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Volume II.

The Schuylkill Navigation.

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At an early day in the history of Pennsylvania, the improvement of its waterway, as a means of transportation, claimed the attention of men prominent in affairs of state.

William Penn, in the year 1690, in a paper writing in reference to transportation routes, called attention to the feasibility of a passage by water between the Susquehanna river and the Tulpehocken creek, a branch of the Schuylkill.

As early as 1762, David Rittenhouse, the celebrated astronomer, and about the same time, Dr. William Smith, Provost of the University of Pennsylvania, surveyed and examined a route for a canal, to connect the waters of the Susquehanna and the Schuylkill rivers, by way of the Swatara creek, a branch of the Susquehanna, and the Tulpehocken, a branch of the Schuylkill. This project was in that day referred to by residents of Philadelphia as—"A part of something greater," a "preliminary step to something further."

These gentlemen at that early day were looking forward to a great line of intercommunication between the rivers of eastern Pennsylvania and the waters of Lake Erie. Such a line was actually traced by them, five hundred and eighty-two miles long, between the Delaware river and the Ohio at Fort Pitt (Pittsburgh), and thence to the lake at Presque Isle (Erie).

They did not propose a continuous navigation, but instead, judicious improvements along water courses by means of locks, dams and wiers, with here and there a

*This paper was prepared at the suggestion of Mr. A. A. Hesser, who read it before the Society, March 28, 1906.

short canal, etc., and a "good turnpike across the Allegheny Mountains."

In the years 1791 and 1792, two companies were chartered, one to open a canal between the waters of the Susquehanna and the Schuylkill rivers, and the other a similar work between the Schuylkill and Delaware rivers. These two companies subsequently consolidated under the name of the Union Canal, which, in addition to being a canal for traffic, was designed for a water supply for the city of Philadelphia.

The Act "to authorize the Governor to incorporate a Company to make a lock navigation on the river Schuylkill" was approved the eighth day of March, A. D. 1815, and the corporation was created under the "name, style and title of The President, Managers and Company of the Schuylkill Navigation Company."

The work of construction was probably begun late in the year 1816, and more or less work on the upper and lower sections of the river had been done before the close of the year 1818. The act of incorporation, unfortunately, provided that in making its improvements:

"The Company shall divide the river into two sections, the first extending from Lancaster Schuylkill Bridge, (now Callowhill Street, Philadelphia) to the Borough of Reading, and the second from the Borough of Reading to the mouth of Mill Creek; and shall commence their improvements of the first section at or near the lower falls in the County of Philadelphia, and at the same time shall commence their improvements of the second section at or near the Borough of Reading, and shall proceed upward in each section with the improvements; and it shall not be lawful to demand toll from any person for the passage of any boat or other craft through a lock or locks in the first section until a lock or locks be completed within the second section, and so to progress with similar improvements in each section until both are finished."

The charter limit of the work was from Mill Creek, two miles above Pottsville, to the Lancaster Street Bridge, (now Callowhill Street) at Fairmount. The distance was

108.23 miles, and the entire lockage from the established level of Dam No. 1 at Port Carbon to mean-tide at Philadelphia, 618.76 feet.

The Schuylkill Navigation is what is known as a slack-water navigation, being partly pool and partly canal. The length of the slack-water formed by dams in the river was 50.50 miles, and the length of the canals aggregated 57.73 miles.

The original works were designed for light draught and small tonnage boats, mostly 23 tons capacity, 75 feet long and 8 feet wide, designed to pass in pairs locks 17 feet wide.

The dams were necessarily small and cheaply built of wooden crib works. The only traffic anticipated was lumber and agricultural products, and a small coal tonnage descending the river, and return cargoes of merchandise from Philadelphia to the up river towns and settlements.

After the charter was obtained the season was too far advanced and the undertaking too imperfectly understood to render it advisable to begin the construction of works on the river. The Board of Managers, however, took measures to gain all the information possible in regard to any other works of a similar character that had been constructed in this country. The Erie Canal was not yet in existence, nor were there any others finished or in use that could be referred to.

Attention was called, however, to the improvement of the Connecticut river in Massachusetts, which had been effected by dams and canals, and a committee was sent there in the year 1815 to make inquiry concerning that work.

At Springfield they were introduced to Ariel Cooley, of that city, who had been the principal engineer on the improvements, and who, at the time, was engaged in erecting and completing some of the dams and locks on the Connecticut river, and also in constructing locks near the Falls of the James River at Richmond, Virginia.

Mr. Cooley received the committee at his residence and took pains to explain to them fully the nature of the improvements in the navigation that had been made. He

also went with them over a portion of the works, extending for several miles above Springfield, on which there were dams and locks. One dam in particular at Holyoke, Mass., a great work at that early day, was 1,040 feet long, 25 to 35 feet high from its foundation, and was constructed entirely of timber, bolted together with iron bolts, and fastened with iron to the rocky bed of the river. It was planked on the up stream slope and, unlike the timber dams of the present day, had but little stone filling. At that time it had been in use, withstanding the freshets of the Connecticut river for a period of twelve years, and under the advice of Mr. Cooley was taken as the pattern for the dams about to be built on the Schuylkill river.

