A STUDY OF THE GROTON IRON BRIDGE COMPANY AND THE PRESERVATION OF AMERICA'S HISTORIC METAL TRUSS BRIDGES

A Thesis

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by

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ABSTRACT

This thesis presents a brief overview of the history of bridge building, particularly as related to developments in the industrial era and the use of iron and steel in metal truss bridge construction. The history of the Groton Iron Bridge Company, operating from its plant in Groton, Tompkins County, New York, from 1877 until approximately 1920 is described. In addition, the research has located 107 surviving examples of the bridges built by the firm. The contemporary problems of the preservation of historic iron and steel trusses are examined, case examples given and the practical problems in the rehabilitation of bridges are discussed.

The research revealed that the Groton firm was among the major manufacturers of bridges in the last quarter of the nineteenth century. Production data supplied to the American Iron and Steel Association, and published in its directories of 1894, 1896 and 1898, ranked the Groton firm, of the 119 companies reporting, as one of the top twenty-three in annual operating capacity. Although most of the firm's bridge building was conducted in the Mid-Atlantic region, it built bridges in at least twenty-six states and the District of Columbia. Agents for the firm were at various times stationed in eleven branch offices.

The firm's history can be viewed in three distinct periods, the first beginning with the initial incorporation as the Groton Iron Bridge Company in 1877 as the result of the merger of an iron foundry

with an agricultural equipment manufacturer. The second and most profitable period, begun in 1887 with a recapitalization and new Charter of incorporation as the Groton Bridge and Manufacturing Company, continued until 1899. That year, the Groton firm, along with twenty-two of its competitors, was purchased by the American Bridge Company, later a subsidiary of the United States Steel Corporation. The American Bridge Company continued the operation of the plant at Groton for one year before closing it and removing the equipment.

The third period of the company's history began in 1902 with the repurchase of the buildings by the Groton community and the operation of the plant as the Groton Bridge Company. Business continued for more than two decades afterward, although certainly on a scale more limited than that experienced in the last decade of the nineteenth century at the height of the firm's success.

This thesis describes an exciting and competitive period in American bridge building history. It is hoped that this work will contribute to the appreciation of the unique beauty of metal truss bridges and help develop the recognition that metal truss bridges are features of America's cultural heritage to be accorded the full protection of historic preservation law.

BIOGRAPHICAL SKETCH

Pamela Thurber was born on September 30, 1947, in Elmira, New York. She lived in Ithaca, New York, until 1950 when her family moved to Bethesda, Maryland, where she was educated in the public schools. Graduating from the Calvin Coolidge High School in Washington D.C. in June of 1965, she attended the New York State School of Industrial and Labor Relations at Cornell University from which she was graduated in June of 1969. She continued her education at the George Washington University in Washington D.C., obtaining the Master of Arts in Government in May of 1973.

From June of 1969 until June of 1975, she was employed by the Government of the District of Columbia, serving as a Research Assistant at the D.C. City Council, Executive Secretary of the Steering Committee on the Reciprocal Income Tax, Staff Assistant to the Director of the Department of Human Resources and Special Assistant to the Director of Public Health.

In 1975, Ms. Thurber entered federal government as the Chief of the Executive Secretariat of the National Institute on Drug Abuse. In the fall of 1977, she served as a staff member to a review of federal drug abuse programs conducted by the Office of Drug Abuse Policy of the Executive Office of the President. In March of 1978, Ms. Thurber became Special Assistant to the Director of the National Institute on Drug Abuse and was responsible for congressional liaison. In addition, she resumed her duties as the Executive Secretary of the National Advisory Council on Drug Abuse and chaired, for the period of one year, the Institute's Task Force on Women's (Drug Abuse Program) Concerns.

In August of 1981, she entered the Graduate Program in Historic Preservation Planning at Cornell University. Upon completion of her coursework in May of 1983, Ms. Thurber was employed by the National Trust for Historic Preservation as Congressional Liaison and later as Project Researcher for the State Historic Preservation Legislation Project first phase study on state enabling law for local historic district commissions. Currently, she serves as Information Services Assistant in the Library, Department of Preservation Services, of the National Trust.

