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The rise of John Bloomfield Jervis, 1795 to 1830: a history of the construction of the Erie canal, Delaware and Hudson canal, and gravity railroad

H. Benjamin Powell
Lehigh University

THE RISE OF JOHN BLOOMFIELD JERVIS, 1795 TO 1830: A HISTORY OF THE CONSTRUCTION OF THE ERIE CANAL, DELAWARE AND HUDSON CANAL, AND GRAVITY RAILROAD

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H. Benjamin Powell

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George D. Harmon
Professor in Charge

George D. Harmon
Head of the Department

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H. Benjamin Powell

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Chapter I

Early Life and Training of John Bloomfield Jervis

The United States in 1800 was a vast wilderness stretching from the Atlantic Ocean to the Mississippi River. Through this wilderness many rivers flowed, providing the main means of transportation into the interior. Poor roads connected these channels of navigation. A few intelligent men, knowing of the success of the Bridgewater Canal in England, dreamed of connecting these arteries by means of canals. At this time a young man was born who would engineer two of the most important canals in the United States, the Erie Canal and the Delaware and Hudson Canal. He would later build some of the most important railroads and reservoir systems in the United States before the Civil War. Yet it was his work on the Erie Canal and on the Delaware and Hudson Canal that made him by the age of thirty-five the leading engineer in the United States.

John Bloomfield Jervis was born on December 14, 1795, at Huntington, Long Island, to Timothy and Phoebe Bloomfield Jervis. The name was originally Jarvis. Timothy in the First United States census of 1790 spelled his name Jarvis.[1] This family was among the original settlers at Huntington, moving there within one decade of the first settlement in 1653.[2] About the time of John's birth,

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1. Charles R. Street (ed.), Huntington Town Records (1889), III, p. 152.

2. Ibid., I, pp. 1 and 53.

his uncle, John W. Bloomfield, moved to Fort Stanwix, now Rome, New York, from New Jersey. He was to act as an agent and to look after a large tract of land in that vicinity, which resulted in the purchase for himself and two or three others of a six thousand acre tract.[3]

In 1798 Timothy Jervis moved to Fort Stanwix, which was known as having a navigable canal of about two miles in length, connecting the Mohawk River with Wood Creek. This canal was the portage for boats traveling between the waters of the Atlantic Ocean and the Great Lakes. The country was mostly a wilderness of heavy timber. Timothy, following his occupation as a carpenter, soon became interested in a saw mill which was attended by himself and his sons.[4]

John B. Jervis was the oldest of seven children and had the experiences and the trials of settlement in a new country. What education he had was obtained at the common schools of the day, which he attended until he was fifteen years of age. There were then no public schools sustained in whole or in part by the state. His parents were interested in his education, however, as evidenced by a gift of ten pounds of New York money to the Huntington Academy in 1793.[5]

The Jervis family were members of the Congregation Church, the first religious body organized in Rome. Their first pastor was

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3. American Society of Civil Engineers, Proceedings (October, 1885), XI, p. 109.

4. Ibid.

5. Street, op. cit., III, p. 168.

Rev. Moses Gillet from Connecticut. John joined this church when he was sixteen years old. At that time one of the important aids in religious education was the old New England Primer. John remarked in his autobiography, "My parents were extremely anxious for what they regarded likely to promote the happiness of their children, and next to the Bible the Primer was the guide to religious education."[6] The Primer was Calvinistic in theology, although it did not enter into the Calvinistic policy of church government. John added that it was an excellent epitome of scripture teaching, laying the foundation of evangelical doctrine.[7]

Pastor Gillet was a Calvinist, though not holding the erroneous views which have been attributed to Calvin by his enemies. He was a plain, sensible man and his teachings were essentially Biblical. Under his guidance, the church grew in the knowledge of the scripture, and became a body of intelligent Christians. Under this influence Jervis adopted the religious sentiments of Calvinistic theology, except as to church policy. "This was my education, and as I advanced in life, my experience and observation confirmed my early sentiments," he added. All through his days it had been a monitor and reproof of his doing wrong, and a supporting pillar to whatever he did that was good.[8]

Between the ages of fifteen and twenty-two Jervis spent his

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6. John B. Jervis, Facts and Circumstances in the Life of John B. Jervis (Unpublished manuscript in the Jervis Library of Rome, New York), pp. 2-3. Hereafter cited as Jervis, Facts and Circumstances.

7. Ibid.

8. Ibid., p. 4.

summers in managing a team and attending the sawmill, with occasional farm work. During the winters he was engaged in hauling sawlogs to the mill.

At one time Jervis entertained the idea of obtaining an education of a higher order than he could have in the common school of the day. But his father was not able to help him, and needed the services he rendered. The method he employed to gain an education was quite unique. He wrote in his autobiography:

> I thought to study and work at the same time, and made arrangements with an educated teacher to hear my recitation, and began the study of Latin. The time I had to study was--after setting the log, I could study until the saw ran through. As the saw stopped by its machinery when it reached the end of the log, I could study until admonished, of the time to reset the log.[9]

After making what he considered a fair experiment in this method of obtaining an education, John gave it up. The demands of the work he had to do absorbed so much of his time and thought that he felt compelled to give up the attempt.[10]

While John B. Jervis was growing to manhood advocates for a canal connecting the Hudson River and the Great Lakes were spending time in the state legislature at Albany gaining political support for their project. They were also out in the wilderness of upper New York State making surveys of the terrain over which the canal would pass. One of the leading men for the canal project was Benjamin Wright, a local Judge who resided in Rome. Wright and Timothy Jervis were good

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9. Ibid., p. 5.

10. Ibid.

friends.

Though but a youth at that time, Jervis regarded the canal project with much interest. He had no definite idea as to whether it would pay for construction, but somehow he thought it a good work. John had not the least idea of anything personal more than to supply such demands, as it might make for lumber.[11]

The demand for lumber by the Erie Canal was important to the Jervises. Later Timothy Jervis received the contracts for the lumber needed in the Rome area. He had to build the road bridges over the line of the middle section and to furnish all the materials except stone. All the fence on each side of the canal from the dam at the Oriskany Creek to the aqueduct at Whitestown were given to him, plus the occupation bridges between Rome and Utica.[12] When the canal was being planned, however, they could only dream of the great prosperity it would bring them. Little did John Jervis realize how much fame and fortune the Erie Canal would bring him, as a top ranking civil engineer.

The ground breaking ceremony was held in Rome on July 4, 1817. There had been a difference of opinion on the question of location through Rome, in consequence of which the exact location of the line was delayed until late in the autumn. A party of engineers was sent to make the survey through a piece of cedar swamp.

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11. Ibid., p. 7.

12. Laws of the State of New York in Relation to the Erie and Champlain Canals, together with the Annual Reports of the Canal Commissioners, and Other Documents Requisit for a Complete Official History of Those Works (1825), II, p. 431. Hereafter cited as Laws ... to the Erie and Champlain Canals.

The party which came to make the survey was composed of experts, depending upon obtaining expert axe-men at the locality. These latter were a portion of the force indispensable for this service. To supply this defect in the engineering party, Judge Wright, knowing that Timothy Jervis had in his employ, men working as axe-men, called upon him to engage two for a few days in this party. Mr. Jervis referred the matter to John. He intended to make proposals for a contract for this section of the canal, and thought John would be able to obtain useful information as to the character of the work. John assented to his father's wish to go as one of the axe-men, and taking another man, entered the service of the party.[13]

The cedar swamp was so soft it was necessary to drive stakes into the ground in order to set up the leveling instruments. The party started out in November, 1817, with the possibility of cold weather and snow ever present. Within a few days snow began to fall, loading down the cedar bushes and rendering the work for the axe-men very disagreeable. The axe-men had to go forward cutting the path, shaking the snow from the bushes and trees, and open the way for the engineers. Jervis was of a slender frame, rarely weighing over 125 pounds; his associate was tall and stout. They pushed through the bushes and snow with the zeal of a new enterprise. Their main ambition was to satisfy the chief of the party, N.S. Roberts. Roberts was a man of austere manner who did not hesitate to speak plainly.[14]

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13. Jervis, Facts and Circumstances, p. 8.

14. Ibid., p. 9.

John Jervis' main job was to drive pegs into the ground for two target men to set their instruments upon for the observation. After driving in the pegs he would have some leisure until the observation was made. John became interested in the surveying instruments, which at first appeared quite mysterious. After a day or two he ventured to ask a few questions in relation to the instruments and their mode of operation. He learned from the conversation that the target men were regarded as occupying the first step in the science of engineering. On reflection it appeared to him that he could do this type of work if he could get a little practice. In the low rank of his position in the party, John did not feel at liberty to ask Mr. Roberts any questions about engineering. All his communication was with the target men, who were both young.[15]

It was soon evident that Nathan Roberts was pleased with the manner in which Jervis executed his duty. On one occasion Roberts expressed his approbation of their dexerity as axe-men. After that he very frequently stated that he had never had a pair of axe-men so skillful and efficient as they were; and at the same time took occasion to manifest a partiality to men who were not afraid to work.[16]

Roberts action encouraged Jervis to think that the same application of industry, might enable him to master an art that seemed then so mysterious. Jervis later remarked, "I had nothing

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15. John B. Jervis, "A Memoir of American Engineering," Transactions of the American Society of Civil Engineering (1878) VI, p. 40. Hereafter cited as Jervis,"A Memoir of American Engineering."

16. Jervis, Facts and Circumstances, p. 11.

but a common school education, and how should I be able to master the mysteries of such a science as engineering appeared to be?"[17] He pondered the subject and concluded that what others could do, he could do also. On the last day of service, while the party was taking its lunch in a little huddle in the swamp, he ventured, half jest and half earnest, to ask the principal, "What will you give me to go with you, next year, and carry one of those rods?" To this, Roberts replied that he would give Jervis $12 a month. The reply was so prompt that John was a little startled, and began to think very seriously of the matter.[18]

After Jervis returned home he began to consider to what he had given his assent. It was not his objective to engage his services for $12 a month.[19] He must see something beyond this. Again the question arose, could he ever become an engineer? He had only seen a very small edge of the great field. So far he had only looked at the target. The mystery of the level, the taking of sights, its adjustment and the computations of the observation were all unknown to him. As he pondered these matters, he began to think that after all it might be a mere joke. Roberts might have had no idea that John would accept his prompt assent. But the idea of being an engineer was ever present. Finally, determined to ascertain if the parties were in earnest, Jervis went to Benjamin Wright, to whom John had

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17. Jervis, "A Memoir of American Engineering," p. 40.

18. Ibid.

19. Jervis, Facts and Circumstances, p. 12.

already told Nathan Roberts' reply. Having a personal acquaintance with Judge Wright, the chief engineer, Jervis asked him, if they had accepted his proposition. Wright replied very promptly, "If you say you will go, I say you shall go."[20]

On inquiry Jervis found that land surveyors were considered best qualified for engineers. At the recommendation of Nathan Roberts he purchased two books on surveying. These John studied in the evenings, and at such odd times as the weather did not allow team work.

On April 10, 1818, John Jervis started with his target-rod on his shoulder in a surveying party for Geddesburg (now Syracuse). The party consisted of thirteen people, to rank and station thus: a chief engineer, a surveyor, an assistant engineer, two rodmen, two chainmen, three axe-men, a packman, a cook, and a teamster. Except for Nathan Roberts and the teamster, everyone made the journey on foot. They started in the afternoon and only made seven miles that day. The road was excessively muddy. They reached Geddesburg in the afternoon of the third day and pitched their tents among hemlock logs and bushes. On the journey John occupied his spare time in studying the target, making himself familiar with the movements and especially with the reading of the figures. The target rod used at the time was ten and a half feet long.[21]

On arriving at Geddesburg the party immediately organized for work. The method of surveying was as follows: The surveyor, with an eye to engineering skill, would take a course over ground of

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20. Ibid., pp. 12-13.

21. Ibid., p. 14.

probable water level, then covered with large trees and small woods of hemlock, cedar, alder bushes, and weeds. He would sight an object and note its compass bearing. Then, with compass in one hand and staff in the other he would lead the way through swamp and swale, still eyeing the object ahead until it was reached.[22]

One axe-man closely followed him, chopping bark from adjacent trees near the line where it was necessary. Two other axemen then cleared the pathway about four feet wide of bushes, weeds and all obstacles to level sighting. The chainmen followed and checked the station stakes from the previous survey. At the foot of each stake a peg was driven level to the surface of the ground, or on hard earth the heels of the rodman's boots would make a solid standpoint for the rod to rest upon, so that no variation in the base would take place between the forward and back sighting. Bench marks more permanent were the usual standards for level references of succeeding and repeating surveys. A prominent root of a tree just under a broad hewn surface would be found by hewing, to rest the rod upon, and its level marked on the surface for all succeeding ones.[23]

The assistant engineer then placed the leveling instruments intermediate to stations and nearly equidistant therefrom, and screwed it to a level. The chief engineer sighted on the graduated poles of the rodmen; the one in the rear first and then the one in front, and from their reading would determine the rising or falling

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22. William C. Young, "Reminiscences of Surveys of the Erie Canal in 1816-1817," Buffalo Historical Society Publications (1909) XIII, p. 335. Although William Young was in the 1816 survey, the method was essentially the same two years later in 1818. Young's paper was presented to the Buffalo Historical Society in 1866.

23. Ibid., pp. 335-36.

grounds and the variations from a water level by subtraction or addition, requiring judgment to determine which of these to perform.[24]

The surveyor would note the distance at which water courses and form lines would be crossed; the kinds of timber passed through, and of the soil, whether it was sand, loam, gravel, clay, rock, stone, swamp, or swale. They sketched surrounding objects as outlines for mapping purposes and estimates of costs. The engineer would note the level of water beds in inference to the water line, and other changes of general surface intermediate to stations; and when openings of bush and woodland enabled, would sight far away from the line, to determine the general slopes of the surrounding surface.[25]

The levels of 1816 were not only carefully re-examined, but lateral levels were frequently made on each side of the line, with a view to improve the location wherever the nature of the ground would permit. The engineers were directed, in addition, to placing permanent benchmarks, to place three rows of stakes, the middle row to mark the center of the canal, and the two outside rows, which were to be sixty feet apart, to designate the extremities of the part to be grubbed, wherever that operation was necessary. Two other rows of stakes were placed in such manner as to designate the width of excavation.[26]

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24. Ibid., p. 336.

25. Ibid.

26. Laws ... to the Erie and Champlain Canals, I, pp. 368-69.

The Roberts party located the canal from Geddesburg to Montezuma on the Seneca River, a distance of about thirty-six miles. A few days after the party began a severe snow storm occurred, falling to a depth of six inches. The storm was followed by high winds not very agreeable for tent life. As the season advanced warm weather brought out large quantities of mosquitoes, which proved the most serious annoyance. These mosquitoes later proved a real danger to the construction of the canal.[27]

Jervis wrote that it was common during the operation to walk from one to five miles to and from camp to the survey. Roberts walked along with them. The task was regarded as a necessary and proper thing. At the present day this would be thought rather severe service, since the days work on the line was continuous labor except for a half hour for dinner.[28]

At times, when in the opinion of the chief of the party it was necessary all young aspirants for the profession of engineering were required to take an axe, and cut pegs and stakes and clear the line. Most of them did not relish this job. They regarded it as an infringement on their dignity, doing the work in a hesitating and slovenly manner. Jervis had been brought up to work, and did not regard any honest labor a degradation. He performed his part on such occasions with the same alacrity as his regular work. John's readiness on alloccasions gave him favor with the principal, Nathan

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27. Jervis, Facts and Circumstances, p. 15.

28. Ibid.

Roberts, while obtaining knowledge in the art he sought.[29]

The target men were allowed and requested to keep a field book of the observations, and work out the levels so that they would become familiar with the method of taking the observations, and the principle of computing the levels. No one was deemed competent to work the levels except Nathan Roberts. The rodmen could only do this for their own practice, but after a while when Roberts was occupied in camp on his plans and calculations, he would allow them to practice with the leveling instrument. John Jervis eagerly embraced such opportunities.[30]

Jervis had prepared himself with a very plain set of drawing instruments, and on rainy days employed himself in plotting the line, and the profile, making such a map as his limited skill allowed. This practice was of no business value, except for his own improvement. Roberts made all the maps that were regarded as necessary for the business. The practice made John familiar with the art of plotting lines and profiles which then appeared to him the important things to be learned.[31]

There were sometimes errors by the target men in calling off the observation. This would be discovered on running the proof line, which was always carefully done. But the discovery often led to the necessity of making the second proof. An error of this kind did not fail to call out severe reproof from Nathan Roberts. As

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29. Ibid., pp. 15-16.

30. Ibid., p. 16.

31. Ibid.

there were two target men, it was ordinarily impossible to decide to whom the fault properly rested and both were cautioned against similar error. Sometimes it was finally ascertained, the fault was not with the target men at all. All this was good discipline to impress on the mind the strict care required in conducting levels; much more important on canals than on rail or other roads. Roberts had a profound sense of his responsibility in establishing a correct level for the contemplated canal, and this very naturally impressed itself on the mind of young Jervis.[32]

The location for the canal was completed to the east shore of the Seneca River, at Montezuma, about July 10, three months from the day the party left Rome. They had traveled on foot about eighty miles. The party returned to Rome where they were broken up, and reorganized into several small parties that were assigned the job of staking out and superintending the work. At this time, or soon after, the whole of the middle section of the Erie Canal was placed under contract.[33]

The whole line of the middle section from Utica to Montezuma was divided into five parts, to each of which was assigned an intelligent, active and vigilant overseer, or assistant engineer, who had previously learned the use of the leveling instruments. These engineers were ordered to pass backwards and forwards, within the limits assigned them; to stake out the width of the grubbing and

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32. Ibid., p. 17.

33. Ibid., p. 18.

clearing of the excavation or embankment; and to fix pegs in the earth showing the depth and width of the bottom of the canal and the height and slopes of its banks. They were also to watch that no work was done unfaithfully and to take account of and measure all unforeseen obstructions.[34]

John B. Jervis was assigned to a party having charge of seventeen miles of the Erie Canal extending from Canastota, Madison County, to Limestone Creek, in Onondaga County. The head of the party was David S. Bates whose only qualification was that he was a land surveyor of good standing. Jervis during his three months experience as rodman had become familiar in handling leveling instruments. Since he had more experience with the leveling instruments than Bates, the principal very readily allowed him to run the levels. The party spent from July to December of 1818 in performing their duty. At the close of the season for work on the canal, Jervis was sent to the quarry to weigh lock-stone for the winter.[35]

In April, 1819, when the construction season began again David Bates was charged with more extended duties. Jervis was made resident engineer of the seventeen mile section he had worked on the previous year, at a salary of $1.25 a day and $.50 for expenses. Jervis at that time was 24 years old. The position and salary were considered very desirable and lucrative. His only complaint was that he would be employed only nine months of the year.[36]

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34. Laws ... to the Erie and Champlain Canals, I, p. 407.

35. Jervis, "A Memoir of American Engineering," p. 41.

36. Ibid.

John B. Jervis was not the only youth who had made such rapid progress on the Erie Canal. There were few engineers in the United States when the project had begun two years previously. Before going on with the engineering profession of Jervis it is only proper that a brief history of the canal be presented in order to show that the Erie Canal was the first great school of engineering in the United States.

Chapter II

The Erie Canal School of Engineering

The Erie Canal was the first great school of engineering in the United States. From it came the men who designed and superintended the building of practically all the canals built during the next quarter of a century, thereafter, and a great majority of the early railroads. When the construction of the canal began in 1817 there were no engineers in the country worthy of the name. James Geddes and Benjamin Wright, two country lawyers, who had done a little amateur surveying--nothing more--were chosen to direct the work of building the four-foot ditch three hundred sixty-three miles across the State of New York.

Benjamin Wright and James Geddes were the first great engineering professors in the United States. Many young men flocked to them to learn the engineering profession. Among their foremost pupils were Canvass White, Nathan S. Roberts, David S. Bates, Holmes Hutchinson, David Thomas, and John B. Jervis. These men received their schooling in the practical field of survey and construction. And, in their turn, these men became the teachers for the second generation of American engineers.

"Many of the distinctive characteristics of American engineering," said President Ashbet Welsh of the American Society of Civil Engineers in 1882:

> originated with these Erie Canal engineers. We practice their methods today. . . . As a class they wrote little. There were then no engineering

> papers prepared, and no engineering societies to perpetuate them, if they had been prepared. They were not scientific men, but knew by intuition what other men know by calculation. . . What science they had they knew well how to apply to best advantage. Few men have ever accomplished so much with so little means. 1

Owing to the difficulty of ascending the Mississippi and Ohio Rivers during the first decade of the Nineteenth Century, western supplies went by wagon road from the Atlantic seaports. In England, canals were proving their superiority to the common road. The chief advantage lay in the fact that a horse could drag through dead water a load fifty times heavier than on land. Against this advantage was the greater cost of building canals and the greater difficulty of surmounting changing levels. In the North freezing weather temporarily closed canals to traffic, and in all parts of the country washouts often rendered them useless.

If water transportation was to be achieved to the trans-Allegheny West, the most obvious and best route was a connection between the Hudson River and the Great Lakes where the rise was only 630 feet. Rome, New York, was on the highest land between Lake Ontario and the Hudson River at Troy. Rome is situated at the head of the Mohawk River and Wood Creek, the former river running east and Wood Creek west. There are no hills or mountains in its vicinity, a plane extends from it on all sides.

In 1791 a survey was made for a canal to connect the Mohawk River with Wood Creek. Benjamin Wright, who resided at Rome, was

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1. Alvin F. Harlow, Old Towpaths: The Story of the American Canal Era (1926), pp. 299-300.

surveying new land at the time. He was employed to assist in running the lines and measuring distances between certain points in order to get the correct topography of the country. The next year the Western Inland Lock Navigation Company was chartered to construct the canal. Two miles of the canal were completed in 1796, and provided a portage for navigation between the Mohawk River and Lake Oneida.[2]

In 1802 the Western Inland Lock Navigation Company determined to improve the navigation for six miles along Wood Creek west from Fort Stanwix (Rome.) The terrain descended twenty-four feet in this distance making navigation troublesome. Benjamin Wright was employed as the engineer to make the improvement by building four locks.[3]

After locating and constructing all that was necessary for these works, the company was so well satisfied with Wright's achievements that they directed him to make a survey, ground plan, and profile of Wood Creek from where the construction of the previous year ended at Lake Oneida. Immediately on completing the work on Wood Creek in 1803 Benjamin Wright received further direction from the Western Inland Lock Navigation Company to survey the Mohawk River from Fort Stanwix east to Schenectady. He was also to submit a plan for "improving the river in as cheap and economical a manner as possible, and one adapted to the situation and circumstances of the company."[4] Wright performed his duty in 1803 by recommending a compound of dams, locks, and short canals for slack water navigation

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2. David Hosack, Memoir of DeWitt Clinton (1829), pp. 500-01.

3. Ibid., p. 501.

4. Ibid., p. 501.

as the cheapest possible and most useful plan. Unfortunately the pecuniary affairs of the company never permitted them to carry any part of the proposed plan into effect.[5]

Another person who was deeply interested in connecting the waters of the Great Lakes with the Hudson River was Gouverneur Morris. He was one of the first men to have the idea for this great waterway. He thought of it and planned it long before anyone else. During the Revolutionary Period he publicly proposed his idea; in 1803 he began the agitation in its favor that culminated in its realization, and he was chairman of the canal commissioners from the time of their appointment in 1810, until a few months of his death. The first three reports were all in his pen. Stephen Van Rensselaer, himself one of the commissioners from the beginning, said, "Gouverneur Morris was the father of our great canal."[6]

On February 4, 1808, Judge Joshua Foreman proposed a resolution in the New York State Assembly for a canal joining the Hudson River and Lake Erie. After two months debate the Legislature ordered a survey made of a route from the Hudson to Lake Erie by way of Lake Ontario and other inland water routes. James Geddes, was appointed to make the survey. On January 20, of the next year, Geddes reported his survey.

New York shied from large scale undertaking until 1810, when those interested approached the powerful, patriotic, and

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5. Ibid.

6. Theodore Roosevelt, Gouverneur Morris (1898), p. 295.

intensely state-conscious DeWitt Clinton. Clinton embraced the vision of a canal from the Hudson through the Mohawk Valley and on to the Great Lakes, and made the dream his own. He brought reality to bear on vague unlettered schemes, doubts, and jealousies. He acted without pay as commissioner, touring the ground repeatedly, writing forcefully, and early becoming convinced that only a lock canal was feasible. He was convinced that Lake Erie, not Lake Ontario as some wished should form the western outlet of the canal.

In March of 1810 seven commissioners were appointed by the State Legislature to examine inland waters for the purpose of a canal. Three thousand dollars was appropriated for their use. The first canal commissioners were Gouverneur Morris, Stephen Van Rensselaer, William North, DeWitt Clinton, Thomas Eddy, P.B. Porter, and Simeon DeWitt. The commissioners spent the summer of 1810 exploring the survey that James Geddes had made in the wilderness of northern New York. One year later they reported that the distance was three hundred ten miles from Lake Erie to the Hudson River with a fall of five hundred twenty-five feet. They estimated the cost of construction to be five million dollars on the inclined plane principle. Their estimate was only one million dollars off from the final cost.

