusions.

Baltimore and Ohio Rail-road.

From Baltimore to Point of Rocks, 67½ miles, by report of chief engineer, (October, 1832,) this section was stated to be nearly complete, and the cost $29,193 per mile. In a document of second session 22d Congress, No. 93, it is asserted this road had then cost nearly $34,000 per mile: We have examined the subsequent reports of the directors and their officers, and find nothing to change the statement of $29,193 per mile.

The grading of this road is done in a substantial and durable manner; over $\frac{2}{3}$ of the superstructure is timber sills and rails, capped with an iron plate: $\frac{1}{4}$ (or $\frac{26}{100}$) is stone rails capped with iron plates, and $\frac{1}{17}$ is timber rails on light stone blocks.

The cost of transportation for the year ending 31st September, 1834, as per report of superintendent of transportation, was for motive power and all other charges, (excluding repairs of road,) except interest and fund for renewal of wagons,.....	$62,348 57
Superintendent of machinery reports 1,000 wagons on the road; their cost is not given. They probably cost from $150 to $200 each; if on steel springs, the latter, otherwise the former: they may be estimated at $150 each, which for 1,000, is $150,000: interest on their cost, and to provide a fund for renewal, is believed should be at 25 per cent, which is,..................................	37,500 00
Total cost of transportation, exclusive of tolls or profit, for 56,120 tons, is, ...	99,848 57
The average charge of the company, per said report, is within a small fraction 4⅔ cents per ton per mile, produces the sum of,....	116,254 79

The ratio of receipts to expenditures is 1 to 0.85, and $4.66 \times 0.85 = 3.96$ cents per ton per mile, as the expenses.

The expenses the previous year are stated by same report to have been higher: but as we have not the detailed statement, we cannot give the exact difference.

This rail-road has ascents, descents, and curves, which affect the economy of transportation.

In regard to curves, this road may be considered as having more than is usual on rail-roads, designed mainly for general trade.

All lines of rail-road, of any considerable extent, will be curved more or less, according to the character of the country through which they are constructed. It is the first object to have it straight, and next, the lightest curvature the country will admit. The minimum will therefore, be determined by local circumstances.—While it is considered this road has more curvature than will occur as a general average, it is obviously impracticable to determine what this average may be. The chief engineer, J. Knight, of this (Bal. and Ohio) rail-road, made experiments on the increased resistance produced by curves, which led him to the conclusion, that in a curve having a radius of 400 feet, the traction was increased 50 per cent. If locomotive engines were used, then loads would be regulated by the greatest resistance they had to overcome, on any part of the route; but a horse can increase his effort, for a short distance, which enables him on a road that has occasionally, sharp curves or ascents for moderate distances, to perform a greater average of useful effect, than can be obtained from locomotive steam power. The freight business for this road is performed by horse power. The sharpest curves generally occur in short distances, intervening between straight lines and larger curves, and will not, therefore, affect the cost of transportation to so great a degree as if locomotive steam power was used. If we assume 10 per cent of the resistance on a level and straight line, as the excess over a general average arising from extra curvature on this road, and apply it to the section between Parr Ridge and Baltimore, we shall not probably be far from its true influence on the cost of transportation.

The next, and most important question that affects the cost of this transportation is, the ascent and descent. The character of this road in relation to its elevations, seems to indicate the propriety of dividing it into sections, and applying on each, the power necessary, without regard to the other. The following divisions have therefore been made, to wit:

1st. From Baltimore to Parr Ridge, foot of 1st inclined plane—length, 40¼ miles; ascent westward, 590 feet; descent, 23 feet; total, 613 feet; ascent averages 14.75 feet per mile.

2d. Embraces the 4 inclined planes that pass Parr ridge, 1.94 miles; ascent and descent, 429 feet, viz:

No, 1,	2,150 feet,	rise	$\frac{1}{26.75}$	= 80 feet,	Total asc't 179 feet,	
2.	3,000	"	$\frac{1}{30.12}$	= 99 "		
3,	3,200 feet,	fall	$\frac{1}{20.05}$	= 160 "	" dec't 241 "	
4.	1,900	"	$\frac{1}{23.35}$	= 81 "		
					Total, ...	420 "

Intermediate level, about 3½ miles.

3d. From foot of plain No. 4, to end of continuous declivity westward, 11¼ miles; total descent, 285 feet; average, say 25 feet per mile.

4th. The remainder of road, to point of rocks and branch to Frederick, a fraction over 16 miles; descent westward, 169 feet; average 10.56 feet per mile; ascent westward, 131 feet.

Total rise and fall, 300 feet.

The ascent westward, for the 4 divisions, is..........	900 feet,
The descent " "	718 "
Total ascent and descent,....................	1,618 "

By the report referred to, it appears the ratio of freight moving eastward to that moving westward, was nearly as 2 to 1; for calculation we therefore adopt this ratio.

It has been shown that the 1st division has an average ascent of 14.75 feet per mile. This ascent, however, is not uniform; in several places for short distances it descends westward, some portions are level, and the ascents are at rates varying between 2.64 and 37.48 feet per mile, excepting a short piece near the foot of inclined plane. They seldom much exceed 20 feet, except for short distances. The length of grades at the higher rates of ascent is generally less than one mile, and alternate with those of medium rate; except near the inclined plane. In view of the character of this division, it is believed animal power will allow such variations, as to accommodate the varying resistance, with nearly as much economy as on a uniform ascent. If we calculate on a uniform ascent of 18 feet per mile, we shall not probably vary essentially from the true economy of the case.

It has been observed, the freight is as 2 to 1 in the opposite direction, being least westward. The weight of the wagons will probably be $\frac{1}{3}$ of the gross load; and for computation, we may assume the wagon to weigh one ton; and consequently the freight eastward will be 2 tons and that westward 1 ton.

The resistance from friction is taken at $\frac{1}{250}$ of the gross load, the velocity being low. On a level this will require nearly 9 pounds per ton, on an ascent of 18 feet per mile gravity will be $\frac{1}{293}$ of the load, or 7.64 pounds per ton. The wagon and its freight going westward, makes a gross load of 2 tons; the resistance will therefore be $9+7.64\times2=33.28$ lbs. To carry on a level road, a load which including wagons would be 3 tons, the resistance would be $9\times3=27$ lbs. The road with a few exceptions, descends eastward or is level. The ascents are small and so near the eastern termination, that, in the average, less power would be required than on a level; but we require 33.28 lbs. to move westward, after providing for varied effort by the animal. Now, as a general result, we could not expect a more equal ratio of freight in the two opposite directions than in this case, and if 27 lbs. is required on a level, we have an excess of power to provide for the load moving westward, of $33.28-27=6.28$ lbs., and as this will return with the opposite load, we have extra power for the two directions $=12.56$ lbs. more than required for a level road, or 23 per cent extra. This added to the extra curvature of 10 per cent, raises the extra traction to 32 per cent on this section. The cost of the moving power is nearly $\frac{2}{5}$ of the total expense, and 32×.40=14.80, say 15 per cent, the cost of transportation over a level road; and 40.25 ×.15=6.03, or equal an increase in the length of this division, of 6 miles.

2d division. The total ascent westward is, on the inclined planes Nos. 1 and 2; their total length is 5,150 feet, and ascend at an average rate of one in twenty-eight and three-fourths. It is obvious, the load moving westward will determine the expense of power, as that in the opposite direction on these planes will descend by its own gravity, requiring only the expense of brakemen to control its descent within a safe velocity, which may be done by a part of the drivers, whose teams could be led back by others. In moving up this ascent, a horse would require 35 per cent of his power to overcome the gravitating force of his body; but as he would be loaded only in one direction, and the length of either plane but little exceeding half a mile, it is believed to be a fair estimate to compute in this case, the useful effort of his power, as equal what it would be on a level. We have one ton of goods and one ton of wagon, making a gross load of 2 tons moving westward. The total resistance up the plane, will be 173 lbs., or 5.4 times greater than the load in the opposite direction, (3 tons gross,) would be on a level. The two planes are together, 0.97 miles in length. The ascent will make the extra resistance, equal 5.23 ×.4=2.09 miles.

The 3d and 4th planes descend westward; their total length is 5,100 feet, and descend at an average rate of $\frac{1}{21.13}$. For these planes, we must compute the power required to ascend them with the load moving eastward, which is 3 tons including wagon. The horse will require 47 per cent of his power to overcome the gravitating force of his body up the plane; and though he will as in the case of the other planes, be loaded only in one direction, still it is believed that 10 per cent should be taken from his average useful effect in ascending Nos. 3 and 4. The resistance of 3 tons up these planes will be 344 lbs., equal 11.73 times greater than on a level, or including the loss in the effective power of the horse, equal 13.13 times greater. The two planes are .96 miles ×13. 13×.4=$4\frac{3}{4}$ miles extra length of transportation. The influence of the planes on this division, increases the moving power equal to what would be required for 17 miles of level road, and taking the moving power at 40 per cent of the total expense of freight, a fraction over $6\frac{3}{4}$ miles, entire cost of transportation.

3d division—Ascends eastward at the average rate of 25 feet per mile, varying from 9.76 to 52.80. The grades that have the higher rates of ascent are short, and in view of the small amount of labor required of the horses in the opposite direction, it will probably not vary materially from the truth, to compute the power at the average rate of ascent, or $\frac{1}{211}$. A load eastward is 3 tons including wagons, and the resistance will be 58 lbs., equal 2.14 times that on a level; or for 11.25 miles, requiring extra moving power, equal what would be required for 12.82 miles on a level, or equal the total expense of transportation for $5\frac{1}{8}$ miles.

4th division—Is quite of an undulating character; the ascent is greatest in the aggregate in the direction of the greatest trade, but the grades have a less rate of ascent, than in the opposite direction. The average ascent in the direction of the greatest trade, will be a fair basis of computation for the section. This is $\frac{1}{300}$, and the resistance for 3 tons, (as before,) is 40.44 lbs. or 50 per cent greater than a level. For 16 miles the extra moving power is equal 8 miles on a level, or equal the total cost of transportation for 3¼ miles nearly.

In the first division we have extra equal,			6	miles.
" Second,	"	"	6¾	"
" Third,	"	"	5⅛	"
" Fourth,	"	"	3¼	"
			21⅛	"
Total length of road is,			71	
				92.12

The actual cost of transportation has been shown to be 3.96 cts. per ton, per mile. To reduce this to our standard, we have the cost of transportation, exclusive of toll or profits, 3.05 cts. per ton per mile, with freight as two to one in the different directions.

By report of superintendent, the moving power cost 1.08 cts. per ton, per mile.

Repairs.

Year, ending October, 1833, $444 per mile.
" " " 1834, $321 " "
Average, for 2 years, $382.50.

A road constructed mostly of timber will vary much in the cost of repairs for different years, and several are therefore necessary to obtain a proper average.

Cost of transporting passengers per mile, 1.98 cts. as stated in Hazard's Register of Pennsylvania, v. 15, p. 112.

Liverpool and Manchester railway.

In a statement published by Mr. Booth, the treasurer of the company, dated June 30, 1830, the expenditure up to that time, including an estimate, (the road was at this time nearly completed,) to finish some unimportant items of work, it appears the construction of the railway, exclusive of warehouses, wharfs, offices, engines, wagons and other items not connected with the construction of the road, cost £694,595 for 31 miles, equal £22,406×4.80=$100,748 per mile. There have, subsequently, been heavy expenditures, not embraced in the account of repairs, but we are not sufficiently advised of their object to say, whether or not, any part of it belonged to the amount of the original construction of the road.

Repairs.

It appears from four semi-annual reports of the directors, the expense of repairs have been as follows, to wit:

Report of July, 1832, 1st January to 30th June,...	£7,331	0	6
" January, 1833, 1st June to 31st Dec....	6,878	4	3
" July, 1833, 1st January to 30th June,...	6,714	9	3
" January, 1834, 1st July to 31st Dec.....	6,425	14	8
Total for 2 years,...............................	£27,349	8	8

Equal, for 31 miles, 882×4.80=$4,233 per mile, which, for one year, is equal $2,116 per mile, commencing about a year after the road was opened for business.

A table is given of the general expenses in the six months previous to that reported in July, 1832, in which the expenses of repairs is included with some other items. This aggregate sum is very nearly the same as reported in detail, showing there had been no material variation in repairs for the six months previous to that particularly reported.