It may be of interest, as illustrating the discouragements encountered by managers of public works at that time, the difficulty of procuring sufficient money and even skillful men to carry on the work, to quote from the first report of Cadwalader Evans, Jr., presented to the Stockholders of the Schuylkill Navigation Company on December 1st, 1820. Mr. Evans says:

"In pursuance of the Act of Incorporation, there have been completed in the upper section of the river Schuylkill, which commences at the mouth of Mill Creek in Schuylkill County, and ends at Reading, fifteen dams, fourteen canals, and forty-six locks. With the exception of a tunnel, a short canal and three locks, which are under contract to be finished early in the spring, the navigation is completed from the vicinity of the coal mines to Kern's Mill, about one mile from Hamburg, making in that section a distance of about twenty-five miles, and overcoming a fall of about two hundred and fifty feet.

In the lower section, which commences at the Lancaster Schuylkill bridge, near Philadelphia, and extends to Reading, they have erected eight dams, four canals, and twenty-one locks, overcoming a fall of eighty-eight feet, making in the whole, twenty-three dams, eighteen canals, and sixty-seven locks, thereby rendering navigable about fifty-four miles, including twelve miles of excavation for the canals; overcoming a fall of about three hundred and forty feet, comprising all the most difficult parts of the

river, and leaving to be improved about two hundred feet of fall, exclusive of the natural descent necessary for the discharge of the water.

In the progress of this arduous and novel undertaking, the managers have had great obstacles to encounter.

First. In procuring skilful persons to execute the work, and second, by the simultaneous construction of the works on both sections of the river, as enjoined by the Act of Incorporation.

In conforming to the will of the Legislature in the latter respect, great difficulty and loss has been experienced from the want of proper superintendence, which it was impossible to give at the same time, at points so remote from each other. To this cause is to be attributed, in a great degree, the failure of part of the works performed by contract.

The causes which thus embarrassed the managers have at length yielded to their perseverance; the works are now brought within more confined limits, and the experience which has been acquired, and the skill of the engineers now employed, leave no ground to apprehend further difficulties on that account."

At this time, to December, 1820, it was recognized that the anthracite coal trade would grow to large proportions, and that it would yield a considerable revenue to the canal.

Mr. Evans goes on to say in the same report:

"The importance of the work appears to increase as it approaches to completion. Abundant mines of coal, beds of iron ore, of limestone and marble, which for the want of navigation have remained inert, are continually developed and promise to add considerably to the wealth and resources of the state."

Mr. Evans refers to the great demand for coal already existing and to the fact that if the canal were completed throughout:

"From the city of Philadelphia to John Potts' Forge, near the coal mines in Schuylkill County, immediate sales to a great extent could no doubt be made. That this opinion is well-founded must appear from the extraordinary

fact, and which has never yet been known to be the case with respect to any other species of fuel, that wagons are now employed to transport this coal from the mines to a distance of from eighty to ninety miles, and large quantities are now brought by wagons and consumed in this city."

During the year 1821 there was completed on the upper section of the river, the tunnel and the canals and locks under construction the year previous, "so that the navigation as stated in the report for that year is now complete from John Potts', at the coal mines, to within half a mile of Hamburg, below the mountain, and within sixteen miles of Reading. Thus far the navigation is complete, and boats have during the last fall (1821) been engaged in transporting the produce of the upper country, and large quantities of coal from the mines to the neighborhood of Hamburg, where it has been deposited and the coal sold out from the yards at that place to the country people in its neighborhood, and for many miles distant. The Board of Managers did not require any toll from the boats navigating this section of the river, believing that true policy dictated every encouragement to experiments upon this novel kind of navigation."

Below Reading, the work done up to the close of the year 1821, embraced the whole extent of the river from Fairmount to the lower line of the borough of Reading. There remained to be done the section between Reading and Hamburg, a distance of about sixteen (16) miles, "to complete and render perfect the navigation from the city of Philadelphia to the coal mines in Schuylkill County."

About this time, also, the managers of the company were giving attention to the development of the water power of the lower river, more particularly at Manayunk and Conshohocken. The first grant of power was made at the former place on the 10th of April, 1819, and was followed during the years 1821-22, by extensive grants of power, on the Manayunk Canal, all of which are still in use, in mills for the manufacture of paper, and in cotton and woolen mills. The town of Manayunk, now the 21st ward of the city of Philadelphia, was laid out by the Schuylkill

Navigation Company, and it was the expectation of the management that it would prove a source of great emolument independent of the whole water power.

The report of January 7th, 1822, goes on to say:

"The daily experiments which are making for the introduction of anthracite fuel into the houses of our citizens; its applicability to all purposes of manufacture, and the extensive purchase which has been made by a number of respectable citizens of New York of coal lands at the head of the Schuylkill, for the purpose of establishing a coal company for the supply of that city, fully warrants the belief that to meet the demand which both objects will create, will require all the industry of those who may be engaged in the transportation on the river, and must necessarily give the company, from this source alone, an ample remuneration for the cost of the work, while it may be remarked that little doubt can exist but that the rent of water power and the transportation of the trade of the river, independently of the coal, will yield at least six per cent. on the capital invested by the stockholders."