In 1812 DeWitt Clinton and Gouverneur Morris went to Washington, D.C., to solicit Federal aid, but were unsuccessful. The Madison administration was busy in a war with England, and preparing for the forth-coming election. The campaign of 1812 was a bitter presidential race between George Clinton, DeWitt's father,

and the incumbent, James Madison. The two canal commissioners could expect little financial help to come their way.

This refusal was not the first defeat of the New York canal enthusiast in the national capital. Joshua Foreman once told John Jervis that after they had presented their plan and made request for aid, Thomas Jefferson said to him, "We are trying to make a canal three miles long at this city, and we have not been able to obtain sufficient funds from individuals, the state government and the general government to complete it, and now you ask us to aid you in building a canal three hundred miles long through a wilderness. Preposterous!"[7]

Not until 1815, after the end of the War of 1812, did the canal enthusiasts in New York meet and decide to petition the state legislature. DeWitt Clinton wrote the memorial which not only told why but how the canal should be built, the probable cost, and the meaning to the state and nation. This memorial was one of his greatest contributions to canal history. He was subsequently elected governor of New York. Under his leadership as governor from 1816 to 1822 his favorite project would be pushed forward with vigor and nicknamed "Clinton's Ditch." When the great value of his project was realized he was elected for a second term from 1824 to 1828.

On May 17, 1816, the canal commissioners met in New York City. They agreed to appoint three engineers for the Erie Canal and one for the Champlain Canal. Each engineer was to be assisted

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7. John B. Jervis, "A Memoir of American Engineering," p. 41.

by a surveyor and a competent number of hands. The Erie Canal was divided into three great sections and an engineer was assigned to each. The western section extended from Lake Erie to the Seneca River, the middle section ran from the Seneca River to Rome, and the eastern section went from Rome to the Hudson River. In the course of their investigation the commissioners found it expedient to appoint a fourth engineer to explore and survey the country from Buffalo to the eastern line of the Holland Purchase, on the south side of the mountain ridge. They thought that this route might be preferable to the route on the north side.[8] Under these orders the first permanent surveys were made for the Erie Canal.

James Geddes was appointed to engineer the survey of the western section of the canal from Lake Erie to the Seneca River. Lake Erie is 194 feet above the Seneca River. To provide for this descent twenty-five locks were needed on the canal line. The lift of some of these locks was small owing to the unusual evenness of the country. At some places there were embankments and deep cuttings to keep the canal on one level. The major obstacle over which the canal had to pass was the Genesee River. Two guard locks were needed here.[9]

Benjamin Wright was appointed to engineer the survey of the middle section of the canal from the Seneca River to Rome. Between these two places there was a rise in the line of the canal of 48 1/2 feet in a distance of seventy-seven miles. The topography in this

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8. Laws ... to the Erie and Champlain Canals, I, p. 197.

9. Ibid., pp. 222-23.

section was excellent for a canal. Lake Oneida bordering the field or survey, miles away on the north, provided a forty-one-mile summit level. After passing the summit level the waters of Onondaga, Skaneateles, and Owasco Lakes provided another long level of thirty miles.[10] The whole extent of this section required only six locks.

The eastern section lies along the Mohawk River from Rome to the Hudson River. Charles Broadhead was appointed to engineer the survey between Rome and the Schoharie Creek. He accordingly leveled over and explored this route. In the course of seventy-one miles between the two points, the canal line descends 132 feet needing sixteen locks to accommodate this fall.[11]

Geddes, Wright, and Broadhead made their surveys in the summer and fall of 1816. When the New York State Legislature met that winter a bitter debate took place between the pro-canal and anti-canal factions. DeWitt Clinton using his powerful political influence forced the Legislature to pass a law on April 15, 1817, for construction of the Champlain Canal and the middle section of the Erie Canal. Although New York City gained the most from the canal, her delegates voted solidly against the act in 1817. Within five years after the completion of the canal in 1825, she overtook Philadelphia as the leading port in the United States.

New York State needed experienced engineers to prosecute the work before construction of the canal could begin. There were

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10. Ibid., p. 245.

11. Ibid., p. 264.

no first rate engineers in the United States in 1817. The two best qualified men for the job were Benjamin Wright and James Geddes. Wright was born in 1770 in Vermont. After studying surveying he moved to Fort Stanwix in 1789. From his new home on the frontier he surveyed much of the land in Oneida and Oswego Counties in New York State. In his work for the Inland Lock Navigation Company he gained little experience as an engineer and canal surveyor. In 1813 he was appointed county judge, and served in the State Legislature as an active canal enthusiast. While in this position he was appointed to make the Erie Canal survey in 1816. James Geddes had a similar background. The older of the two men, Geddes, was born in Onondaga County in 1763. He studied surveying and law in his youth and was later made a county judge. He made the original survey for the Erie Canal in 1808, served in the State Legislature, and was also appointed to make the 1816 survey. Neither of the two men was a trained engineer. What knowledge they had was from practical experience. Since both men were esteemed surveyors, in the profession that was considered the basis of engineering, they were appointed the chief engineers for the canals.

Fortunately for the purpose of the Erie Canal, a youth of twenty-six years was discovered in the survey of 1816. Canvass White began his career as a pupil of Benjamin Wright by carrying the target. When Wright finished his survey White became the surveyor of Charles Broadhead's party on the eastern section. In the fall of that year he made a voyage to England on his own account, where he walked over

two thousand miles along their towpaths studying all the details of construction. White returned the next spring in time for field operations with instruments for laying out the canal, plans and models of a canal boat, and a mind stored with useful information.[12] Benjamin Wright said, "To this gentleman I could always apply for counsel and advice of the difficult case. To his sound judgment in locating the line of the canal in much of the difficult part of the route, the people of this state are under obligations greater than is generally known or appreciated."[13]

Before construction began in 1817 the summit level was extended from Rome to Utica. After the summit level was extended, considerable solicitude was felt least the engineers had deviated from the exact water level. While Benjamin Wright was re-examining and laying off sections west from Rome along the canal line, James Geddes was ordered to start at Rome on the canal line, carry a line to Lake Oneida, then proceed with the level to Lake Onondaga, and back to the canal line at Salina. When Wright's level had been carried along the canal line to the place where Geddes had terminated his; the levels of these engineers,which embraced a circuit of nearly one hundred miles, differed from each other less than one and a half inches.[14] This feat brought the two engineers into high repute.

On June 27, 1817, the first contract was let for the Erie Canal. One week later, on July 4, ground was officially broken at

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12. William C. Young, "Reminiscences of Surveys of the Erie Canal in 1816-1817," p. 345.

13. Hosack, op. cit. p. 504.

14. Laws ... to the Erie and Champlain Canals, I, pp. 369-70.

Rome. Samuel Young, one of the canal commissioners in his address said, "By this great highway, unborn millions will easily transport their surplus production to the shores of the Atlantic, procure their supplies, and hold a useful and profitable intercourse with all the maritime nations of the world."[15]

Before the close of that summer of 1817 the right-of-way for the new canal was being marked off by five rows of red surveyor stakes, marching over hill and vale in both directions from Rome. Fifty-eight miles of canal were placed under contract on the summit level during the year. This region was almost a trackless forest with large areas of swamp and marshes along the valley of the Seneca River. Benjamin Wright's son assisted in the 1816 survey. He later said that he could count upon the fingers of one hand the spots of ground then cultivated along the eighty-six miles surveyed from Rome to the Seneca River.[16]

The line of the canal was divided into short and convenient sections before being let to the contractors. The engineers arranged these sections in such manner that every section, where practicable, had a brook, ravine, or low piece of ground at each end. In this way every contractor had the advantage of draining his works without interfering with the adjoining contract. The length of the sections varied from forty rods to three miles. The contracts were made to embrace less than would otherwise have been necessary, in order that

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15. Ibid., p. 371.

16. Noble E. Whitford, History of the Canal System of the State of New York, Supplement to the Annual Report of the State Engineer and Surveyor of the State of New York, 1905. (1906), I, p. 87.

men in moderate pecuniary circumstances might be enabled to engage in the work, provided they could procure the necessary security.[17]

The contractors would furnish their own tools and be paid a stipulated price per cubic yard for excavation and embankment. It was believed that under this arrangement the necessary tools would be much better preserved from injury and destruction than they would, were they the property of the state. It was also foreseen that a set of tools in the hands of a contractor who had finished one job would furnish him with a strong inducement to engage in another contract. The tools which remained in the hands of an individual after the completion of any section of the canal might be useful to the repairment of roads or to the purpose of agriculture. If they were the property of the State, they would come to little account. In this manner the canal commissioners promoted free enterprise among the citizens of the wilderness.[18]

To prevent deception and fraud in the performance of the work of excavation and construction of embankments, the engineers were instructed to employ vigilant assistants to travel frequently over the line of the canal. They were to inspect and report on every job and to insist on a rigid compliance with the contracts, which required the contractors to complete their contracts and have them inspected and accepted before they were entitled to payment. Monthly advance payments were made when the work was carried on in a faithful manner.

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17. Laws ... to the Erie and Champlain Canals, I, p. 371.

18. Ibid., I, p. 368.

If any deception was discovered, payments were suspended. Arrangements were also made to fill the canal with water after the completion of a job, and previous to a settlement with the contractor, in every place where this was practicable, so that leaks might be at once discovered and repaired at the expense of the contractor.[19]

In addition to his abilities as a surveyor and his practical knowledge of construction, Benjamin Wright was a most able executive. He gathered around him a remarkable group of young men, all of whom afterwards occupied important positions in the engineering field. "Wright never made any plans of importance," Jervis once said, "Though he did not draw plans, he was a very sagacious critic of any presented. He excelled in practical judgment."[20] Wright made Canvass White his principal assistant and to him was committed the duty of preparing plans for the mechanical structures. White delighted in plodding over plans and methods of construction. He prepared the plan for the locks which, considering the times, was highly creditable to his engineering skill. He was characterized by Jervis as having possessed "the most strict engineering mind of any of his time." The chief engineer and White worked remarkably well together, and performed a better service to the canal as partners than either one would have done alone.[21]

The discovery of American cement was another one of the great contributions of Canvass White to the Erie Canal and American

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19. Ibid., I, pp. 372-73.

20. Jervis, "A Memoir of American Engineering," p. 42.

21. Ibid., pp. 42-43.

life. At the commencement of the works on the canal a proper cement was needed for the stone work. None had then been discovered in this country, and a quantity sufficient for the construction of the Erie could not be obtained from Europe without an immense expense. While in England, White had made inquiries on the subject. After returning home he began to search for the substances for cement and to make experiments. His labor resulted in the discovery of hydraulic cement in Madison County in 1818 for which he received a patent from the United States two years later. Even after this cement was made known to the public, the common lime mortar was used in the construction of the stone work on the canal owing to a lack of confidence in White's discovery.[22]

Within a year after the original discovery of the cement, it began to prove its value over the lime mortar. At that time it came into high repute and was used throughout the whole line of the canal. The contractors violated the patent of White on his cement for which he brought suit. After much trouble the State of New York gave him ten thousand dollars for the use of the cement on their canals.[23] Thanks to the original discovery of hydraulic cement by Canvass White on the Erie Canal, John B. Jervis discovered cement at Rosendale along the Delaware and Hudson Canal when he was engineer for this project. White also discovered the rock where the busy cement manufacturing district of Northampton, Pennsylvania, is now

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22. Laws ... to the Erie and Champlain Canals, II, p. 382.

23. Ibid., II, pp. 381-83.

located when he was chief engineer of the Lehigh Canal.

Another pre-eminent engineer of Benjamin Wright's classroom was Nathan S. Roberts. Born in 1776, he moved to Oneida County, New York, in 1804 where he taught school. He also surveyed land and superintended cotton mills. In 1816 he was the surveyor for Wright's party. From that time until 1822 he was engaged in exploratory surveys and location work, on the section of the canal between Rome and Rochester. He was then placed in charge of construction from Lockport to Lake Erie. William Young said his plottings and maps of land surveys were accurate, plainly written and neatly drawn. "He seemed qualified for any general business," Young added.[24]

The greatest engineer to graduate from the Erie School was John Bloomfield Jervis. Jervis had time and health on his side. The two chief engineers were growing old when the canal was completed in 1825. Benjamin Wright was fifty-five years old and James Geddes was sixty-two. Both of these men lived through the next decade of canal construction serving as expert consultants on many projects. Geddes (1763-1838) worked on the Ohio Canals and Pennsylvania System. Wright (1770-1842) was consulting engineer for the Farmington Canal in Connecticut, the Blackstone Canal in Rhode Island, and the Chesapeake and Delaware Canal; before the Erie Canal was completed. He was chief engineer in an advisory

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24. Young, op. cit., pp. 344-45.

capacity for the Delaware and Hudson Canal, the Chesapeake and Ohio Canal, the St. Lawrence Canal, and the Welland Canal. He also surveyed for some early railroads. Although Wright's list is impressive in many cases, his assistant engineer did all of the important work. Wright would better be termed as "the father of American engineering."

Poor health kept Canvass White from achieving what properly belonged to him. He was the real genius behind the construction on the Erie Canal. In 1825 he became chief engineer of the Union Canal in Pennsylvania, but was forced by ill health to relinquish the position after a year of service. He was consulting engineer for the Schuykill Navigation Company, in Pennsylvania, and the Windsor and Farmington Canals in Connecticut. Later he was chief engineer of the Lehigh Canal in Pennsylvania and the Delaware and Raritan Canal in New Jersey. As construction on the Delaware and Raritan Canal neared completion he suffered a stroke which led to his death in 1834, at the age of forty-four. Given the life span of John B. Jervis, Canvass White might have equaled his achievements, if not excelled them. Nathan S. Roberts, David S. Bates, Holmes Hutchinson, and David Thomas also received fame from the Erie School of Engineers. Nathan S. Roberts worked on the Pennsylvania Canal System and the Chesapeake and Ohio Canal. David Thomas built the Welland Canal. But none of them ever came close to the accomplishments of Wright, White, or Jervis.

John B. Jervis' real claim to greatness lay not in the construction of canals, but in his balance between canals and railroads. The decade immediately following the completion of the Erie

Canal in 1825 was the period of greatest canal construction. This period was also the pioneer decade for the development of the railroad and locomotive in the United States. When the Erie Canal was completed he went to work for the Delaware and Hudson Canal Company. This company was the first privately owned company to build a canal worth more than a million dollars. Most of the canal projects like the Erie were state financed and owned. While working for the Delaware and Hudson Company he built the third railroad in this country and ordered the first locomotive ever used in the United States. From this time forward John Jervis was constantly sought as the leading expert on both canals and railroads. In the ninety year span of his life he devoted most of his time to the engineering profession.

The engineering profession was highly respected in the days of the Erie Canal. The first field duty was that of the survey for location. The terminal points were usually determined at the outset of the project. The engineer would settle the intermediate line or at least he would make all necessary surveys, maps, and estimates of expense, and give his opinion as to the best route. This method placed a direct responsibility on the engineer who was best qualified to meet it, and whose professional reputation was materially concerned to guard against errors that a future observer might discover. On his skill and fidelity much depended. The directors of a railroad or canal company needed good judgment in selecting an engineer whose experience and skill guaranteed that

the duty would be discharged with ability and fidelity to the interest of the enterprise.[25]

The method of construction during the early period of railroad and canal building was to have maps and profiles of the line, and plans and specifications of the manner in which the work was to be done. As soon as these were prepared the work was advertised for contract and let to the lowest bidder who was considered responsible for the undertaking. Propositions for the work received in this way were reduced to contracts providing for payments at certain rates on the several items. The engineer was made the inspector and the umpire between the parties from whose decision there was no appeal in regard to anything pertaining to the contract, the manner of performing the work, the measurement and estimate of quantities provided for in the contract, and the valuation of any extra work that unforeseen circumstances might call for in the course of construction. In this method the engineer stood between the corporation and the contractor. Upon his capacity for duties and fidelity to the parties the system depended. A want of confidence could not fail to produce dissatisfaction. The whole system could only be maintained by the administration of engineers of sound business experience and unquestionable fidelity of character.[26]

In the early days the engineers were willing to learn from all sources. Jervis said that the running of lines and levels, was

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25. John B. Jervis, Railway Property: A Treatise of the Construction and Management of Railways (1872), p. 44.

26. Ibid., p. 51.

well understood at that time; but the mechanical department of engineering was practically in its infancy. Such matters were freely discussed with intelligent mechanics, whose skill was supposed to be useful in this department of engineering. The plan for a timber trunk for the aqueducts was prepared and submitted by a carpenter, Mr. Cady, of Chittenango. His plan was adopted in nearly all the wood trunk aqueducts on the Erie Canal.[27]

One cause of the success of these engineers may be found in their freedom from restraints of political patronage and official favoritism, and their liberty to choose competent assistants. Jervis said that whatever may have been the views of men in political office, it was not regarded proper to interfere with the economical conduct of business on the canal. In all his seven years of engineering on the Erie Canal no intimation was given him to look to the right hand or the left for any motive, but the strict interest of the canal.[28]

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27. Jervis, Facts and Circumstances, p. 61.

28. Ibid.

LAKE ONTARIO

LOCKPORT

ROCHESTER

LYONS

BLACK ROCK

BUFFALO

LAKE ERIE

GENESEE RIVER

CANANDAIGUA LAKE

SENECA R.

MONTEZUMA

SENECA LAKE

CROOKED LAKE

CAYUGA LAKE

OWASCO LAKE

SKANEATELES LAKE

LIMESTONE CREEK

LAKE ONEIDA

WOOD CREEK

ROME

UTICA

MOHAWK R.

LITTLE FALLS

FONDA

AMSTERDAM

ERIE CANAL

SCHOHARIE RIVER

SCHENECTADY

COHOES FALLS

ALBANY

TROY

HUDSON RIVER

0 10 20 30 40
MILES

ERIE CANAL

SENECA RIVER

ROME SUMMIT LEVEL

UTICA

LITTLE FALLS

SCHOHARIE RIVER

SCHENECTADY

COHOES FALLS

HUDSON RIVER

HUDSON RIVER LEVEL

PROFILE OF MIDDLE AND EASTERN SECTIONS OF ERIE CANAL

Chapter III

Construction of the Erie Canal

Dexterous with an axe, apt and ambitious to learn, eager to do all and more than was required John B. Jervis advanced rapidly in position on the Erie Canal. Starting as a mere axe-man in 1817 two years later he was made a resident engineer on seventeen miles of the middle section extending from Canastota, Madison County, to Limestone Creek, in Onondaga County. This section was a part of the long summit level on the Erie.

When Jervis took over a good deal of the work had been completed. The virgin timber through which the curved line of the canal had to pass was cut. Irish immigrants were imported to dig the channel four feet deep and forty feet wide. During four months of the 1819 season between two thousand and three thousand men with five hundred teams of horses were employed in constructing the middle section of the canal. The work was painfully slow. Most of the digging was by pick and shovel. By October the channel was ready for the test.

On October 21, 1819, two and a half feet of water was let into the Rome section of the canal. Some leakage occurred early the next morning. When the repairs were completed the water level was increased to three feet for a distance of eighteen miles. The first admission of water into a canal is always attended with great solicitude. It is the ultimate test of the accuracy of the levels;

and affords most important inferences as to the solidity and fidelity with which the banks have been constructed, and the sufficiency of the feeders.[1]

The following letter written by a citizen of Utica appeared soon after in the Albany Daily Advertizer:

> The last two days have presented in this village a scene of liveliest interest, and I consider it among the privileges of my life to have been present to witness it. On Friday afternoon I walked to the head of the grand canal, the eastern extremity of which reaches to within a very short distance of the village, and from one of the slight and airy bridges which crossed it I had a sight which could not but exhilarate and elevate the mind.
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> The waters were rushing in from the westward, and coming down their untried channel towards the sea. Their course, owing to the absorption of the new banks of the canal, and the distance they had to run from where the stream entered it, was much slower than I had anticipated. They continued gradually to steal along from bridge to bridge, and at first only spreading over the bed of the canal, imperceptibly rose and washed its sides with a gentle wave.
>
> It was dark before they reached the eastern extremity, but at sunrise next morning they were on a level two feet and a half deep throughout the whole distance of eighteen miles. The interest manifested by the whole country as this new internal river rolled its first waves through the State cannot be described. You might see the people running across the fields, climbing trees and fences, and crowding the bank of the canal to gaze upon the welcome sight.[2]

It was in this vicinity two years earlier that the first shovelful of earth was excavated in the construction of this great work. On October 23, 1819, Governor DeWitt Clinton, Stephen Van

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1. "Commencement of Navigation on the Erie Canal," The Plough Boy, December 18, 1819. Reprinted in Bottoming Out (New York State Canal Society Publication, October, 1957), II, pp. 3-5. Hereafter cited as "Commencement of Navigation."

2. Anon, History of Oneida County, New York (1878), p. 181.

Rensselaer, Henry Seymore, and Benjamin Wright started in a canal boat from the eastern extremity of the middle section on an excursion of curiosity and experiment for Rome. Canvass White, David Bates, and John Jervis were in their company.[3]

Amidst the cheers and shouts of almost the whole neighboring population, the ringing of the church bells in Utica, and the patriotic tunes of a band of music on board the boat began its journey. The craft was drawn by one horse by means of a rope eighty feet long of which one end was connected with the whippletree and the other end with a hook secured to the boat at a little distance from the bow on the towing-path side. Everybody was surprised to see the ease with which a single horse moved at the rate of four miles an hour drawing a boat with from seventy to one hundred passengers on board.[4]

The boat was built at Rome on a neat and convenient model supplied by Canvass White. The dimensions were sixty-one feet long, eight feet wide, and four feet deep with two cabins fourteen feet long. She was christened in honor of Benjamin Wright The Chief Engineer.[5]

The middle section was essentially completed at the close of 1819. The accuracy of the levels was ascertained by the most satisfactory and infallible proof, the admission of water; and boats actually navigated the canal for a distance of seventy-five miles.[6]

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3. "Commencement of Navigation," p. 3.

4. Ibid., p. 6.

5. Ibid., pp. 9-10.

6. Laws ... to the Erie and Champlain Canals, I, pp. 440-41.

There were some deficiencies found in the work which required attention in the spring of 1820. The duty of attending to the final completion of this section was given to John B. Jervis.[7]

In April of 1820 the first voyage was made from the eastern end of the middle section at Utica to the western end at Montezuma on the Seneca River. This section of the canal was ready for navigation. A celebration was held on May 20 when two boats the Montezuma and Chief Engineer made the trip from Utica to Montezuma and returned. The celebration was attended by Governor Clinton and other important dignitaries.[8]

On June 1, 1820, "The Erie Canal Navigation Company" announced that the canal was in operation for the accommodation of passengers for a distance of one hundred miles. Boats were to leave Utica every Monday and Thursday morning at 9:00 A.M. The price for passengers including board was four dollars.[9]

After navigation on the middle section began several places required repairs. It was soon discovered that the supply of water would not be adequate to the requirement of an extensive and increasing transportation. Some time was occupied in repairing breaches, in strengthening weak places, especially those where the high embankments had settled, and in opening several new feeders.[10]

On July 1, 1820, the canal was reopened and tolls were

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7. Jervis, "A Memoir of American Engineering," p. 43.

8. History of Oneida County, New York, p. 181-82.

9. Ibid., p. 182.

10. Laws ... to the Erie and Champlain Canals, II, p. 13.

charged. Three days later, on July 4, the Oneida Chief of Utica met the Montezuma from Cayuga Lake at Syracuse. A distance of one hundred miles had been traveled on the inland waterways of New York. From that time until the ice prevented further travel the sum of $5,244 was received for toll on the middle section of the Erie Canal.[11]

In the meantime the New York State Legislature over the protest of New York City passed on April 7, 1819, an act authorizing the construction of the Erie Canal from the ends of the middle section westerly to Lake Erie and easterly to the Hudson River. The canal commissioners met at the celebration of the opening of the Rome section at Utica in October, 1819, and decided that sixty-three miles of the western section and twenty-six miles of the eastern section should be placed under construction. The distance on the eastern section extended from Utica to the foot of the Little Falls of the Mohawk River. This was the most difficult part on the upper Mohawk above the Schoharie Creek.[12]

The location of the canal between Little Falls and the Hudson River caused the engineers and commissioners much solicitude. Benjamin Wright and Canvass White made repeated investigations to discover some route other than that along the valley of the Mohawk River. Their efforts were unavailing, so the commissioners were forced to adopt a line through this valley until the Cohoes Falls

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11. Ibid.