Transportation.

The reports above referred to, embrace 4 semi-annual accounts for transportation, and one tabular view of transportation for 6 months previous, from which the following table is made.

The report of July, 1832, contains a statement of transportation for the two semi-annual terms preceding.

In the tabular account given by the directors, the maintenance of way and rate, taxes and omnibusses are charged to transportation; but in the following table these are not included, as it is the design to exhibit the cost of transportation separate from other expenses; these items are given in the table of directors' reports, with others, but are separate in the general account.

TABLE, showing the cost of transportation per passage, and per ton of merchandize, for 31 miles, on the Liverpool and Manchester rail-road.

	Report of January, 1832.		Report of July, 1832.		Report of January, 1833.		Report of July, 1833.		Report of January, 1834.		Average of five semi-annual statements.	
	Cost per passenger.	Cost per ton, of merchandize.	Per passenger.	Per ton of merchandize.	Per passenger.	Per ton of Merchandize.	Per passenger.	Per ton of merchandize.	Per passenger.	Per ton of merchandize.	Per passenger.	Per ton of merchandize.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s, d,*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Disbursements in the merchandize department, consisting of porterage, salaries, carting, stationary engine, disbursements, &c. &c., ...	......	4 6¾	......	4 0	......	3 5	......	3 7½	......	3 9¾	......	3 10½
Disbursements in the coaching department, comprising porterage, salaries, repairs, &c. &c., ...	0 7	......	0 7¾	......	0 6¾	......	0 9¼	......	0 9	......	0 7¾	......
Locomotive power account, proportioned according to the number of trips of 30 miles in each department; comprising repairs of engine, wages, coke, &c., ...	0 6¼	1 11	0 7½	1 7¼	0 10¾	1 2¼	1 0	1 6¾	0 8¾	1 6½	0 9	1 4¾
Sundry disbursements, proportioned according to receipts, as between coachery and merchandize, comprising police and gate establishment, and general office, ...	0 1⅞	0 3¾	0 2	0 4	0 1¾	0 3¼	0 2	0 3½	0 2⅛	0 2⅝	0 2	0 3⅜
Interest, on loans, and chief rents, proportioned according to the amount of profit in each department, calculated exclusively of these items of disbursement, ...	0 4¾	0 4¾	0 6¼	0 8¼	0 4½	0 7	0 5	0 6¾	0 4½	0 4⅞	0 5	0 6⅜
Total disbursements, ...	1 7⅞	7 2¼	1 11½	6 7½	1 11¾	5 5½	2 4¼	6 0½	2 0⅛	5 11¾	1 11¾	6 1

From the reports of the directors and their statement of general accounts, it appears probable, the amount of repairs of wagons and coaches, includes the purchase of new ones when required, to supply the place of those that fail: the interest account is supposed to be interest on cost of locomotives, engines, coaches, wagons, &c.; there is no other item that embraces the interest on the outlay, and it is presumed this is intended. There is a charge for carting included with other items, and from the general account would appear to be about 6d per ton: we have not deducted this item, for the reason it was impracticable to determine exactly what it amounted to; and the question whether the interest account included the total interest on the outlay for the transportation department, with such allowance as would, beyond what was included in repairs, make the necessary renewals, being doubtful, we have thought a further reason for leaving it as it is. The table cannot however, be far from the proper expense of transportation.

For Merchandize.

The lowest cost per ton is 5s. 5d.=$1.31, or per mile,..4.22 cts.
The highest cost per ton is 7s. 2¼d.=$1.72, or per mile, 5.55 "
The medium, or average of the table is 6s. 1d.=$1.46,
or per mile,.. .... 4.70 "

For each Passenger.

The lowest cost is 1s. 7¾d., equal to $0.39¾, or per mile,1.28 cts.
The highest " 2s. 4¼d., " 0.56½, " " 1.82 "
The average " 1s. 11¾d., " 0.47½, " " 1.53 "

The table below contains the aggregates for one term of six months later than the above table: it does not appear that transportation was lower for this term than previously, but on the contrary is confirmatory of the above average results; which may therefore, be viewed as based on three years experience.

TABLE, showing the number of passengers, and the tons of merchandize, passing the whole length of the road; and also receipts and expenditures for the entire transportation, including the way and coal business, and that passing the whole length of the Liverpool and Manchester road.

Information, where obtained.	Passengers.			Merchandize.			Total.		Excess of receipts over expenses.	Ratio of receipts to expenditures.
	No.	Expense.	Receipts.	Passing through.	Expenses.	Receipts.	Expenses.	Receipts.		
		£.	£.	*Tons.*	£.	£.	£.	£.	£.	
Semi-annual report of directors, dated July, 1831, for 6 months, ending December 31, 1831, ...	....	25,930	58,348	....	21,841	29,022	49,025	89,809	40,784	as 1.83 to 1
Semi-annual report of directors, for 6 months, ending 30th June 1832, ...	174,122	21,957	40,044	57,174	22,445	30,436	46,658	74,706	28,048	1.60 1
Semi-annual report of directors, dated January, 1833, for 6 months, ending 31st December, 1832.............	182,823	23,744	43,120	61,995	22,277	35,509	48,278	80,902	32,624	1.67 1
Semi-annual report of directors, dated July, 1833, for 6 months, ending 30th June, 1833, ...	171,421	24,746	44,130	68,284	26,447	38,149	52,900	86,071	33,171	1.62 1
Semi-annual report of directors, dated January, 1834, for 6 months, ending 30th December, 1833,.............	215,071	27,345	54,685	69,806	27,357	38,641	56,350	97,234	40,884	1.70 1
Rail-road Journal, vol. 3, 609, given as facts from report of directory of July, 1834, for 6 months, ending June 30th, 1834, ...	244,326	....	50,770	77,528	....	44,014	60,092	94,784	34,692	1.57 1

NOTE—It will be perceived the column of tons, only embraces that passing the whole length of the road, while the receipts and expenses on transportation include the way business.

Having ascertained the cost of transportation on the Liverpool and Manchester railway, we now proceed to reduce the cost of freight to our standard of comparison; a level road.

Inclined plane at Liverpool.

Length, 1.12 miles; rise $\frac{1}{48}$. The *extra* cost of the transit for moving power, taking the average from two semi-annual reports, is 1.80 cts. per mile, 2.02 cents for the total length, per ton; equal, for total cost of transportation, to 0.43 of a mile, on a level.

Sutton and Whiston Planes,

Are each 1½ miles long, and have an inclination of $\frac{1}{96}$ or 55 feet per mile. They incline in opposite directions, and therefore, if the trade was equal in each direction, only one plane should be calculated as affecting the total transportation; as it is obvious, a load passing in either direction, would only require additional power to ascend one plane. In the reports of the directors they give the total freight, not distinguishing *between* the different directions; and we are left to determine, from the general character of the trade, whether any and what difference there was. It appears that not more than $\frac{1}{6}$ of the tonnage between the two cities passes on the railway; and we, therefore, are led to infer the railway takes the lighter character of freight, which is probably about equal in both directions; and our computation of cost is made on this basis.

This road being worked entirely by locomotive steam power, except the inclined plane at Liverpool, which has stationary power, our computation is made accordingly.

In ascending the plane the resistance will be $\frac{1}{225}$, (friction,)+$\frac{1}{96}$, (gravity,)=$\frac{1}{67}$, or ratio to a level of (3.35 to 1,) or a little more than three and one-third to one. The power of the engine will be reduced by its gravity, and that of its tender to 70 per cent of its power, on a level; or to make it equal its power on a level, it must be increased to 142 per cent, which makes the cost of moving power to ascend the plane, as compared with a level, as 4.75 to 1, or four and three-fourths to one. The extra moving power to ascend this plane over a level, is equal to the transit of 5.62 miles on a level. The moving power is 26 per cent of the total transportation, exclusive of the interest account in which the items of moving power and wagons are blended; this will not be less than 4 per cent, making the total cost of moving power at least 30 per cent. The extra cost of the planes are therefore equal 1.68 miles entire transportation on a level.

The greatest inclination on any part of this railway, except the inclined planes above mentioned, is $\frac{1}{880}$ or 6 feet per mile. It is presumed the ascent of this inclination will regulate the load of the engines, on which the resistance will be $\frac{1}{225}+\frac{1}{880}=\frac{1}{179}$, or ratio to a level of 1.25 to 1. The power of the engine will be reduced by its gravity, and that of its tender to 97 per cent, or its power must be increased over what would be required on a level, say to 104 per cent, making the cost, as compared with a level, as 1.30 to 1. This will be applicable to 27 miles of road, on which the extra cost for moving power is equal 8.1 miles, or for entire transportation equal 2.43 miles.

The influence of the elevations on this railway in increasing the cost of transportation over that of a level, is (43+1.68+2.43=4.54,) a little more than four and half miles of level way. The actual average cost of transportation for 31 miles was found to be (4.7,) nearly four and three-fourths cents per ton, which, reduced to a level road, we find to be (4.07,) over four cents, per ton, per mile.

An interesting fact is developed in this investigation, in relation to the comparative cost of transportation on inclined planes by stationary and by locomotive steam-engines. The plane at Liverpool is worked by stationary steam power, and has an inclination of $\frac{1}{48}$ or 110 feet to the mile. The Whiston and Sutton planes, worked by locomotive steam power, have an inclination of $\frac{1}{96}$ or 55 feet in a mile, being exactly half the inclination of the Liverpool; yet the cost of moving power on the Liverpool to Whiston or Sutton is as 1 to 2.90; showing that locomotive power, for an ascent of 55 feet to the mile, is about 3 times the expense of stationary power for a plane 110 feet to the mile, calculated for equal horizontal distances. It should be observed, in relation to this fact, that economy of stationary power on inclined planes, depends materially on the amount of business. In this case it was about 500 tons per day.

Baltimore and Washington Rail-road.

This road commences a at point in the Baltimore and Ohio rail-road, about 6 miles from Baltimore, and extends 30 miles to the city of Washington. Its operations are conducted by the Baltimore and Ohio company. In their report of October, 1833, they state the estimated cost at a little over $53,000 per mile, for 26 miles. The estimate for the whole 30 miles is given at $50,000 per mile, in a report on canals and rail-roads, as presented, 25th June, 1834, to the House of Representatives in Congress. In their report of October, 1834, the directors say the graduation and masonry, (the part of the expenditures liable to the principal contingencies,) is nearly completed; they make no allusion to the probability of the work costing more or less than the estimate; and as it would be natural to do so, if any important disagreement was probable, it is inferred the road would cost the estimated sum; and being so near completed we have thought it proper to put it in the table. This road has iron rails on stone foundation, except the embankments, which have timber foundation.

Columbia Rail-road.

This rail-road is 82 miles long, and per last report of Pennsylvania commissioners, the road has cost, including an estimate for an unimportant amount of unfinished work, $40,450, per mile. It has mostly iron rails, partly on stone and partly on timber foundation.

Allegany Portage Rail-road.

This rail-road is 36 miles long, and per report of Pennsylvania commissioners, has cost, including a small estimate for unfinished work, $47,977, per mile. It has iron rails for a fraction over two-thirds its length, about half of which are on stone foundation, and the balance on timber; nearly one-third is timber road with iron plates.

Mohawk and Hudson Rail-road.

The main stem of this road is 16 miles in length. It has timber rails with iron plates, about half of which are on a stone foundation, and the other half on timber. Cost per mile of double road, $38,107, per company books. (They have also about 3½ miles of single road in branches that cost $15,847 per mile.)

Actual cost of transportation for freight by locomotive and stationary steam, 3.5 cents per ton per mile. All the ascent for the greatest trade, (being as 3 to 1,) is overcome by one stationary engine, which does not materially enhance the ratio of cost over a level, taking the whole road. Experience has been quite limited on this road, and considering that the ratio of trade in different directions, in connection with the facility of overcoming the principal elevation by stationary power, would not materially increase the cost of transportation over a level, it has not been thought important to reduce it by computation. The cost of transporting passengers has been 1.7 cents per mile.

Saratoga and Schenectady Rail-road.