How well this expectation was borne out is illustrated by the fact that about ten years thereafter the Navigation Company earned and divided among its stockholders, dividends at the rate of six per cent. quarterly, or twenty-four per cent. per annum, and had still remaining a large surplus of money, which it expended on building monumental cut stone locks, and permanent abutments for some of the dams on the river, which to this day remain as monuments of the skill of the builders.

In the report of Jospeh S. Lewis, dated 2nd of January, 1826, the President and Managers report:

"That after innumerable difficulties, and vexatious delays, they now have the pleasure to say that the great work entrusted to their care is nearly brought to a happy conclusion, and that the time has arrived when there is every prospect of remuneration to the Stockholders for their advances, and for their zealous and cordial support of the Board in this arduous and important undertaking."

It was during the year 1825 that the Navigation was

first put into use throughout, from Philadelphia to Mt. Carbon, and the report for that year is a record of vexatious delays in completing the work and of much trouble in maintaining the Navigation throughout, on account of the frequent occurrence of leaks in those parts of the canal which passed over limestone formations.

The report also refers to:

"The lamented decease of their engineer, Thomas Oakes, (whose merit deserves their most respectful commemoration) followed almost immediately by that of another engineer, Mr. King, interposed obstacles in the way of the prosecution of the work not easily surmounted, nor without much delay."

Although the early reports of the Navigation Company make no mention of the fact, it is evident that Thomas Oakes was the chief engineer of the company, on whom was laid the duty of locating and constructing the line throughout, from Philadelphia to Mt. Carbon. The Oakes Canal, opposite Phoenixville, bears his name.

The works, as has been stated before, were in extent about one hundred and eight miles, of which sixty-two miles were by canal and forty-six miles by pools in the river. The number of locks below Reading was thirty-nine and above Reading, eighty-one, being in all one hundred and twenty, of which twenty-eight were guard locks, overcoming a fall of five hundred and eighty-eight feet.

To this report of January 2nd, 1826, is appended a statement of receipts and expenditures, from the commencement of the works to the 1st of January, 1826, showing that the amount of money received from subscribers and from tolls, rents, loan and interest, and also from the city of Philadelphia, for removing the restriction on the surplus water of Fairmount, was $1,951,483.89, and the amount paid for the improvements on the river and the construction of locks, canals and dams, was $1,949,816.47, leaving a balance on hand, January 1, 1826, of $1,667.42. The amount of tolls and rents received by the company during the same period was $34,129.00, included in which is the amount of toll received during the year 1818 on

some one section of the river, on which the improvements had been finished, amounting to $248.00.

In the early days of the navigation of the Schuylkill river, lumber from the upper country was usually run by way of the river in rafts and floats.

The first locks of the Schuylkill Navigation were built of the size eighty feet long by seventeen feet wide, and were planned for arks and rafts. After a few years, when the anthracite coal trade increased in volume, an erroneous notion prevailed that there would not be water enough in the river to supply locks of the size, eighty feet long by seventeen feet wide, and an application was made to the Legislature of Pennsylvania for permission to reduce the size to thirteen and one-half feet in width, and many locks were so built, although in later years it was recognized that a mistake had been made.

The early navigation was for boats carrying only eighteen tons. About the year 1829 the canal had been deepened so that boats were enabled to carry about twenty-three tons. Following this, about the years 1833 to 1835, the depth of water in the dams and canals was increased from forty inches to forty-eight inches, or four feet, and the boats were increased from a width of nine feet to thirteen feet, so that their carrying capacity was about forty tons. The locks were doubled in pairs, being placed side by side, throughout the Navigation, and in that way the capacity of the works were very much increased.

During the year 1828 the Navigation was extended from Pottsville to the mouth of Mill Creek (Port Carbon), by George Duncan, an engineer and contractor of great ability. He built the original canal below Leesport, known as the "Duncan Canal," three miles in length, involving heavy rock cutting and other extraordinary work.

In addition to the dams and locks between Mt. Carbon and the head of the Navigation at Port Carbon, two miles above "Potts' Forge" (now Pottsville), he was the engineer of and planned and constructed the canal tunnel near Auburn. This was the FIRST TUNNEL IN THE UNITED STATES. It was a great curiosity, and people

came from as far as Philadelphia to see it. It was originally about four hundred feet long, but was shortened from time to time until about the year 1857, when it was reduced to an open cutting. Three brothers—Job, Samson and Solomon Fudge—were the contractors. This tunnel was constructed through a low hill, or spur of the hill, which might easily have been avoided by laying out the canal line about one hundred feet westward, on the location afterwards occupied by the Reading Railroad, but the people interested in the Navigation Company wanted a tunnel, knowing that it would be the first one in the United States.

The Union Canal, connecting the Schuylkill Canal with the Susquehanna river, was completed and put into use during the year 1827, and toll was received by the Schuylkill Navigation Company upon about one thousand tons of freight from that source during the year. The trade from the Union Canal continued to grow and was a source of large revenue to the Schuylkill Navigation Company; so that at the close of the year 1828 the management looked forward to making some return to the stockholders in the way of dividends for their "long continued patience and perseverance."