12. Ibid., I, p. 453.

were reached. Beyond the falls the canal bore to the south, and conforming to a gradual descent of the ground took a direct course to Albany where the junction with the Hudson River was made. Another connection was made with the Hudson opposite the city of Troy. During 1820 the construction of the eastern section was started with a thirty-mile stretch from the termination of the middle section at Utica eastwardly along the Mohawk Valley to the town of Minden. From Minden the survey was continued along the south side of the Mohawk River to the head of the Cohoes Falls. The engineers put the canal line from Minden to Schenectady in a situation to be placed under contract before winter. Canvass White was most responsible for this engineering work and survey.[13]

In the spring of 1821 John B. Jervis was made resident engineer of a division of the eastern section extending for a distance of seventeen miles from "The Nose" to Amsterdam. This was a much more difficult duty than he had on the middle section. The principal difficulties in the construction of this section were in the narrow passes along the Mohawk where the hills crowd to the waters edge and terminate abruptly. In such a situation it was necessary to construct the canal either entirely over the river, or partly in the hill and partly over the river. In either case the foundation must be laid at the bottom of the river and the work must be carried up above the highest floods. The outer slope of the high embankment must also be secured with a covering of stone to prevent the earth from being worn away by the rapidity of the current. The magnitude of these embankments, the quantity of the stone required to protect them, and the

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13. Ibid., II, pp. 16-18.

difficult of excavation through solid rock rendered this job the most expensive of all the undertaking on the Erie Canal. Although there were several other places along the Mohawk Valley where these conditions existed, most of them were within the scope of Jervis' jurisdiction. The most difficult place was at "The Nose."[14] His experience along this section was very valuable when he had to build the Delaware and Hudson Canal along similar precipices on the eastern bank of the Delaware River.

At Schenectady a change of location was made after the canal had been partly constructed. Jervis' description of the change shows an interesting bit of local contention. Schenectady is built upon a tongue of land that projects from a hill on the south side to the shore of the Mohawk River. West of this tongue of land, the half mile wide valley of the Mohawk extends for three miles terminating at a hill reaching to the river. The canal was located along this interval of land with an excavated channel of one to six feet in depth. As the line neared the city, it curved off to the shore of the river, and passed between the tongue of land on which the city was located and the river. This made a cheap line to construct. The canal was nearly constructed down the Mohawk Valley, and some work had been completed along the river shore at Schenectady. This line had been opposed as being liable to damage from floods.[15]

There was much local interest in the location with some heated debate among the citizens. One party favored the location as

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14. Ibid., II, p. 73.

15. Jervis, Facts and Circumstances, cited from Noble E. Whitford, History of the Canal System of the State of New York, I, pp. 107-108.

made while another contended for a line through the center of the city across the elevated tongue of land. At that time it was considered that the business of the city would center on the canal, and hence the local excitement. The river route party was led by Governor Yates; and the town party route by R. Gevins, the proprietor and
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keeper of Gevins Hotel.

The commissioners and engineers were guests at the Gevins Hotel. Mr. Gevins did not lose the opportunity of influencing his guests so far as he could on the question of location. He was very active in advocating the route through the city which would probably run near the hotel. At this time a heavy flood occurred in the Mohawk River raising the water over the banks of the canal and giving great force to the objections against the river route. The engineers saw the necessity of some change, either by a new line or expensive guard
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locks to protect the canal from similar floods.

This circumstance gave energy to the Gevins party. Although much work had been done, they succeeded in impressing on the engineers and commissioners the necessity of a change in the location. Gevins was a sagacious man. He finally induced the engineers to run a new line through the city, and got the canal authorities to vacate
18
the river line.

The day after the decision was made Yates and Gevins met at the halfway house between Schenectady and Albany. Gevins later

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16. Ibid., p. 108.

17. Ibid.

18. Ibid.

said to Jervis that Governor Yates called him out privately and gave him a severe reproof for the course he had taken. He called Gevins an uneasy Yankee that could not be kept still. Gevins said he took the rebuke very quietly, knowing that the matter was settled.[19]

Jervis had the locks at the upper end of the valley taken up, and the canal banks raised to the corresponding new level. The former excavation was not filled up, giving the water in the canal six feet extra depth. The canal sides were suppposed to be water-tight. After the water was let in the sides were found to be full of holes, like pipe stems, made by the decay of aqueous roots. There was a good deal of trouble in securing the banks against this difficulty. In some cases long courses of sheet-piling were put in, but the method adopted for the most part was to line the sides and bottom with sand from the nearby hills. It was not until midsummer 1823 that this section of the canal was improved as to hold water for navigation.[20]

This division and the greater part of the section between Utica and Schenectady was substantially completed at the close of 1822. From four thousand to seven thousand workers were employed during the season on the whole section. By November 15 the canal was so far finished that two feet of water was admitted sufficient to navigate light boats nearly sixty miles from Little Falls to the flats of Schenectady. On the line between "The Nose" and Schenectady there was more light porous soil and more stone work connected with

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19. Ibid., p. 108-09.

20. Ibid., p. 109.

the embankments of earth than on any other part of the canal. In December navigation byond "The Nose" was suspended during the construction of a feeder from the Paper Mill Creek, and while the lining of the canal between "The Nose" and Schenectady was in progress.[21]

On February 24, 1823, the canal commissioners reported to the New York State Assembly that boats had actually passed on the Erie Canal for a distance of more than two hundred twenty miles. They added that in the month of April tolls would begin to be received on two hundred miles of the canal, and that before the end of June the whole line from Rochester to Schenectady would be navigable. Speed on the canal was limited to four miles an hour.[22]

In the spring of 1820 John B. Jervis became well acquainted with Henry Seymour, one of the canal commissioners, while working on the middle section of the canal. These two men soon became good friends. When the middle section was completed both of them were transferred to construction work on the eastern section.[23] When navigation began in 1823 each commissioner divided his jurisdiction of the canal into sections varying in length from twenty to forty miles. To each of these sections the commissioner appointed a superintendent whose duty it was, under the advisement of the commissioner, to keep the canal navigable and in good repair. For this purpose the superintendent was authorized to employ men, teams, boats, and the necessary implements for the repairment of breaches, the enlarging and strength-

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21. Laws ... to the Erie and Champlain Canals, II, p. 109.

22. Ibid., II, p. 95.

23. American Society of Civil Engineering, Proceedings (October, 1885), XI, p. 111.

ening of the banks, and other works. The superintendents were held responsible for the good conduct of the lock keepers; and in case of their neglect of duty were authorized to remove them, and employ other persons to take their places. They were to take notice of, and report to the acting canal commissioner all cases of injury done to the canal, and of abuses committed upon it.[24]

In the spring of 1823 Henry Seymour appointed John B. Jervis superintendent of fifty miles extending from the Minden Dam to the aqueduct across the Mohawk River. This duty was one of personal value to Jervis. He said, "Hitherto I had been exclusively engaged in construction, and this gave me opportunity to see the working of the canal in actual operation, and was highly interesting. It, moreover, gave me experience in the management of such work."[25] In 1823 he did not have exclusive control of this section because some of his brother engineers were more or less occupied in completing their sections. Jervis received full charge in the month of September, and remained in full charge during 1824. Benjamin Wright left for other works during 1823, and was seldom on the canal. The section of the canal under Jervis' charge was about one-seventh of the entire line, and more expensive to operate than the general average.[26]

Henry Seymour gave Jervis full authority in regard to everything relating to the work; making an occasional visit, and consulting

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24. Laws ... to the Erie and Champlain Canals, II, p. 372.

25. Jervis, "A Memoir of American Engineering," p. 43.

26. Ibid.

fully on the wants of the work. There were no politics in the selection of workmen. John selected all the foremen; and visited them all twice every week, personally directing them in regard to their work. No other part of the canal exhibited the same economy. In view of his experience in the maintenance of the canal, Jervis was disturbed to see the subsequent expenditures of from three to ten times the amount on later jobs.[27]

Some of the first work was experimental, of course, and a small percentage of it had to be corrected or replaced; but most of it functioned as desired. There were many bridges over the canal line in this section. The settling of the banks of the canal in some instances reduced the height of these bridges. The matter of their elevation received considerable attention before the work was entirely completed. Even after the canal was completed low bridges were a constant danger on the Erie Canal.

There were other matters which required attention. Portions of new work were damaged by fresh-lets and by frost. Dams were carried away, and banks injured on account of the porous character of the soil of which they were constructed. Many culverts required watching and repairing from time to time.

In May of 1823 the canal navigation was stopped twenty-two miles below Little Falls on account of a deficiency of water between that place and the Schoharie Creek. Under this condition no doubt remained of the necessity of obtaining a more copious feeder from the

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27. Ibid., p. 44.

Mohawk River. A dam was built at the town of Johnsville to supply the needed water. While this work was in progress the banks of the canal were strengthened along the line, particularly near Schenectady.[28] The dam was not finished until September, but the canal was opened between Utica and Schenectady to a limited extent in June.[29]

Between Schenectady and the Cohoes Falls is the most difficult section of the whole Erie Canal. For a great part of this section the bed of the river flows through a deep ravine. The obstacles were so great on the south side of the river that the engineers finally decided to cross to the north side. After passing the most difficult places the canal recrossed the river. After mainly trying to find a suitable location for the canal on the south side, Canvass White decided to try a line along the north side. Finding this side much more favorable, he recommended crossing the river twice. Benjamin Wright and James Geddes carefully examined the situation, and agreed with White. Accordingly, aqueducts were built, one at a place known as Alexander's Mills about four miles below Schenectady and the other at the locality called Fonda's Ferry about four miles above the Cohoes Falls. The portion on the north side of the river between these two aqueducts was about twelve miles long.[30]

The work on the section between Schenectady and Albany began in 1822. During that season five locks were completed, most of the lock pits were excavated, and the materials for the remaining locks

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28. Laws ... to the Erie and Champlain Canals, II, pp. 171-72.

29. History of Oneida County, New York, p. 182.

30. Whitford, op. cit., I, p. 106.

were collected and transported to the places where they were to be used. Most of the excavation and embankment on this part of the line was well under progress.[31] During the 1823 season this section was completed. Water was let into the canal on October 1. There were twenty-nine locks including two at the side cut opposite the city of Troy. This part of the line presented a great variety of formidable and appalling obstruction. In some places it occupied the bed of the river, and was overhung with lofty precipices which seem to threaten the existence of the navigation below. At other places the canal was forced through hills and spurs of rock of more than thirty feet in height. In its course ravines were filled up to the depth of forty feet and valleys were elevated to planes.[32]

On October 8, 1823, the Erie Canal was opened from Rochester to Albany amid great enthusiasm. From that day until the canal was closed by ice there was only one small breach which obstructed the navigation for three days. During this period from thirty to forty boats were frequently seen to pass in the course of twenty-four hours. Among the benefits already resulting from the Erie Canal the commissioners showed that the price of wheat west of the Seneca River had advanced fifty per cent. To appreciate this result it is necessary to understand that wheat was the chief staple crop of New York State, and that the largest portion of wheat was grown west of the Seneca River.[33]

The next year the canal commissioners reported:

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31. Laws ... to the Erie and Champlain Canals, II, p. 111.

32. Ibid., II, pp. 172-73.

33. Ibid., II, p. 174.

> None but those who had examined the line previous to the commencement of the work; who had seen the rude and undulating surface which it traversed, the rocks which were to be blasted, the irregular ledges filled with chasms and fissures which were to form the sides and basis of a water-tight canal; the spongy swamps, and gravel beds, and quick-sands, which were to be made impervious to water; and in short, the huge masses of rough materials which with immense labor were to be reduced to symmetry and form can duly appreciate the effort which it has required to surmount these various obstacles. 34

They continued with the execution of the various works on this section tested all the experience and skill which had been previously acquired by the engineers. It imposed the necessity of constant vigilance in examining and calculating probabilities, in carefully balancing one difficulty against another, and in striving to adopt not only the most judicious plans, but the best mode of effecting them. The canal commissioners and their engineers did not hesitate to admit that had this section been commenced originally while their information of the subject of constructing canals was merely theoretical, it was probable that the attempt to complete the canal would either have been entirely abortive or so imperfectly executed as to have defeated and perhaps postponed for a century the accomplishment of the great work.[35]

After Canvass White left the Erie Canal in 1823 and Benjamin Wright became the consulting engineer on many other canals the responsibility for the entire eastern section from Amsterdam to Albany fell upon John Jervis and Henry Seymour.[36] In the latter part of April, 1824, water was admitted throughout the entire section.

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34. Ibid., II, p. 173.

35. Ibid., II, pp. 173-74.

36. American Society of Civil Engineering, op. cit., p. 111.

In several places the banks had to be raised and strengthened, fences had to be finished, a number of lock keepers' houses had to be built, and a great number of drains had to be cut. In addition, a number of side culverts were required around the locks to conduct the water from one level to another; and the damages throughout the greatest part of the section had to be assessed, entered on record, and paid.[37]

Jervis said that because the work was new there were frequent failures. As weak points developed they were repaired, and the work was constantly improved. In many cases it required a good deal of activity to keep up the navigation. This section was maintained at a cost of six hundred dollars per mile, including a large amount of work in graveling the tow-path.[38]

Henry Seymour reported to the State Legislature in 1825 on the organization of the engineering department. He said that from the beginning the canal commissioners had exercised their power of appointing the principal engineers, while the latter were authorized to employ such subordinate and assistant engineers as the service required. He continued that this mode of organization, if not judicious, was certainly fortunate. The engineers were able and efficient men who discharged their duties in a manner highly creditable to themselves and satisfactory to the public. Their importance was terminated by the near completion of the canal, and several of the principal engineers had accepted employment in the neighboring states.

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37. Laws ... to the Erie and Champlain Canals, II, p. 174.

38. Jervis, "A Memoir of American Engineering," p. 43.

There were, however, a number of experienced and faithful men still employed in directing and overseeing the completion of the unfinished work. These men could be advantageously retained in double capacity of engineer and superintendent.[39]

One of these men which Seymour mentioned was John B. Jervis. Circumstances were working, however, against Seymour and for Jervis. One of the canal projects that Benjamin Wright had undertaken in 1823 was the proposed Delaware and Hudson Canal. This canal was to bring anthracite coal from the northeastern corner of Pennsylvania across a treacherous terrain to New York City. Only two men could qualify to build this canal -- John B. Jervis or Canvass White. Since White had already taken the job of chief engineer for the Union Canal in Pennsylvania, the key position of assistant engineer on the Delaware and Hudson Canal naturally fell to Jervis.

In March of 1825 Jervis resigned from the Erie Canal. After eight years service he left with the unequivocal complement of canal commissioner Seymour.[40] By October of that year the western section of the canal was completed. The grand march to the sea was ready to begin.

On October 26, 1825 the Seneca Chief moved from Lake Erie into the new canal. At once a battery five hundred miles long began to fire. The gunners of Rochester heard a booming in the west and

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39. Laws ... to the Erie and Champlain Canals, II, p. 328.

40. Jervis, "A Memoir of American Engineering," p. 44.

pulled their lanyards. The Syracuse cannoneers sent the sound echoing over the hills to Utica. The valley of the Mohawk gave it a channel toward Albany. Spurts of white smoke crowned the high promontories of the Hudson, and the Catskills resounded with sharp explosions. Man-made thunder shattered against the columned walls of the Palisades. The first message ever carried on sound waves from Buffalo to New York had arrived in eighty-one minutes. The answer was back in Buffalo eighty minutes later. The whole state knew that by a new channel Erie water was running to the sea.

Several boats were in the procession all of them loaded with passengers containing as many as could safely be allowed. Governor DeWitt Clinton was standing in the bow of the first boat. He was well dressed. His feeling exulted the success of the great measure on which he had for many years staked his reputation and for which he had contended against fearful odds and a determined opposition.[41]

When the line of elegant packets reached the ocean Governor Clinton took one of two bright green keys from his boat. Pouring the water from Lake Erie into the Atlantic, he said, "May the God of the heavens and the earth smile most propitiously on this work accomplished by the wisdom, public spirit, and energy of the people of the State of New York and may He render it subservient to the best interest of the human race."[42]

The Erie Canal was three hundred sixty-three miles long.

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41. Levi Beardsley, Reminiscences: Personal and other Incidents; Early Settlement of Otsego County; Notices and Anecdotes of Public Men; Judicial, Legal, and Legislative Matters; Field sports; Dissertations and Discussions (1852), p. 214.

42. Carl Carmer, The Hudson (1939), pp. 224-25.

It was constructed at an average cost of twenty thousand dollars a mile, the total amounting to approximately seven million dollars. The canal was forty feet wide and four feet deep, and could accommodate thirty ton barges. There were seventy-one locks between Albany and Buffalo, of these sixty-six lifted toward the west and five toward the east. Sixteen days were consumed on the average round-trip between Albany and Buffalo, permitting the canal boat fourteen trips during the season.

The Erie Canal immediately provided an all-water route to the West, thus furnishing an outlet for the bulky products of the interior. The time spent in traveling from Buffalo to New York was cut from twenty days to eight days, while freight rates dropped from one hundred dollars to fifteen dollars per ton. Nineteen thousand boats and rafts passed West Troy on the Erie and Champlain Canals during 1826. Within nine years tolls from the canal had paid off the entire debt of the two canals.

Farm produce of western New York doubled in value and that of the states north of the Ohio River was increased. New York City doubled its population between 1820 and 1830 and took from Philadelphia its leadership as the leading port in the United States. Albany, Utica, Syracuse, Rochester, and Buffalo all grew rapidly. The Great Lake cities of Buffalo, Cleveland, Detroit, and Chicago began to rival Pittsburgh, Cincinnati, St. Louis, and New Orleans, as the produce of the Western farmers was drawn through the northern route.

Philadelphia was shocked to find that her cheapest route to Pittsburgh was by way of New York City, Albany, Buffalo, and wagon road from Lake Erie. Pennsylvania in order to counteract the growth of New York State built the expensive portage system across the Alleghenies. Many other states began to build canals with each city hoping to be connected with the next by canal. The canal mania was on and would not be stopped until the railroad gained the lead. To build these canals and railroads the Erie had fathered a new breed -- the civil engineer.

BINGHAMTON
SUSQUEHANNA RIVER
DEPOSIT
DELAWARE RIVER
KINGSTON
EDDYVILLE
ROSENDALE
ROUND OUT CREEK
ELLENVILLE
PHILIPSPORT
SUMMITVILLE
MOUNTAIN
CANAL RESERVOIRS
NEVERSINK RIVER
WESTBROOK-VILLE
SHAWANGUNK
NEWBURGH
SUSQUEHANNA RIVER
LACKAWANNA RIVER
CARBONDALE
DYBERRY CREEK
HONESDALE
HAWLEY
LAKE WALLENPAUPACK
RIVER
HAWKS NEST MT
SAWMILL RIFT
PORT JERVIS
CARPENTERS POINT
SCRANTON
WILKES-BARRE
DELAWARE RIVER
NEW YORK CITY

DELAWARE AND HUDSON CANAL

Chapter IV

Assistant Engineer of the Delaware and Hudson Canal

The anthracite area of Pennsylvania occupies about five hundred square miles embracing three great regions, the Schuylkill Valley or southern region, the Lehigh Valley or middle region, and the northern region including the Lackawanna Valley, Scranton and Wilkes-Barre. As early as 1808 Judge Jesse Fell of Wilkes-Barre showed the value of anthracite coal as a heating agent.

The pioneer of the Delaware and Hudson Canal was Maurice Wurts, a merchant of Philadelphia. During the War of 1812 he discovered coal in the Lackawanna Valley, and hoped to market it. In 1814 he selected and obtained control of several thousand acres of land in this valley for a price of fifty cents to three dollars per acre. The first attempts to market the product in Philadelphia met with failure. In order to improve transportation Maurice and his brothers applied to the Pennsylvania Legislature for permission to improve the Lackawaxen River, a tributary of the Delaware River. On March 13, 1823, this plea became law.[1]

By 1823 the supply of coal from the Lehigh Valley had so reduced the price in Philadelphia that the profit would not justify the transportation. A new market was needed. At that day the city of New York received mineral oil for fuel from Richmond, Virginia, Nova Scotia, and England. The rest of their fuel was supplied by wood.

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1. H. Hollister, Contributions to the History of the Lackawanna Valley (1857), pp. 286-90.

When the original plan was frustrated by the reduced price of coal Maurice Wurts, in whom the privilege of improving the navigation of the Lackawaxen River was vested, conceived the project of reaching the New York market by a direct canal communication between the Delaware and Hudson Rivers. With the hope of accomplishing this object William Wurts began to explore the route on which the Delaware and Hudson Canal was constructed. After a superficial inspection he came to the conclusion that the character of the ground and the abundant supply of water would justify the prosecution of the enterprise.[2] On April 23, 1823, the Delaware and Hudson Canal Company was incorporated with a capital of five hundred thousand dollars in shares of one hundred dollars each to open a communication between the Hudson and Delaware Rivers.[3]

In the spring of 1823 Maurice and William Wurts secured the services of Benjamin Wright, chief engineer of the Erie Canal, and in May of that year instructed him to have a proper survey or running level carried over the country from the tidewater of the Hudson River, at the mouth of the Walkill, up the valley of the Rondout, and thence over to the Delaware River, and thence up the same to the confluence of the Lackawaxen, and thence up the Lackawaxen to a point as near to the coal mines as possible.[4]

The first official survey was made by John B. Mills and Edward Sullivan under directions from Wright. From the survey made by

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2. Ibid., pp. 290-91.

3. Laws ... to the Erie and Champlain Canals, II, p. 609.

4. Noble Whitford, History of the Canal System of the State of New York, I, p. 732.

these two men, a map was prepared and widely circulated in the New York and Philadelphia financial circles. It was a copy of this map that first brought the enterprise to the attention of one of the most influential men of the time, Philip Hone. Hone immediately became interested in the proposition, and his name alone gave assurance to others that the venture was likely to succeed.[5]

On December 7, 1823, a more thorough survey was begun, likewise, under the direction of Benjamin Wright. Colonel John L. Sullivan, builder of the Middlesex Canal in Massachusetts, was employed to make the survey. Wright's young assistants, John Mills and Edward Sullivan gave him valuable aid. One month later they finished their survey and published their report. A canal four feet deep and thirty-two feet wide at the surface could be dug for nearly one million three hundred thousand dollars. They figured the cost of a canal from the Hudson River to Saw Mill Rift on the Delaware River, and slack-water navigation up the Delaware and Lackawaxen to the foot of Moosic Mountain at Keen's Pond. A railroad would carry the coal over the mountain from the coal mine. This estimate included an extra five per cent for unforeseen expenses.[6]

On April 7, 1824, the New York State Legislature increased the company's stock issue to one million five hundred thousand dollars, and empowered the Delaware and Hudson Canal Company to go into the banking business with fifty thousand dollars of its surplus funds for

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5. Edwin D. LeRoy, The Delaware and Hudson Canal, A History (1950), p. 8.

6. Ibid., pp. 8-10.

unforeseen expenses.[6]

On April 7, 1824, the New York State Legislature increased the company's stock issue to one million five hundred thousand dollars, and empowered the Delaware and Hudson Canal Company to go into the banking business with fifty thousand dollars of its surplus funds for a period of twenty years, if they would begin construction within six months of their organization.[7]

Subscription books for the purchase of stock in the Delaware and Hudson Canal Company were opened on January 7, 1825, and by 2:00 P.M. that day all of the stock had been sold. In spite of the avidity with which the public subscribed to the stock of the company, there were still many who doubted the practicability of building a canal over such mountainous country. The Gazetter, a New York City newspaper of the time, commented:

> A good deal has been said among some very enterprising and intelligent persons about a canal making an artifical navigation between the Hudson and Delaware Rivers to bring coal of the Lackawaxen, a river in Pennsylvania, to the New York market.
>
> People, generally, doubt the practicability of the proposed route from the vague ideas of the mountain character of the intermediate country.[8]

On March 8, 1825, the first Board of Managers of the Delaware and Hudson Canal Company was elected at the Tontine Coffee House in New York City. Three days later Philip Hone was elected president, and John Bolton was elected treasurer. One of their first acts was to

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6. Ibid., pp. 8-10.

7. "Building the Delaware and Hudson Canal," Olde Ulster: An Historical and Genealogical Magazine (August, 1910), VI, pp. 233-34.

8. LeRoy, op. cit., pp. 13-14.

engage the services of Benjamin Wright as chief engineer.[9]

At this time John B. Jervis resigned from the Erie Canal and took his first steamboat ride from Albany to New York City. Soon after his arrival in New York he had an interview with Benjamin Wright. At the insistence of Wright, John had a conference with a committee of the Board of Directors of the Delaware and Hudson Company which resulted in his employment as principal assistant engineer on May 12 with Wright as the chief engineer.[10]

Benjamin Wright held the position of chief or consulting engineer for several other works. It was understood that Jervis would organize the engineering force and superintend the general duties of the service. While he had the benefit of the advice of the chief engineer it was his duty to examine the route, make surveys, and establish the location of the canal. He was also to prepare the plans and specifications of the various structures required for the canal. The discussion of all particulars and difficult situations was, as a matter of course, referred to the chief engineer for his decision.[11] In receiving this duty John Jervis climbed another rung on the ladder of success.