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CHAPTER I

A Short History of Developments in Bridge Building

Just over one hundred years ago the Brooklyn Bridge was dedicated, an event having a great influence on man, not only here in the United States, but throughout the world. The bridge symbolized the creativity and emerging new technology that characterized the industrialization of the last decades of the nineteenth century. The history of bridge building, however, spans the history of all time and cannot be adequately summarized in these few pages. Therefore, only the developments leading directly to the use of iron and steel trusses in bridge construction will be discussed in this brief first chapter.

The Brooklyn Bridge, or the "Great Bridge", as it came to be known, symbolized an age of experimentation with new materials and new building technologies. The ability to weave the steel cables and to sink the tremendous coffer-dams required to build the piers to anchor the span was gained through hundreds of years of experimentation and technological growth and development. Further, the experimentation required in building the Brooklyn Bridge generated an excitment coupled with the realization that the limitations once accepted were no more. This had a catalytic effect on other enterprises and stimulated an era of intense business competition. The manner in which the numerous bridge building concerns pursued their task in the last quarter of the nineteenth century, and to some extent for the first decade of the twentieth, contributed to the "spirit of enterprise" which developed in this era.[1] Many date the initiation of the industrial spirit with the need to rebuild the nation after the Civil War. Indeed, a great number of bridge building companies were founded in the years immediately following the war.[2]

It is clear that in all civilizations bridges have been needed to link place to place, crossing natural barriers, and to join people together for purposes of trade, commerce, exploration, conquest and socialization. What is particularly significant about bridge building in the industrial age is the use of a new material, iron, and the trend toward the scientific analysis of the stresses upon materials as they worked together to hold up and constitute a bridge.

The use of iron as a bridge building material had been demonstrated to the world by the construction, in 1775, of the bridge at Coalbrookdale, over the Severn Gorge in Shropshire, England. The use of iron for the five arches of this structure was made possible, in part, by the work of Abraham Darby, who in 1713, introduced the process of using coal for smelting iron. Later in the century, John Wilkenson, a prominent British ironmaster, improved the coke blast furnace.[3] It must be said, however, that these developments were preceded by centuries of experimentation in bridge building.[4]

The trend toward the scientific analysis of materials and their wear began in the eighteenth century and continued to the nineteenth when iron was more commonly available for building. Many consider the French to have been the leaders in the institutionalization of scientific methodology in the experimentation with new materials. Iron was used in several of the designs included in the <u>Traité de Ponts,</u> for example, the first treatise on bridge building published by a Frenchman, Herbert Gautier, in 1714.[5] The first governmental civil department for bridge building, the Corps des Ponts et Chaussées, was established under Louis XV in 1719. Graduates of the first engineering school, the École des Ponts et Chaussées de Paris, founded in 1747, approved all plans for roads, bridges and canals.

Developments in bridge technology were not confined to the French; the British led the way with many significant achievements. John Rennie, the Scottish architect who built his first bridge at the age of twenty-four in 1785, advanced scientific methodology by advocating that one must be in complete understanding of the theory of a bridge before any designs can be placed on paper.[6] George Stephenson, also an Englishman, was the first to use iron for railroad bridges; his Britannia Tubular Bridge of 1849 was the most famous example.[7] These efforts would not have been possible had it not been for the experiments of builders and scientists of the preceeding centuries.

In 1586, for example, Simon Slevin published the results of a study of statics using experiments with loaded strings which established the triangle of forces upon which the truss system for bridge building is based. Galileo studied the strength of materials for bridges and described loading or weighting factors in his <u>Two New Sciences</u>, which was translated into English in 1665. Robert Hooke examined the forces of tension and compression in bridge construction and concluded that "extension is proportional to force."[8]

In addition to the study of the parts of a bridge and their relationships, the invention of the steam engine and machinery used to fabricate metal work stimulated bridge building using iron and steel.

Henry Cort developed rolling mills which shaped iron and patented this invention in 1783. In 1784, he patented a crucial process; that of producing wrought iron from pig iron. Practitioners rapidly moved the new iron working technologies into refined processes and the materials became more usable for bridges and other structures.

Thomas Pope was among the first Americans known to have written on bridges. In 1811, in his treatise on Bridge Architecture, he wrote:

> It is a notorious fact that there is no country of the world which is more in need of good and permanent Bridges...Nature, ever provident for man, has, however, afforded us ample means of remedy. Our forests teem with the choicest timber; and our flood can bear it on their capacious bosoms to the requisite points. Public spirit is alone wanting to make us the greatest nation on earth; and there is nothing more essential to the establishment of that greatness than the building of Bridges; the digging of canals, and the making of sound turn-pike roads. Necessity has already produced some handsome and extensive specimens of bridge building in the United States.[9]

In the United States after 1800, a number of experiments with wooden truss forms began and patents were taken out on particular configurations. Based first on the construction of wooden bridges, these patented truss forms were used for covered bridges as well as other types. Wood was easily available and used extensively, although it was not flexible and could be destroyed by fire.