It was during the year 1830 that an examination was made in order to ascertain another route which woud permit of abandoning the canal through the city of Reading, and for some six miles northward, where there had been continual interruptions and delays, caused by the nature of the limestone formation. For this purpose Judge Wright, an eminent engineer of that day, was chosen to examine into the matter in company with Edward H. Gill, engineer of the Navigation Company.

These examinations extended over a period of two years and led to the building of the present dams in the river from Reading to a point nine miles northward, forming a slackwater navigation which has been perhaps the least expensive and the most serviceable of all the works of the Schuylkill for a period of seventy years past. The works were admirably laid out by Edward H. Gill, and the

construction was carried on under the superintendence of George Duncan. It was completed and ready for trade at the opening of navigation in 1833.

In completing these works George Duncan showed great skill, particularly in the building of the timber dams of the river, at least two of which are still in use. For his day George Duncan was not only a great builder and contractor, but was a competent engineer as well, being able to design as well as construct.

In the making of the slackwater navigation, five miles in length, at Reading, to take the place of the leaky canal through the limestone formation, Mr. Duncan built three dams, eight locks, and a connecting canal one mile in length. These new works were opened for navigation on the 14th of June, 1833.

George Duncan began the construction of and nearly completed the first or Lower Tumbling Run Reservoir at Mount Carbon, but owing to some misunderstanding in reference to the work he resigned and left the company's service late in the year 1833.

As these reservoirs in the Tumbling Run Valley have always been an important adjunct of the Schuylkill Navigation, it may be well to say that upon the resignation of George Duncan the work was turned over to Edward H. Gill, civil engineer, in the company's service. He completed the lower reservoir and it was put into use for supplying the Navigation early in the year 1834. It has a depth of forty-one feet and holds 180,000,000 gallons of water. Mr. Gill also planned and laid out the second or Upper Tumbling Run Reservoir in the year 1834, with a depth of fifty-three feet and a capacity of 225,000,000 gallons of water. The work of construction was commenced in 1835 and the reservoir finished in a most substantial manner in the year 1836. It was put into use in the fall of that year.

Many able men were engaged upon the construction of the Navigation works during these years, notably during the several enlargements of the canal, extending over the period from 1830 to 1841.

Thomas Oakes was an engineer and millwright, of considerable reputation. He built the "Girard Canal," twenty-two miles long, in five levels, from Lewis' dam, below Reading, to what is now known at Parker Ford, formerly Lawrenceville. He also built the feeder dam and the canal, called by his name—the Oakes Canal—opposite Phoenixville.

Among these early canal builders may be mentioned Ariel Cooley, who built the Fairmount dam and the water power canal at Manayunk. Mr. Coole at that time said he thought in the future a dam at Flat Rock would be the right location from which to draw a supply of water for the city of Philadelphia, instead of pumping by steam from the river at Market Street, Philadelphia, as was then being done in the year 1816.

Henry and Peter Rankin, Scotchmen, were prominent stonemasons and builders of that time. They constructed a number of locks and abutments of dams and other structures of first-class cut stone masonry laid in cement, many of which are in use at this day.

These men are mentioned by Joseph S. Lewis, President, in his report for the year 1830, as the builders of the cut stone locks at Flat Rock, which were completed in September of that year, and were described as a very handsome specimen of work and did much credit to the builders, Messrs. Henry and Peter Rankin. The same may be said of all their other work on the Schuylkill Navigation, and there are no better specimens of cut stone masonry to-day in the State of Pennsylvania than the abutments of dams and the lock chambers built by these men.

The Schuylkill Navigation Company at that time had its own mills for the manufacture of hydraulic cement, at a location about two miles above the city of Reading. This is worthy of mention because it is evidently one of the two first hydraulic cement works in the United States. The other, as near as the writer can ascertain, having been located at the same time near Rondout, New York.

Another of the early builders was Michael Tower, who constructed portions of the work, including the Norrris-

town dam, the Vincent dam, and part, if not all, of the Vincent Canal, four miles in length. He was a man of ability in the handling of public works, and left his mark upon everything he undertook. He also built the second Flat Rock Dam at a later date. Showing how well this work was done, it may be mentioned that a large part of it was in existence in the year 1904, when it was replaced by a new structure. The eastern and western abutments, however, show no signs of deterioration.

Louis Wernwag was connected with the works on the lower end of the river, near Philadelphia, but the writer is unable to say just what part of it was constructed by him. He was a builder of great reputation, his specialty being bridge building, of which, at that time, he had constructed some notable examples.

In the year 1812, he built the upper ferry or original Callowhill Street Bridge, of one span, three hundred and forty feet. This bridge was designed by Robert Mills, and was destroyed by fire in 1839.

Samuel Griscom, from an early period of the Navigation to the year 1848, was the general superintendent, and several dams, notably the present dam at Catfish (now Port Kennedy) was built by him in the year 1841. The dam at Reading (Poplar Neck) was also built under his supervision in the year 1838.