To these engineers the managers of the company submitted the reports of Colonel John Sullivan and John B. Mills, requesting a critical examination of the line proposed for a canal from the Hudson River to the coal mines. They were to revise and make accurate esti-

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9. Delaware and Hudson Company, A Century of Progress: History of the Delaware and Hudson Company, 1823-1923 (1925), p. 23.

10. Jervis, Facts and Circumstances, p. 82.

11. Ibid., pp. 82-83.

mates in order that the question of prosecution or abandonment of the project might be decided.[12] With these instructions, the reports and maps made the previous year, and John B. Mills, Jervis set out for the field of operation. The next day they arrived at Kingston, the eastern terminus of the proposed canal.[13]

Mills and Jervis traveled on horseback from Kingston through the Mamakating Valley sixty miles to the Delaware River, and up this river about three miles to Sawmill Rift. From this point there were no roads. It was impracticable to travel in the saddle north through the Delaware Valley. They sent their horses by way of Milford, Pennsylvania, to Mount Morviah on the Lackawaxen River, a distance of thirty miles; and then proceeded on foot with the examination of the canal.[14]

Jervis found the lower ten miles of the Rondout Valley rougher than the country he had been accustomed to seeing along the Mohawk River. Although there were serious obstacles on the route between the Hudson and Delaware Rivers which could only be partially understood by such an examination, the country generally had a reasonably fair look for a canal. This part was easy compared to the Delaware section. On passing up the Delaware River the severe aspect of the bold steep shores and its rapid current looked very unfavorable, compared with anything he had seen before as a route for a canal.[15]

After passing Sawmill Rift the two engineers traveled over a hill that formed the shore of the river at Butler's Falls, a dis-

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12. Whitford, op. cit., I, p. 736.

13. Jervis, Facts and Circumstances, p. 83.

14. Ibid., pp. 84-85.

15. Ibid., p. 85.

tance of about one mile. The path was about three hundred feet above the river. At the time of the examination the ground was covered with one inch of snow which had fallen the previous night. The snow made walking on the steep slanted ground rather difficult, requiring Jervis and Mills to seize the bushes and limbs of trees for support. Jervis said:

> As we began to descend the hill above the Falls, we had a fine view of the river below. The bold rocks rising nearly perpendicular from fifty to two hundred feet above the river, the turbulent action of the water at its base with the general gloom as heightened by the snow and the wild surroundings of the scene made an impression on my mind that fifty years have not eradicated. It certainly presented a very unfavorable situation for a canal, and did not fail to impress the difficulties of the enterprise. 16

The same precipitous shore of the Delaware continued with modifications to the mouth of the Lackawaxen River, a distance of seventeen miles. Although no other place was as severe as Butler's Falls, at several points they were compelled to leave the shore of the river and follow foot paths over the rocky ledges. At Meeteck Falls, in passing along one of these paths, Jervis' foot was caught in a bear trap that was set in the path. The trap was covered with leaves and hidden from view. Fortunately, the jaws of the trap caught the heel of his boot, and no harm resulted. The trap was large enough to have broken John's leg had it struck him in the right place. The water in the river was at a good rafting pitch. The occasional passage of a lumber raft was the only stir that gave evidence of civilization in this district. 17

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16. Ibid., pp. 85-86.

17. Ibid., pp. 86-87.

The Lackawaxen Valley for about fifteen miles from the mouth of the river presented a bold character, but was less severe than that portion of the Delaware Valley described. The remaining ten miles to the junction of the Dyberry Creek was comparatively moderate. They arrived at the mouth of the Dyberry in about eight days from Kingston.[18]

Jervis and Mills then proceeded seven miles up the valley of the west branch of the Lackawaxen to Keen's Pond, the proposed terminus for the canal. This valley from the mouth of the Dyberry was less precipitous than that of the Lackawaxen Valley below. In his report Colonel Sullivan had terminated the navigation at Keen's Pond, and proposed a railroad to carry the coal from the mines in the Lackawanna Valley to Keen's Pond. He suggested in his report that he was of the opinion further examination of the area would show the practicability of carrying the canal from Keen's Pond to the coal mines. Jervis saw nothing to warrant this suggestion. He supposed it had its origin in the views of that day on the superior economy of canal transportation.[19]

After visiting the mines in the Lackawanna Valley they retraced their steps, giving special attention to such prominent objects on the route as demanded more careful attention than they were able to give on their first examination. John Mills afforded Jervis the aid he was prepared to give from his experience of the previous year.[20]

Sullivan's plan was to make about three-fifths of the work between the Hudson and the Delaware Rivers through the Mamakating

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18. Ibid., p. 87.

19. Ibid., p. 87-88.

20. Ibid., p. 88.

Valley a regular canal, and the remaining two-fifths slack-water navigation. After reaching the Delaware Valley his plan was mostly by locks and dams forming pools or slack-water for navigation. This last was a feature of the enterprise which had to be decided before the work of construction could be commenced. This feature was an important matter of the examination, and Jervis made it the subject of special attention. It did not appear to him that the character of the rivers was favorable to Sullivan's plan for slack-water navigation. The rapid fall in the rivers and their great rise in time of floods would require great expense in constructing dams, guard locks, and guard banks to protect the navigation of short pools. Jervis formed the opinion that an independent canal would be at least as cheap and at the same time afford better navigation. Therefore, he reported in favor of an independent canal as most suitable for the enterprise.[21]

Jervis also recommended that the canal be terminated at the Forks of the Dyberry, instead of Keen's Pond. There was too steep an ascent from the Dyberry to Keen's Pond. The cost of building additional locks would be too expensive, and the water supply was not adequate for such an operation.[22]

After Jervis returned to Kingston the Delaware and Hudson Canal Company ordered him to examine as a possible route for its canal the region from Carpenter's Point at the mouth of the Neversink River, easterly through Sussex County in New Jersey and Orange County

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21. Ibid., p. 90.

22. Ibid., p. 91.

in New York, to Cornwall-on-the-Hudson; and to render a report.[23] The previous year the people of Newburgh, New York, had petitioned the State Assembly to build a canal from their city to the Delaware. On April 9, 1824, the Orange and Sussex Canal Company was incorporated with a capital of six hundred thousand dollars to open a communication between the Hudson and Delaware Rivers.[24] The Newburgh people proposed to tunnel the Shawangunk Mountain near Westbrookville, New York, and shorten the distance of the trip between the coal mines and New York City by at least fifty miles.[25] Jervis explored this route and decided that the tunneling was too expensive. If a second railroad were built across the mountain, the cost of loading and unloading the canal boats would exceed the expense incurred by traveling the fifty extra miles. Therefore, he abandoned the complete idea.

A second examination of the canal line was made by John Jervis and Benjamin Wright. After making the examination Wright assented to the views of Jervis. On May 21, 1825, Wright rendered a report discussing the route that should be adopted for canal construction. In it he expressed a clear preference for the route that in actual construction was substantially adopted. Beginning at the tide-water lock at Eddyville the boats would pass through Rondout Creek for three miles to the point where the actual canal would begin. The canal would rise through a series of fifty locks to an elevation of five hundred twenty-five feet above sea level. It would then con-

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23, Delaware and Hudson Company, op. cit., p. 25.

24. Laws ... to the Erie and Champlain Canals, II, p. 609.

25. James S. McEntee, "James S. McEntee's Story of the Canal," Olde Ulster: An Historical and Genealogical Magazine (October, 1910), VI, p. 295.

tinue along that level for sixteen miles to the Neversink River before descending fifty-eight feet through a series of six locks to a twelve mile level. From the western end of this level, at Butler's Falls on the Delaware River, the canal would rise to an elevation of nine hundred seventy-two feet at its western terminus. Wright also recommended with a master's confidence the building of a railway as the final link between the navigation and the mines. He said, "There remains then only a good road, or a railroad,--the latter I think will be preferred."[26]

The first sixty miles of the canal followed the first major road in the United States built by the Dutch settlers of New York State. The Dutch built the "Old Mine Road" from the famous Delaware Water Gap north along the east side of the Delaware River to the mouth of the Neversink River and through the Mamakating Valley to Esopus (Kingston, New York) some one hundred sixty-five years earlier. In 1659 the Dutch west India Company began to search for copper along the Delaware Valley which led to the discovery of the copper mines at the Delaware Water Gap. Many Dutchmen had subsequently settled along this route.[27]

By an act of April 1, 1825, the State of Pennsylvania authorized the Delaware and Hudson Canal Company to succeed to the rights of Maurice Wurts and others associated with him to improve the navigation of the Lackawaxen River and its branches, provided such succession was agreeable with the Wurts' interest. Three months later,

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26. Delaware and Hudson Company, op. cit., pp. 27-28.

27. C.G. Hines, Hines' Annual, 1908: Fact, Fancy and Romance of the Old Mine Road, Kingston, New York, to the Mine Holes of Pahaquarry (1909), pp. 1-5.

on July 2, the Board of Managers agreed with the Lackawaxen Coal Mine and Navigation Company for the transfer to their company of the mining properties and canal privileges in the State of Pennsylvania. The Lackawaxen Coal Mine and Navigation Company received for this surrender forty thousand dollars in cash and two hundred thousand dollars of the Delaware and Hudson Canal Company's stock.[28]

John B. Jervis needed experienced engineers to help build the canal. John B. Mills was his only experienced engineer at the outset of the work. He was placed in charge of the first party for the actual location of the canal, commencing his work at tide-water on the Hudson.[29] In June James S. McEntee joined Jervis on the Delaware and Hudson Canal. McEntee knew Jervis previously. He had started out as an axe-man on the Erie Canal in 1819 at the age of nineteen, and had helped Jervis during the 1821-22 season on the difficult section between Amsterdam and "The Nose." Later he had helped to superintend on the eastern section of the Erie.[30]

Mills and McEntee were the only two qualified engineers that Jervis had when construction began in July. But as time went on, he was able to improve their service by men who developed sagacity and showed themselves able to take higher places than they were first called to fill. Two such men were James Archbald and Horatio Allen. These two were sent to Jervis from the Delaware and Chesapeake Canal by Benjamin Wright. Later in the year Jervis obtained the services of Portus R. Root, who had several years experience

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28. Delaware and Hudson Company, op. cit., p. 26.

29. Jervis, Facts and Circumstances, p. 96.

30. Nathaniel B. Sylvester, History of Ulster County, New York (1880), p. 204.

on the western section of the Erie Canal, and John T. Clark, who had experience on the eastern section of the Erie.[31] In 1826 Russell Lord completed the seven-man team of engineers for the Delaware and Hudson Canal.[32]

John H. McAlpine was another valuable assistant to whom Jervis intrusted the machinery department. McAlpine introduced his son, William, to Jervis; and requested that he should be placed in one of the engineering parties. William McAlpine was then about sixteen years old. He was a light, active, and pleasant boy. Advancing from station to station, he was many years in Jervis' employ; always manifesting capactiy, industry, and fidelity. Jervis said, "He was one of my most esteemed assistants."[33]

On July 13, 1825, near the present town of Summitville, Sullivan County, New York, Philip Hone turned the first shovelful of earth in the construction of the Delaware and Hudson Canal. Later the same month the first contracts for construction of sixteen miles of the canal known as the "Summit Level" were signed.[34] Horatio Allen was made resident engineer of this section.[35]

Active work under contract began at once. In a letter to the editor of the Independent Republican, Goshen, New York, a corres-

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31. Jervis, Facts and Circumstances, p. 96.

32. McEntee, op. cit., p. 300.

33. Jervis, "A Memoir of American Engineering," p. 49.

34. LeRoy, op. cit., p. 14.

35. Edwin B. Callaway, History of and Documental Proof that the "Stourbridge Lion" was the First Locomotive to Turn a Wheel on a Railroad on the Western Hemisphere (undated), p. 14. Hereafter cited as Edwin B. Callaway, Stourbridge Lion.

pondent in Montgomery, New York said:

> I have just returned from a visit to the Hudson and Delaware Canal. There are about 1,000 men employed already, and increasing daily. The contractors appear to be men of business, and their men are civil. I was gratified to see the management of the contractors. They have their rules and regulations, which if any trespass they are immediately discharged. They are prompt in their payments, and give from $12 to $14 per month for good hands. The engineers are busily engaged in establishing the line. It is expected that the whole line from the Hudson to the Delaware will be under contract by the first of November next, and that the canal between these rivers will be finished in the course of next season. 36

Rensselaer Schuyler took a contract to build thirty locks for the canal. He transported a quantity of cement to the site of the first lock from Chittenango, Madison County, New York, where Canvass White had discovered a deposit in 1818. Within a few weeks of the day the first sod for the canal was turned the engineers noticed a close similarity of the rocks at High Falls to that at Chittenango, and determined to ascertain its value and adaptability. A quantity was blasted out, burned in the forge at High Falls, pounded to the necessary fineness, and thoroughly tested. To the delight of the engineers it was found to be of the finest quality, superior to any natural cement then known. Here was the material needed right upon the spot. No more cement would have to be brought from Chittenango. 37

Immense deposits of cement rock were also discovered near the town of Rosendale, several miles east of High Falls. The quarry-

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36. Edward H. Mott, "The Antiquarians' Story of Anthracite," Independent Republican, Goshen, New York, February 16, 1918.

37. "Building the Delaware and Hudson Canal." op. cit., pp. 235-36.

ing, burning and grinding of cement began in earnest the next spring. John Littlejohn took a contract to furnish all that was needed in the construction of the canal. This was the cement later known as Rosendale which supported a great industrial district in the Rondout Valley.[38]

On November 7, 1825, the route of the canal through the Rondout Valley for a distance of sixteen miles was settled, and on December 6 the last contract was let for construction between the Hudson and Delaware Rivers.[39] The line between the two rivers was divided into four main divisions. James S. McEntee was appointed the resident engineer of the Rondout Creek section extending twenty miles from tide-water at Eddyville to Ellenville. He also had charge of the construction of the docks at Rondout.[40] John T. Clark was appointed resident engineer of the Ellenville section extending about eight miles from Ellenville to Phillipsport. The ascent in this section was very steep. There were fifteen locks within three miles at Phillipsport raising the canal level about one hundred fifty feet. Sixteen miles of the Summit Level from Phillipsport to Cuddebackville were given to Horatio Allen early in the summer. Four canal reservoirs were built in the mountain on the north side of the canal to feed the Summit Level. Portus Root was appointed resident engineer of the Neversink section extending from Cuddebackville to the Delaware River. With the exception of six locks at the eastern end this

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38. Alphanso T. Clearwater, The History of Ulster County, New York (1907), p. 358.

39. Delaware and Hudson Company. op. cit., p. 32.

40. Sylvester, op. cit., p. 204.

section was one continuous level.[41]

DeWitt Clinton, Governor of New York, in his annual message delivered January 1, 1826, referred to the Delaware and Hudson Canal. He said:

> The whole extent of this proposed work is about one hundred fourteen miles. Sixty-three miles are already under contract and in a state of considerable progress. More work has been performed on it than was done on the Erie Canal the first year, although the latter was begun much earlier in the season. This communication will be very important for the supply of anthracite coal and other useful minerals, lumber and other products of the fertile regions with which it will have connection. [42]

On January 7, 1826, Philip Hone resigned from the presidency of the Delaware and Hudson Canal Company. He had been elected the Mayor of New York City, and felt that his duties as mayor would prevent him from doing justice to the canal company. On January 21 Hone was made a permanent member of the board of managers, and John Bolton was elected the second president of the company. Hone kept a very active interest in the company's affairs throughout the rest of his life.[43]

The Kingston Advocate reported twenty-five hundred men and two hundred teams at work in the spring of 1826, and added that more were needed.[44] John B. Mills was ordered to locate the canal north along the eastern bank of the Delaware River from the mouth of the

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41. Letter from John B. Jervis to Russell Lord, 1826, in the collection of Emma Jane Weale, Port Jervis, New York. Hereafter cited as Weale's Collection.

42. Mott, op. cit., February 16, 1918.

43. Delaware and Hudson Company, op. cit., p. 32.

44. LeRoy, op. cit., p. 14.

Neversink River to the mouth of the Lackawaxen River. Russell Lord and James Archbald were rodmen in his party.[45]

In order to guard against drought, of which the summer of 1825 had furnished a warning, Jervis deemed it advisable to bring the Neversink River into the western end of the Summit Level. This added thirty thousand dollars to the original estimates. It gave a continuous summit level of sixteen miles to the canal, supplied water in descending towards both the Hudson and the Delaware Rivers, lessened the descent to the latter river twenty-two feet, and reduced the ascent the same number of feet.[46]

Work on the canal was pushed with full force throughout the 1826 construction season. On November 25, 1826, the eastern terminus of the Delaware and Hudson Canal was opened with a joyous celebration. John Bolton, Maurice Wurts, John Jervis, and James McEntee were the honored guests on board the Morning Star. The boat entered the tide-water lock at Eddyville and followed the flat smooth surface of the Rondout to the third and fourth locks. After the officials inspected these works and gave a few remarks the boat returned to the starting point. The Ulster County Sentinel in discussing this event four days later said that "the water is now filling in the canal from the eastern termination to the summit level of the Delaware River--a distance of thirty miles--and the whole line of the

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45. Letter from John B. Jervis to Russell Lord, 1826, Weale's Collection.

46. J.A. Clark, The Wyoming Valley, Upper Waters of the Susquehanna and the Lackawanna Coal Region (1875), p. 137.

eastern section is expected to be completed in less than two weeks."[47]

On March 14, 1827, Benjamin Wright resigned as the chief engineer of the Delaware and Hudson Canal Company. Wright recommended that John B. Jervis succeed him in the position.[48] Jervis had gone over the complete route thoroughly, and had recommended some changes from the original survey which saved the company money. He had organized an engineering force of ambitious young men who had met every expectation, and had carefully inspected their work.

On the same day that Wright resigned the company appointed Jervis chief engineer at a salary of four thousand dollars yearly. The most difficult part of the construction lay ahead. The canal had to be built from Butler's Falls on the Delaware River to its western terminus on the Lackawaxen River, and the railroad had to be built across the Moosic Mountain from the terminus of the canal to the coal mines in the Lackawanna Valley. After surveying for the railroad Jervis ordered the first locomotive to be used in the United States from England. He had one of his foremost pupils, Horatio Allen, buy the locomotive; and run it on the railroad. These three projects plus the final details of construction would keep John B. Jervis busy for the next three years.

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47. "Building the Delaware and Hudson Canal." op. cit., pp. 257-64.

48. Delaware and Hudson Company, op. cit., p. 42.

Chapter V

The Canal Port of Jervis

After John B. Jervis was made chief engineer in March of 1827 the engineering force was rearranged. James McEntee was appointed resident engineer and superintendent of the nearly completed canal from the Hudson River to the Delaware River. It was his duty to maintain navigation on the canal after each section was completed, just as Jervis had superintended the eastern section of the Erie Canal. He was also given the job of building the docks at Rondout. McEntee held this position from 1827 to 1830.[1]

Work continued on this section throughout the spring of 1827. On July 4, 1827, the Kingston, New York, Plebian published an article stating that water would soon be let into the canal.[2] Water was let into the canal during the first week of July, 1827, and appropriate celebrations were held along the line of the canal. It was soon found that the banks were too porous to hold a boating head of water and several of the locks were imperfect. It was not until September 15 that the first freight, a raft of pine lumber consigned to Theron Steel of Kingston, was shipped from Warwarsing.[3]

Along the line of the canal artificial ponds or basins were built for regular stopping places to load and unload merchandise. These basins were also largely utilized as locations for the construction of canal boats. They were named for important men in the

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1. Nathaniel Sylvester, History of Ulster County, New York, p. 204.
2. Edwin LeRoy, The Delaware and Hudson Canal: A History, pp. 14-15.
3. Ibid., p. 15.

service of the Delaware and Hudson Canal Company. Honesdale and Phillipsport were named for Philip Hone, Port Jackson for President Andrew Jackson, Port Benjamin for Benjamin Wright, Port Clinton for Governor Clinton, Bolton Basin for John Bolton, and Port Jervis for John B. Jervis.

The company planned to make a basin at the place where the canal turned from the Neversink Valley into the Delaware Valley. At that time this area was mostly farm land owned by Stephen St. John, Wilhelmus Westfall, and Moses Cuddeback. The name Port Jervis was given to this basin during the summer of 1827 while that portion of the canal was in process of construction. James McEntee said that a number of people, accidentally gathering at a blacksmith's shop, were discussing the subject of a name for the place. It had previously gone by the name of Carpenter's Point, although that particular locality was in reality a mile below the basin where the Neversink River empties into the Delaware River. McEntee said that during the discussion a Mr. Valentine, happening to arrive on the scene, was asked to suggest a name. "Call it Port Jervis," he said, "in honor of John B. Jervis, the chief engineer of the canal."[4] It has since borne that name. Jervis said that he knew nothing of the proceeding until it was publicly announced. "At that time the place had very little to give importance to the name, but the natural position was beautiful,"[5] he added.

Stephen St. John came to this locality in 1819, and bought a quantity of land on the flats including an old stone house at Germantown. The house had been burned during Joseph Brandt's raid

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4. James S. McEntee, "James S. McEntee's Story of the Canal," p. 296.

5. Letter from John B. Jervis to Russell Lord, 1882, in the collection of Port Jervis Free Public Library, Port Jervis, New York.

through the Delaware Valley in 1779, and rebuilt in 1793. John Jervis was the guest of St. John when in the area, and frequently stayed in this house.[6] St. John was the first Yankee to settle among the Dutch landed proprietors in the valley. He was the first collector for the canal at Port Jervis, and was the agent of the powder company in supplying the contractors in the Delaware Valley with blasting powder.[7]

In 1828 the main part of Port Jervis including a part of Germantown was owned by Wilhelmus Westfall. When the company had completed their canal to Port Jervis they were desirous of purchasing all this land. They offered Westfall four thousand dollars for it. The company said that if it could not buy this land, it would not build a basin for constructing canal boats or make Port Jervis a stopping place. Westfall finally decided to accept the offer.[8] The company executed their part of the agreement.

The canal company planned and mapped Port Jervis on liberal lines. It established the port as its central point with a boat yard and dry dock for the building and repairing of boats. The company planned the new Main Street nine rods wide. This street from the canal to the tavern at the great oak tree made possible the parking of a double row of the great logging and timber wagons on either side with a free central driveway. It provided land for a free public school, three churches, and a public play ground. Main Street from

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6. Ibid.

7. William H. Nearpass, "Judge Nearpass Tells of Early Canal Days and the Bringing of the Erie to Port Jervis," The Port Jervis Union, March 16, 1923. Hereafter cited as The Nearpass Story.

8. "Forty-six Years Ago--Port Jervis Then and Now," The Evening Gazette, Port Jervis, New York, April 14, 1874.

the canal to and around the great oak tree became the first race track in the area. This street also became the parade and drill ground.[9] The land which was purchased by the company remained in its possession for two decades until the Erie Railroad was built to the village.

Port Jervis remained an active canal village for nearly twenty years. In 1846 a citizen of the area said that the port was a small village on the canal where it first approaches the Delaware. It was located one mile north of Carpenter's Point and the junction of the Neversink and Delaware Rivers. The village owed its population and importance to its position about midway between Honesdale, Pennsylvania, and Kingston, New York, the two terminals of the Delaware and Hudson Canal. There were five stores in the village; three taverns in spacious buildings; one three-story grist mill; three churches, a Dutch Reformed, Baptist, and Methodist; and one large school house. Coal and lumber were sold in considerable quantities. A mail route from Kingston, New York, to Milford, Pennsylvania, and to Philadelphia passed through the village.[10]

John B. Jervis had the deciding influence in bringing the New York and Erie Railroad (present day Erie Railroad) through Port Jervis and up the Delaware Valley. Although he was never the chief engineer on this project, he made important decisions which affected the railroad and the canal village of which he was the godfather.

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9. William L. Cuddeback, Deerpark: The Delaware and Hudson Canal (1928), pp. 12-13.

10. Russell Headley, The History of Orange County, New York (1908), pp. 209-10.

The New York and Erie Railroad Company was chartered in 1832 to build a railroad from Piermont-on-the-Hudson through the southern counties of New York to Dunkirk on Lake Erie. The construction of a railroad of such length over a country, much of it broken, hilly and forbidding, was a herculean task that not only required "faith and works," but a large expenditure of money.[11]

The railroad applied to the New York State Legislature for financial aid. Wishing to learn the comparative advantage of canals and railroads the Assembly on February 23, 1835, addressed a resolution to the canal commissioners. They requested a report on the relative charges for transportation, and an enumeration of articles that could be better carried by rail than by water.[12]

The commissioners selected John B. Jervis, Holmes Hutchinson, and Frederick C. Mills to investigate the subject. In submitting their report to the Assembly on March 14, 1835, they said:

> It is believed that it will not be difficult to show that the expense of transportation on railroads 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 compute with their interest. 13

In summarizing their report the engineers declared their

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11. Levi Beardsley, Reminiscences, pp. 403-04.