This rail-road is 22 miles long. It is constructed with a timber rail, capped with an iron plate on timber foundation, except about three miles that has a light stone foundation. This road has a single track; it cost, per report of directors, November, 1832, $11,010 per mile, exclusive of building, &c.; to make a second track of the same character, would cost $6,000, making the total cost for double road $17,010 per mile.

Delaware and Hudson Canal Company Rail-road,

Is 16 miles long, has 5 mile of double and 11 miles of single track. The valleys on this road were generally bridged with timber. The road is timber with an iron plate. It cost originally, including stationary engines, about $10,500 per mile, (the exact amount not known.) To have made it double would have raised the expense to $14,000 per mile; average annual repairs for four years is $623 per mile. Transportation when the business is at 250 tons per day, is 4 cents per ton per mile, and when 500 tons per day, is 3 cents per ton per mile. This arises mostly from the cost of operating the planes, which is nearly the same in both cases.

The ascent of this road (855 feet) is overcome by five stationary steam engines, working on planes whose total length is 2¼ miles. The cost of motive power for 500 tons per day, averages essentially the same as it does for horse power on a level, having the same in horizontal length. From the summit the principal descent is effected by three self-acting engines, so arranged that the loaded wagons draw up the empty ones: and the balance of the declivity is advantageously arranged for a descending trade. The economy in the use of stationary steam power, arising from the cheapness of fuel, and the great regularity which may be obtained in a coal business, and the comparatively small amount of agencies to conduct the business, leave no doubt on our minds, that transportation is effected on this road as cheap per ton per mile as a general business could be on a level road.

New-Castle and Frenchtown Rail-road,

Is 16 miles long; timber rail capped with iron plate, about one-third on light stone foundation and the remainder on timber; cost $30,000 per mile, (see report of committee on roads and canals to Congress, January 25th, 1834.)

Camden and Amboy Rail-road.

The part extending from Amboy to Bordentown is 33 miles in length, is believed to be entire iron rail, partly on stone and partly on timber foundation; cost (as per congressional report above mentioned) 30,000 per mile.

South Carolina Rail-road,

Is 130 miles long; timber rail capped with an iron plate. This road is built on piles; no embankments made in the grading; cost about $7,000 per mile. It is not known whether it is a single or a double road, but believed to be mostly single track.

There are several important rail-roads in the United States, which we should have been gratified to have added to those above given. But we have not the information in relation to them, that would enable us to derive any practical advantage. There are others that we have not thought proper to introduce in a question that relates to the general utility of rail-roads as public thoroughfares: they are roads made mostly for local objects, or for short distances, where the surface of the ground is nearly level, and the road made to conform nearly to the natural level or inclination, and very little expense incurred to remove those irregularities in the surface, which in a road of any considerable length and importance, are generally encountered to obtain an economical grade: and the superstructure of such roads are usually made in an imperfect manner, not calculated to serve the purpose of accommodating an important general trade.

In the roads described, it is believed a fair view may be obtained of the general question of cost. In their *graduation* some have been of an expensive character, to wit: The Baltimore and Washington, Allegany Portage, the Columbia, Mohawk and Hudson, and a part of the Baltimore and Ohio, though on the average the latter cannot be much above a medium: the Camden and Amboy, and the New-Castle and Frenchtown rather below a medium, and the Saratoga as very favorable. The South Carolina road having been placed on piles, excavation has been avoided as much as possible, and embankments omitted altogether, by which the expense of grading has been very little. The general character of the superstructure has been stated; and their rails, or the foundation of the rails appears to be, to a great extent of timber.

The superstruction of rail-roads when composed of timber with the rail capped with an iron plate will cost, for a double track, from $6,000 to $10,000 per mile, according to the value of timber and the stability given to the road; (this is exclusive of grading.) The cost on the Baltimore and Ohio, for this kind of road, was $8,852 per mile. When composed of iron rails, laid on stone foundations, the cost will vary from $18,000 to $25,000, according to the convenience in obtaining stone, the extent of the ballasting, and the weight of rail that may be adopted; the probable average may be $22,000 per mile. The difference then, between a medium of the two kinds, is $14,000 per mile. To have adopted the iron rail on a stone foundation in the roads mentioned, would have have materially increased their average cost. But in the first construction, it is usual, even when iron rails are adopted, to put down a timber foundation to support them on the embankments, until the embankments have time to become fully settled.

The first rail-ways in England, were constructed of timber without any iron. The timber being found to wear too rapidly under the wheel, the iron plate was then put on. From this rude beginning in rail-roads, their advantages began to be developed; and experience soon sugested improvements. Hence we find the wooden rail soon abandoned, even in the coal districts. Cast iron rails on a stone foundation followed timber; and now wrought iron is generally used in preference to cast iron. These remarks are introduced to show the result of experience in England. In this country, timber will doubtless be used to a greater extent, and for a longer period, than it was in England. The cheapness of timber, the want of capital, and the limited amount of business in many places, will operate as causes to produce this result. We already observe, however, in this country, a departure from the use of timber rails on several important rail roads. Among those who have critically attended to this subject, there is probably very little difference of opinion, in regard to the most suitable material for rails and their foundation, when an extensive business may be anticipated, and particularly where a high velocity is an object. The Baltimore and Ohio Rail-Road Company, after an experience of several years with timber rails, have come to the following conclusion, as appears in their last annual report: "In the construction of the Washington road, the board have had regard to its durability, not less than to making it a source of immediate profit to those interested in the undertaking. The experience of the main stem, has *conclusively* shown, how important it is, to avoid the expense of repairs of the rail-way, which not only materially affect the revenue, but occasion constant *interruption* and *inconve-*

nience to the *travel* on the road. True economy consists in constructing the road, in the first instance, so as to obviate the necessity of *frequent* repairs, and to enable the *motive power* used in transportation, to be employed to its fullest effect, without the *fear* of injury to the rails or bridges over which it passes in the performance of its daily work."

Timber is found to be less durable in a rail-road than in almost any other situation. The action of the carriages tend to open the pores of the timber, which renders them more liable to imbibe moisture; all horizontal joints are much exposed under this action, and particularly that under the rail plate. There is, no doubt, situations where timber may be advantageously adopted. The cheapness of this article, the scarcity of stone for foundations, the scarcity of capital, limited extent of business, and the experimental character of the particular investment, will often present arguments in favor of its adoption. At the same time, we are fully of the opinion, that all rail-roads, which constitute important avenues of communication, the period is not distant when timber rails will be wholly abandoned for iron.

The question in relation to the average cost of rail-roads, it will be difficult to determine, as the graduation will be very different at different places. The table given, of the cost of several rail-roads, excluding the Liverpool and Manchester, would afford an average of $30,393 per mile. Had all these roads been constructed entirely with iron rails and stone foundations, their average cost would probably have been between $35,000 and $40,000 per mile. Taking all the rail-roads, designed to accommodate a large general trade, that have been constructed in this country, and add to their expense what would be required to complete an iron rail with stone foundations, we believe the cost for a double road would not fall below $35,000 per mile; and to reduce the same to a timber road of the best character, would not be less than $25,000 per mile. The grading in both cases, is supposed to be done in a permanent manner. We are aware of the fact, that rail-roads, in some instances, have been made for much less; but for the reasons before given, we do not believe them entitled to a place in this examination, which is designed to investigate the utility of rail-roads as a means of general intercommunication of trade. There is no doubt, many situations where the favorable formation of the country, and the facilities for obtaining materials, will reduce the cost below the amount stated above, and a less expensive road may be sufficient for the trade to be accommodated. But there will be others that will be more expensive, as experience has fully demonstrated; and our object is to reach an average result for the accommodation of a general trade, where expedition, regularity and economy in the moving power will be important. It should be observed in relation to this question, that the cost of a rail-road will depend materially on the amount of tonnage, and the speed it is necessary to maintain. This arises from the economy of motive power; for instance, where a small amount of business is to be accommodated, it will be economy to apply greater motive power, and avoid expensive graduation; on the other hand a large amount of trade, will induce greater expense in bringing the lines of graduation to the most favorable standard for economising this power.

Remarks in relation to repairs on Rail-roads.

Experience on this point is yet quite limited. We have the account of two years on the Baltimore and Ohio road, four years on the Delaware and Hudson company road, and four semi-annual statements of the Liverpool and Manchester road. We have also, in relation to the latter, a general statement of the half year preceding and the half year subsequent to the four full reports, from which we are led to infer that no material variation occurred for three years. The average of the three roads is $1,040 per mile per annum.

There is a great difference in the annual expense of repairs for these roads, which suggest the propriety of examining into the cause.

The moving power on the Baltimore and Ohio, and also on the Delaware and Hudson company's road, admitted for freight, only a moderate speed, probably seldom exceeding 4 miles per hour, and nearly the same amount of tonnage was conveyed on each: on the latter, no passengers are carried; on the former, the passengers constitute about half the business.

The Baltimore and Ohio road has less timber in its structure, though it has a large majority of timber road. The Delaware and Hudson Company road is about $\frac{2}{3}$ single track, and considering the passenger business has not over half the use, and still itsr repairs are more than 50 per cent higher. Two years with a moderate amount of trade, on a timber road, would not give a fair average of the cost of repairs, and the condition of the two roads at the end of the year, in regard to the age and durability of their timber, may be very different. We are, therefore, led to conclude that further experience will show the repairs on the Baltimore and Ohio road, as the business increases, to be greater than they have hitherto been.

The Liverpool and Manchester road has cost over five times as much for repairs as Baltimore and Ohio, and over three times as much as the Delaware and Hudson Company road. The Liverpool road was made in the most substantial manner, with very little curvature. The Baltimore road is very much curved, which increases the expense of maintaining the parallelism of the rails. The statement of the cost of repairs and maintenance by the directors of the Liverpool road is very explicit, and continued for successive terms with very little variation; leaving no ground to misunderstand the subject. The amount of business on the Liverpool has been from three to four times as great, as on the Baltimore for equal terms of time; and the velocity of travelling both with freight and passengers, has been also much greater on the former than on the latter. In view of all the facts we have obtained, we are led to the conclusion, that the amount of business, and the velocity of travelling, has a material influence on the question of repairs. In the last report, the directors of the Liverpool road, they allude to the expense of maintaining their road on the Whiston and Sutton planes, in consequence of the high velocity which the engines and wagons often obtain in their descent; and propose to lay heavier rails to guard against this inconvenince. In a report recently made to the directors of the London and Bermingham rail-way, by R. Stephenson, (late engineer of the Liverpool road,) on the propriety of adopting the undulating plan; he urges, as an objection to this plan; the injurious tendency of the high velocities obtained in the descents, to the road and particularly to the locomotive engine, as a reason that he considers conclusive against it.

The repairs of a rail-road composed mostly of timber will generally be much less for two or three years after it is put into operation, than the average for a term of ten or fifteen years. Our experience is limited in this branch of the investigation, but from the facts we have obtained, we are led to the conclusion, that the average expense of repairs for a road, designed to accommodate a large general trade requiring a high velocity, will not be less than that stated as the average of these roads, viz: $1,040 per mile per annum.

Transportation on Rail-roads.

The cost of transportation (reduced to a level road,) on the Baltimore road, we have found to be 3.05 cents per ton per mile, and 4.07 cents per ton per mile on the Liverpool road. In the former case, it is done by horse power, in the latter, by locomotive (except on one plane,) steam power. The ratio of cost of motive power to the entire cost of transportation is for the Baltimore road as 4 to 10; and for the Liverpool road, as 3 to 10. It, therefore, appears, that the Liverpool road, with 10 per cent less ratio in cost of motive power, (which makes the motive power nearly equal on the two roads,) cost one-third more for entire expense of transportation. If our accounts can be relied on as presenting accurate results, it would appear highly probable the extra expense in repairs and management of the business, was incurred in consequence of the greater speed maintained. Some abatement should doubtless be made, for the ratio of difference in expense of loading and unloading, which, in consequence of its being shorter, would bear heavier on the Liverpool road, than on the Baltimore. The accounts for the Liverpool transportation are presented in much detail, and are very satisfactory in their character. Those for the Baltimore road are not given in as much fulness and detail, but we have no reason to doubt their accuracy. It further appears, that horse power is a little more expensive for motive power, at a low velocity, than locomotive steam, at a high velocity, as compared for the two roads. But this would not be the case if the power was reversed for the two roads, as the short ascents on the Baltimore road would greatly depress the economy of steam power. The average cost of transportation on these two roads, when reduced to a level, is 3.56 cents per ton per mile. This allows no profit or toll; the cost stated for the Mohawk and Hudson road is 3.5, and for the Delaware and Hudson Company's road is also 3.5 cents per ton per mile, as the nett cost. It may, therefore, be considered that experience thus far has settled the cost at 3½ cents per ton per mile, on a level road.