In 1803, Theodore Burr patented a wooden arch, combined with the King post truss, that was known as the Burr Arch Truss. (Figure 1) The diagonally latticed web truss patented by Ithiel Town in 1820 and 1835 was commonly used and the patent made Town a wealthy man. In 1830, Stephen H. Long devised a truss form for wooden bridges which included connections of wooden tees.[10]

The Burr Arch, Town and Long truss forms were used for covered bridges and other wooden bridges in the first decades of the nineteenth century. After 1840, however, with the emerging availability of iron for use in bridge building, these wooden truss forms were transferred to metal. William Howe, in 1840, patented the first truss form in the United States which used metal members. The truss featured timber lattice work with iron verticals. The metal members functioned in compression, being pushed together, while the wooden vertical members were in tension, having forces tending to pull apart.[11] The use of metal in bridge construction became more common, stimulated by the need to provide greater strength, and consequent safety, for bridges carrying the railroad.[12]

To meet this need, Thomas and Caleb Pratt patented a truss form in 1844 which used vertical posts in compression and diagonals of iron in tension. Proving to be economical and strong, this all metal truss became the most commonly used bridge form. As wrought iron was found to be stronger in both tension and compression, while cast iron was strong only in compression, later, to increase the strength of these bridges, the main structural members were constructed of wrought, or manipulated, iron.[13]

The basic Pratt truss was improved upon by others in attempts to strengthen it to bear greater loads, as railroad equipment became heavier. In 1847, Squire Whipple of Utica, New York, patented a Double Intersection Pratt truss, the key feature of which was the extension of diagonal members across two panels of the truss.[14]

A Pratt form using curved upper and lower chords in the shape of a parabola, the lenticular truss, was invented in Germany in the 1850's and first used in the United States in 1878.[15] The original holder of the patent in the United States was William O. Douglas of Binghamton, New York. Surviving work of the major American manufacturer of lenticular bridges, the Berlin Iron Bridge Company, East Berlin, Connecticut, is extremely rare.[16]

Wendall Bollman and Albert Fink, students of the architect of the Capitol, Benjamin Henry Latrobe, developed Pratt truss forms exclusively for use by railroads. The Bollman truss was patented in 1852, the Fink in 1854. These forms strengthened the Pratt truss with the addition of sub-struts and sub-ties. The Fink was longer than the Bollman and thought to better distribute the load.[17] Bridges of these types are rare today.

The railroads continued to strengthen their bridges as train equipment grew heavier. The Baltimore Petit Pratt, developed from the patent of Wendall Bollman, used a straight top chord. The Pennsylvania Railroad bridges used curved chords on the top. These bridges, however, built primarily with cast iron, could not absorb tensile stress adequately in the bottom chords and were discontinued for reasons of safety.

By 1890, the Fink and Bollman bridges had been superseded. It was written in Engineering News in that year:

> All of these old Fink and Bollman bridges, as we said about a year ago in pretty frank terms, have really passed beyond their time of useful service, and are carrying heavier loads than they were ever designed for, use cast iron with a freedom which is no longer tolerated, and ought to be taken down before they fall down.[18]

The Stearns truss, another Pratt form, was introduced in 1890 and touted as an improvement over the basic Pratt by saving in materials and ease of erection. The Stearns was a controversial form, however, and throught to be unsafe because of the added strain it placed on the top chord: "(I am)...not sure that such an economy is really attained ...without considerably reducing the safety of the bridge," wrote Charles Steiner of Minneapolis to the Engineering News in August of 1982.[19] The earlier Parker truss, a Pratt with a polygonal top chord, and the Camelback, a variant of the Parker truss with five slopes in the top chord, were more frequently used models.[20]

After the turn of the century, the Warren truss came to replace the Pratt as the most commonly used truss for highway bridges. Patented by two British designers in 1848, this truss is distinguished by its triangular "W" shape. Its diagonal members are capable of withstanding forces both in tension and in compression.[21]