As Mr. Griscom was connected with the works for so many years, to him must be given the credit of organizing not only the working force for the repairs and maintenance of the canal and slackwater navigation, but also the building up of the boating interests and the transportation of freight and coal upon the navigation. In this connection it may be mentioned that for many years coal brought down by canal and destined for points on tidewater beyond Philadelphia, was trans-shipped at tidewater and sent by sailing vessels to New York, Boston and elsewhere. This trans-shipment of coal ceased about the year 1839 through the enterprise of Asa Packer, who came from the Lehigh Valley. He constructed and put into operation a fleet of boats called the "Packer Boats." This

ran as a through line, via the Schuylkill Navigation to tidewater at Fairmount, thence they were towed to Bordentown on the Delaware river, and ran through via the Delaware and Raritan Canal to New York Harbor. They were the first boats supplied with hatches and made seaworthy, whilst the Schuylkill boats, not being covered with hatches, were unable to go to New York Harbor. They carried 60 tons each, and were taken around from Fairmount to Bordentown in tows of fifteen to twenty boats each. Mr. Packer, before he became interested in the Lehigh Valley Railroad, had a large interest in the Schuylkill coal trade and in boats on the Schuylkill Canal.

The years of greatest prosperity of the Schuylkill Navigation appears to have been from 1835 to 1841, inclusive, during which time the tonnage, not only of coal boats but of miscellaneous freight, increased by a large percentage from year to year, and there was a corresponding increase in the tolls collected, making it possible for the company to pay large dividends and at the same time to set aside a considerable sum of money for improvements and for the extinguishment of its debt. This period of prosperity was never equalled in any of the subsequent years of the operation of the Navigation.

Passing through the period of financial depression following the year 1837, it soon became necessary to reduce the tolls on coal, which depleted the revenues of the company to such an extent that in the years 1842-3 no dividends were paid. This was again followed by the necessity of enlarging the works to meet the increased competition of the Philadelphia and Reading Railroad, which had just gone into operation.

It was in the year 1843 that the effects of competition were first felt. The quantity of coal brought down by canal in that year was 447,058 tons, or nine per cent. less than the trade of the preceding year. This diminution had been caused by diverting a portion of the Schuylkill coal trade to the railroad.

The whole number of Schuylkill canal boats in use in 1843, was about 800. Of these, 278 were covered boats,

adapted to the through coal trade from Pottsville to New York; 434 were open coal boats for way trade, and 58 were lime boats and miscellaneous. In that day the burning of lime in the Schuylkill Valley was a large industry and the trade was almost entirely on the canal.

As an indication of the carrying capacity it may be stated that the direct trade to New York in 1843 amounted to 119,972 tons, taken through the Delaware and Raritan Canal, in 2,045 boat loads, averaging 58¾ tons each. Although this carrying capacity of the boats was a very considerable increase over what had prevailed before the first enlargement of the canal throughout, in 1834-5, when their capacity was only 60 tons, and although the time consumed in making the round trip was reduced one-half, nevertheless it was recognized that in order to compete with the railroad it would be necessary to very considerably enlarge the Schuylkill Navigation works.

The minimum depth of water in the canals and pools was originally thirty-six inches. It had been increased to forty-eight inches or four feet, in the enlargement of 1834, although there were many places where the depth was greater.

As a matter of maximum tonnage it is recorded that during the year 1843, with the levels kept as full as possible, one boat, No. 169, called the "President," went through from Pottsville to tidewater drawing forty-nine inches of water and carrying 71½ tons of coal. This was what may be called over-loading. The regular tonnage of the boats at that time was sixty tons. It was recognized that the only way in which to reduce the freights by canal as much as possible was to increase the carrying capacity of the boats, and this could only be effected by an enlargement of the works.

The enlargement of the Schuylkill Navigation of 1845-6 was brought about through the exertions of Solomon W. Roberts, President, and from the beginning of the discussion as to the plans, the question narrowed down to one of enlargement of the prism of the twenty-two miles of Girard Canal or of building a slackwater navigation in

the river instead. There was no question as to the remaining parts of the navigation. It was a slackwater throughout, with short connecting canals, and in a few instances, canals of three to four miles length, where the utilization of the river was not practicable.

The report to the Board of Managers upon the enlargement is dated January 2, 1845, and was approved by the stockholders. This was followed by the report of Edward Miller, civil engineer, of the improvement on the Schuylkill Navigation, dated 11th of March, 1845, in which the whole subject of the proper size of locks to be adopted, the depth to be maintained in the canals, and a supply of water for feeding the same, was gone over at great length. Mr. Miller summed up his conclusions as follows:

(1) The present Navigation is in many respects a very imperfect work.

(2) It can be improved by reducing the number of locks from 109 to 82 and increase the dimensions of the locks and canals so as to accommodate steamers and other vessels of 180 tons burden, at a cost of one million dollars, exclusive of damages, without materially interrupting the navigation, and at furthest, in time for spring trade of 1847.

(3) When thus improved the quantity of water required to pass boats will be much less than on the present navigation, and if necessary the supply may be hereafter increased to any extent that may be desired.

(4) The increased dimension of the works will reduce the cost of transportation between the coal region and Philadelphia to one-half its present rate and make a much greater proportional reduction on the coal taken to New York.

(5) The capacity of the enlarged works will be vastly greater than at present and they will be susceptible to further improvement at moderate cost to an extent practically indefinite.