It has been shown in this investigation, that where locomotive steam power is used, it is important to its economy, to have all the inclination reduced to a uniform angle, and the curves to a uniform radius, otherwise the traction that occurs on the sharpest curves, and greatest ascents, will determine the load of the engine. It is obvious that the load of the engine must be regulated by its ability to overcome the greatest resistance that occurs on the road over which it passes, unless extra power is stationed on the line to aid in passing ascents: the inconvenience of stationary power would prevent a resort to this method, unless the increased power required, was considerably greater than was generally necessary on the route travelled. This consideration is highly important where a large general trade is to be accommodated, and accounts for the great expense that is often encountered to bring the grade to the most favorable standard.

The cost has been shown to be 3½ cents per ton per mile on a level, and as rail-roads are not often entirely level, it has been thought proper to a full understanding of the subject, to present a statement, showing the comparative economy in motive power, by locomotive steam engines on roads of different inclinations. In the calculations, the engine is assumed to weigh 6½ tons (13,000 lbs.,) with 7,000 lb. on its working wheels; adhesion at 10; the weight of the tender at 7,000 lb.; resistance from friction $\frac{1}{225}$. The load carried is exclusive of the tender, and includes freight and wagons. Two-thirds of the gross load will be tonnage goods.

On a level the gross load will be,				75.25	tons
On a road or section having an ascent of		10	ft. per mile,	49.53	"
"	"	20	"	37.35	"
"	"	30	"	27.24	"
"	"	40	"	20.22	"
"	"	50	"	17 04	"
"	"	60	"	13.92	"
"	"	70	"	11.31	"

In the load on a level, we have 50 tons exclusive of wagons, taking the cost of motive power at 40 per cent of the entire cost of transportation; the total cost at the level being $3\frac{5}{10}$ cents.

The total cost on an ascent of		10	feet per mile is per ton,	4 20	cts.
"	"	20	"	4.90	"
"	"	30	"	5.95	"
"	"	40	"	7.28	"
"	"	50	"	8.19	"
"	"	60	"	9.66	"
"	"	70	"	11.41	"

There are engines of a larger size than the one assumed; but it is the most approved at this time, in reference to the weight of engine, and the weight of the working wheels. This however is unimportant, as the comparison will not be at all affected by varying the power of the engine: the ratio between a level and the ascents will remain the same notwithstanding.

COSTS OF CANALS.

We subjoin a table marked A, containing the cost of 50 canals in England: this table gives the name of each canal, the total cost in pounds sterling, cost per mile, length of each canal in miles, lockage in feet, date of completion, original cost for each share, and the value and dividend of each share in 1821, in March 1828, in November, 1831, in 1833, and on the 21st of October, 1834. Forty-five of these canals, being the most important in England, have an aggregate length of 1,464 miles. We also subjoin a table of the principal rail-ways, only one, however, of those which are completed and in operation, (the Liverpool and Manchester,) is calculated for general trade.

In table B, we give a view of the principal canals in this country, it contains all the particulars that we were able to obtain of 40 canals, principally in the northern and middle States. It has the names of the canals, the length of the main trunk and feeders, depth of water, width of surface, number of locks, their length and width, and the aggregate lockage on the canals and feeders, number of dams, date of completion, cost per mile, total cost and the tolls for each, for the years 1833 and 1834.

The information contained in the tables for the canals of this State, was obtained from public records and from documents in the Comptroller's office. That for the Pennsylvania and the other canals, were taken principally from the official reports, and from information derived from the officers having charge of these canal respectively; we have also been assisted in the inquiries by private records and memorandums in our possession.

The Erie canal extends from the Hudson river at Albany to Lake Erie; is 363 miles long and has 689 feet of lockage; the canal is 40 feet wide on the surface, 28 feet wide at the bottom and four feet deep. The locks are 90 feet long, between the gates, 15 feet wide, and built prinipally of lime stone, laid in hydraulic cement, with the front stone cut and laid in courses. Although there is a small amount of elevation, compared with the distance, being but $1\frac{9}{10}$ feet of lockage per mile, there are a few places that presented formidable difficulties in the construction: a part of the distance between the Hudson and Schenectady, the rock excavation at Little-Falls and the deep cutting in the mountain ridge west of Lockport.

The Champlain canal is the same dimensions as the Erie canal; the locks are constructed in the same manner, except they are 7 feet longer, and one foot less width. This canal is 64 miles long, and extends from the junction 9 miles north of Albany to Lake Champlain. The summit is supplied with water from the Fort Edward pond, and by a navigable feeder from the Hudson river, taken out above Glen's-Falls.

The Glen's-Falls feeder is 7 miles long, and with the pond, makes a navigation of 12 miles in length; there is a descent of 132 feet by 13 wood locks.

The Oswego canal is constructed similar to the Erie canal, but has nearly one half river navigation. The locks are of the same dimensions and quality, except one, which is built of wood.

This canal extends from the Erie canal at Syracuse to Lake Ontario.

The Cayuga and Seneca canal is, with the Cayuga branch, 23 miles long, connects the Erie canal at Montezuma with Seneca lake at Geneva, one half of which is river navigation. It has 11 wood locks that overcome an elevation of 80 feet. The dimensions of the canal and locks are similar to those on the Erie canal.

The Crooked Lake canal is 8 miles long, connects the Crooked and Seneca lakes and has 269 feet of lockage; this, although the locks are of wood, is the most expensive of the State canals; the large expenditure is accounted for by the great elevation overcome, and by the difficulties in construction in the narrow rocky valley of the outlet.

The Chemung canal extends from the head of the Seneca lake to the Chemung river: it is 23 miles long, and the summit is supplied by a feeder of 13½ miles in length, from the Chemung river, at the Chimney Narrows in Steuben county. This canal and feeder, (as also the Crooked Lake canal,) is 42 feet wide on the surface, 26 feet wide on the bottom, and four feet deep; the locks are of wood, connected with the upper level by a wall of masonry at the head. The length of navigation, including 2½ miles of pond in the Chemung river above the feeder dam, is 39 miles, with a lockage of 516 feet, and is the cheapest of the State canals.

The Erie canal cost............	$19,255 49	per mile.
Champlain, ...	15,520 95	"
Oswego................	14,879 93	"
Cayuga and Seneca.........	10,295 85	"
Crooked Lake	19,597 11	"
Chemung	8,504 96	"

The aggregate cost of the six State canals, paid by the Canal Commissioners for their construction up to the time when they were completed, for the 558 miles of navigation, is $9,692,106.68, being an average cost of $17,367.57 per mile.

The Delaware and Hudson canal extends from the Hudson river, near Kingston, to Honesdale on the Lackawaxen river, in the State of Pennsylvania. This canal is 108 miles long, 36 feet wide on the surface of the water, and four feet deep. The locks are 76 feet long, nine feet wide in the chamber, 110 in number and overcome an elevation of 1,073 feet: 60 of the locks are of hammered stone masonry, and 50 are composite, of stone and wood.

There was some formidable rock excavation in the valley of the Delaware and Lackawaxen rivers, which increased the expense of construction. The average cost of this canal was $20,665 per mile.

Pennsylvania Canals.

The Pennsylvania State canals are divided into 9 divisions, and they have an aggregate length of 601½ miles. The main line of these canals form a communication in connection with the Columbia and the Portage rail-roads, between Philadelphia and Pittsburgh. Between these places there are 282 miles of canals and 119 miles of railway.

The Delaware division extends from Bristol to Easton, 59¾ miles; and in the valley of the Susquehannah, including the west and north branch, there are 183 miles of canal, besides the Beaver and French creek divisions, west of the mountains. These State canals have 1,933 feet of lockage, and their total cost is $13,301,235.69, or an average of $22,113.44 per mile.

Beside the State improvements there are three important canals in Pennsylvania owned by corporations, viz: The Schuylkill, the Lehigh and the Union canals.

The Schuylkill canal extends from the city of Philadelphia up the river of that name, 108 miles, to the coal district. This work has 62 miles of canal and 46 miles of pools, formed by 28 dams across the Schuylkill river. There are 92 lift and 28 guard locks, and the total lockage is 588 feet. This canal was completed in 1825, and the business upon it has increased so rapidly that it has been necessary, and the directors are now constructing double locks to accommodate the trade. At its completion (in 1825,) the canal cost $16,741.26 per mile

The Lehigh canal was constructed principally for the transportation of coal, and extends from Mauch Chunk to Easton on the Delaware river, 46¾ miles. This canal is 60 feet wide on the surface and 5 feet deep; the locks are 100 feet long (except 4, which are 130,) and 22 feet wide in the chamber; and its large dimensions has, doubtless, added much to its cost.

Coal that is brought from the Lehigh mines down this canal, may be sent to Philadelphia by the Delaware canal, or to New-York through the Morris or the Delaware and Raritan canals. This canal cost $33,610.75 per mile.

The Union canal connects the Schuylkill and Susquehannah rivers; this, although a small canal, 36 feet wide on the surface of the water, and 4 feet deep, has been expensive in construction. Connected with this canal is a feeder of 24 miles in length, to supply its summit level. This feeder is navigable, and a rail-road of 4 miles in length extends to the coal mines. A large expenditure has been incurred to construct reservoirs, 3 feeders, and for the use of two steam engines, of 100 hundred horse-power each, to supply the summit level with water, and for several miles the sides and bottom of the canal have been planked, to prevent leaks in the lime-stone districts. This canal cost $18,518.51 per mile.

The three canals have 1,452 feet of lockage, and cost $5,354,151.13, and the average cost of the 262¾ miles is $20,377.36 per mile.

The State of Ohio completed their canal, from Lake Erie to the Ohio river, in 1832, which, together with the Miami canal and feeders, make an aggregate of 400 miles of navigation. The total amount of lockage is 1,557 feet; the locks, 184 in number, are constructed of cut stone laid in hydraulic cement; and the total cost of the canals and appendages, as appears in the Canal Commissioners report of 1833, is $4,189,539.64, or an average of $10,473.84 per mile.

The Chesapeake and Ohio canal will form a communication from the city of Washington, 342 miles in length, to Pittsburgh. That portion nearly completed and navigable extends from Tiber creek, in Washington city, 109 miles to a point 8 miles west of Williamsport. This canal varies from 5 to 7 feet in depth, and from 50 to 80 feet in width; the ascent is 353 feet, overcome by 44 lift locks 100 feet long by 15 feet wide in the clear, constructed of cut stone masonry laid in hydraulic cement.

This canal is situated in the valley of the Potomac; it is of large dimensions and formidable difficulties have been encountered in its construction. The amount expended and required to complete 109 miles is $4,164,732.04, or an average cost of $37,291.12 per mile.

There are five canals in New-England, having an aggregate of 170½ miles in length, with 1,363$\frac{6}{10}$ feet of lockage, constructed by private corporations at an expense of $2,187,000, or an average of $12,838.71 per mile. The Blackstone canal between Worcester and Providence, of 45 miles long, has 48 locks of cut granite, laid in cement; the other four canals have wood locks.

Three of the canals embraced in the tables are of large dimensions, and were constructed of suitable capacity for the navigation of coasting vessels.

These canals connect the great bays of the Atlantic, as follows, viz: The Dismal Swamp, between Albemarle sound and the Chesapeake bay; the Delaware and Chesapeake canal, across the peninsula between those bays; and the Delaware and Raritan forms a channel for coasting vessels between Philadelphia and New-York. The above, with a canal between Barnstable and Buzzard's bays, were originally designed as the four great cuts to connect and form a continuous inland coasting navigation from Boston Harbor to the bays of North Carolina. One of these canals, the Delaware and Chesapeake, was attended with peculiar difficulties in its construction, but neither are considered as proper for a standard of comparison.

The following table exhibits the length, lockage, and cost of some of the principal canals:

TABLE

Exhibiting the length, lockage, and cost of some of the principal canals.