The frequency with which bridges collapsed alarmed bridge engineers and signaled the shift from iron to steel for bridge construction. In the 1870's, one out of four railroad bridges failed.[22] The most famous accident, the collapse in 1877 of a Howe wrought iron truss built for the Lake Shore Railroad over a gorge near Lake Erie at Ashtabula, Ohio, was a major disaster. Thereafter, the question was raised in Engineering News:

> Would this not be a good time for the Society of Civil Engineers to bring up again and press through to consummation the plan for a committee of engineers to approve of every structure of this kind before it is open to public use?[23]

Railroad stopped using cast iron and began to lighten bridge structural members.[24] The transition to steel in roadway bridges occurred generally by 1880 as well, as highway bridge failures were more common than railroad collapses.[25] Generally, although the transition to steel began at the same time for both highway and railroad bridges, iron continued to be used, in combination with steel or by itself, for the construction of roadway bridges.[26]

The catalytic converter, invented in 1856 by the Englishman Henry Bessemer, led to the more widespread availability of steel.[27] The open hearth steel production process, while not surpassing the production of steel by the Bessemer method until after the turn of the century, was further refined by French ironworkers, father and son, Pierre Emile Martins.[28] William Siemans, a German, also patented an open hearth process and produced steel rolled into rails in 1867.[29]

In 1850, the production of steel in America was estimated to be one-sixth that of the British. It was not until 1878 that steel was first made here using a hearth furnace or crucible.[30] In that year, the first all steel bridge was built in the United States by General William Sooysmith to carry the Chicago and Alton Railroad over the Missouri River at Glasgow, South Dakota.[31] An earlier bridge which used steel extensively was perhaps more famous, the Eads Bridge at St.

Louis, constucted between 1868 and 1874.[32]

After 1892, the more widespread availability of steel changed the manufacturing of bridges. The larger steel producing companies controlled the supply of the material and provided standard structural forms and elements from their lines of stock, which the bridge companies cut, fabricated and marketed as finished bridges.[33]

Concrete, which had been known since Roman times, was not used extensively in bridge building in the United States until after 1900. In 1908, addressing the American Society of Civil Engineers, Professor William H. Burr challenged its members to make greater use of the material, noting that more was known about its strength at the time than was known of steel.[34] The first book on concrete by an American author; An Account of Some Experiments with Portland Cement Concrete, Combined With Iron, as a Building Material, was published by Thaddeus Hyatt in 1877.[35]

Bridges of pre-cast molded concrete blocks appeared in Britain as early as 1840 and in the United States beginning in 1870. Near the end of the nineteenth century, several railroad bridges had been built in concrete and a concrete arch bridge constructed in San Francisco in 1889. In 1897, the Nashua Aqueduct in Boston was built entirely in concrete.[36]

Both the marketing of Portland cement, which began intensively in 1889, and the introduction of the Melan system of reinforced concrete bridge construction in 1894, using rolled steel as a reinforcing material, helped encourage the use of concrete in bridge building in this country.[37] The stronger steel produced after 1920 made the use of reinforced concrete more common and the lean and beautiful designs in concrete by Swiss bridge architect Robert Maillart rendered its use more completely and asthetically acceptable by the 1920's.[38]

After the Civil War, bridge building companies began forming in the United States, many developing from iron foundries or similar enterprises. These companies assembled metal truss bridges, using patented designs of their own development for some variant in building technique or form. By 1893, 119 companies reported their annual operating capacity for the production of tonnage of iron and steel to the American Iron and Steel Association for publication in their directory. There were certainly many more companies capable of building bridges, perhaps as many as 450.[39]

In New York State, the volume of bridge building business supported the existence of over fifty firms. At least eleven were established in upstate New York including the Buffalo Bridge and Iron Works; the Kellogg Bridge Company, Buffalo; the Niagara Bridge Company, Buffalo; the Climax Road Machinery Company of Marathon; the Elmira Bridge Company, Ltd.; the Good Roads Machinery Company of Marathon; the Havana Bridge Works of Montour Falls; the Lane Bridge Company, Painted Post; the Leighton Bridge and Iron Works of Rochester; the Owego Bridge Company; the Horseheads Bridge Company; and several other firms in the major cities of Buffalo, Rochester, Albany and Syracuse.[40] The Groton Iron Bridge Company, later the Groton Bridge and Manufacturing Company of Groton, Tompkins County, New York, was among the largest of these central New York firms.