The size adopted for the locks in this enlargement was 110 feet long and 18 feet wide, with 5½ feet of water on the mitre sills, and for the canal and in ordinary cuttings,

40 feet wide on the bottom and 58 feet wide at water surface, with a depth of 6 feet. The capacity of any canal is fixed by the size of the locks and the depth of water upon the mitre sills, as well as by the width and depth of the canals. The dimensions given above, adopted for the enlargement of 1846, have not been changed up to the present day.

The report of Edward Miller, before mentioned, was followed by an elaborate one on the position and prospects of the Schuylkill Navigation Company, made in 1845, by Charles Ellet, Jr., a civil engineer of great distinction, from which it may be well, as a matter of history, to quote:

"The Schuylkill Navigation Company was incorporated by an Act of the General Assembly of Pennsylvania in the year 1815, and the works were prosecuted in the face of numerous financial and physical difficulties to a successful completion in the year 1826. At this period the line terminated in the coal region and the company's revenue from the products of that district and other sources speedily augmented.

In 1829 the first dividend was declared, and in 1830 the trade was found to augment with such rapidity that the works were likely soon to prove inadequate. Measures were accordingly taken to increase its capacity by adding to the depth of the water and constructing an additional line of works. The capacity was thus greatly raised from a canal intended for the passage of boats of 25 tons burden, to a navigation adapted to the use of boats of 65 tons, the burden of the boats now in use.

In the progress of this enlargement many miles of the work was deepened sufficiently for the use of barges of 200 tons burden. It is proposed now to contract a loan for the purpose of removing one line of the old locks and substitute a line of new ones of enlarged dimensions to increase the depth and breadth of the channels where necessary, so as to obtain an uniform depth throughout the line, suitable for the passage of barges of 200 tons burden.

The estimated cost of this enlargement is $1,080,000."

The cost of the subsequent gradual enlargement, with

a new line of 51 lift locks and an entire change of location and reconstruction of six miles, to take the place of the Reading Canal, the increase of the width and depth of all the channels to accommodate boats of 65 tons burden was, $1,696,545, making the aggregate cost of the work in the year 1845, with all the company's real estate and water power, $3,896,545.

The success which followed the opening of the Navigation to the coal region was greater than the most enthusiastic friends of the enterprise had anticipated. The traffic increased with great rapidity and the ample revenues authorized the most gratifying dividends, which ranged from nine to twenty-four per cent. per annum, and the stock and loans of the company were sought as the safest investments of the day. This extraordinary success led the way to a change of fortune which resulted immediately from the construction of a rival work.

In 1829 when the company declared its first dividend the traffic all told was but 134,524 tons.

In 1832 when the dividends had reached 5½ per cent. per annum, the traffic was but 327,921 tons.

In 1835, when the dividends amounted to 15 per cent. per annum, the aggregate trade was but 535,194 tons.

In 1839, when the dividends amounted to 19 per cent. per annum, the trade was 686,716 tons.

In 1844 the canal was not earning a dividend. The total traffic amounted to 573,471 tons, and the company was in easy financial position without the embarrassment of any floating debt. It was earning only enough to clear its expenses and interest on bonded indebtedness.

It was the rapidly increasing anthracite coal trade from the Schuylkill region, the inability to handle it with boats of small tonnage, as well as the inability of the Navigation Company to compete with the railroad in the transportation of coal with boats of small tonnage, that made it the universal sentiment of those concerned in the Schuylkill coal business, and of the great body of residents and proprietors of manufactories along the line, that the canal should be considerably enlarged in its dimensions, in order

to accommodate the increasing trade, and also make it profitable to its stockholders.

The enlargement having been determined upon and approved by the stockholders at their annual meeting, in January, 1845, Mr. Edward Miller, a civil engineer of large experience, was appointed by the Board to take charge of the work; but in the month of April of that year he resigned and the work was reorganized in charge of three resident engineers.

The upper division, extending from the head of navigation to Althouse's (Leesport) thirty-one miles, was laid out and successfully executed under the direction of Ellwood Morris, civil engineer.

The next division, extending from Althouse's to the outlet of the Girard Canal, was placed under the general superintendence of Antes Snyder, civil engineer.

The work on the lower division, extending from the Girard Outlet to Fairmount, was conducted with indefatigable labor and attention by James F. Smith, civil engineer.

In prosecuting the work of the enlargement these men were assisted by Samuel Griscom, the general superintendent of the Navigation Company, and to whose zeal the company was indebted for the rapid and substantial execution of the work.

The final examination and surveys of these engineers resulted in a reduction of the number of locks from 109 to 70. They were designed to accommodate boats 100 feet long by 17½ feet wide, capable of carrying 150 to 200 tons of coal, and of being propelled by steam. The enlargement was prosecuted with vigor.

Fairmount Locks was first prepared for trade and opened for the passage of boats on the 4th of May, 1846. The Navigation was further opened as far as Phoenixville on the 29th of June and as far as Reading on the 11th of September. Boats of the large class of 180 tons were able to pass throughout the line from Port Carbon to Philadelphia on the 16th of November. Following the enlargement and at the beginning of the year 1847, the Navigation was in possession of large and well arranged docks and

landings at Schuylkill Haven, and were engaged in constructing others at Mount Carbon and Port Carbon, so that at the close of the year there were landing facilities for the shipment of 600,000 tons of coal per annum.