12. Noble Whitford, History of the Canal System of the State of New York, I, pp. 142-43.

13. Ibid., I, p. 143.

opinion that canals, in general, had decided advantages over railroads, saying:

> 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 railroads both in their construction and repairs.
>
> In regard to their relative matters as affording the means of transportation.... 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. 14.

New York State loaned the New York and Erie Railroad company three million dollars credit to expedite the construction of the road. The bill was debated in the State Senate for several days, and was passed by a small majority on April 20, 1836. On that day Levi Beardsley, a strong advocate for internal improvements, closed the debate. He said that it would be only a few years before a railroad would be carried up Lake Erie, uniting with some one or more of the railroad routes to the Mississippi. Beardsley believed that within fifteen years this would be accomplished, and that within ten years there would be a continuous and unbroken communication by railroads and steamboats from New York City to St. Louis. He finished his speech by saying, "Is it extravagant to believe that before another thirty-six years expire we shall not only have an organized state government beyond the rocky mountains with important commercial cities, but a communication by steamboat and railroad to the mouth of the Columbia?" [15]

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14. Ibid

15. Beardsley, op. cit., pp. 407-8. Beardsley was exceptionally accurate in his prediction. The first railroad to reach Chicago was the Michigan Southern and Northern Indiana in 1851 built by John B. Jervis. The first to reach the Mississippi River was another Jervis project, the Chicago and Rock Island Railway, in 1854. The year 1869 completed the railroads march from sea to sea.

In 1843 when the construction of the New York and Erie Railroad reached Middletown, New York, a disagreement arose concerning the course of the route across the State to Binghamton. One group wanted to build a high viaduct across the Neversink Valley near Cuddebackville, and to run the railroad through the hills of Sullivan County to the Delaware River. A second group wanted to build a steep grade down the Shawangunk Mountain and to run the railroad up the Delaware Valley from Port Jervis.[16]

John B. Jervis was chosen as chairman of a commission of seven to decide the route question. Jervis writing to a resident of Port Jervis in March, 1882, said that the only important service he had with the Erie Railroad was as chairman of a commission to decide the question of location between Middletown and Binghamton.[17]

The commission appointed Jervis chairman with authority to conduct all necessary surveys. After surveys, maps and estimates had been prepared the commission in a body made an examination of both routes. They met with bodies of citizens, and listened to their arguments. During this journey most of the commissioners were very reticent as to their opinions. They left Binghamton and proceeded in a body to Utica. On the way much incidental discussion took place. Jervis formed the Board of Utica, and took the first informal vote before any definite discussion took place. Four of the commissioners voted for the inland Sullivan County route and the other three for the

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16. The Nearpass Story.

17. Ibid.

18

Delaware Valley route.

Jervis said the question was then open for discussion. He saw that it would require decided effort to get a majority for the river route. He entered into the discussion of the merits of the river route. After several hours discussion one of the commissioners who had informally voted for the inland route changed his mind. On taking the regular vote, four commissioners voted for the river route and three for the inland route. The commissioners then assigned Jervis the task of writing the report. When the Legislature met the friends of the inland route had a report from the minority, and used vigorous efforts for that route. The Legislature approved the majority report, 19
and the Delaware River route was adopted.

The chief officers of the New York and Erie Railroad were very jealous of Jervis. They knew nothing of his opinion, nor did he think it proper they should know until it was officially announced. They manifested their jealously to such a degree that Jervis felt under a suspicion of their confidence in any impartiality. Jervis said, "It was in my mind a clear question of engineering and one, I was satisfied, very important to the success of the Erie Railway." When they attempted to force the name "Delaware" 20 on the village of Port Jervis, John thought that they did not appreciate the services he had rendered 21
in simply acting on his judgment as an engineer.

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18. Ibid.

19. Ibid.

20. The Erie officials called the lone station on the flats below the canal port "Delaware." The village grew between these two places, and could have been called either Delaware or Port Jervis.

21. The Nearpass Story.

If the inland route had been chosen, the railroad would have crossed the Neversink Valley in the neighborhood of Cuddebackville; and the latter village might easily have changed places with Port Jervis in the matter of growth and prosperity. The name Delaware did not long survive its introduction. Public sentiment and changed views on the part of the Erie officials gave the name Port Jervis to the railroad station. The idea of keeping up two rival villages was abandoned.[22]

The Erie Railroad was completed to Port Jervis on December 31, 1847. Four years later, in 1851, an excursion train bearing President of the United States, Millard Fillmore, Senator Daniel Webster, and the directors of the company officially opened the railroad. Their train reached Port Jervis on May 14, 1851.[23] Even after all these years Port Jervis was called a village only by courtesy. It was not a village, but simply an unincorporated district of the town of Deerpark subject to town government.[24]

On July 20, 1853, the village of Port Jervis applied to the Court of Sessions of New York for incorporation. The application was accompanied by a necessary survey and certificate of election. The first election was held on August 9, 1853.[25] John Bloomfield Jervis had a permanent namesake. The canal had created the name, and the railroad brought the event to pass.

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22. Herman Lytell, Story of the Delaware and Hudson Canal: Materials for a History of Port Jervis, New York (1937), II, p. 280.

23. The Nearpass Story.

24. "From Hamlet to City," Port Jervis Union, July 29, 1907.

25. Ibid.

Chapter VI

Defying the Dangerous Delaware

The section of the Delaware and Hudson Canal from Sawmill Rift to its western terminus was not started until the spring of 1827 because the company was unable to get the necessary cash for construction. On March 10, 1827, New York State loaned the company five hundred thousand dollars in the form of special certificates of stock, bearing five per cent interest and redeemable at the pleasure of the State after twenty years. The company was required to give a first mortgage on its entire lands and privileges in both states, and all premiums on the sale of stock were to be repaid to the State for the common school fund. The company was also authorized to raise the sum of three hundred thousand dollars in addition upon second mortgage security.[1] The State loan insured the completion of the enterprise.

The original act of incorporation of April 23, 1823, called for slack-water navigation from Sawmill Rift on the Delaware River to the western terminus. When New York increased the corporate stock a year later from five hundred thousand to one million five hundred thousand the company was also given the privilege of building a canal along the Delaware River within New York from Carpenter's Point to the mouth of the Lackawaxen.[2] On February 9, 1826, Pennsylvania authorized the company to construct the locks on the Lackawaxen "of such dimensions as they should deem expedient, provided they were of sufficient capacity

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1. Noble E. Whitford, History of the Canal System of the State of New York, I, pp. 741-42.

2. Ibid., pp. 733-34.

to pass boats, arks and crafts at twenty-five tons burthen." If the size of the locks was smaller than eighteen feet wide by sixty-four feet long, the method of construction had to be by canal and not by slack-water navigation; and the feed water from the Lackawaxen had to be discharged into the Delaware at the mouth of the former river.[3]

Jervis assigned John B. Mills the task of locating the canal up the Delaware and Lackawaxen Rivers. By the spring of 1827 he had located the canal as far as the Narrows of the Lackawaxen.[4]

The contracts for the Delaware section and the Lackawaxen section as far as the Narrows were let in March of 1827. Thirteen locks would have to be built on the Delaware River, and twenty-two locks on this section of the Lackawaxen. On April 25 Maurice Wurts, as agent, reported that thirteen additional miles beyond the Narrows were signed, bringing the canal to within seven miles of Keen's Pond. The signed contracts called for the completion of the canal by July of 1828.[5]

Construction of the canal through the wide flat valley of the Neversink River and the upper Rondout Creek was an easy matter compared to the undertaking along the shores of the Delaware and Lackawaxen Rivers where the mountains dropped abruptly to the river's edge and numerous cliffs rose abruptly out of the river. In those days before the invention of dynamite blasting was a slow, laborious,

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3. Ibid., p. 739.

4. David Torrey, Memoir of Major Jason Torrey (1885), pp. 101-02.

5. Delaware and Hudson Company, A Century of Progress, pp. 36-37; Edwin D. LeRoy, The Delaware and Hudson Canal, pp. 15-16.

and continuous process. It took hours, sometimes days, to drill by hand one hole which today could be finished in half an hour or less. The steel or iron rods which were then used for drilling were far below present day standards of hardness. They required frequent sharpening. When the blasting hole was finally ready it was filled with black gun powder and an uncertain fuse made of twisted paper saturated with saltpeter. The hole was then plugged with not-too-moist clay. When all was ready the "blower" lit the fuse and ran to safety hoping, if the fuse did not sputter out, it would fire the powder within a reasonable time. Many lives were lost when a charge hung fire only to explode when the "blower" returned to relight it.[6]

At the foot of Hawks' Nest Cliff the mountain walls rose a sheer three hundred feet out of the Delaware River. The engineers built the canal wall forty feet directly above the river bed and as close to the base of the cliff as possible. A similar problem presented itself at the Narrows of the Lackawaxen where the raftsmen years before had blasted away the sixteen foot falls. Here the canal also was built along a sheer rock wall and the embankment was built upon a cribbing of heavy timbers to a height of thirty feet above the river. This place is called the Narrows because the Lackawaxen boils through a narrow gorge no more than forty feet wide.[7]

At the mouth of the Lackawaxen River a dam six hundred feet long was built across the Delaware River to transport the canal boats

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6. LeRoy, op. cit., p. 16.

7. Ibid., pp. 16-17.

by slack-water from Pennsylvania to New York. It was necessary to make a sluice in the dam one hundred feet long and three feet deep to provide passage for the lumber rafts. The sluice was filled with flush plank supported by brackets to hold the water during canal navigation, and were removed during the rafting season. Twenty years later this dam was replaced by the Delaware Aqueduct, one of the first steel cable suspension bridges built by John A. Roebling. This bridge is still used for automobile transportation.[8]

A mile above the Narrows at the mouth of the Tinkwig Brook the Lackawaxen River make a sharp "L" turn. To have followed the river would have made it much too difficult for navigation of the boats. A new channel was dug for the river. The canal embankment was built across the mouth of the Tinkwig, and its water diverted into the main channel of the canal. A basin or lake was created by this hazardous undertaking, and was known up and down the canal as the "Poolpit." The rumor that this basin had no bottom was widely believed. Actually, the old river bed was from ten to sixteen feet lower than the bed of the new channel. As the canal neared completion in 1828 the embankment holding the new river channel gave way for a considerable distance, causing a flash flood. This was the opportunity for which the hostile raftsmen were waiting.[9]

The raftsmen and the canal company were never on friendly terms. The Delaware and Hudson Canal Company had imported many "wild Irish" to work for seventy-five cents a day. The records are not

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8. Ibid., p. 51.

9. Ibid., p. 17.

specific as to the maximum number of men employed on the Lackawaxen section, but one account states that over six hundred men were at work all winter (1827-28). The number of wild Irishmen during the spring and summer of 1828 undoubtedly exceeded that figure by a wide margin, and large barracks for housing these men were built near Paupack Eddy (Hawley, Pennsylvania). These Irishmen soon became the terror of the countryside. They were beyond control of the local authorities. They fought with the other laborers and among themselves, but their main enemies were the raftsmen and lumbermen upon whose domain they were encroaching.[10]

Man for man these two factions were an even match, and their dislike was mutual. The raftsmen in particular thought they had a real grievance against the canal and all those connected with it. The dam being built across the Delaware River below the mouth of the Lackawaxen and the feeder dams on the Lackawaxen itself would interfere seriously with the navigation of their rafts. They contended that the water drawn from the river to fill the canal would so reduce the river level that rafting would be impossible. The canal itself, they thought, would put an end to, or at least seriously injure their business. This would have been a severe blow to many people, for during the late 1820's on the average of seven million feet of lumber was rafted down the Lackawaxen each year.[11]

After the flash flood at the "Poolpit" the raftsmen lost no time in presenting to the Pennsylvania Legislature their claims

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10. Ibid., pp. 15-16.

11. Ibid., p. 16.

that the Canal Company had violated its charter. They said that the canal embankments were inadequate, and that the Delaware dam was improperly constructed so as to make rafting unnecessarily dangerous. The Legislature conceded that "some individual losses had been sustained" because of the break, and as a result the Canal Company was obliged to settle the claims of various raftsmen.[12]

The western terminus of the canal was not decided upon until late in 1827. The original recommendation for the terminus was Keen's Pond, seven miles above the Forks of the Dyberry and Lackawaxen Rivers. John B. Jervis had recommended that the canal end at the latter place in his report of 1825. About 1800 Jason Torrey bought four hundred acres at the Forks of the Dyberry. In addition to the general interest taken by the citizens of Wayne County, Pennsylvania, in the construction of the canal and railroad, Torrey took a strong personal interest in the location of the western terminus of the canal.[13]

At this time the Forks of the Dyberry was a dense forest of overgrown hemlocks and other trees. Jason Torrey cleared part of his land in 1826, and erected a building for the engineers. In order to bring on a decision in favor of the Dyberry Forks he proposed to the company that if the head of the canal should be located on his land, he would give to the company a half interest in the entire village plot which would be located there.[14]

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12. Ibid., pp. 17-18.

13. Torrey, op. cit., pp. 98-99.

14. Ibid., p. 101.

In the spring of 1827 men were sent to work at Dyberry Forks. The chopping and burning of logs was the order of the day. On August 13, 1827, John Bolton and Jason Torrey signed a formal contract whereby it was stipulated that the head of the canal should be located on Torrey's property, and that the canal company should be equally interested in the village plot with him. Bolton and Torrey laid out the village.[15] Washington Irving later named the village Honesdale in honor of Philip Hone.

In September of 1827 the Board of Directors of the Delaware and Hudson Canal Company refused to approve the contract signed by Bolton and Torrey. At the same time they decided to locate the head of the canal on a tract of land adjoining the Torrey property on the south. This land had recently been purchased by Mr. Wurts, and conveyed to the canal company. This breach of faith caused a split in the relations between Torrey and the company. The boundary between his land and that of the company was arranged by them to be "a line running across the plain from East to West through the middle of the court house square and precisely between the legs of the bronze statue on the soldiers' monument there."[16]

In the report to the stockholders concerning the activities of 1827 the company said, "It is determined, after much reflection and examination, to stop the canal at Dyberry Forks and from thence to construct a railroad to the coal mines, a distance of fifteen miles nearly." This same report states that fifty acres of land owned by

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15. Ibid., p. 102.

16. Ibid., p. 103.

Jason Torrey and William Schoonover were given to the Delaware and Hudson Canal Company by these farsighted land owners, who retained a like quantity for themselves "in consideration of the benefits to accrue to the land which they retained."[17]

With the coming of the canal now a certainty, a group of citizens from Wayne County gave serious consideration to the possibility of constructing a branch canal up the Dyberry to a point as near the headwater of the Lackawanna River as possible. They confidently expected another canal would shortly be built up the Lackawanna to meet their canal. Their plans never went beyond the discussion stage.[18]

During the early days of the canal the managers of the canal company were ever hopeful that New York State would build a branch canal up the Delaware River from the mouth of the Lackawaxen to bring to their canal the freight of western New York. On February 7, 1824, Colonel John Sullivan presented a letter to the commissioners, stating that he had seen a letter addressed by Philip Hone to one of the mine proprietors, expressing a disposition on the part of the commissioners to receive any communication relative to the canal. He said he was induced to lay before them further considerations that could not be brought into his report of the preliminary survey. By the further improvement of fourteen miles of the Delaware River above the Lackawaxen the company could extend navigation for a hun-

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17. LeRoy, op. cit., p. 15.

18. Ibid.

dred miles westward, and still better results could be obtained by connecting with the Susquehanna River. As to the probable success of a canal, he stated England at that time possessed twenty-six such canals, all financially successful.[19]

It would seem that the managers of that period, not satisfied with the work in hand, were already turning their attention toward a western extension of the enterprise. They wanted to take the canal beyond the mouth of the Lackawaxen, up the valley of the Delaware to where that river approaches to within twelve miles of the Susquehanna at the great bend of the latter river. This locality was within the State of New York. A charter had been secured from the Legislature giving authority to improve the navigation of the Delaware and Susquehanna Rivers within certain counties in New York and to connect them by a canal or railway. Although this project was placed in the hands of a different set of commissioners who were to organize the Delaware and Susquehanna Canal Company, it is not to be doubted that the Delaware and Hudson Canal Company was in full control of the enterprise.[20]

On October 26, 1826, John Mills began a survey and examination for an extension of the canal westward from the mouth of the Lackawaxen up the Delaware on the New York side as far as Deposit, sixty-eight miles. Judge Wright stated that the survey was made by the request and at the expense of the company, and was part of an important plan of

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19. Whitford, op. cit., p. 734.

20. Ibid., p. 738.

connecting navigation between the Delaware and Susquehanna Rivers at a point in Delaware and Broome Counties, New York. No stone of value for cutting was found along the line and the lock estimates were, therefore, based upon a wooden living backed by rough walls. The connecting link followed up the valley of Oquago Creek, passed through the summit of the dividing ridge by a tunnel one mile in length, and descended along Johnson's Brook to the Susquehanna River near Bettsburg. The tunnel, eighteen feet in diameter and lined with brick,was estimated to cost three hundred thousand dollars. The six hundred ten feet of ascent and descent were to be overcome by inclined planes.[21]

Benjamin Wright's comments on submitting this survey to the managers on January 3, 1827, are of unusual interest. The rugged handwriting and the clear vision of this able engineer reveal a mental grasp of transportation problems as they then existed. Wright had traveled over the proposed route in June and October, 1826, and had personally examined the entire line. He said:

> This excursion satisfied me that nature had formed a valley from the foot of Otsego Lake to the western part of Steuben County, 220 miles; where a canal could be formed at comparatively small expense; where many towns and flourishing villages are already seen; and where a few more years will show a dense population. The project of an extension up the Delaware, thence over to the Susquehanna, and thence through the valleys of the Susquehanna and Tioga is only second in importance to that of the Erie Canal. [22]

This main line was only part of a great scheme of internal

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21. Ibid., pp. 739-40.

22. Ibid., pp. 740-41.

improvements by lateral canals which Wright felt

> sure would hereafter be executed along the valleys of the Unadilla; the Chenagno and its branches; from Owego to Cayuga Lake; from Newtown (now Elmira) to Seneca Lake; and from the branches of the Tioga River to Canandaigua Lake; thus opening communication with the Erie Canal for exchange of production peculiar to each. 23

To Wright the increasing trade on the Erie Canal and the throng of boats even then passing upon it so soon after its completion proved that not many years would elapse before that canal would be unable to accommodate the traffic of the growing western states. He believed that the fifth year after the finishing of the Ohio Canals would see the limit of tonnage capacity reached. The southern line would relieve this pressure. He considered that locks passing boats of twenty-five or thirty tons would accommodate an even greater amount of tonnage than those of the Erie Canal, if the boats were made to fit them. In England he said it was well settled that narrow boats for canals were decidely preferable.[24] He concluded by saying that "this proposed canal will open a week earlier and close a week later than the Erie Canal. Its route will be shorter and the cost of transportation consequently cheaper."[25]

Construction of the Delaware and Lackawaxen sections of the canal were pushed throughout 1827 and 1828. John B. Jervis in

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23. Ibid., p. 741.

24. Ibid.

25. LeRoy, op. cit., pp. 14-15.

the capacity of chief engineer went over the canal line to inspect the work several times. He had placed Horatio Allen, Russell Lord, and John Clark on this part after they had completed their other sections. On October 16, 1828, the packet boat Orange left Rondout with many important people on board bound for Honesdale. The Orange appears to have been the first boat to navigate the entire canal. Upon its arrival at the new settlement of Honesdale the passengers were accorded an elaborate welcome by the local citizens under the leadership of Jason Torrey.[26]

Philip Hone was not among the passengers on the first packet. He was far too busy to spare the time to travel by canal boat, but he did arrive at Honesdale by stage coach on October 28, 1828. He went to inspect the coal mines at Carbondale and later wrote in his diary, "The supply of coal is inexhaustible and of superior quality."[27] After viewing the gravity railroad he began the return trip to New York City on horse back along the tow-path of the canal. He was greatly impressed by "the stupendous rock work" at the Narrows of the Lackawaxen and the dam at the mouth of the Lackawaxen.[28]

During the winter of 1827-28 a quantity of anthracite coal had been hauled over a hastily finished wagon road through Rixe's Gap to Honesdale. Late in November, 1828, there was a sufficient quantity on hand to load ten small boats with ten tons each, and start them on their history making voyage to tidewater. The first four boats

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26. Ibid.

27. Allen Nevins (ed.), The Diary of Philip Hone: 1828-1851 (1927), I, p. 6.

28. LeRoy, op. cit., p. 21.

were called Superior, United States, Company Boast #2, and the Oliver H. Perry.[29]

As this little squadron passed through the various locks and towns, toasts were drunk to -- and by -- the captains and their crews in celebration of the great event. When the boats neared the end of the canal the Kingston band came out to meet the flotilla, boarded the Superior, and "accompanied it to Rondout amidst the playing of appropriate airs." The ten boats arrived at Rondout on December 5, 1828, and were greeted by volleys of musketry fire in salute by the assembled militia. After a brief parade many speeches were made in honor of the event. The orators of the day made many fabulous predictions of the future prosperity of the canal. Few, if any, of those present that day realized how far short of the actual truth these seemingly fanciful predictions fell. No one there could foresee that the canal would be completely inadequate to carry the quantity of coal later demanded of it.[30]

On the same day that the ten canal boats arrived at Rondout their cargo of coal was transferred to the sloop Toleration, the same ship which four years before had brought the first sample of "Lackawaxen Anthracite" to New York City by way of Philadelphia. The Toleration arrived in New York five days later, on December 10, and part of the cargo was sent without delay to the Western Hotel on Cortland Street where a grate had been prepared to demonstrate the

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29. Ibid.

30. Ibid.

great advantages of coal over wood. Later another grate was set up in the company's offices on Wall Street. A part of the first hundred tons to reach Rondout was shipped to Albany for use by Governor Martin Van Buren and members of the Legislature who had been so helpful.[31]

On December 20, 1828, the Albany Argus printed the following article:

> The public scarcely seems aware that a canal 108 miles in length commencing at tidewater, near Kingston, and terminating at the forks of the Dyberry in Pennsylvania has been completed since October--and this great work has been accomplished principally by the enterprise of an individual company. The first squadron of boats loaded with coal arrived at tidewater on the 5th instant. Fifty tons have been consigned to Messrs. Townsends of this city which will afford our citizens an opportunity to test its quality. [32]

The Delaware and Hudson Canal had been constructed and its original purpose fulfilled. The Wurts brothers, Philip Hone, John Bolton, and John B. Jervis were well pleased by the accomplishment. The final completion of the canal also fulfilled the "Legend of Lock Twenty-two." James McEntee said that many years before the canal was even a dream an old man of that unsettled neighborhood was crossing from a settlement on the east side of Stony Kill to a settlement on the west side. As he stepped upon the body of a tree which formed a bridge over the brook, he saw coming toward him from the opposite side a boat the deck of which was crowded with well dressed ladies and gentlemen. They had music and were dancing. A festal air

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31. Ibid.

32. Ibid., p. 22.

prevaded the old man's apparent vision. He became alarmed at the unwanted spectacle and returned to tell the incident to his family and friends. He gave them a minute description of the boat and passengers, and the direction in which it came. The canal as surveyed and located was almost identically in the course of his phantom boat across the flats.[33]

The canal was one hundred eight miles long, from thirty-two to thirty-six feet wide at the water line, and twenty feet wide at the bottom. The minimum depth of water was four feet, and designed for boats carrying cargoes of not more than thirty tons. It was taken across the Rondout by means of a stone aqueduct supported by two arches, and across the Neversink by a wooden aqueduct two hundred twenty-four feet long supported on stone piers. There were in addition ten other smaller aqueducts of varying lengths, all of wood supported by stone abutments.[34]

From the Hudson the canal ascended for thirty-five miles through a series of fifty locks to a point near Phillipsport at an elevation of five hundred twenty-five feet, and then followed a level course for sixteen miles to the Neversink River. After that it descended fifty-eight feet through a series of six locks to the twelve mile Port Jervis level. From the western end of this level at Butler's Falls on the Delaware River the canal rose to an elevation of nine hundred seventy-two feet to its terminus in Honesdale. Originally

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33. James S. McEntee, "James S. McEntee's Story of the Canal," pp. 292-93.

34. J.M. McAndrew, History of Hawley, Pennsylvania (undated), pp. 9-10; LeRoy, op. cit., p. 22.

there were in all one hundred nine locks with an average of eight to twelve feet per lift. Sixty of these, on the Kingston-Port Jervis section, were of hammered stone, the balance being "composite," or with chambers of wood backed by stone walls. Each lock was seventy-six feet in length and nine feet in width. The early boats could be no larger than seventy feet in length and eight feet seven inches in width.[35] The water level in the canal was maintained by a series and system of feeding inlets from streams. Stop-locks and waste weirs regulated the flow of water. The heavily frame timbered stop-locks, raised by machinery, were of strength to withhold the force of the flow of water in either direction. Watchmen in continuous employ controlled the inlets and outlets.[36] The original cost of the New York section was $1,424,994, and the Pennsylvania section $612,128.[37]

In his address to the Minisink Valley Historical Society on February 22, 1928, Dr. William L. Cuddeback paid special tribute to the builders of the canal. He said:

> The vision, the foresight, and the daring of the promoters and projectors of the canal were most unusual. The goal of their ambitions was momentous for that period. The genius and judgment of their construction engineers were tested to the limit as they crossed, above flood level, the Mongaup River at Mongaup and the Neversink River at Cuddebackville and yet received by gravity their waters through feeders to maintain the water level of the canal. They snatched from the rocky bottom of the Delaware River miles of the bed of the canal, blasted from the rocky base of the Hawks' Nest Mountain. The whole project was stupendous.