	Names of canals.	Length.	Lockage.	Cost per mile.	Total cost.
		Miles.	Feet.	Dolls.	Dolls.
6	New-York State canals,.......	558	2,016½	$17,367 57	$9,692,106 68
1	" Delaware and Hudson,...................	108	1,073	20,665 00	2,231,820 00
9	Pennsylvania State canals,...........................	601½	1,933	22,113 44	13,301,235 69
3	" Schuylkill, Lehigh and Union,.	262¾	1,452	20,377 36	5,354,151 13
2	Ohio State canals,.	400	1,557	10,473 84	4,189,539 64
1	Chesapeake and Ohio canal,......	109	353	37,291 12	4,164,732 04
5	New-England canals, ...	170½	$1,363\frac{6}{10}$	12,838 71	2,189,000 00
27	Canals. Totals,......	2,210	9,748	$18,608 41	$41,122,585 18

By the preceding table it appears that 27 of the principal canals of this country, having an aggregate length of 2,210 miles, with 9,748 feet of lockage, embracing many difficulties, and constructed in nine of the United States, in a great variety of locations, have cost $41,122,585.18, or an average of $18,608.41 per mile.

Repairs of Canals.

It appears from the report of the Comptroller, Assembly Document, No. 216, of 1835, that the repairs of the State canals, including salaries of superintendents and lock-tenders, have been for the last year as follows, viz:

For the Erie canal, including 14 miles of the Champlain, and the sloop-lock at Troy,	$883	78	pr mile.
Erie and Champlain canal,........	1,005	03	"
Oswego canal,...............	320	63	"
Cayuga and Seneca canal,.............	401	46	"

The repairs for the last 3 years, ending September 30, 1834, have been, annually,

For the Erie and Champlain canal,..........	$826	13	pr mile.
Oswego canal,.....................	313	13	"
Cayuga and Seneca canal,........	339	88	"

And for the last 6 years, from 1829 to 1834, both years inclusive, ending on the 30th September, the repairs have been, annually,

For the Erie canal,..........	$603	76	pr mile.
Champlain canal,........	681	01	"
Oswego canal,....................	309	19	"
Cayuga and Seneca canal,........... .	301	07	"

In the Document before alluded to, there is a division of the cost of repairs upon the Erie canal, stated separately, and the amount for the last year is,

For 159 miles, from Buffalo to Montezuma,..	$600	47	pr mile.
73 " from Montezuma to 7 miles west of Rome,............	660	34	"
146 " from 7 miles west of Rome to Albany, including 14 miles on the Champlain and the Troy dam and lock, ...	1,304	04	"

The repairs of the Erie canal in 1829 averaged $493 12 per mile.
" " " 1834 " 883 78 "

Being an average in the cost of repairs, of 79 per cent.

The lockages at the first lock west of Schenectady—

In 1829 were,..............................	12,619
In 1834 were,....	22,911

An increase of 80 per cent.

The last results, as do also the comparisons of former years, indicate that the expense of the repairs of the Erie canal increases in nearly the same ratio as the business.

The repairs on the Delaware and Hudson canal, for the last 4 years, ending Dec. 31, 1834, was an average of $527 per mile;

and for the year 1833, including the salary of superintendents and lock-tenders, on the Schuylkill canal, was $710.44 per mile.

Cost of transportation on Canals.

In this inquiry we have selected three canals that have a large amount of business and those that have their prices well established.

The Erie canal, and the Delaware and Hudson canal in this State, and the Schuylkill in Pennsylvania. We are not able to give the items that compose the cost of freighting upon canals, with the same certainty as that expense has been reported by the Liverpool and Manchester, and the Baltimore and Ohio Rail Road companies; but we assume the prices, paid on canals for down freight, upon articles of the greatest tonnage.

The Schuylkill canal in 1833, had 361,054 tons of down freight, of which 250,558 was coal from the mines; and the up freight, consisting of merchandize, plaster, iron ore, &c., amounted to 84,795 tons. The price for the transportation of coal, is one cent per ton per mile, exclusive of tolls.

The Delaware and Hudson Canal Company, in 1833, sent to market from the mines, 111,777 tons of coal, and the merchandize up, amounted to 9,700 tons. In 1834, the coal sent to the Hudson river, was 45,000 tons. The established price of transportation, was $1.12½ per ton; of 2,240 pounds of coal for 108 miles by this canal, from Honesdale to the Hudson river, equal 1.041 cts. per ton per mile.

The property arriving at tide water, by the Erie and Champlain canals, in 1834, as appear from official statements,

Was equal to,..................................	553,825 tons.
Passing from tide water,......................	114,608 "
Making an aggregate of	668,433 "

The proportion of down freight or property going to market, is to merchandize or tonnage going from tide water, as $4\frac{83}{100}$ to 1, or as 5 to 1 nearly.

The cheapest prices of freight on the Erie canal, are paid for staves, timber, wood, stone, lime, plaster and salt; the highest charges are for merchandize. We put down the rates, exclusive of tolls, as charged by the different forwarding lines, although goods are frequently taken up the canal by boats unconnected with the lines, at about half those rates; this higher price is intended, besides the cost of freighting, to pay for the risk to which the forwarding merchant is liable as a common carrier.

During the season of navigation last year, there was brought down the canals, 32,670 tons of staves, and we are informed, that the average price of transportation of this article, has been $2 per ton for the last 6 years, from Tonnawanta to Albany, exclusive of tolls. The distance is 352 miles by the canal, and this would give only $\frac{57}{100}$ of a cent per ton per mile.

There was also sent down—

181.016	tons of boards and scantling,	at $\frac{74}{100}$	of a cent per mile.		
96,642	" of wood,	"	at $\frac{2}{100}$	"	"
23,894	" salt, to Buffalo passing Utica,		at $\frac{47}{100}$	"	"
70,372	" merchandize,	"	at $2\frac{15}{100}$	"	"

Making an average of the above prices, of $\frac{95}{100}$ of a cent per mile for a ton of 2,000 pounds.

Flour is a large item of the down freight; there is about 120,000 tons sent to market annually, and this, together with provisions, may be taken as a standard of comparison.

Flour has been carried from Rochester to Albany, 269 miles, by transient boats, as low as 18 or 20 cts. per barrel, exclusive of tolls; we are informed, however, that contracts for freight to a large amount, have been made by millers at Rochester, with the established lines of forwarding merchants, for the ensuing year, at 24 cents per barrel, from the first of June to the first of October; before and after those periods, at 30 cents per barrel for flour, exclusive of tolls.

For this comparison we will take an average between these two prices, which is 27 cents per barrel, and this is believed to be about the average price paid for freight on the whole tonnage of the Erie canal during the season of navigation.

At the above rates the prices of transportation on the three canals, exclusive of tolls, would be, for a ton of 2,240 pounds, as follows, viz:

On the Erie canal,............	1.04	cents	per ton	per mile,
On the Delaware and Hudson,..	1.041	"	"	"
Schuylkill,..................	1.00	"	"	"

or an average of a little over one cent per ton per mile, on the three canals.

For a more perfect comparison of the cost of transportation, we will reduce these canals to a level, by an allowance of 20 feet of lockage on the Erie and Schuylkill, as equal to a mile of distance, and in consequence of the less crowded navigation, of 30 feet to the mile on the Delaware and Hudson canal.

The distance on the Erie canal from Rochester to Albany, is 260 miles and the lockage 626 feet, and reduced to a level would be equal to $300\frac{3}{10}$ miles.

The Schuylkill canal is 108 miles long, and 588 feet of lockage, and reduced to a level in the above mentioned ratio, is equal to $137\frac{4}{10}$ miles.

The Delaware and Hudson is 108 miles long, and has 1,073 feet of lockage, and is equal to $135\frac{8}{10}$ miles of level canal.

On a level canal, the prices of freight would be for the

Erie canal,......................	$\frac{828}{1000}$	of a cent	per ton	per mile,
Schuylkill,......................	$\frac{785}{1000}$	"	"	"
Delaware and Hudson,........	$\frac{766}{1000}$	"	"	"

and the average price of the three canals would be, without toll, $\frac{793}{1000}$, or a little less than $\frac{8}{10}$ of a cent per ton per mile.

In Hazard's Register, vol. 15, page 112, it is stated that the Lehigh, the Delaware, and Delaware and Raritan canals paid last year $\frac{1}{10}$ of a cent per ton per mile, for the transportation of 105,000 tons of coal; the contractor finding every thing, except paying the tolls.

GENERAL REMARKS.

Having presented such facts as are within our knowledge, with the circumstances connected with them; together with such explanations of principles, as appeared to us necessary to a correct understanding of the subject in its practical character, we have not thought it would aid in the object of inquiry, to attempt any precise ratio of comparative cost of construction or repairs, between canals and rail-roads: the reason for this is to be found in the obvious modification to which any ratio must be exposed, in the varied local circumstances that will be encountered in the progress of improvements of this character, and whose tendency would render any ratio of little or no practical value. We, therefore, refer to the several statements, and particularly the tabular views, for information, which we believe when applied to any known case, will afford some useful hints in regard to the relative merits of the two different modes of facilitating internal communication. We may, however, be permitted to state, what appears conclusive from the facts presented, that canals, on the average, have thus far, cost less than rail-roads, both in their construction and repairs.

In regard to their relative merits as affording the means of transportation, there is less difficulty in reaching an approximate ratio. In reducing them both to a level, we attain for general purposes, a fair standard of comparison. Taking the facts we have obtained as a basis, we find the relative cost of conveyance is, as 4.375 to 1, a little over four and one-third to one, in favor of canals: this is exclusive of tolls or profits. If the cost of construction, the annual cost for repairs, and the amount of tonnage were the same on a canal as on a rail-road, then the same rate of toll would produce the same rate of profit on each. Our examinations have shown, as before stated, that rail-roads in the average, cost more than canals, both in their construction and repairs. But for comparison, we assume a case in which they are equal, and charge the same toll. The average tolls on the Erie canal are less than one cent per ton per mile: assuming an average toll of one cent per ton per mile, the ratio of the entire cost of transportation and toll is, as (2.5 to 1,) two and ahalf to one, in favor of canals. In the preceding computations, the cost of transportation on rail-roads is the nett cost, as reported by rail-road companies, allowing no profit on this business, while the charges on the canals is at contract prices, which are supposed to yield a profit to the carrier. The cost of transportation on canals, as previously stated, is the average on the Erie canal, the Delaware and Hudson canal, and the Schuylkill canal; on the two latter, the cost of transporting coal only is known; and the total average of the three canals is almost exactly the same as the average price for the several different articles transported on the Erie canal. The preceding calculations are confined to a velocity not much exceeding 50 or 60 miles in 24 hours. We have not instituted any investigation to show the relative economy in high and low velocities. For the conveyance of freight, we are of the opinion, canals are not well adapted to any material increase of speed beyond 3 miles per hour; and as the speed on half of the rail-roads embraced in this computation, is from 10 to 15 miles per hour, we may consider this comparison as nearly similar to one of high velocity on rail-roads, and low velocity on canals. And goods that can afford to pay the difference above indicated, for the saving of time, would hold the two kinds of conveyance in equilibrium. The amount that would find so great an object in the saving of time, in comparison to the total quantity requiring transportation, it is believed would be small. In relation to the conveyance of passengers, the saving of time is highly important, and the rail-road becomes eminently the superior method of communication. We are therefore led to the conclusion, that in regard to the cost of construction and maintenance, and also in reference to the expense of conveyance at moderate velocities, canals are clearly the most advantageous means of communication. On the other hand, where high velocities are required, as for the conveyance of passengers, and under some circumstances of competition, for light goods of great value, in proportion to their weight, the preference would be given to a rail-road.

It may be observed in favor of rail-roads, that they admit of advantageous use in districts where canals, for the want of water, would be impracticable. This advantage often occurs in mining districts, and sometimes for general trade, where it is necessary to cross dividing ridges at a level too high to obtain water for their summits.

The facts and reasonings presented, we believe clearly show, that both canals and rail-roads, are highly important means of internal communication; that each has its peculiar advantages, and will predominate according to the character of the route, and the trade for which it is intended to provide.