The company also had upwards of 600 cars of the most approved pattern, and the line was equipped with a considerable number of new boats of the increased size, adapted to the enlarged Navigation. These landing facilities were increased from time to time until they were adapted to the shipment of a million and a-half tons of coal per annum, and the number of cars was increased until in later years it reached 3,400, which were run upon lateral roads of Schuylkill County under agreement with the Philadelphia & Reading Railroad Company, thereby bringing the trade from the mines to the boats. These Navigation cars for many years were known by their color, and were called "yellows," by railroad men, to distinguish them from the "blacks," the color of the railroad cars.

After the enlargement of the canal about 600 boats were regularly engaged in the trade, many of them running through to New York and on Long Island Sound, as far as New London, Connecticut.

The works of the Navigation were practically new and in superb order. It was well equipped for trade but was not in position to surmount the financial difficulties brought about by the suspension of the Navigation for the entire year of 1846, the loss of its trade, the depreciation and casting aside of the small boats formerly used, and the necessity of expending a large sum of money to create a new boat stock. It was extremely difficult under these conditions to earn sufficient money to provide for the bonded indebtedness and floating debt.

About 1847, Frederick Fraley, a man of large experience and great ability, was elected president, and remained with the Schuylkill Navigation Company in that capacity until the lease of the works to the Philadelphia and Reading Railroad Company in 1870, a period of twenty-three years.

To overcome the difficulties outlined above, one of the

first acts of President Fraley was to negotiate a loan of $3,600,000 to take care of the liabilities of the company and to provide a fund for procuring an additional supply of boats, cars and landings. In the year 1849, there were 392 boats and scows engaged in the coal trade, and 138 in miscellaneous trade.

In order to increase the boat stock which it was recognized was too small for the trade of the Navigation, it was necessary in 1849 to create a new loan for the express purpose of building boats. This loan was called the Boat Loan Trust, and out of it grew the leasing of boats to individual captains, who by that means were not only enabled to take care of and gradually pay for their boats, so that they became owners, but at the same time made good wages. This method of carrying on transportation in the hands of individual owners and the leasing of the company boats was carried on until the year 1870, when the Schuylkill Canal Transportation Line was formed.

The administration of President Fraley from 1849 to 1870 was a vigorous one and full of interest to those who were identified with the Schuylkill Navigation Company. He built up the coal tonnage of the canal until it reached the maximum in 1859, of 1,699.101 tons, of which 1,372,109 tons was of anthracite coal. There were about 1,400 boats of 180 tons capacity each, on the canal.

Notwithstanding this great increase of tonnage the canal was never able to overcome its financial difficulties, and to recover from the disaster which befell it.

One of the greatest of these was caused by two floods in the river during the year 1850. One on the 19th of July, and the other on the 2nd of September. Of these Mr. Fraley says in his report for the year 1850:

"On the 19th of July last, the first of the two great freshets of the year occurred and injured in its progress several important portions of our line, but the whole canal was made navigable by the 26th day of August and shipments of coal resumed with unusual activity, but the second great disaster of the year rendered all that had thus been restored useless.

On the 2nd of September last, our history is marked by a flood, with which nothing that has heretofore occurred in the Valley of the Schuylkill within the memory of man can be compared. In the great elevation of water, in the destruction of property and life, and indeed in all its accompaniments, no living witnesses have seen its parallel.

The wreckage included dams and guard banks, canal embankments and lock-houses. Of the dams twenty-three received more or less injury and two required to be entirely rebuilt. The most important of these was situated in the gap of the Blue Mountains and was about 35 feet in height.

In the same flood the lower Tumbling Run Reservoir was nearly destroyed and a large section of the embankment was carried out to its foundation."

Notwithstanding the great damage done, the works were repaired and business resumed between Philadelphia and Reading, sixty-four miles, on the 14th of November following, and the remaining section, above Reading, including the Blue Mountain Dam was finished and ready for navigation early in the following spring. The loss of trade and revenue, and the cost of repairs was great.

At the opening of navigation in the spring of 1853, the facilities for shipping coal at Schuylkill Haven were very much enlarged by the opening of a new dock, called the Lippincott dock, which furnished about 3,000 feet lineal front of landing, and which was intended to take care of the trade from the Mine Hill and Schuylkill Haven Railroad at the same time. The maintenance and repairs were placed under the direction of James F. Smith, resident engineer, and the supervision of the cars, landings and shipment of coal under Edward T. Warner, and the boats and towage were attended to by Philip D. Thomas.

This systematic sub-division of the work of the Navigation led to favorable results in the business of the year 1852, and practically the same system was carried out in the operation of the Navigation until the leasing of the canal to the Philadelphia and Reading Railroad Company in 1870.

During this period the Philadelphia and Reading Rail-

road Company was an active competitor of the Navigation Company for the anthraicte coal trade. The latter had a through water route to New York harbor, and to points east, without reshipment, whilst the rail route involved transfer to vessels at Port Richmond. The coal tonnage of the canal during the season of navigation was greater than that of the railroad for many years, and it was not until after the year 1867 that it began to decline.