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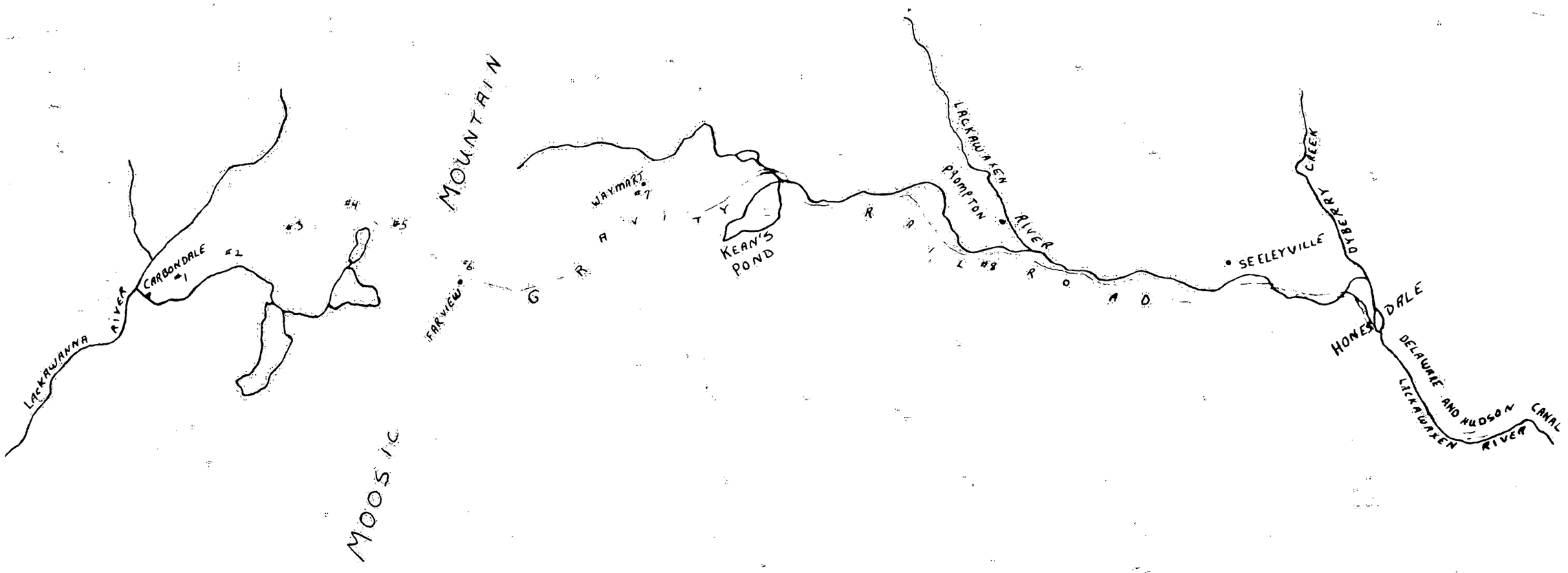
35. Ibid.

36. William L. Cuddeback, Deerpark, p. 12.

37. E.M. Ruttenber and L.H. Clark, History of Orange County, New York, p. 117.

38. Cuddeback, op. cit., p. 12.



THE GRAVITY RAILROAD

Chapter VII

America's Third Railroad

When Benjamin Wright submitted his final report on the route of the Delaware and Hudson Canal on May 21, 1825, he recommended the building of a railroad as the final link between the navigation and the coal mines. He said, "There remains then only a good road, or a railroad--the latter I think will be preferred."[1] From the date that Wright submitted his report recommending the railroad the canal company seems never to have had the possibility of its construction absent from their minds. On April 5, 1826, the Pennsylvania Legislature authorized construction of the railroad from the coal mines to the canal at the Forks of the Dyberry on the West Branch of the Lackawaxen, or to Belmont and the Eastern Turnpike on the Wallenpaupack. The company could choose between the two routes.[2]

On March 14, 1827, John B. Jervis was appointed chief engineer of the canal company when Benjamin Wright resigned. Jervis immediately organized his engineering force for the construction of the Delaware and Lackawaxen sections of the canal. With this duty out of the way he was ordered by the canal company on April 4 to survey and locate a railroad route from the proposed terminus of the canal to the coal mines at Carbondale.[3]

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1. Delaware and Hudson Company, A Century of Progress, pp. 27-28.
2. David Torrey, Memoir of Jason Torrey, pp. 97-98.
3. Delaware and Hudson Company, op. cit., pp. 42-43.

At this time the Quincy Railroad in Massachusetts was the only railroad in operation in the United States. It was built to convey granite from the Quincy granite quarries four miles to a shipping port on the Neponsett River.[4] In July Jervis made a visit to Boston with the single object of ascertaining what he could learn from the Quincy Railroad which had just been put in operation.[5]

A few railroads had been constructed and operated by stationary power in the mining districts of Europe. In England a railroad similar to the one planned over the Moosic Mountain from Honesdale to Carbondale had been built. This was the Hetton Railroad extending seven miles from the town of Sunderland on the River Weir to the Hetton Collieries. The Hetton Railroad, completed in 1822, overcame an elevation of eight hundred twelve feet, and was operated by fixed engines upon inclined planes. It had locomotives on the levels; a single one of which had drawn "a train of twenty-four chalder wagons containing ninety tons of coal," and in a day six hundred tons. The force of gravity was also used. An article on this railroad was published in the Franklin Journal late in 1825, and in a Philadelphia daily newspaper in January, 1826, together with a view of the locomotive and the train of chalder wagons. What effect this railroad had on the managers of the canal company is hard to determine.[6]

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4. David Stevenson, Sketch of the Civil Engineering of North America: Comprising Remarks on the Harbors, River and Lake Navigation, Lighthouses, Steam-Navigation, Water-Works, Canals, Roads, Railways, Bridges and Other Works in that Country (1838), p. 238.

5. Jervis, Facts and Circumstances, p. 104.

6. Alfred Mathews, History of Wayne, Pike and Monroe Counties, Pennsylvania (1886), p. 234.

Most of the machinery that had been put into operation was of English origin. Jervis said that the machinery was sufficiently described in books that he was able to procure. He was not satisfied with these plans. They appeared to him too cumbersome in their works, and did not secure the convenience of operation necessary to the best economy.[7] Jervis worked on the survey and plans for the railroad throughout the summer and fall of 1827.

On October 24, 1827, John Bloomfield Jervis submitted a report to the Delaware and Hudson Canal Company which was one of the great pioneer documents in railroad history. No report of this kind had ever before been prepared in the United States on railroads. The total absence of precedent forced him to present a complete argument for and against every method that he proposed to employ. The report is a long document, and discusses in great detail a number of matters that are too technical for presentation here.[8]

In 1827 there were engineers who believed that the "single-rail railroad"was likely to be the form of construction that the world would adopt. The early pages of the report are devoted to a discussion of the possible advantages of a single-rail railroad. Jervis' conclusion on this subject was that those advantages would not appear in the work contemplated. He recommended the adoption of a double-rail railroad.[9]

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7. Jervis, Facts and Circumstances, p. 105.

8. Delaware and Hudson Company, op. cit., p. 43.

9. Ibid.

At this time there was no railroad in the United States, either in operation or under construction, longer than ten miles; and so new were railroads in England that few standards had been arrived at as to dimensions or materials. In making his recommendations Jervis was constrained almost to prove each statement he made. A page or more is devoted to the dimensions of the cars, and to such questions as whether these cars should have iron or wooden wheels. So early in the history of railroading was this report prepared that even iron rails had not come into use. In regard to rail material Jervis said, "I presume no other will be thought of for the contemplated work than the timber rail capped with iron plates."[10]

After a long discussion of the most durable methods of roadbed construction and track laying then known, Jervis considered the question whether the iron plates to cap the rails should be made or rolled or cast iron. He stated that the comparative durability of cast and rolled iron for rails is a subject on which "there is a great diversity of opinion among English engineers." The plates of the Quincy Granite Railroad were of rolled iron. Partly for this reason and partly because "rolled iron will have the advantages of few joints,"[11] he gave it preference.

The elevation of the summit of the Moosic Mountain between Honesdale and Carbondale is eight hundred fifty-eight feet. On this

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10. Ibid.

11. Ibid., pp. 43-44.

ascent from Carbondale to the summit of the mountain John B. Jervis regarded the use of horse power as out of the question. His attention was directed to steam power by stationary engines. Inasmuch as the expense for attendance would be essentially the same for large or small engines, his first survey sought a location at which the whole ascent could be gained by three inclined planes. Since this was impossible in view of the topography of the country, he recommended dividing the ascent among five inclined planes. Each plane would have an ascent of from one hundred twenty to two hundred five feet, separated by short lines of level or moderately declining road. Under this plan all the planes except one would have had an ascent of one foot in twelve.[12]

For hauling cars up such inclined planes at that time ropes were generally used in England. It was estimated that if they were adopted it would require a rope six inches in circumference to sustain a strain of four thousand pounds. Jervis believed that chains would be more durable in service, and recommended them.[13]

In respect to the application of the power of stationary engines to the sheaves, the location of friction rollers at proper distances on the planes to support the chain, and the estimate of the cost and expense of the necessary machinery and engines for providing such steam power; the recommendations of this report were full and

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12. Ibid., p. 44.

13. Ibid.

careful in a high degree. For these purposes Jervis recommended five stationary steam engines at a cost, inclusive of the expense of procuring water, of $24,500 in all.[14]

For the descent from the summit to Honesdale and to retard motion on the steep descending grades, Jervis proposed a simple, curious contrivance of sails connected with the gearing to hold the cars to a low and safe velocity. Three descending planes on this portion of the road were proposed. For the nearly level distances between the planes the use of steam locomotives was advocated. According to Jervis there would be about eleven miles of such almost level roadbed. The proposal to use steam locomotives as tractive power over these distances is of the highest interest.[15]

In September, 1825, George Stephenson ran the first successful locomotive in the world on the Stockton and Darlington Railroad, an English coal mine road. No general traffic had been carried by this means of transportation. A great controversy existed in England over whether this type of power could be used for passenger service. The Stephenson locomotive was not yet perfected, and there was no such contrivance in the United States. Nevertheless, John B. Jervis recommended that seven locomotives of six or seven tons be obtained by the Delaware and Hudson Canal Company for use on their railroad.[16]

Jervis frankly confessed that he had no idea of the cost of

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14. Ibid., p. 45.

15. Ibid.

16. Ibid.

the locomotives. The data he has was only approximate. He gave a covering estimate for the seven of $12,600, and added a further amount for the cost of locomotive fuel, attendance and water. These additional amounts reached to $41.30 per day for the seven engines considered as a lot. In recommending locomotive power at this date Jervis felt the necessity of advancing the strongest reasons. He gave an elaborate comparison between the cost of horse and steam power as applied to these sections. He reached the conclusion that the daily expense of horses would be $71.87. He stressed the point that locomotives could work without rest. For at least ten years after this initial report of John B. Jervis, successive engineers in various parts of the United States were busy themselves from time to time in making just such comparisons with similar results. Many of them used Jervis' report as the key reference in their report.[17]

John B. Jervis estimated the cost of the railroad at $178,228.13. This estimate included railroad iron, locomotives, bridges, and the machinery for stationary power. Due to the limited period during which the railroad had existed, he could not predict closely the durability of the structures. He believed that three hundred twenty railroad "wagons" would be required to transport five hundred forty tons of coal daily, and estimated the daily cost of operation at $159.32, a ton cost of 29.5¢ or 1.8¢ per ton per mile.

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17. Ibid., pp. 45-46.

He added that this per ton per mile expense was "very little in excess of the cost of transportation on a canal with a medium quantity of lockage." By these words he made an early contribution to the long controversy over the relative cost of transportation upon railroads and canals. Jervis concluded his report by predicting that the "successful accomplishment will form a new era in the internal improvements of our country."[18]

The Delaware and Hudson Canal Company acted upon Jervis' report with caution and deliberation. The subject matter was new, and many of the estimates were conjectural. The company decided to refer the report to Professor James Renwick of Columbia College for careful examination.[19] Renwick went to Carbondale to consult with Jervis. John was anxious to learn his opinion on the report. Renwick agreed with Jervis on the major points. He pointed out some errors of calculation which Jervis easily understood.[20]

On November 17, 1827, Professor Renwick submitted his views to John Bolton in writing. The report with James Renwick's comments on it was submitted to Benjamin Wright. In a short letter dated December 6 to the president of the company Wright agreed with slight qualifications to the conclusions which the other two had already reached.[21] Wright advised the use of horse power instead of steam power for the ascending planes.[22]

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18. Ibid., p. 46.

19. Ibid.

20. Jervis, Facts and Circumstances, p. 107.

21. Delaware and Hudson Company, op. cit., pp. 46-47.

22. Jervis, Facts and Circumstances, p. 108.

The decisions of the directors of the company to enter upon the construction of a railroad on such a route was then a step far in advance of any previous undertaking in that line. President Bolton, in a public explanation of the company's policy, defended railroads by declaring that "all were agreed in their great superiority over turnpike roads, and in their near approach to canals in respect to cheapness and facility of transportation."[23] The canal company gave the engineering skill and the great daring of John Bloomfield Jervis a vote of confidence.

The topography of the section through which the railroad was to be constructed required great skill in engineering and much originality of plans. Of the two railroads in the United States, the three-mile railroad Quincy completed in 1827 and the nine mile railroad at Mauch Chunk, (now Jim Thorpe, Pennsylvania), then being constructed, neither was constructed over such unfavorable grounds.[24] They had set few precedents to guide Jervis.

John B. Jervis needed a competent engineer to go to England and get the required material for the railroad. During the years 1826 and 1827 the use of the locomotive on the Stockton and Darlington Railroad became known to many, and especially to the civil engineers in the United States. Among these civil engineers was Horatio Allen, who had worked for Jervis on the summit level of the Delaware and Hudson Canal. The material he obtained led him to a

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23. Noble Whitford, History of the Canal System of the State of New York, I, p. 743.

24. Gerald M. Best, "The Gravity Railroad of the Delaware and Hudson Canal," Bulletin No. 82 of the Railway and Locomotive Historical Society (April, 1951), p. 9.

decided conviction about the future of the locomotive as the tractive motive on railroads for general freight and passenger transportation.[25]

Early in 1827 after the completion of the construction on the summit level Allen resigned from the canal, and turned his attention to the locomotive. Believing that the future of civil engineering lay to a great and most attractive degree in the direction of the railroad; he decided to go to the only place where a locomotive was in daily operation, and could be studied in all its practical details. He spent several months straightening out his personal affairs, and then went to New York City to wait for a ship leaving for England. On his arrival at New York he found that the Delaware and Hudson Canal Company had decided to intrust to him the duty of buying the railroad equipment.[26]

On January 16, 1828, John B. Jervis wrote a general letter of introduction to govern Horatio Allen on his foreign mission. Allen was to buy the rolled iron for the railroad track, the stationary steam engine and chains, and four locomotives. Jervis gave Allen wide discretion in some matters. Whether the locomotive should have four or six wheels was left to his care. The gauge between the wheels was definitely to be four feet three inches. It was not contemplated that Allen should purchase or contract for the railroad cars, but the letter in its closing paragraph instructed him to make inquiries in regard

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25. Horatio Allen, The Railroad Era: First Five Years of Its Development (1884), p. 11.

26. Ibid., pp. 13-14.

to every detail of their construction and adaptability for convenient commercial use in carrying coal.[27]

Horatio Allen left New York on January 24, 1828, and reaching Liverpool on February 15. Six days after landing in England he met George Stephenson, and from him received much valuable aid and advice.[28] The iron rails for the railroad were the first item requiring attention. Its manufacture, although executed in England, was on a plan of American origin. The instructions which accompanied Allen's authority to contract described a mode of making iron. On reading the description Allen thought that a less expensive plan could be used. He had explained his idea to a committee of the Delaware and Hudson Canal Company. They thought it was proper to have the judgment of someone having experience in rolling iron since Allen had never seen a bar of iron rolled. The proprietor of the only rolling-mill near New York at the request of the committee came to New York to consider the plan proposed. After examination he stated that the plan would not be a success. Nevertheless, Allen thought it would be well to suggest his plan at the rolling-mills in England.[29]

Since this was the first order for iron made expressly for a railroad from the United States, Allen deemed it advisable to go to the mills and explain just what he wanted, and to suggest one way

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27. Delaware and Hudson Company, op. cit., p. 48.

28. Ibid., p. 49.

29. Allen, op. cit., p. 15.

in which the iron could be made. Of the seventeen mills he visited, and from which proposals were received only three thought well of his suggestion. With one of these three, the firm of R. and A. Hill of Cardiff and Merthyr Tydvil, a contract was made to furnish the rail-road iron. When the time for examination of the iron came Allen found the product unsatisfactory. He told the company that he would not accept iron of that quality.[30] They refused to deliver any other.

Horatio Allen then made application to W. and I. Sparrow of Wolverhampton, another of the three, and referred to what had occurred at Methyr Tydvil. He gave an accurate description of just what he wanted. The rolling company informed him that the intention of its proposals was what he had fully explained. The contract was, therefore, made with W. and I. Sparrow. The company granted Allen's wish to remain and see the preparation of the iron rails. The rollers were fitted up, and in ten days the iron was delivered in every respect satisfactory. Allen later said that "the large amount of iron of the same character made for this country in after years, was all made of this plan."[31] Before turning his attention to the purchase of the locomotives he made contracts for the stationary steam engines and the iron chains to hoist the railroad cars.

Early in 1828 John B. Jervis organized his engineering force for the construction of the "Gravity" Railroad. He chose young James

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30. Ibid., p. 16.

31. Ibid., p. 16.

Archbald to be his principal assistant engineer.[32] In numbering the planes Jervis started his count on the west side of the Moosic Mountain at Carbondale. Numbers one through five were the ascending planes, and numbers six through eight were the descending planes to Honesdale. Its route from the mines required an ascent of nearly 850 feet in the first four miles in order to reach the summit level, and then an equal descent was necessary in order to reach the western terminus of the canal.[33]

The entire length of the railroad from the mines at Carbondale to the canal basin at Honesdale was sixteen and seven-eighth miles. When commencing its construction Jervis was directed to so construct the road that it would afford ample facilities for transporting one hundred eight thousand tons of coal per year of two hundred working days, or five hundred forty tons per day. That quantity was deemed adequate to meet the future demand. A plan of construction was adopted which was designed to accommodate the object sought with as little outlay of money as practicable. Ninety per cent of the entire route lay through unbroken forests where timber could be very cheaply obtained. Where possible all heavy enbankments for grades were dispensed with and large scale excavations were avoided.[34]

Where the grade was more than four feet above the natural surface trestle work of timber was generally used. In this way the

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32. H. Hollister, Contributions to the History of the Lackawanna Valley, p. 295.

33. Best., op. cit., pp. 8-9.

34. Ibid., p. 9.

rails were supported on trestles of timber for about one-third of the entire distance. In a few places of little length where the track was still nearer the surface wooden posts were placed upright in holes dug in the earth three feet or more in depth, and broken stones were filled in around the base of the posts. Then the tops of the posts were sawed off at the proper height to receive the cross ties upon which the rails rested. In other places where the grade was near the surface the hemlock timber cross ties, generally six inches thick, nine inches wide and eight feet long, were placed in position on the road-bed at a distance ten feet apart. Upon the upper side of the cross ties two grains were cut four inches deep and eight inches long to secure the wooden rails. The hemlock rails were generally six inches thick, twelve inches high, and either twenty or thirty feet long. The rails were made to extend across two or three spaces between the cross ties.[35]

The rails were placed in grains in the cross ties, and secured by wooden keys or wedges in such a position that the space between the rails would be just the width of a four-foot-three-inch gauge adopted. The roadbed was not ballasted between the cross ties. There was nothing to hold the cross ties in position except their gravity, and the long wooden rails keyed into them. The only thing that kept the rails in place was the cross ties.[36]

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35. Ibid.

36. Ibid., p. 10.

Upon the top and at the inside edge of these rails iron plates two and one-half inches wide and one-half inch thick were laid to form the tracks for the wheels to run upon. The iron rails were fastened to the wooden structure by large, long screws through holes in the plates made for that purpose. These holes were made a little larger to permit expansion and contraction by changes in temperature. After a little experience the parts of the hemlock rails between the knots were found to be too soft for a firm bed for the iron plates, while the knotty parts remained firm. This caused an unevenness in the surface of the track. To remedy the situation strips of hardwood one and one-half inches thick and four inches wide were spiked to the top of the wooden rails, and the iron plates were laid upon these strips. The use of screws for fastening the iron plates was also discontinued, and iron spikes substituted.[37]

The inclined planes were constructed with a single track and with turn-outs. To permit the cars moving in one direction to pass those moving in the opposite direction a short one hundred to one hundred fifty foot double track was constructed in the middle of each plane. The turn-outs were provided with self-acting switches, or latches. Whenever a car passed out of a turn-out in either direction the switch was left in the right position to turn the next car moving in the opposite direction into the side of the vacant turn-out.[38]

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37. Ibid.

38. Ibid.

Stationary steam engines were located at the summit of each of the first five planes on the western side of the mountain. Each engine operated two huge drums placed in tandem. Each drum was eight feet in diameter, and had a flanged rim nine inches wide. Around each pair of these drums a huge chain made three turns, and then passed to the foot of the plane where it was attached to a trip of three to five loaded cars. The other end of the chain was attached to a like number of empty cars. When the empty cars were lowered they acted as a counter balance, and left only the dead weight of the coal to be overcome by the hoisting engine. Only one of the drums was geared to the engine. The other drum acted merely as an idler to help create friction and prevent the chain from slipping.[39] In order to guard against the slipping of the chain on the upper sheave steel studs were sunk in its groove.[40]

The chains for the railroad planes were made in Liverpool. After being tested under Horatio Allen's supervision they were sent to New York.[41] As soon as the canal was navigable in 1828 the iron rails, the steam engines, and the chains were sent to Port Jervis. The first thousand or fifteen hundred tons of coal that was mined was shipped from Carbondale to Port Jervis by wagons. These wagons took the railroad iron and machinery to Honesdale and the different points along the railroad on their return.[42] The iron rail that the

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39. LeRoy, op. cit., p. 24.

40. Jervis, "A Memoir of American Engineering," p. 45.

41. Mathews, op. cit., p. 238.

42. James McEntee, "James S. McEntee's Story of the Canal," p. 300.

Delaware and Hudson Canal Company had ordered from England was not used exclusively on the Gravity Railroad. On November 5, 1828, the company ordered five tons of the rail already received from England shipped to New York City from the supply at Delaware Turn on the canal near Port Jervis. They sold the rails to Brown Brothers and Company for use on the Baltimore and Ohio Railroad.[43]

When put in operation the machinery worked well; but the chain frequently broke, and had to be abandoned.[44] After using the chains for only a few months during 1829 they were discarded in favor of hemp rope. Dr. Benjamin Sillman wrote to Mr. Hazard of Philadelphia during July, 1830, saying:

> Last year there was much inconvenience from chains by which the steam engines drew up the coal wagons from the mines. During the season about fifty coal wagons were dashed to pieces in that manner. When chain links parted the wagon could not be seen in its descent. So instantaneously did it dart to its goal that only a dim streak could be traced through the air. They now use cables of hemp and the accidents no longer occur.[45]

Jervis felt that the rope would not have sufficient hold in the sheave to prevent slipping. He placed a second sheave on the same shaft, by means of which the rope had two holds in the groove instead of one. This was found to be quite sufficient. His new method worked satisfactorily.[46]

The hemp ropes were expensive and cumbersome. They

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43. Delaware and Hudson Company, op. cit., p. 38.

44. Jervis, "A Memoir of American Engineering," p. 46.

45. LeRoy, op. cit., p. 24.

46. Jervis, "A Memoir of American Engineering," p. 46.

measured seven and one-half inches in circumference. To protect the investment the ropes were bound with cords and heavily tarred. They were carefully taken in each Saturday night, and not brought out again until Monday morning. The "Gravity" like the canal did not operate on Sunday. Years later they were replaced by the first steel cables made by John Roebling.[47]

On the east side of the Moosic Mountain there were three self-acting planes and three levels carrying the railroad from the summit to Honesdale. After reaching the summit the line passed about one and one-half miles to the brow of the mountain on the opposite side, and then had a descent of nearly five hundred feet in one mile.[48] On descending planes six, seven, and eight a similar system was used to control the speed of the train as on the first five ascending planes. The three planes descending to Honesdale were worked by gravitation without the use of steam. The descending loaded cars drew up the ascending empty cars attached to the other end of the chain. The velocity of their motion was controlled by an ingenious device invented by John B. Jervis.