Respectfully submitted,

JOHN B. JERVIS,
HOLMES HUTCHINSON,
FREDERICK C. MILLS,
Civil Engineers.

Albany, 14*th March*, 1835.

Comparison of rates of transportation.

	Ton of 2,000 pounds. Price per ton per mile. cts. mills.	Cost if carried 200 miles. Dolls.
Prices of transportation during the years 1817, 1818, 1819, by teams, from Albany to Buffalo, (usual rates, $4.25 pr cwt.,)..	29.3	$58 60
Rates of 1835, (including tolls,):		
By Erie canal—		
For merchandize,....................	3.95	7 90
Flour,...........	1.83	3 66
Staves,..........................	0.97	1 94
Salt,...............	0.93	1 86
Baltimore and Ohio Rail-Road—		
Down freight, ...	4.0	8 00
Up "	6.0	12 00
Liverpool and Manchester Rail-Road—		
For merchandize,....................	7.5	15 00
Hudson river, 145 miles—		
Heavy goods, (from N. Y. to Albany, 10 cts. per 100 lbs.)..	1.38	2 76
Light " 20 " " ..	2.76	5 52
Provisions, &c., 7 " " ..	0.96	1 92
Lake Ontario—		
Merchandize, (from Oswego to Lewiston, 146 miles, 20 cts. pr 100 lbs. all kinds,)	2.74	5 48
Lake Erie—		
Merchandize, (from Buffalo to Cleaveland, 190 miles, 23 cts. pr 100 lbs.) for heavy goods,.......	2.42	4 84
29 cts. pr 100 lbs. for light goods,....	3.00	6 00

(A.)

Description and Cost of certain Canals and Rail-Roads in England, and the prices of stock at various periods.

Names of the several Canals, Rail-roads and Lines of Navigation.	Total cost in pounds sterling.	Cost per mile.*	Length of each canal in miles.	Lockage in feet.	Date of completion.	Original cost of each share in pounds sterl.	Price of each share in 1821.	Dividend on each share at that time.	Price of the same in March, 1828.	Dividend at the same time.	Price of each share November 1, 1831.	Dividend at the same time.	Price of each share in 1833.	Dividend at the same time.	Price of each share, Oct. 21, 1834.	Dividend at the same time.	REMARKS.
Ashton and Oldham,	£172,920⅜	£15,720	11	152	1796	97⅞	.....	.....	.....	.....	.....	.....	£160	£ 6 0 0	£160	£6 0 0	The summit pound is 6 ft. deep and serves as a reservoir.
Ashby de-la-Zouch,	167,466	4,186	40	.....	.....	113	.....	.....	.....	.....	.....	.....	74	4 0 0	65	4 0 0	2 tunnels, one of 700 and the other 200 yds. in length.
Barnsley,	97,000	6,466	15	120	1812	160	300	£13 0 0	.....	.....	£210	£10 0 0	290	13 0 0	272	13 0 0	
Birmingham,	115,000	5,111	22½	204	1772	100	203	12 10 0	565	£20 0 0	244	12 10 0	.....	12 10 0	235	12 10 0	2 tunnels, 1 of 1,000 and 1 of 2,078 yards in length—184 under the hill.
Bridgewater,	.....	.....	40	82	1776	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Tunnel of 18 miles in Worsley hills; estimated £168,960; profits of canal, 50 to £80,000.
Chesterfield,	160,000	3,478	46	380	1776	100	150	8 0 0	120	8 0 0	170	8 0 0	.....	.....	.....	.....	2 tunnels, one of 2,850 and 1 of 153 yards in length.
Coventry,	120,000	4,444	27	96	1790	100	1,200	44 0 0	999	44 0 0	750	50 0 0	610	32 0 0	806	42 0 0	Connected with the summit level of this canal is the longest level in England, 82 miles, including side branches.
Cromford,	80,000	4,444	18	80	1794	100	400	19 0 0	.....	.....	410	19 0 0	.....	.....	.....	.....	Tunnel of 3,000 yards in length, cost £7 per yard; there are several other tunnels; 3 reservoirs.
Chelmer and Black Water,	40,000	3,077	13	.....	.....	100	.....	.....	.....	.....	.....	.....	102	5 0 0	102	5 0 0	
Derby,	90,000	10,000	9	78	1794	100	150	7 10 0	.....	.....	120	6 0 0	.....	.....	.....	.....	Cast iron aqueduct.
Dudley,	206,075	15,852	13	.....	1797	100	.....	.....	.....	.....	.....	.....	60	2 10 0	67	3 5 0	3 tunnels, 1 of 3,776, 1 of 2,926 and 1 of 623 yds. in length.
Ere wash,	23,100	.....	11¾	108⅔	1797	100	1,400	72 0 0	1,000	58 0 0	600	54 0 0	.....	.....	.....	.....	Supplied by reservoirs.
Ellsmere and Chester,	400,000	7,017	57	.....	.....	133	.....	.....	.....	.....	.....	.....	80	3 15 0	87	3 15 0	2 tunnels, 1 of 775 and 1 of 487 yds. long. Pont Cysylty cast iron aqueduct 320 ft. long, on stone piers 52 ft. apart, and the highest 125 ft.
Forth and Clyde,	421,525	12,043	35	321	1790	100	570	25 0 0	.....	.....	600	27 0 0	560	25 0 0	560	25 0 0	2 reservoirs, 70 and 50 acres, 22 and 24 ft. deep.
Glamorganshire,	60,000	2,400	25	300	.....	100	250	13 12 8	.....	.....	290	13 12 8	290	13 12 4	290	13 12 4	
Grand Junction,	2,000,000	21,390	93½	796	1805	100	307	13 0 0	218	9 0 0	235	13 0 0	241	12 0 0	242	12 0 0	5 reservoirs for supplying canal; 2 tunnels, 1 of 3,080 and 1 of 2,045 yds. in length.
Grantham,	124,000	3,348	33¾	140	1799	150	215	9 0 0	.....	.....	195	9 0 0	202	10 0 0	202	10 0 0	Wholly supplied by reservoirs.
Grand Derbentures,	.....	.....	.....	.....	.....	100	.....	.....	.....	.....	.....	.....	.....	5 0 0	76	4 0 0	
Grand Union,	284,950	.....	.....	.....	.....	100	.....	.....	.....	.....	.....	.....	23	1 0 0	23	1 0 0	
Kennet and Avon,	420,000	5,384	78	263	1801	39⅞	.....	.....	.....	.....	.....	.....	28¼	1 5 0	25¼	1 5 0	
Leeds and Liverpool,	600,000	6,153	130	841	1774	100	395	16 0 0	278	10 0 0	405	20 0 0	452½	20 0 0	515	20 0 0	2 tunnels, 1 of 1,030 yards in length.
do new,	200,000	.....	.....	.....	.....	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	16 0 0	
Leicester,	84,000	3,907	21½	230	.....	100	325	17 0 0	260	10 0 0	211	17 0 0	185	13 0 0	170	12 0 0	
Lancaster,	614,000	8,105	75¾	287	1803	47⅓	.....	.....	.....	.....	.....	.....	27	1 0 0	25	1 0 0	2 tunnels about 800 ft. long; aqueduct, 5 arches, 51 ft. high, 70 ft. span each; one level 42½ miles long.
Leicester and Northampton,	300,000	6,857	43¾	307½	.....	83½	.....	.....	.....	.....	.....	.....	82	4 0 0	82	4 0 0	4 tunnels, 1,056, 990, 880 and 286 yards in length.
Loughborough,	7,000	736	9½	41	1776	100	4,000	200 0 0	2,400	119 0 0	2,550	180 0 0	1,820	.....	.....	136 0 0	
Melton and Mowbray,	41,000	.....	.....	.....	.....	100	240	11 0 0	170	8 10 0	190	2 10 0	190	9 0 0	200	10 0 0	Navigation.
Mersey and Erwell,	50,000	1,000	50	.....	.....	100	825	35 0 0	650	30 0 0	525	40 0 0	720	40 0 0	.....	40 0 0	do
Monmouthshire,	275,330	15,512	17¾	1,057	1796	100	215	10 0 0	.....	.....	208	12 0 0	.....	10 0 0	191	11 0 0	Railway, with inclined planes.
Monkland,	10,100	841	12	96	.....	100	.....	.....	.....	.....	90	.....	.....	.....	.....	.....	
Montgomeryshire,	92,000	3,407	27	.....	.....	100	.....	.....	.....	.....	.....	.....	86	4 0 0	90	4 0 0	
Neath,	35,000	2,500	14	.....	1798	100	350	15 0 0	.....	.....	300	18 0 0	.....	.....	300	15 0 0	
Nottingham,	75,000	5,000	15	.....	1802	150	290	12 0 0	.....	.....	245	12 0 0	.....	.....	.....	.....	
Oxford,	330,000	3,473	91½	269	1790	100	670	32 0 0	640	32 0 0	510	32 0 0	.....	32 0 0	610	32 0 0	1 steam engine, 100 horse power; 3 tunnels, 1,188, 125, —— yds. long; 3 reservoirs on the summit. The summit pound is 6 ft. deep, and also serves as a res.
Peak Forest,	150,000	6,521	23	.....	1800	78	.....	.....	.....	.....	.....	.....	71	3 0 0	90	3 10 0	Aqueduct 360 ft., arches 100ft. high; inclined plane 515 yds. in length, 204 ft. fall.
Regents or London,	400,000	57,143	7	90	.....	33⅞	.....	.....	.....	.....	.....	.....	17	0 13 6	17	0 13 6	
Rochdale,	291,900	8,842	33	613½	.....	85	.....	.....	.....	.....	.....	.....	.....	4 10 0	124½	4 10 0	Tunnel 70 yds. in length, and deep cut of 50 ft. in rock; 1 steam engine and 2 reservoirs, (one of which is 14 ft. deep,) to supply the summit pond. Shrewsbury has one double inclined plane 223 yds. in length, 75 ft. rise. 1 tunnel, 970 yds. in length.
Shrewsbury,	70,000	4,000	17½	155	1797	125	210	10 0 0	.....	.....	205	11 0 0	255	11 0 0	205	11 0 0	3 inclined planes, of 207, 126 and 120 yds. long, no locks; summit supplied with
Shropshire,	47,500	6,333	7½	453	1792	125	135	7 0 0	.....	.....	140	8 0 0	136	7 10 0	106	7 10 0	2 reservoirs above, and by steam engines from 2 other reservoirs below summit.

* The fractional parts of a £ in tne column of cost per mile omitted.

A.—CONTINUED.

Description and Cost of certain Canals and Rail-Roads in England, and the prices of stock at various periods.

Names of the several Canals, Rail-roads and Lines of Navigation.	Total cost in pounds sterling.	Cost per mile.	Length of each canal in miles.	Lockage in feet.	Date of completion.	Original cost of each share in pounds sterl.	Price of each share in 1821.	Dividend on each share at that time.	Price of the same in March, 1828.	Dividend at the same time.	Price of each share November 1, 1831.	Dividend at the same time.	Price of each share in 1833.	Dividend at the same time.	Price of each share, Oct. 21, 1834.	Dividend at the same time.	REMARKS.
Somerset Coal, ...	£185,000	£10,571	17½	138	1802	£50	£170	£10 0 0	......	....	£160	£10 10 0	......	£10 0 0	£170	£10 0 0	Upper pound supplied by steam engines.
Somerset Lock Fund, ...	45,000	... .	....	......	......	12½	......	....	......	....	......	....	£13	6 5 0	13	....	
Stafford and Worcester, ...	100,000	2,150	46½	394	1772	140	800	40 0 0	£642	£40 0 0	155	36 0 0	600	34 0 0	645½	36 0 0	3 short tunnels and 2 reservoirs for supplying canal.
Stourbridge,....	30,000	6,000	5	191	1776	145	220	12 0 0	......	....	220	11 0 0	200	8 0 0	......	8 0 0	Summit supplied by a reservoir.
Stroudwater, ...	20,000	2,500	8	108	1796	150	450	23 0 0	......	....	480	23 0 0	525	24 0 0	525	24 0 0	Has no towing-path.
Swansea,............	90,000	5,142	17½	366	1798	100	280	12 10 0	......	....	203	15 0 0	220	11 0 0	215	12 0 0	
Trent and Mersey, ...	334,250	3,594	93	778	1772	100	820	37 10 0	900	75 0 0	620	37 10 0	660	37 10 0	640	32 10 0	Tunnel of 2,888 yds. in length; the first canal tunnel in England, and cost £3 10s. 8d. per yard run. There are 4 other tunnels, 1,241, 572, 350 and 130 yds. long, and 5 reservoirs.
Warwick and Birmingham, ...	180,000	7,200	25	......	1799	100	265	12 0 0	210	11 0 0	230	12 0 0	280	16 0 0	280	14 0 0	Tunnel, 300 yds. in length.
Warwick and Napton,....	130,000	8,666	15	......	1799	100	205	12 0 0	235	10 0 0	210	12 0 0	210	12 0 0	......		
Wyrley and Essington,..........	160,000	6,956	23	288	1794	125	160	6 0 0	......	....	115	6 0 0	115	6 0 0	80		
Worcester and Birmingham,......	470,250	16,215	29	428	......	78⅜	......	....	......	....	......	....	87½	4 0 0	86	4 0 0	Supplied by steam engine and reservoir; 1 tunnel of 2,700 yds. in length; 4 others of 500, 400, 120 and 110 yards long.