In all the years, except two from 1855 to 1867, inclusive, it was over one million tons for each boating season. The total tonnage of coal for the thirteen years was 15,003,500 tons, an average of 1,154,000 (nearly) for each boating season, and the maximum was in the year 1859, when 1,372,000 tons were carried, of which nearly one-half, or 646,178 tons went to New York and vicinity.

The handling of so large a tonnage required the maintenance, on the part of the Navigation Company, of its own coal cars, for use on the lateral railroad, and its own locomotives for working the landings at Port Carbon, Mount Carbon, Schuylkill Haven and Port Clinton.

The number of cars reached 3,400, many of which were built in the company's own shops at Reading, including all the iron work, wheels, axles, etc., and the repairs of cars were kept up in shops for that purpose at Port Carbon and Schuylkill Haven.

For a number of years following the enlargement of the Navigation works in 1846, the company controlled, in a measure, a number of the lateral roads, which were owned and managed by separate and distinct corporations. Through this control it was able to bring from the mines to the canal at its shipping landings a large coal tonnage, which might otherwise have been diverted to the railroad. One of these arrangements, which at the time was referred to as the most important for business that had been made since the enlargement of the Navigation in 1846, was the contract entered into with the Mine Hill & Schuylkill Haven Railroad Company, to continue for ten years from January 1st, 1862, and which placed the Navigation Company in an independent position for participation in a fair

proportion of the coal trade of Schuylkill County. It was from the Mine Hill & Schuylkill Haven Railroad that the Navigation Company had heretofore derived the largest portion of its tonnage. The trade for the year 1861, for example, being 812,013 tons, out of the total tonnage for that year of 1,183,570 tons.

This active competition led to an agreement between the Railroad Company and the Navigation Company in the year 1864, under the terms of which the coal trade was divided under certain restrictions, in the proportion of fifty-five per cent. to the railroad and forty-five per cent. to the canal, an arrangement which naturally led up to the lease of the works of the Schuylkill Navigation to the Philadelphia and Reading Railroad Company, under agreement dated the 12th day of June, 1870.

The leasing of the canal, corporate rights and franchises, of the Schuylkill Navigation Company for the term of 999 years, from January 1st, 1870, was brought about by the inability of the Navigation Company to meet its financial difficulties, caused in part by the disastrous flood which occurred in the Valley of the Schuylkill, on the 4th day of October, 1869, (a little more than nineteen years after the disastrous flood of the year 1850), and which damaged the works greatly, causing an entire loss of trade for a month thereafter. This, following the stoppage of navigation by the city of Philadelphia on the 11th of August, 1869, during which time the Navigation was suspended by the illegal action of the city in drawing the dam and levels of Fairmount pool for the supply of water power to the wheels at Fairmount, so interfered with the operation of the Navigation that the company was not able to meet its expenses and was financially embarrassed from early in August until the close of navigation.

The winter following called for the expenditure of a large sum of money to make permanent repairs where damage had been done by the flood of October, 1869. In consequence the Navigation Company entered upon the spring of the year 1870 with its finances in straightened condition, and the lease of its works to the Philadelphia

and Reading Railroad Company followed shortly thereafter.

The canal was operated by the Philadelphia and Reading Railroad Company, as lessees, from July 1st, 1870 until the close of the year 1886, with its transportation in charge of Mr. T. C. Zulick, Superintendent of canals, at Schuylkll Haven, and under his supervision a transportation line was organized operating at one time about 850 boats.

There were relay stations at an average distance of twelve miles, with accommodations for teams and drivers. This line operated through to New York and to points on Long Island Sound, and in that period of years successfully carried on the transportation of a large tonnage of anthracite coal.

The works were maintained by the Railroad Company, lessees, to a high degree of efficiency, but nevertheless canal transportation, as the years went by, compared unfavorably in net results with railroad transportation, so that at the close of the year 1886, it was found to be desirable to transfer the greater part of the boat stock to New York harbor, to be used as lighters.

The larger part of the tonnage of anthracite coal which had formerly gone by canal was transferred to the railroad. Since the year 1887 the works of the Navigation have been maintained as before, in a good state of repair, but the tonnage has been limited to what can be handled economically upon the line of canal and shipments to tidewater have been almost entirely discontinued. The miscellaneous trade, which in years past was large, has also left the canal. The reason for this being that it is no longer considered essential to locate a manufacturing establishment upon the water front. The locations sought are those upon railroads of the country, and this of itself leads to the diminution of canal traffic.

These conditions have not been brought about in any large degree by the railroad companies of the country. It is the natural drift of things and the desire of manufacturers to locate on the railroads for the easy and economical handling of freight, and the inability of small canals, working under local conditions, to compete with the great rail-

way systems of the country. In other words the operations of canals were confined to a limited area, whereas a loaded car could be sent from New York to San Francisco, or from Maine to Mexico.

The Schuylkill Navigation in its day filled its place and did a great work. Whether it will ever again be filled with traffic is a question that under present conditons of the transportation of freight in this country cannot be answered. In some European countries the heavier and coarser freights seek the canals and rivers, whilst the railways are crowded with the transportation of passengers and high class freight, but these conditions are not likelv to be reached in this country for many years.