To provide means to resist the preponderating gravity of loaded trains as compared with empty trains was a serious matter. The braking system consisted of two drums similar to those of powered planes. Jervis said that the method described in European engineer-

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47. LeRoy, op. cit., p. 27.

48. Jervis, "A Memoir of American Engineering," p. 46.

ing was by a friction brake. He objected to this method when applied to so large a preponderating force. He thought that it might be possible to use the resistance of the atmosphere in regulating the speed. Experiments had been made on this resistance. After reading the records he decided to increase the scale of these experiments. He made a great number of experiments at different velocities, and decided that air was the best element for controlling the speed of the coal cars. Jervis immediately began to devise the method of application.[49]

The plan adopted was to place a spur wheel on the upright shaft immediately under the sheave wheel. The spur wheel extended to each side of the road, and worked the pinions of two shafts. As the sheave wheel revolved, the two shafts revolved in the opposite direction. Each shaft had four sails made of thin boards of about twenty square feet in area. The sails from their natural position drove the air in the opposite direction from the sheave wheel, slowed the speed of the train, and prevented gyration. On one of the sail shafts was a powerful friction brake to be used in stopping the trains at the head and foot of the planes, and for any emergency that might require it.[50]

Jervis called the invention a "pneumatic convoy." He was anxious to see the success of the experiment as the first train passed

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49. Ibid.

50. Ibid.

over the angle of the plane. The friction brake was at command, although its use was not required. As the train moved down the descent, the sails moved regularly, and held it to a uniform velocity of about four miles per hour. Jervis' "windmill" had proved successful. As business increased on the road, it became necessary to increase the speed of the trains, and to reduce the area of the sails until only their arms were left.[51]

After the first two self-acting planes the railroad went on a level for six miles to the head of the third self-acting plane.[52] A level of four miles lay between the third plane and the canal basin at Honesdale. Actually there were no "levels" on the road. The term was only relative. While the grade on the planes was extremely steep, there was a slight grade on the levels favoring the loaded cars. It was necessary to haul the empty cars back.[53]

In December of 1827 the Delaware and Hudson Canal Company upon the recommendation of John B. Jervis decided to adopt locomotive steam engines as the motive power to be used on the three levels of the railroad. The "Summit Level" extended one and one-half miles across the top of the mountain; the "Six Mile Level" extended from Waymart to Prompton, and the "Four Mile Level" extended from Prompton to Honesdale.[54]

Work progressed slowly on the railroad throughout 1828

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51. Ibid., pp. 46-47.

52. Ibid, p. 47.

53. LeRoy, op. cit., p. 24.

54. Best, op. cit., p. 10.

and 1829. About the first of July, 1828, nine engineers were employed in New York City by the company to go to Carbondale and Honesdale. Three of them were to run the locomotives and six of them the stationary engines. They went directly to Carbondale. After staying there a month they were sent to Honesdale to put the line in running order.[55] The historic event for the Delaware and Hudson Canal Company was ready to take place. On August 8, 1829, the first locomotive in the United States began to turn its wheels on the Gravity Railroad built by John Bloomfield Jervis.

The "Gravity" was the third railroad completed in the United States. Jervis had taken some of his ideas for construction from the Quincy Granite Railroad. The second railroad was built by the Lehigh Coal and Navigation Company to connect the original Summit Hill Coal Mine with Mauch Chunk (Jim Thorpe), Pennsylvania. In 1827-28 they had built a gravity railroad nine miles in length. This road was suggested by the railroad the Delaware and Hudson Canal Company had projected. Because of the short extent and convenient facilities for construction it was quickly made available. This railroad was put in operation first, but the "Gravity" was the first one planned and begun.[56]

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55. Letter to Honesdale Democrat dated November 8, 1855, from one of the nine engineers. The letter was published in that paper on November 17, 1855, and reprinted in Herman R. Lytell, The Delaware and Hudson Canal, I, pp. 56-57.

56. Edward H. Mott, "The Antiquarian's Story of Anthracite," Independent Republican, Goshen, New York, August 6, 1918.

Chapter VIII

America's First Locomotives

When George Stephenson ran his locomotive on the Stockton and Darlington Railroad in September of 1825 a great controversy arose in England over the potential use of that vehicle. In 1826-27 the Liverpool and Manchester Railroad offered a prize of five hundred English pounds to the person who developed the best locomotive. The competition for the five hundred pounds attracted many distinguished engineers, scientific men, and enterprising gentlemen from all parts of the world to witness the contest.[1] Among the engineers from the United States was twenty-five year old Horatio Allen, who left New York for Liverpool on January 24, 1828.[2]

One week previously John B. Jervis had written a letter of instruction to guide Allen. He was to buy four locomotives. Very minutely the letter specified the details for the locomotives, although leaving certain points of considerable importance to Allen's discretion. The contemplated speed of these engines was about four miles an hour. Whether the locomotives should have four or six wheels was left to Allen. The gauge was definitely to be four feet three inches.[3] The weight of each locomotive "should not exceed five and a half tons."[4] If Allen discovered unexpected difficulties

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1. William H. Brown, The History of the First Locomotives in America (1874), p. 74.

2. Delaware and Hudson Company, A Century of Progress, p. 48.

3. Ibid.

4. American Society of Civil Engineers, Proceedings, p. 112.

in respect to the use of steam locomotives, he was instructed not to "make an engagement" but to communicate the result of his observations as early as possible.

On February 21, 1828, Horatio Allen met George Stephenson with whom he immediately established a most agreeable relationship.[6] Stephenson was becoming world famous as a civil engineer and locomotive inventor. In 1814 he had constructed his first locomotive which drew eight loaded wagons at the rate of four miles an hour on Killingworth Colliery Tramway. In 1819 he was employed to construct a railway for the Hetton Colliery, and in 1822 the Stockton and Darlington Railroad. The Stockton and Darlington, which opened September 27, 1825, raised the question, could passengers be conveyed on steam railways as well as coal. In 1826 he began construction of a railway between Liverpool and Manchester to carry passengers.[7]

In order to study all matters connected with the construction and use of railroads and locomotives, Horatio Allen spent much time at Liverpool in connection with the Liverpool and Manchester Railroad and at Newcastle on the Stockton and Darlington Railroad. He also visited Stourbridge, a manufacturing town on the River Stour fifteen miles west of Birmingham. Foster, Rastrick and Company of Stourbridge had bid on the contract for railroad iron and for the locomotives.[8]

The exact date when Allen contracted for the locomotives is

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6. Ibid.

7. "George Stephenson," The Encyclopedia Americana (1958), XXV, p. 621.

8. Horatio Allen, The Railroad Era, pp. 16-17.

not known. In a letter dated July 19, 1828, he advised the Managers of the Delaware and Hudson Canal Company that he had closed with Robert Stephenson and Company of Newcastle for one locomotive and with Foster, Rastrick and Company of Stourbridge for three. Late in June he had been authorized to engage in England two competent men to superintend the running of the locomotives. There is no record that any such engagement was made. To place orders for locomotives upon specifications satisfactory to himself, required devoting much time to the consideration of plans, particularly those of the boilers.[9]

Allen liked the multi-tubular boiler proposed for the Liverpool and Manchester Railroad, but he found many who distrusted that type of boiler because it had not yet been tried. John Rastrick recommended a boiler of small flues riveted to the fire-box, the type used on the Stockton and Darlington Railroad. Allen decided that the boiler of the locomotive built by Stephenson and Company was to be a multi-tubular boiler. The dimensions of the tubes were to be decided by the builders. The boilers of the three locomotives built by Foster, Rastrick and Company were to be flue boilers. The size and number of the flues were to be decided by the builder. The plans for the locomotives, the proportion of parts and all other details were left to the judgment of the builders.[10]

Horatio Allen said that his order for the locomotives in 1828 was "the first order for a locomotive after the demonstration

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9. Delaware and Hudson Company, op. cit., p. 50.

10. Allen, op. cit., p. 17. Allen stated in his article published in 1884 that he ordered two locomotives from Stephenson and one from Foster, Rastrick and Company. The more accurate record is the letter written to the company in 1828 just after he made the purchase.

of the locomotive as a successful tractive power on the Stockton and Darlington Railroad in 1825." He was quite proud that it came from an American company at the request of his esteemed friend John B. Jervis. The locomotives were built after Allen left England. He did not see them until they arrived in New York.[11]

Although there has been uncertainty concerning the names of three of the four locomotives which Allen purchased during this trip to England, the name of one is thoroughly established. This locomotive, the "Stourbridge Lion," has acquired an unique place in transportation history. Upon evidence that is to some extent conflicting, the names attributed to the other locomotives have been, respectively, the "America," the "Delaware," and the"Hudson." Clement E. Stretton, author of Development of the Locomotive, gives the name of the Stephenson locomotive as "America"; and in a letter dated November 13, 1896, to the Brotherhood of Locomotive Engineers' Journal, states that the names of the other two locomotives were the "Delaware" and the "Hudson". Stretton is probably the most reliable source as to the actual names of these locomotives.[12]

The "America" accepting this name, was shipped from the Stephenson works at Newcastle on the River Tyne to London on October 20, 1828, and from London to New York on November 27, 1828. The locomotive arrived at New York on January 15, 1829, on the ship

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11. Ibid., pp. 17-18.

12. Delaware and Hudson Company, op. cit., p. 50.

"Columbia". Delivered, it cost the company $3,663.30. It was unloaded and set up on blocks in the yard of Abeel and Dunscomb Foundry at 375 Water Street. The "America" was demonstrated under steam to a very interested public on May 27, 1829.[13] Philip Hone wrote in his diary that day:

> I went to Abeel and Dunscomb Foundry to meet a large party of gentlemen who were assembled by invitation to see one of the new locomotive engines in operation which was recently imported from England for the use of the railroad belonging to the Delaware and Hudson Canal Company, and which has been temporarily fitted up.[14]

The second locomotive to arrive in New York was the "Stourbridge Lion". The "Lion" was suggested to Horatio Allen by a painter; who found on the boiler head a circular surface, slightly convex, of nearly four feet in diameter. He painted on it the head of a lion in bright colors, covering nearly the entire area.[15] The "Stourbridge Lion" was shipped from Stourbridge to Liverpool in February, 1829, and from Liverpool on April 8, 1829, by the ship "John Jay", reaching New York on May 13. It cost the company, delivered, $2,914.90.[16]

The locomotive was landed at the wharf of the West Point Foundry Works at the foot of Beach Street. Horatio Allen had the engine blocked up in the yard of the West Point Foundry, and demonstrated there under steam on May 28, 1829. It became the object of curiosity to thousands who visited the works from day to day to see

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13. Ibid., p. 52.

14. Allen Nevins (ed.) The Diary of Philip Hone, I, p. 14.

15. Edwin B. Callaway, Stourbridge Lion, p. 11; Allen, op. cit., p. 18.

16. Delaware and Hudson Company, op. cit., p. 53.

the curious "critter" go through the motions only. There was no road
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for it about the premises.

The Morning Courier and New York Inquirer printed the following article on June 12, 1829:

> We yesterday attended the first exhibition of a locomotive engine, called "The Lion", imported by the Delaware and Hudson Canal Company to be used upon their railway. On Wednesday the engine, just imported, was tried; and gave such general satisfaction that the present exhibition was unanimously attended by gentlemen of science and particular intelligence. The engine was put up in Mr. Kemble's manufactory by Horatio Allen, Esquire, who went to England to purchase it for the company, and it gave us great satisfaction to say that the most important improvements which have lately been made in the construction of these engines originated with him. It is of nine horse power, having a boiler sixteen and a half feet long with two cylinders, each of three-foot stroke. It is calculated to propel from sixty to eighty tons at five miles per hour. The power is applied to each wheel at about twelve inches from the center; and the adhesive power of the wheel, arising from the weight of the engine, will give locomotion to the whole structure. 18

The Delaware and Hudson Canal Company had originally expected to have the railroad completed in time to celebrate the opening of the road and the running of the first locomotive upon it on the fourth of July. But the railroad was not ready for the planned event
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when July came. The company had transported two canal boats at a cost of fifty dollars from Rondout to New York to bring the locomotives to the railroad. When Jervis was informed of this by President Bolton,

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17. Brown, op. cit., pp. 75-76.

18. Ibid., pp. 83-84.

19. Ibid., p. 86.

he advised against it, feeling that the risk of loss or damage to the locomotives would be too great if they were loaded on canal boats and transported on the Hudson River. Bolton, therefore, arranged with the agent of the steamboat, Congress, to take the locomotives up the river, and to tow the empty canal boats. The cost of this operation was seventy-five dollars, which also included freight charges on eighty pairs of wheels for the railroad cars.[20]

On July 2, 1829, the "America" and the "Lion" were put on board the steamboat Congress, and sent up the Hudson River.[21] They arrived at Rondout on July 4 where they were taken apart and loaded on the canal boats. On July 16 they cleared the collector's office, and started up the canal for Honesdale. Within the next week they reached the railroad.[22] The Dundaff Republican of Susquehanna County, Pennsylvania, on July 23, 1829, said, "The boats begin to arrive with the traveling-engines and railroad machinery; all is hustle and business."[23] The newspaper article continued that the engine intended for the railroad was a plain, stout work of immense height, weighing about seven tons. The locomotive was predicted to travel four miles per hour with a train of thrity to thirty-six carriages loaded with two tons of coal each. The engine is called the "Stourbridge Lion", its boiler being built something in the shape of that animal and painted accordingly. The writer said, "Now imagine to yourself the

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20. Delaware and Hudson Company, op. cit., p. 52.

21. Ibid.

22. Brown, op. cit., pp. 78-81.

23. Ibid., p. 84.

appearance of that animal, the body at least twelve feet in length and five feet in diameter, traveling at the rate of four or five miles per hour, together with a host of young ones in the train, and you will have some idea of the scene before us."[24] The article ended by saying that in a few days the whole train would be set in motion. When the train was ready for operation a general notice would be published inviting the people of the area to attend. The canal company had purchased a large cannon and intended to station it on top of the high peak to sound the occasion.[25]

Being at liberty during July and August of 1829, Horatio Allen volunteered to go to Honesdale and take charge of the transfer of the locomotive from the canal boat to the railroad track. The "Stourbridge Lion" was elevated by the use of a temporary inclined plane to the level of the railroad. The railroad tracks were twenty feet from the canal and about eighteen feet above the level of the canal boat. As the locomotive passed in mid-air from the canal boat to the railroad, Allen saw that the axles had an unyielding parallel position. There was no king-bolt to provide facility for passing round the curves of the railroad. The four wheels holding their rigid position would have to be forced round the curve by the power of the steam engine.[26] On August 5 John B. Jervis wrote to John Bolton that the "Lion" was on the railroad, and that steam would probably be put into the engine in the next day or two.[27]

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24. Ibid., pp. 84-85.

25. Ibid., p. 85.

26. Allen, op. cit., pp. 20-21.

27. Delaware and Hudson Company, op. cit., p. 55.

The line of the road over which the run was to take place was straight for about six hundred feet and parallel with the canal. It then crossed the Lackawaxen Creek by means of a trestle thirty feet high on a curve nearly one-fourth of a mile long having a radius of seven hundred fifty feet and went in a straight line into the woods of Pennsylvania. In the original construction of the railroad a considerable portion of it was trestle work of hemlock timber built in 1828. It had stood nearly a year exposed to the sun and rain. The road had been built of timber in long lengths and had not been well seasoned. Some of the rails were not exactly in their true position when the time came that they were to carry the locomotive in its onward movement. Under these circumstances many people felt that either the road would break down under the weight of the "Lion", or the locomotive would not keep the track when going around the curve and would fall into the creek thirty feet below.[28]

On Saturday, August 8, 1829, a fire was kindled in the engine of the "Stourbridge Lion", and the steam was raised. The historic event was ready to begin with Horatio Allen at the throttle. When the New York and Erie Railroad was completed in 1851, Horatio Allen made a speech at the celebration at Dunkirk on Lake Erie. A portion of this speech has often been repeated. He said:

> When the steam was of the right pressure and all was ready, I took my position on the platform of the locomotive alone, and with my hand on the throttle valve handle, said: 'If there is any danger in this ride it is not necessary that the life and limbs of

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28. Allen, op. cit., pp. 20-21.

more than one should be subjected to that danger, and felt that the time would come when I should look back with great interest to the ride that was now before me.

The locomotive, having no train behind it, answered at once to the movement of the hand; and there being no doubt as to the result, a motion was had at once in which there was not any evidence of distrust. Soon the straight line was run over, the curve was reached and passed before there was time to think as to its not being passed safely, and soon I was out of sight in the three miles' ride alone into the woods of Pennsylvania.

I had never run a locomotive nor any other engine before. I have never run one since, but on August 8, 1829, I ran that locomotive three miles and back to the place of starting. Being without experience or a brakeman, I stopped the locomotive on its return at the place of starting.

When the cheers of the lookers-on died out, as I left them on the memorable trip, the only sound to greet my ears until my safe return, in addition to that of the exhaust steam, was the creaking of a timber structure when the parts are brought into the bearing state.

Over a half century passed before I again re-visited the track of the first ride on this continent. Then I took care to walk over it in the very early morning, that nothing should interfere with the thoughts and feelings that, left to themselves, would rise to the surface and bring before them the recollections of the incidents and anticipations of the past, the realization of the present, and again the anticipations of the future. It was a morning of wonderful beauty, and that walk alone will, in time to come, hold its place beside the memory of that ride alone over the same line more than fifty years before. 29

When Allen returned to Honesdale he was greeted by the shouting cheers of the people and the booming of a cannon. That day a great celebration was held in the small village of Honesdale. Stephen Torrey, the son of Jason Torrey, reported that no work was done until the middle of the morning.[30]

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29. Ibid., pp. 21-22; Callaway, op. cit., pp. 10-11.

30. Brown, op. cit., p. 87.

This three-mile run of the "Stourbridge Lion" on August 8, 1829, is an historic event of prime significance. It was the first operation of any railroad locomotive in the United States; and antedated by two months the famous Rainhill trials on the Liverpool and Manchester Railroad, where the prize winning "Rocket" established the practicability of steam railroad transportation. If the "America" had been selected for the first run, the remarkable circumstance that a trial of an engine which Horatio Allen said was built on substantially the plan of the famous "Rocket" would have occurred in the United States before that celebrated event took place in England.[31]

The date of this trial run at Honesdale is fixed beyond any possibility of doubt by a report from John B. Jervis to President John Bolton on August 8, 1829. Jervis said that they had put steam on the locomotive that morning for the first time, and had given the vehicle motion. The result led them to the conclusion that the curved road with fifteen feet stretches without support would require additional support. He felt the stretches of ten feet were sufficient. There was not much trial on the straight road that had fifteen feet stretches, but they felt there was no important deficiency apparent in strength that would need any immediate additional work. He was not able to state the amount of work of this kind that needed additional strength, but knew the quantity was not great. The engine went round the curves very well. The only difficulty was in the road.

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31. Allen, op. cit., pp. 19-20.

He thought that the locomotive would fully answer their expectations when the road was made firm enough to bear it. He added that all the difficulties discovered could easily be remedied, although it would be necessary to lose time in opening the road. Jervis took the necessary steps to secure those parts of the work that were deficient in strength.[32]

About the middle of August, 1829, when the news reached Wall Street that the railroad could not adequately sustain the imported locomotives at some points the stock of the Delaware and Hudson Company became weak. In a single day the one hundred dollar shares fell in price from eighty-two dollars to seventy-four dollars.[33]

Horatio Allen remained in Honesdale for about a month after the first experimental trip of the "Stourbridge Lion." During this time he made some improvements in the locomotive, and tested it on the track.[34] On September 13 he wrote a letter from Honesdale stating that on September 9 they had the engine in motion again. Its operation and effect on the road were carefully observed. He said, "The railroad as it now stands is not sufficiently stable for the operation of the locomotive. Before it is put to work the road ought to be carefully examined and strengthened. Without doing so it would be unsafe to put the engine at work."[35]

Allen was always grateful to John B. Jervis for the trust that he and the company had placed in him. When writing his

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32. Delaware and Hudson Company, op. cit., pp. 56-57.

33. Ibid., p. 59.

34. Jervis, "A Memoir of American Engineering," p. 47; Alfred Mathews, History of Wayne, Pike and Monroe Counties, Pennsylvania, p. 241.

35. Delaware and Hudson Company, op. cit., p. 57.

reminiscences over fifty years later (1884) he said that his connection with the construction of the Delaware and Hudson Canal led to the important railroad trusts being placed in his hands. He had always felt an appreciation of the professional obligation to that company, "and to their chief engineer, John B. Jervis, by whose counsels their action was determined."[36]

The locomotive worked well, and no doubt would have done good service, had the trestle work been sufficient to sustain the weight of the engine in working. John B. Jervis when he reported to the company on January 29, 1830, said that at the time he presented his plan of work to the Board in 1827, locomotives were in high reputation in England. He explored every means of information to which he could gain access to ascertain their influence on the road, and particularly their lateral pressure in curve lines. With reference to the latter he said he could find no intimation of the severity of their operation. It had been the intention to have engines of one and one-fourth tons on a wheel. The builders at the time had very little experience, and the weight on each wheel was nearly two tons.[37] Jervis said the locomotive was bought under an order by him for a locomotive which should not exceed five and a half tons in weight. The "Stourbridge Lion" actually weighed seven tons exclusive of coal and water. With this fuel the weight came to eight tons, and consequently was in excess of the weight which the trestles

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36. Allen, op. cit., p. 32.

37. Delaware and Hudson Company, op. cit., 57-59.

of the railroad were built to sustain.[38]

As soon as it was shown by the trial runs that the "Stourbridge Lion" was too heavy for the track, the company initiated estimates of the time and cost required to adapt the track structure to the unexpectedly heavy weight of the locomotives. On the advice of Jervis they deferred an actual decision to undertake the necessary improvements with the result that other business relegated to one side, all immediate plans for reconstruction.[39] The criticism that the trestles were too weak for their intended purpose was negated by the fact that they bore in the first twenty years of use the transit of about five million tons of coal. John B. Jervis is entitled to the credit of having introduced the first locomotive on the American continent.[40]

After the experimental runs the "Stourbridge Lion" was removed from the rails, and stored alongside the track. As winter approached it was given a rough covering of boards to protect it from the weather. Here it remained until about 1849. It was then taken to Carbondale where the boiler was put into use in the company's shop. Many of the other parts were also put to use. The boiler remained in this service for over twenty years, until replaced by one of higher power. Subsequently it was sold, and in the 1880's was again located at Carbondale in the foundry of Lindsay and Early. On June 18, 1889, that firm deposited the "Lion" in the Smithsonian Institute at

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38. American Society of Civil Engineers, op. cit., p. 112.

39. Delaware and Hudson Company, op. cit., p. 61.

40. American Society of Civil Engineers, op. cit., p. 112.

Washington, D.C. A number of the other parts of the locomotive have also been deposited at the Institute where it has been partially reconstructed.[41]

A replica of the "Stourbridge Lion," which figured prominently in "Transportation on Parade" at the New York World's Fair, 1939-40, and later was exhibited at Chicago, is now in a specially constructed building on United States Route 6, Honesdale, Pennsylvania. The locomotive and pioneer passenger car of the Delaware and Hudson Gravity Railroad system are preserved for posterity's sake by the Wayne County Historical Society. The structure housing the "Stourbridge Lion" stands on the site of the original survey transversed by the original "Stourbridge Lion" on August 8, 1829.[42]

The remains of the other three locomotives are a mystery. After the "America" passed the collector's office at Eddyville on July 16, 1829, nothing was heard or written about it. When the Centennial History was written for the Delaware and Hudson Company the authors discovered in the Smithsonian Institute a cylinder which Lindsay and Early of Carbondale deposited there on October 15, 1890. This cylinder was proven to be from the "America." The best assumption is that the locomotive eventually made its way to Honesdale, but was never tried on the railroad.[43]

The second locomotive made by Foster, Rastrick and Company of Stourbridge was shipped from Liverpool on June 21, 1829, on the

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41. Delaware and Hudson Company, op. cit., p. 57.

42. Callaway, op. cit., p. 12.

43. Delaware and Hudson Company, op. cit., pp. 52-53.

ship Splendid, and reached New York on August 9. The cost of this locomotive, delivered in New York, was $2,944.40. With the exception of the cistern, the locomotive was forwarded to Rondout from New York on the sloop Cornelia on September 6. The cistern followed the next day on the steamboat Congress. The third Stourbridge locomotive left Liverpool on August 8 by the ship John Jay, and arrived in New York on September 17. It cost the company $2,992.90. The sloop Cornelia left New York for the eastern terminal of the canal on October 3 or 4 with it on board. The boiler was sent up the river on the sloop Forrester[44] on October 21.