Cost of Rail-ways in England, and prices of stock at the same dates.

Names	Total cost in pounds sterling.	Cost per mile.	Length in miles.	Lockage in feet.	Date of completion.	Original cost of each share in pounds sterl.	Price of each share in 1821.	Dividend on each share at that time.	Price of the same in March, 1828.	Dividend at the same time.	Price of each share November 1, 1831.	Dividend at the same time.	Price of each share in 1833.	Dividend at the same time.	Price of each share, Oct. 21, 1834.	Dividend at the same time.	REMARKS.
Cromford and Peak-Forest, ...	168,707	5191	32¾	1800	1831	100	......	....	......	....	......	....	......	....	......	....	Has 9 inclined planes, overcomes 1,800 ft. rise and fall. Several tunnels, one of 1,590 yds. in length. The cast rails weigh 63 lbs. per yard.
Canterbury,.......	... .	... .	....	......	......	50	......	....	25	....	35	....	......	....	40		
Cheltenham, ...	... .	... .	....	......	......	100	......	....	78	....	78	....	......	....	......		
Croydon, ...	... .	....	...	......	1803	65	......	....	......	....	......	....	......	....	......		
Clarence, (Durham,)...........	.. ..	....	...	......	......	100	......	....	......	....	65	....	100	....	70		
Forest of Dean, ...	... ...	....	....	......	......	50	......	....	45	2 16 0	33	2 4 0	25	1 2 0	......	0 19 0	
Grand Junction, ...	....	....	....	......	......	20	......	....	.....	... .	......	....	......	....	20½		
Jersey,.	....	....	....	......	......	60	......	....	......	... .	......	....	......	....	......		
London and Greenwich, ...	... .	....	....	......	......	4	......	....	......	....	......	....	4	....	7¾		
Leicester and Swanington,.......	... ...	... ...	...	......	......	50	......	....	......	....	......	....	57	....	58		
Liverpool and Manchester, ...	... .	... .	...	......	1830	100	......	....	......	... .	205	8 0 0	210	8 4 0	199	9 0 0	Cost including carriages, engines, ware-houses, &c.
do do	1,089,818¾	....	31	379	......	25	......	....	......	....	......	....	51½	....	48½		
do do	....	.... ..	...	......	......	25	......	....	......	... .	......	....	51	....	48½		
London and Birmingham,.......	....	... ...	...	......	......	5	......	....	......	... .	......	....	13¾	....	15¾		
Monmouth, ...	....	....	...	......	......	50	......	....	......	... ...	......	....	......	....	......		
Severn and Wye,........	....	....	. ..	......	......	50	......	....	23	1 11 0	117	0 17 0	16½	0 17 4	19½	1 0 0	
Stockton and Darlington, ...	130,000	5,200	25	......	.....	100	......	....	160	5 0 0	230	6 0 0	297½	8 0 0	250	8 0 0	From the river Tees to Darlington coal mines, the expense is exclusive of branches, the cost of land and their charter. These cost about £25,000.
St. Etienne and Lyons,*.........	$1,370,954 19	$40,036 38	34⅕	......	1831												

* In France. Has 14 tunnels, one a mile in length, another 2,990 ft. under the river Degier; one bridge over the Soane, cost 17,000 franks. Wrought iron rails, chains cast, supported in stone blocks, Clarence rail.
The fractional parts of a £ in the column of cost per mile omitted.

(B.)

Description, Cost, Tolls, &c. of various Canals in the United States.

1. NEW-YORK CANALS.

Names of Canals.	Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	Total amount of tolls rec'd.	REMARKS.
	Dimensions.																	
Erie,	363	8	371	4	40	84	90	15	689	....	....	1825	$19,255 49	$7,143,789 86	$1,290,136 20	$1,179,744 97	....	From Lake Erie to the Hudson river; has cut stone locks; feeders 4 ft. deep, 28 ft. surface.
Champlain,	64	....	.	4	40	21 5g	97	14	163½	....	no4 4900	1824	....	....	....	....	10,535,613 19	From Lake Champlain to the Erie canal at the Junction; has 7 lift locks from lake to summit=54 feet, and 14 locks from summit to the Hudson=134; locks of cut stone. dam at Fort-Edward across the Hudson 28 ft. high 900 ft. long, with short feeder and guard lock; 4 other guard locks, 1 at Saratoga dam, (the dam is about 1,390 ft. long,) 1 at Fort-Miller dam, and 2 at the Mohawk dams; locks of Glen's-Falls feeder are of wood.
Glen's-Falls feeder,	....	12	79	4	30	13	97	14	......	132	1 800	1829	15,520 95	1,257,604 26	132,559 02	115,211 89	....	
Side cut at Waterford,	....	....	..	4	40	3	97	14	......	35	... .	......	....	....	....	... .	....	From Waterford to Troy; 3 cut stone locks at Waterford side cut of same dimensions as main canal; one at Troy dam 9 ft. lift.
River navigation above Troy dam	....	3	..	...	...	1	130	22	......	9	1 1200	1824	....	....	....	....	....	
Oswego,	38	....	38	4	40	14	90	15	123	....	8 5667	1828	14,879 93	565,437 35	22,950 47	22,168 02	105,708 08	From Erie canal to Lake Ontario; about half the distance slack water or river navigation, with towing-path on the bank; has 14 lift locks of cut stone, 2 of them used as guard locks; there are also 6 guard locks of 17 ft. wide and 90 ft. long, 1 of which is of wood, the others of hammered stone.
Cayuga and Seneca,	21	2	23	4	40	11	90	15	73	7	... .	1828	10,295 85	236,804 74	17,174 69	18,130 43	83,029 55	From the Erie canal at Montezuma to Geneva; 1 half slack water navigation and 2 miles of side cut to Cayuga lake; locks of wood.
Chemung,	23	16	39	4	42	53	90	15	488	28	1 630	1833	8,504 96	331,693 57	694 00	3,378 05	4,072 05	From Seneca lake to Elmira; has 1 guard lock, which connects the feeder with the Chemung river, at Chimney narrows; locks of wood; original estimate for the work $331,125, excess $568.57.
Crooked Lake,	8	...	8	4	42	27	90	15	269	....	1 50	1833	19,597 11	156,776 90	200 84	1,473 40	1,674 24	Connects Crooked lake, which is 20 miles long, (having a branch of 7 miles,) with the Seneca lake at Dresden; locks of wood.
Totals,... ...			558						1805½	211				$9,692,106 68	$1,463,715 22	$1,340,106 76	$10,730,097 11	N. B. Average cost per mile of the above canals is $17,367.57.
Chenango,	97	....	97	4	42	109	90	15	1021	....	....	......	20,210 87	1,960,456 28	... .	....	....	From the Erie canal at Utica to the Susquehanna at Binghamton; to be completed in 1836; cost, as per estimate of 29th Dec. 1834, (see rep. of Canal Commissioners, 1835,) exclusive of land damages; composite locks.
Constructed by an Incorpora'd Co.																		
Delaware and Hudson,	108	....	108	4	36	110	76	9	1073	....	....	1828	20,665 00	2,231 820 00	....	....	....	From the Hudson at Kingston to Honesdale in Pennsylvania; 16 miles of rail-road extends this improvement to the Lackawanna coal mines; has 60 locks of hammered stone, and 50 composite.

2. PENNSYLVANIA CANALS.

Names of Canals.	Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	Total amount of tolls rec'd.	REMARKS.
Delaware Division,...	59¾	....	59¾	5	40	23	95	11	164	....	....	1830	20,720 12	1,238,027 69	....	....	....	From Bristol to Easton; beside the lift locks on main line, there are 2 guard and 1 outlet lock (at Easton) and a tide lock at Bristol; the locks are of stone, laid in cement, and faced with timber and plank.
Eastern "	43	...	43	4	40	... ...	90	17	....	..	1 1998	1831	29,854 26	1,283,733 46	....	....	....	From Columbia to Duncan's Island; a dam at said island 1,998 ft. long, 8½ ft. high; cost $18,421.60; has 19 aqueducts, 1 of which is cast iron; locks of stone.
Junietta "	128	4½	132½	4	40	....	90	15ri.17	682	..	4 2250	1830	18,830 17	2,490,290 13	....	....	....	From Duncan's Island to Hollidaysburg; has 35 lift locks, 3 guard, 1 outlet and 4 river locks below Huntington; there are 4 dams, and in all about 15 miles slack water navigation.
Western "	105	...	106½	4	40	... .	90	15	444	....		1830	25,088 51	2,758,937 71	....	... ...	....	From Johnstown to Pittsburg; the Portage rail-road (36 3-4 miles) connects this division with the Junietta division; has 2 expensive aqueducts, and a tunnel over 1,000 ft. in length.
Feeder above Johnstown,	....	1½											....	64,255 00				
Susquehanna Division,	39	...	39	4½	43	....	90	17	87	....	....	1831	26,647 60	1,039,256 77	....	....	....	From Duncan's Island to Northumberland.
West Branch "	25¾	...	25¾	4	40	6l. 1g.	90	17	41	....	....	1830	16,379 45	421,771 00	....	....	....	From Northumberland to above Muncy rapids.
North Branch "	55½	...	55½	4	40	7l. 1g.	90	17	88	....	....	1830	19,732 94	1,096,178 34	....	... ...	....	do do to Nanticoke dam.
Wyoming "	17	½	17½	4	40	....	90	17	43	....	....	1832	20,164 50	342,796 55	....	....	....	From Nanticoke dam to the Wilksbury and Lackawanna coal beds.
Lycoming, (or West branch,)	41¾	4¼	46	4	40	14	90	17	90	21	....	......	28,876 01	1,205,573 77	....	....	....	From Muncy to Bald Eagle; has 2 side cuts; the Bald Eagle side cut at the northerly termination of said canal, is 3 3-4 miles long, and the Lewisburgh side cut, which has 21 ft. lockage by 3 locks, is ½ mile loug.
Beaver,	30¾	....	30¾	4	40	18	90	18	144½	....	7	......	15,492 08	476,401 48	....	....	....	From Ohio river to Newcastle in Mercer county; two-thirds slack water navigation up Beaver and Chenango creeks.
Franklin line,	22¼	....	22¼	4	40	....	......	......	......	....	....	......	19,890 26	442,558 34	... .	... .	....	From Franklin on the Allegany to French creek feeder; has 17 miles of slack water navigation; the outlet lock at Franklin is 22 ft. wide and 120 ft. long.
French Creek division,	23½	....	23½	4	40	17l. 4g.	90	18	128½	....	....	......	18,785 33	441,455 45	....	....	....	Connects the Franklin line with the Conneaut lake.
Totals,.......			601½						1912½	21				$13,301,235 69	....	....	....	N. B. Average cost per mile of the above State canals, is $22,113.44.
Constructed by Incorporated Co's.																		
Schuylkill,	108	....	108	4	36	92l. 28g.	80	17o13½	588	....	31	1825	16,741 26	1,808,056 17	325,486 63	299,841 00	....	From Philadelphia to Mount Carbon; it has 1 reservoir 41 ft. deep and 1 tunnel of 450 ft. in length; 46 miles of slack water navigation; the total cost of the work, including improvements, up to 1st Jan. 1830, is $2,336,380.
Union,	80	24	108	4	36	91	75	8½	503½	16	....	1828	18,518 51	2,000,000 00	103,462 45	119,870 53	....	From the Schuylkill to Middletown on the Susquehanna; it has 1 tunnel 243 yds. long, 18 by 14 ft., 3 reservoirs, and 2 engines, 100 horse power each, for supplying the summit level; 1 of the reservoirs has an embankment and dam 50 ft. high, contains 1,000 ac.
Rail-road,	....	4																
Lehigh,	46¾	....	46¾	5	60	47l. 6g.	100	22	360⅞	....	8	1829	33,610 75	1,546,094 96	....	....	....	From Easton to Mauch Chunk; has 9 3-4 miles slack water navigation; the 4 locks nearest Mauch Chunk are 30 ft. wide by 130 ft. long; the others, as noted in the table, 2 of which are used as guard locks; locks of stone in cement, faced with timber and plank; also 4 aqueducts and 22 culverts. In 1833 there was shipped on this canal, from Mauch Chunk, 122,928 tons of coal.
Conestoga navigation,	18	....	18	....	....	....	100	22	......	....	....	......	3,807 77	68,539 92	....	....	....	Extends from Safe Harbor on the Susquehanna river to Lancaster, and is effected by a series of locks and dams.
			280¾						1452 37	16	39			$5,422,691 05				N. B. The 3 first canals, viz. Schuylkill, Union and Lehigh average $20,377.36 per mile; including the Canastoga navigation, the average cost is $19,315 per mile.