By the time these two locomotives arrived at Rondout the news that the railroad could not sustain their weight had reached the company. John Bolton in a letter to the company's treasurer on September 22, 1829, from Rondout said that one of the locomotives "came into store this afternoon."[45] James McEntee who at the time was superintendent of the canal from Rondout to Port Jervis said that the name of these two locomotives were the "Fox" and the "Lion." Although he was probably inaccurate in the names of the locomotives when he dictated his recollections in 1874, it is quite possible that he was accurate about the circumstances surrounding their final end. He said that the boilers were taken for other purposes, and the remains were stored in a temporary shed on the upper dock at Rondout until the wood work

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44. Ibid., p. 51.

45. Ibid., pp. 51-52.

rotted away. He said that they were finally removed to the white storehouse near the present Clinton Hall, and were burned up in a fire which destroyed the building.[46] When the canal was completed in 1830 McEntee resigned his position, and moved to Kingston where he led an active life. He was in the best position to know what really happened to them.

At the beginning of 1829 the financial resources of the company were again at low ebb. On January 13, 1829, a petition was presented to the New York State Assembly asking for financial aid. Doubt still remained in some minds whether anthracite would burn. Horatio Allen went to Albany to help the cause. The Assembly committee having charge of the matter reported that, because the State had required a first mortgage on the entire property in order to secure the first loan of its credit, the company was rendered unable to offer sufficient security to obtain the additional three hundred thousand dollars authorized by the act of 1827. On May 2, 1829, the Legislature authorized the issue of three hundred thousand dollars in additional certificates of stock. This loan bore interest at four and one-half per cent instead of five per cent which the State required in 1827. Like the aid granted in 1827, this act required a second bond and mortgage as security for the loan.[47]

This money was consumed in finishing the railroad and transporting coal to the New York market. With the company so deeply in

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46. James S. McEntee, "James S. McEntee's Story of the Canal," p. 302.

47. Delaware and Hudson Company, op. cit., p. 61,; Noble E. Whitford, History of the Canal System of the State of New York. I, pp. 743-44.

debt Jervis felt that the additional cost in reconstructing the railroad would be too great. As a result he recommended that a tow-path be constructed along the whole of the three long "Levels" previously described,[48] and on which the locomotives were to have been used.

Pursuant to that recommendation the three long levels were prepared for using horses to draw the cars. Earth was filled in such parts as were near the surface of the ground, and planks were laid on the cross ties where the grade was supported by posts.[49] On the Summit Level one horse could not draw more than two loaded cars at a time. On the Six Mile Level between Waymart and Prompton the grade permitted loaded cars to descend by gravity. Cars were provided for a sufficient number of horses to ride with each descending train to draw the empty cars back. On this level one horse was able to return four empty cars. These horses became so accustomed to riding down the grade that when by reason of ice on the rails in winter the loaded cars required force to propel them, some of the horses clearly showed an unwillingness to go upon the track and draw the cars in that direction. On the Four Mile Level between Prompton and the Canal Basin the grade was such that one horse could draw five loaded cars down and the same number of empty cars back. The Four Mile and Six Mile Levels each had a branch or side track for a short distance near the center so that cars moving in one direction could pass those going

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48. Best, op. cit., p. 14.

49. Ibid.

in the opposite direction. At these branches were the boarding houses for the car operators.[50]

On October 9, 1829, just two months and a day after the fateful trip of the "Stourbridge Lion", the first coal was carried over the railroad from the mines of Carbondale to the canal basin at Honesdale.[51] Jervis said that the railroad was sixteen miles long with five miles of double and eleven miles of single track. It cost originally, including the stationary steam engines, about ten thousand five hundred dollars per mile. The exact amount, however, was not known.[52]

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50. Ibid., p. 11.

51. Delaware and Hudson Company, op. cit., p. 59.

52. Annual Report of the State Engineer and Surveyor on the Canals of New York for the Year 1862 (1863), p. 159.

Chapter IX

The Consummation of a Great Project

The primary purpose of the Delaware and Hudson Canal was to carry anthracite coal from the mines in northeastern Pennsylvania to New York City. Oddly enough, this canal spent its first two or three years of partial operation largely in hauling wood. The New York Journal of Commerce in May, 1829, announced that "During the week ending May 18 one hundred ten boats and one hundred six rafts arrived at Eddyville and one hundred two cleared. Last season we (New York City) received upward of twenty thousand cords of wood through this channel which otherwise would not have been brought."[1] The company also began passenger service by packet boats on October 7, 1829. Full fare from Rondout to Honesdale was four dollars or five cents a mile.[2] Meals cost extra.

The canal was considered complete from Honesdale to the Hudson River in October, 1828, and seven thousand tons of coal passed through it before the season closed. It was held back during the following year by the railroad which could not handle the coal rapidly enough. Jervis had estimated the capacity of the railroad in advance at five hundred forty tons per day, or one hundred eight thousand tons in a year of two hundred working days. Before the railroad was completed it was necessary to haul coal over the

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1. Alvin Harlow, Old Towpaths, p. 191.

2. William Cuddeback, Deerpark: The Delaware and Hudson Canal, p. 21.

mountains from the mines to the canal by sled or wagon. Twenty to thirty teams were engaged in this work, pulling loads of one to two tons each. It cost two dollars per ton to bring coal to the basin by sledge on snow or two and three-quarter dollars by wagon. The cost to bring coal from the mines to tide-water was five and one-quarter dollars.[3]

At the close of the 1829 season the outlook for the Delaware and Hudson Canal Company was good. Although the shipments of coal already sent to market amounted to only seven thousand tons, the managers were confident that the volume of these shipments would grow rapidly. The company, however, was to undergo a severe crisis during the next two years. The quality of some of the coal sold in 1829 was unsatisfactory. This coal was largely surface coal. The inferior quality of some of the fuel sold late in 1829 and early in 1830 for a time injuriously affected the company's standing and prospects.[4]

The Company could deliver coal in New York City and adjacent points at prices slightly lower than were possible to either of its rivals, the Lehigh Company or the Schuylkill Navigation Company. In accordance with the trade ethics of that day these competitors sought to turn the defect in quality to their own advantage.[5] James McEntee said that "no coal was mined in Carbondale until early in the summer of 1830." In the spring of that year John B. Jervis, James Archbald, and James McEntee made a tour through the Wyoming

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3. Harlow, op. cit., p. 190.

4. Delaware and Hudson Company, A Century of Progress, p. 62.

5. Ibid.

Valley, and visited all the coal mines then being worked which were only four in number. These mines were operated on a small scale because there was no means for getting the coal to market except to send it down the Susquehanna River on rafts and very little was needed for consumption in the immediate vicinity.[6]

Mining operations began systematically in 1830, and forty-three thousand tons of a superior quality of coal were shipped to market.[7] In January of the following year the company published a pamphlet in its own defense. This pamphlet, although anonymous, has been attributed to John Wurts, the younger brother of the original projectors of the company. The pamphlet disclosed the conditions with which the company was confronted, and discussed the main features of the canal and railroad. It said the company owned between three thousand and four thousand acres of coal land selected with special reference to ease of access, quality, and quantity of the anthracite contained.[8] The crisis lasted until the summer and autumn of 1831 when markets in New England were opened, and some steam boats were converted to burn anthracite.[9]

The quality of coal was not the only problem facing the young enterprise. The controversy between the canal people and the raftsmen became so serious by 1830 that Philip Hone was called upon to lay aside his affairs and go to Honesdale to help settle a dispute.

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6. James McEntee, "James S. McEntee's Story of the Canal," p. 299.

7. Noble Whitford, History of the Canal System of the State of New York, I, p. 745.

8. Delaware and Hudson Company, op. cit., pp. 67-68.

9. Ibid., pp. 79-80.

Hone arrived at that town on February 15, 1830. The following day he set out with Jervis in a cavalcade of fifty persons, representing both factions as well as the Pennsylvania Legislature. They proceeded along the towpath following the Lackawaxen River to the Delaware, and viewed the alleged obstructions as they went. The following day Hone and his party returned to Honesdale along the tow-path while the legislative party returned to Harrisburg by way of the lower Delaware River. It was fortunate, Hone recorded in his diary, that the rafting interests returned by a different route for their leader, Merith, had been hung in effigy at several points. As a result of this trip it was determined that the claims of the raftsmen were baseless for the navigation of the Lackawaxen had been improved rather than impeded.[10]

Another result of this investigation was that on March 23, 1830, the General Assembly of Pennsylvania authorized an agreement releasing the Delaware and Hudson Canal Company from building a river lock in their dam across the Delaware until required by the Commonwealth to do so. The sluice in this dam that Jervis had made was sufficient to pass the lumber rafts coming down stream. In return the company agreed to connect their canal with the Delaware Canal System of Pennsylvania from Port Jervis to Easton when required to do so. The agreement was duly executed. Fortunately for the company they never had to build this section.[11]

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10. Edwin LeRoy, The Delaware and Hudson Canal, p. 33.

11. Whitford, op. cit., I, p. 746.

To add to the worries of the builders of the new canal, the New York State Legislature chartered the Hudson and Delaware Railroad on April 19, 1830, authorizing it to build a railroad from Newburgh to Carpenter's Point (Port Jervis). Not content with this plan, which if carried out might render the canal from Port Jervis to the Hudson useless, the new project included extension of the proposed railroad to the anthracite district under the name in Pennsylvania of the Delaware and Susquehanna Railroad Company.[12] At Carpenter's Point the railroad was to cross into Pennsylvania and continue up the Delaware and Lackawaxen Rivers. It would pass over Cobb's Gap which, their engineers reported, was "three hundred feet lower than Rix's Gap, the pass over which the railroad of the Delaware and Hudson Canal Company is carried." By this route they claimed that a load of coal could reach New York City in twenty-four hours.[13] This plan progressed to the point of incorporation and the issue of a detailed prospectus, but never went any further. No competing railroad entered the Lackawaxen Valley until twenty years later.[14]

In spite of the difficulties and the setbacks which the company had undergone, John Bolton wrote a letter to the Governor of New York on December 12, 1830, in which he said:

> As a measure of economy, time was taken last spring to put the canal in the best possible condition which deferred the opening until the 20th of April and the very slight interruptions which

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12. Delaware and Hudson Company, op. cit., pp. 69-70.

13. LeRoy, op. cit., p. 35.

14. Delaware and Hudson Company, op. cit., p. 70.

> have occurred in the navigating proves the good judgment of our chief engineer, Mr. Jervis -- it has now become a substantial work and all exposed parts have been well secured. They have recently been subjected to a very severe test as a heavy fall of snow was succeeded by several days of incessant rain. The Delaware and Lackawaxen Rivers rose with great rapidity. The former, at our crossing place, twelve feet in twenty-four hours, but the only injury sustained was on the Lackawaxen by water passing through a slope wall and washing some of the bank into the canal which was repaired at an expense of fifteen dollars. This detail is given in consequence of doubts having been expressed about the stability of our work in an official memorial to the Legislature in 1829. [15]

With reference to the cost of repairs which President Bolton mentioned, it is safe to say that the cost of the same work today would exceed two hundred dollars.[16] He added that the "railway has fully met our expectations, since the substitution of ropes for chains on the planes. The change, however, which was effected at the close of winter was very expensive."[17]

On April 13, 1831, John Wurts replaced John Bolton as the President of the Delaware and Hudson Canal Company.[18] For the six year period of his service Bolton had given John B. Jervis strong support in constructing both the canal and the railroad. After Washington Irving accompanied Philip Hone ten years later on a trip over the canal and railroad he wrote to his sister in Paris:

> I do not know when I have made a more gratifying excursion with respect to natural scenery--for many miles the canal is built along

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15. LeRoy, op. cit., p. 33.

16. Ibid.

17. Ibid., p. 24.

18. Delaware and Hudson Company, op. cit., p. 72.

> the face of perpendicular precipices rising into stupendous cliffs, with overhanging forests, or jutting out into vast promontories, while upon the other side you look down upon the Delaware, roaring and foaming below you, at the foot of an immense wall or embankment which supports the canal. Altogether, it is one of the most daring undertakings I have ever witnessed to carry an artificial river over rocky mountains, and up the most savage and almost impracticable defiles. For upward of ninety miles I went through a constant succession of scenery that would have been famous had it existed in any part of Europe. 19

In May of 1830 John B. Jervis had resigned his position as chief engineer of the Delaware and Hudson Canal Company. He had spent five hard years at work on this project making sure that every detail of instruction was carried out. He had hired and trained a small corps of engineers who helped him faithfully. He saw the wilderness along the line of the canal become civilized. When working on the Gravity Railroad he saw the western terminus of the canal become another thriving village. On February 28, 1829, Hazard's Register of Philadelphia said that two years previously the site of the village of Honesdale was "occupied by woods, but since the commencement of active operations of the Lackawaxen Canal and on the railroad, both of which terminate near this place, a town has been laid out on this spot and now contains eighteen dwelling houses, four stores, a tavern, a post office and the offices of the Delaware and Hudson Canal Company." 20

The Engineering Magazine for February, 1889, in an article entitled "Pioneer Locomotives in England and America" said:

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19. "Irving Was Our Guest in 1841," The Delaware and Hudson Company Bulletin (June 1, 1927), VII, p. 165. Reprinted from Yale Review, April, 1927.

20. LeRoy, op. cit., p. 23.

> It is one of the curiosities of locomotive history that it was not in, or near, any one of the great cities that the first locomotive was put upon the rails, but far away in the then raw region of northeastern Pennsylvania on August 8, 1829, that the "Stourbridge Lion" made its trial trip. 21

Jervis was responsible for bringing the first locomotives to the United States. He had built a railroad from the available material which he thought would support the machine. Unfortunately the limited knowledge in this area caused failure. Three years later when he constructed his next railroad, the Mohawk and Hudson, he corrected this error.

When Jervis resigned he recommended that Russell F. Lord be placed in charge of the canal and James Archbald be placed in charge of the railroad.[22] On May 21, 1830, a power of attorney was issued granting full authority to Lord for superintending the canal and Archbald for superintending the railroad. This power of attorney was signed by Philip Hone as president pro-tem of the company.[23]

Russell Lord was born in Rome, New York, on August 17, 1802.[24] Jervis said that "he was a man of excellent executive ability, and conducted the administration with good sense and fidelity to his duty."[25] Under his direction the canal was increased to a depth of five feet in 1842-43 enabling the use of forty-ton boats. He enlarged the canal a second time in 1851 so that boats of one hundred twenty tons could be used. At this time he also en-

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21. Edwin Callaway, Stourbridge Lion, p. 8.

22. Jervis, "A Memoir of American Engineering," p. 48.

23. "Interesting Letters," Port Jervis Union Gazette, Feb. 28, 1928.

24. Ibid.

25. Jervis,"A Memoir of American Engineering," p. 48.

larged the canal a second time in 1851 so that boats of one hundred twenty tons could be used.[26] At this time he also enlarged the locks. Lord served the company faithfully for forty years. On January 1, 1864, he resigned his position as chief engineer of the canal, but he remained in service as consulting engineer until his death on July 11, 1867, at Honesdale.[27] Throughout his life he remained a very close friend with John B. Jervis, who had trained him for the engineering profession.

James Archbald was born in Ayrshire, Scotland, on March 3, 1793. At the age of twelve his family moved to the Mohawk Valley. He was a contractor on the Erie Canal where he attracted the attention of Jervis. Jervis gave much attention to this quiet, serious man, and trained him with great care.[28] In 1830 he was made superintendent of the railroad and the mines. Jervis said that "he had an excellent engineering mind of great practical sagacity and was eminently upright in purpose."[29]

In 1832 the railroad hauled ninety thousand tons of coal and three million feet of lumber. This amount of business was claimed to be greater than that of any other railway in the United States for the period.[30] As business increased the Gravity Railroad became inadequate. In November, 1841, the company ordered Archbald to enlarge the road. From 1842 to 1845 the old wood and strap iron rails were replaced by the new "T" iron rails manufactured at Slocum

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27. "Interesting Letters from Builders of the Delaware and Hudson Canal and Erie Railroad," Port Jervis Union Gazette, February 25, 1928.

28. Delaware and Hudson Company, op. cit., pp. 132-33.

29. Jervis, "A Memoir of American Engineering," p. 47.

30. Whitford, op. cit., I, p. 747.

Hollow (Scranton, Pennsylvania.)[31]

At this time Archbald also changed the original plan of the railroad which Jervis had devised. He abandoned plane eight (the last of the self-acting planes), and carried the six-mile grade to the head of the canal at Honesdale. He then made a new plane, worked by steam power, at the head of the canal up which the empty cars were hauled to a certain height. A new railroad was constructed on a grade that would allow the empty cars to descend by gravitation as far as the country would permit. Then by another plane of the same kind the cars were hauled up to such height as could be commanded by the terrain, and a gravity railroad was made as far as the ground would permit. So alternatively, by planes worked by steam and by gravitation the empty cars completed their return from the canal to plane number seven (the second self-acting plane), a distance of about ten miles. This dispensed with all moving power, and completed the machinery character of the railroad. It was worked completely by stationary steam engines and gravitation with no moving power of importance.[32]

One of the great tourist attractions of Honesdale was a trip over the Gravity Railroad to Carbondale. A traveler in 1879 said, "The novelty of ascending and descending the hills or planes with no visible motive power, the grand and beautiful scenery along its route, and the idea of riding in perfect passenger coaches with

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31. LeRoy, op. cit., pp. 43-44.

32. Jervis, "A Memoir of American Engineering," p. 47.

no fear of cinders or dust all combine to make the trip over it one to be remembered and thoroughly enjoyed."[33]

James Archbald was employed as the chief engineer of the Pennsylvania Coal Company to construct a railroad from its mines at Pittston through Cobb's Gap and the valley of the Wallenpaupack to Hawley, a town on the Delaware and Hudson Canal about eight miles from Honesdale. This railroad was about forty miles long and worked by stationary steam engines and gravitation in both directions.[34]

When John B. Jervis was elected President of the Michigan Southern and Northern Indiana Railroad, Archbald was made Vice-President. Both men held their positions from 1850 to 1857. This railroad was the first to enter Chicago in 1851, and later became the main line of the New York Central Railroad. About 1858 Archbald was appointed chief engineer of the Delaware, Lackawanna and Western Railroad, and later he was President of the Lackawanna and Bloomsburg Railroad.[35]

Russell F. Lord and James Archbald were not the only great engineers that Jervis trained. The two most famous engineers that he trained on the Delaware and Hudson Canal were Horatio Allen and William McAlpine. After the famous trip of the "Stourbridge Lion" on August 8, 1829, Horatio Allen took charge of the construction of the South Carolina Railroad connecting Charleston, South Carolina,

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33. Tri-States Union, Port Jervis, October 7, 1879.

34. Jervis, "A Memoir of American Engineering," p. 48.

35. Delaware and Hudson Company, op. cit., p. 134.

with Augusta, Georgia. Under his direction a locomotive was built at the West Point Foundry in New York City named the "Best Friend of Charleston." This locomotive, placed on the South Carolina Railroad on November 2, 1830, was the first one built and the second one operated in America.[36]

When Jervis became chief engineer of the Croton Aqueduct in 1836 he appointed Allen his principal assistant engineer. The Croton Aqueduct was the first resevoir system for New York City built under Jervis' direction from 1836 to 1842. One of Allen's duties was the building of the reservoir at 42nd Street and Fifth Avenue where the Public Library now stands. Another of his achievements was the construction of the High Bridge which carried the Croton Aqueduct across the Harlem River to New York.[37]

In 1842 Horatio Allen became one of the proprietors of the celebrated Novelty Works in New York City. The name of the firm was Stillman, Allen and Company. When it was changed to a stock company Allen was made president of the concern. The works employed one thousand five hundred men during the Civil War filling immense contracts for the Army and Navy. During his connection with the Novelty Works, Allen also acted in the capacity of consulting engineer for the Erie Railroad and was president and chief engineer of the company for a year. He was consulting engineer for the Panama Railroad Company and held other important trusts including that of consulting engi-

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36. Alfred Mathews, History of Wayne, Pike and Monroe Counties, Pennsylvania, pp. 240-41.

37. Callaway, op. cit., pp. 14-15.

neer of the Brooklyn Bridge. He died in 1890 at the age of eighty-eight, just two years short of the mark Jervis set.

William J. McAlpine was the youngest of the engineering force. He remained with John B. Jervis for ten years as a faithful assistant and close friend. He worked on the Mohawk and Hudson Railroad, the Albany and Schenectady Railroad, the Chenango Canal, and the enlargement of the Erie Canal. In 1836 when Jervis resigned the position McAlpine became chief engineer of the eastern division of the Erie Canal. He worked on such projects as the government dry dock in Brooklyn, Erie Railroad, Chicago and Galena Railroad, Ohio and Mississippi Railroad, and the New York Capitol.

McAlpine earned a reputation so substantial in Europe that the British called him into conference over the great Manchester Ship Canal. Later he became consulting engineer in the successful attempt to improve navigation on the Danube River near the famous "Iron Gate." He was one of the first Americans to be honored by membership in the British Institute of Civil Engineers. Fifty years after Jervis had sent one of his men to get help with the first locomotive for the United States, another of his pupils repaid the debt by giving his counsel in solving one of England's major transportation problems.

Why was the construction of the Delaware and Hudson Canal successful? The main reason was the ambition, zeal, and enthusiasm this group of young engineers led by Jervis used in their work.

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38. Ibid., p. 15.

39. John I. Parcel, "William Jarvis McAlpine," Dictionary of American Biography (1933), XI, pp. 548-49.

40. John A. Krout, "New York's Early Engineers," New York History (July, 1945), XXVI, pp. 276-77.

Jervis wrote in his autobiography:

> There was no special discipline for the purpose of securing a vigorous prosecution of the work on the part of the engineering department. My own mind was naturally devoted to the success of the enterprise, and absorbed in the responsible duties I had undertaken. My intercourse with my assistants was frank and cordial, discussing with them freely all matters of business connected with the work, and listening patiently to their suggestions and finding ample material for discussion in the numerous exigencies of the work. 41

Two years after he resigned from his position John B. Jervis in writing to Russell F. Lord on July 17, 1832, said, "It affords me great pleasure to hear the Boys are getting on so well. Indeed the Delaware and Hudson has been (I think fortunately for its interest) connected by Boys pretty much."

Jervis was quite disturbed by an investigation made by Benjamin Wright for the company to see "that the mining, railroad, and canal business were connected with proper economy." He said, "I believe the Board is fully satisfied that the Boys are very important to the successful management of this company." 42

Like the men he trained Jervis went on to build some of the most important projects in the United States before the outbreak of the Civil War. The long list of his projects includes the Mohawk and Hudson Railroad, Schenectady and Saratoga Railroad, Chenango Canal, enlargement of the Erie Canal, Croton Aqueduct of

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41. Jervis, Facts and Circumstances, p. 113.

42. Letter from John B. Jervis to Russell F. Lord, July 17, 1832, Weale's Collection.

New York City, Hudson River Railroad, Southern Michigan and Northern Indiana Railroad, Rock Island Railway, and Pittsburgh, Fort Wayne and Chicago Railroad. He set many impressive records on these projects, and was highly respected the rest of his ninety-year life as the greatest civil engineer of the pre-Civil War period. The pioneer work which he did on the Delaware and Hudson Canal and Railroad earned him this reputation. Through constant activity, enthusiasm, and skill, John B. Jervis earned the reputation of being an ingenious canal and railroad engineer.

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Vita

On May 17, 1937, H. Benjamin Powell was born to David and Margaret Powell at East Stroudsburg, Pennsylvania. Raised on a farm at East Stroudsburg with two brothers, Benjamin was educated in the local public schools. He graduated from East Stroudsburg High School in 1955 with a two thousand dollar scholarship to study at Drew University, Madison, New Jersey.

During his four year tenure at Drew, Powell turned his attention toward sports and the business world. He planned to go into business after graduation. In 1959 he graduated from Drew with a Bachelor of Arts Degree in history. When he graduated he was unable to receive the type of employment he wanted. At that time he turned his attention to the profession of teaching history. He spent the next year at East Stroudsburg State College acquiring skills, knowledge, and training for the teaching profession.

In September of 1960 Benjamin began his teaching career in the Central School System, of Port Jervis, New York. While teaching three different history courses the first year he developed his love and enthusiasm for the subject. He read extensively into the subject and presented several lectures on the local television station concerning world affairs.

In June of 1961 Powell started his work on the Masters' Degree at Lehigh University with the expressed purpose of getting a Ph.D. Degree in history from that institution. While working under Dr. George D. Harmon in the spring of 1962 he discovered

the importance of John Bloomfield Jervis' work on canals and railroads. At that time he set out to do a detailed, thorough study of Jervis. Since no historical work had been written on Jervis, he decided to write the first thirty-five years of the engineer's life for the master's thesis. He hopes to complete this work for the doctoral dissertation. At present he has written newspaper articles and lectured to civic clubs in Port Jervis, New York, on this subject. His ultimate goal is to teach in college and write extensive railroad and canal history.