N. B. Total amount of tolls received on Pennsylvania State canals, including 118¾ miles rail-road, during the fiscal year of 1833, (as per Canal Commisioners report of 1834,) is $151,419.69. For 1834, the total amount is $322,535.08.

Description, Cost, Tolls, &c. of various Canals in the United States.

3. OHIO CANALS.

Names of Canals.	Dimensions. Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	REMARKS.
Ohio, (Main Trunk,)	308¼	25¼ side cut.	400	4	40	152	90	15	1207⅓	52⅔	....	1832	10,473 84	4,189,539 64	136,092 70	159,977 23	Main trunk from Lake Erie to the Ohio river at Portsmouth; it has 9 guard locks, 4 feeders on the Cuyahoga summit, and 1 reservoir, formed by 3 small lakes, containing 350 acres, and 1 side cut, and 1 principally artificial of 2,000 acres, 6 ft. deep, on the Licking summit. The Miami canal extends from Cincinnati to Dayton. Upon these improvements are 22 aqueducts, 182 culverts of stone masonry and 60 of wood, and 9 dams for crossing streams, and 12 feeder dams; locks of stone, cut; the Ohio river at Portsmouth is 413 ft. below the Licking summit, 49 ft. below Portage summit, 96 lower than Lake Erie, 98 lower than the mouth of the Muskingum, and 468 ft. above the tide at Albany.
Miami,	66	½	....	4	40	32	90	15	297	....	....	1832	....	....	50,470 63	50,040 99	
Totals,	374¼	25¾	400			184			1504⅓	52⅔					$186,563 33	$210,018 22	

CONSTRUCTED BY INCORPORATED COMPANIES.

Names of Canals.	Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	REMARKS.
4. KENTUCKY.																	
Louisville and Portland.	2	....	2	....	200	3l. 1g.	183 190	50 50	24	....	....	1831	....	....	....	....	Around the falls of Ohio; is intended for steam-boats of the largest class; the guard and lift locks are combined; walls are 20 ft. high, except the guard lock, which is 42 ft. high, and corresponds with the height of the banks; the entire length of the walls is 921 ft. containing 34,075 perches of masonry, 21,775 perches of which are in the guard lock; there are also 3 stone culverts and 2 bridges, 1 of stone, 240 ft. long, with an elevation of 68 ft., 3 arches, and contains 5,741 perches of mason work; the other is a pivot bridge over the head of the guard lock, and is of wood, 100 ft. long, with a span of 52 ft. Total amount of mason work, 41,982 perches, equal to about 30 common canal locks.
5. MARYLAND.																	
Chesapeake and Ohio,	5 to Lit. Falls, 60 Harp's ferry 44 Total, 109,			7 6 5	80 60 50	44l. 4g.	100	15	353	....	5	1834	37,291 12	4,164,732 04	....	....	From Tiber creek in Washington city to a point 8 miles west of Williamsport; the distance remaining to be completed to Pittsburg, is 233 miles; the total amount of lockage is 3,158 ft.; on the first 48 miles (to point of rocks,) the lockage is 217 ft. by 27 locks; pivot bridges have been substituted for permanent ones in order to avoid annoyance in the conveyance of passengers; there are also 4 aqueducts, No. 1, Seneca, cost $22,784; No. 2, Monocacy, 9,788 perches, cost $125,000; No. 3, Catoclin, cost $33,500; No. 4, Antictam, $22,850; total cost, $204,134; and 151 culverts which cost from $3.50 to $5.50 per perch of 25 ft.; the canal has 5 principal feeders from the Potomac, and 4½ miles slack water navigation; locks of cut stone. The total cost of this work, (342 miles) as estimated by United States engineers, $22,375,427.69; estimated by Geddes and Roberts, $9,347,408.69.
6. VIRGINIA.																	
James and Jackson rivers,	30½	....	30½	3½	40	....	....	....	....	....	....	1825	20,435 77	623,295 00	....	....	From basin at Richmond to a fall in Goveland county.
Irish Falls,	7	....	7	3½	40	....	....	....	96	....	....	1825	48,571 43	340,000 00	....	....	Around Irish falls to the mouth of the North branch, on James river.
Dismal Swamp,	22½																
Lake Drummond, (feeder,)	.. .	*5	27½	6½	40	....	100	22	33	....	....	1822	16,000 00	360,000 00	....	....	From Chesapeake bay to Albermarl sound; part in Virginia and part in North Carolina; its dimensions have since been enlarged; every other 1-4 of a mile the canal is widened to 60 ft. for turn-out stations; the summit is 16½ ft. above the Atlantic at half tide, and is supplied by a feeder of 5 miles in length from Lake Drummond; the basin at Deepcreek is ½ mile long and 15ft. above tide.
	60	5	65											$1,323,295 00			
7. SOUTH CAROLINA.																	
Santee canal,	22	....	22	4	32	13	60	10	103	....	....	1802	29,575 78	650,667 00	....	....	From Santee to Cooper's river; by means of Dreln and Louck's canals, Saluda and Broad rivers, and Saluda and Columbia canals, navigation is continued from Santee river to Columbia; Winyaw canal unites Santee river with Winyaw bay; length 10 miles.
8. DELAWARE.																	
Chesapeake and Delaware,	14	....	14	....	66	2l. 2tide	100	22	24	....	....	1829	157,142 85	2,200,000 00	....	....	It connects the Delaware river with the Chesapeake bay, and is partly in Delaware and partly in Maryland; at Delaware city a harbor extends 500 ft. along the shore, from which 2 piers, that distance apart, project 250 ft. into the river nearly opposite Fort Delaware; has a deep cut of 76 ft. deep, at the summit of which a bridge is constructed over the canal 80 ft. high, 280 ft. span; locks of cut stone.
9. NEW-JERSEY																	
Delaware and Raritan,	43	....	65	....	....	....	....	....	....	....	....	....	....	....	....	....	From New-Brunswick to Lamberton; the water to supply this canal is conducted on to the summit by a navigable feeder 22 miles long, extending from Eagle Island on the Delaware to its junction with the main canal at Trenton; locks of stone, cut; canal calculated for 1 ft. additional depth.
Feeder to said canal,	....	22		7 6	75 50	14l. 1g.	110	24	116 10½	..	1	1834	37,417 91	2,500,000 00			
Morris canal,	101	....	101	4	32	24locks 23plains	75	9	223 1334	..	5	1832	19,703 04	1,990,007 19	....	....	From Jersey city on the Hudson to the Delaware river opposite Easton, Penn., where it connects with the Lehigh canal; there are also connected with this canal 4 guard locks, 5 dams, 30 culverts, 12 aqueducts, and more than 200 bridges; the water to supply this canal is obtained from Hopatcong lake, 900 ft. above tide; locks of stone, uncoursed hammer work; 13,000 tons coal transported through this canal in 1833.
	144	22	166						1683					$4,490,007 19			
10. NEW-ENGLAND.																	
Cumberland and Oxford,	20½	...	20½	4	34	26	80	10	260	....	....	1829	10,292 68	211,000 00	16,475 70	14,468 51	From Portland to the head of Long pond in Oxford county; locks of wood; a lock is constructed in Songo river, by which navigation is continued into Brandy and Long ponds, making the whole water communication 45 miles; has 1 guard lock and a dam across the outlet of Sabago pond.
Blackstone,	45	....	45	4	34	48	80	10	$451\frac{6}{10}$	....	....	1828	13,333 33	600,000 00	....	....	From Worcester, Mass. to Providence, R. I.; locks of cut stone; canal supplied with water by 7 reservoirs, having a total area of 4,600 acres, of an average depth of 6 ft.
Middlesex,	27	....	27	3	30	20	75	12	136	....	....	1808	19,555 55	528,000 00	....	....	From Boston to Merrimack river near Lowell; locks principally of wood.
Farmington,	58	....	78	4	36	....	80	12	218	....	....	1828	10,897 44	600,000 00	....	....	From New-Haven, Ct. to Northampton, Mass.; locks of wood; at its commencement at New-Haven is a basin of 20 acres.
Hampshire and Hampden,	20								298	....	....	1833		250,000 00	....	....	
Totals,			170½						$1363\frac{6}{10}$				$12,838 71	$2,189,000 00			

* Not navigable.

TABULAR VIEW OF THE RAIL-ROADS

Mentioned in the preceding pages, where the authorities for the facts will be found.

NAMES OF RAIL-ROAD.	Length of road.	In direction of greatest trade. Ascent.	Descent.	Inclined planes worked by stationary power.	Cost per mile.	Cost of repairs per mile per annum.	Cost of transportation per ton per mile. Actual cost.	Cost reduced to a level.	Cost per mile per passenger.	Completed in the year.	REMARKS.
	Miles.	*Feet.*	*Feet.*	*No.*	*Dlls.*	*Dlls.*	*cents.*	*cents.*	*cents.*		*The roads in this table are all double tracks, made or computed.*
Baltimore and Ohio, to point of rocks, 67½ Branch to Frederick, 3½	71	718	900	4	29,193	382	3.96	3.05	1.85	1831	Inclined planes are yet worked by horse power. Ratio of moving power, as 4 to 10.
Liverpool and Manchester, England,	31	150	229	1	100,748	2,116	4.70	4.07	1.53	1830	Ratio of moving power, as 3 to 10, of the entire cost of transportation.
Baltimore and Washington,	30	…	…	none,	50,000	…	…	…	…	…	Not completed—diverges from the Baltimore and Ohio, about 6 miles from Baltimore.
Columbia and Philadelphia,	82	…	…	2	40,450	…	…	…	…	…	Essentially completed.
Allegany Portage,	36	802	1,202	10	47,977	…	…	…	…	…	do do The elevation only embraces the inclined planes, which are together, 32,840 feet in length. There are other inclinations, not embraced in the planes, amounting to 1,366 feet. Total ascent and descent, 2,570 feet.
Mohawk and Hudson, exclusive of branches,	16	115	334	2	38,107	…	3.50	…	1.70	1832	
Saratoga and Schenectady, computed for a double road,	22	128	45	none,	17,010	…	…	…	…	1832	
Delaware and Hudson Canal Co., Carbondale,	16	855	913	8	14,000	623	3.05	3.05	…	1829	Computed for a double road; (see remarks on transportation.)
Newcastle and Frenchtown,	16½	…	…	none,	30,000	…	…	…	…	1831	
Camden and Amboy, from Amboy to Bordentown,	33	…	…	none,	30,000	…	…	…	…	1832	
South-Carolina,	130	…	…	1	7,200	…	…	…	…	1833	Believed to be mostly a single track.
Excluding the Liverpool and Manchester road in the cost of construction, the average is					30,393	1,040	3.91	3.53			