Many inventors, builders, mechanics and engineers were responsible for the cumulative knowledge drawn upon for bridge designs. Handbooks were written for the use of the bridge engineer, although some of the early builders did not have formal engineering training. John G. Trautwine's Civil Engineer's Pocket Book of 1872 was recommended by bridge engineer JAL. Waddell, whose own books became the texts of the era.[41] The Phoenix Bridge Company published its handbook in 1869 and the Carnegie Steel Company published its handbook, The Carnegie Pocket Companion, in 1873. These books, along with more elaborate engineering treatises, journals of the engineering schools, colleges and societies, and engineering and builder's periodicals such as the weekly Engineering News, assisted in spreading technology and generating business opportunities for bridge firms.

The movement to professionalize bridge building under the direction of the engineer was led by Waddell. However, some practictioners disagreed with the need. An anonymous "highwayman" from Cleveland wrote Engineering News:

> the great numbers of 'moth-eaten' and 'rust-scarred' bridges which are now standing around the country are more credited to the work of certain educated rascals, who style themselves 'engineers' than to the companies which built them.[42]

Waddell decried the practice of letting the contract to the lowest bidder, regardless of the design or quality of their past constructions. The practice, he thought, often resulted in the construction of unsafe bridges. The King Bridge Company, a competitor of the Groton firm founded by Zenas King in Cleveland, Ohio, in 1871, was often a low bidder on bridge contracts. A gentleman from Maine wrote to Engineering News in 1879:

> I have just returned from a careful examination of several iron bridges which have recently been erected in this State by King Bridge Company...I regret exceedingly to see works of this kind finding their way into Maine, as they are eminently unsafe...in glaring defects of construction and their wretched detail.[43]

To this the company replied; "There are good bridges, there are better bridges, and their are best bridges. We build all kinds just like our neighbors."[44]

In the early days of the operation of these firms, after the Civil War, the calculation of stress and loading factors in bridge design was largely unpracticed. Systematic testing of the strength of individual members and loading capacity came only after the American Society of Civil Engineers met in 1872 to consider the large number of bridge failures. The effort was encouraged by the government, however, even by 1898, with governmental assistance to develop a testing program, only five testing machines for breaking full-sized eye-bars existed, for example.[45]

The solicitation of construction bids was a fairly standardized process. A bridge-letting notice would be published by a county or town or village, to which the bridge company salesman, sometimes called the bridge broker, would respond with a bid. Many thought the bidding process was only a ruse and Waddell observed of common practice:

> It is true that mailed bids are received but they are very seldom accepted, even if the figures be the lowest, for the commissioners are generally unable to resist the combined eloquence of half a dozen bridge-men...[46]
>
> It is surprising how little the average travelling bridge-man really knows about bridges, and how incapable he is of giving advice of any value to a commissioner...What he does know is how much bridges will probably cost, and this know-ledge he obtains from the company engineer. His forte is to do the heavy talking, in which it is by no means necessary for him to stick to the truth...[47]

A bid would be based on a specification and the cost estimate and plans, Waddell estimated, took from one-half to three hours to prepare for a small county bridge.[48] The cost of the construction of a bridge included not only the materials used, but also the expenses of hauling and freight, framing, falsework, erection, painting, blacksmithing, coal, freight on tools, travel, bidding, labor for construction and incidentals.[49]

After a contract was won, the wrought iron or steel was obtained from producers in standard shapes. The bridge company, or fabricator, cut the shapes by machine into the parts necessary to put the structure together. Holes were drilled in the appropriate places for the pin-connections. The parts were labeled and shipped to the site for erection.

The erecting foreman, usually an employee of the bridge company, made arrangements for the materials to be sent to the site and hired the labor from the area in which the bridge was to be built.[50] Crews from six to sixty members were used depending upon the size of the bridge to be erected. Waddell thought that six men could erect a small pony truss and seven a through, or full, truss under eighty feet in length. If a bridge was between eighty and 100 feet long, eight men were required. Between 100 and 125 feet, nine to ten were used; 125 to 150 feet, eleven to twelve; 150 to 175 feet, Waddell recommended thirteen to fourteen men; 175 to 200 feet, fifteen to sixteen; 200 to 250 feet, sixteen to twenty-four; and from 250 to 300 feet, twenty-four to thirty-six men. These numbers were to be doubled if speed in construction were required.[51]

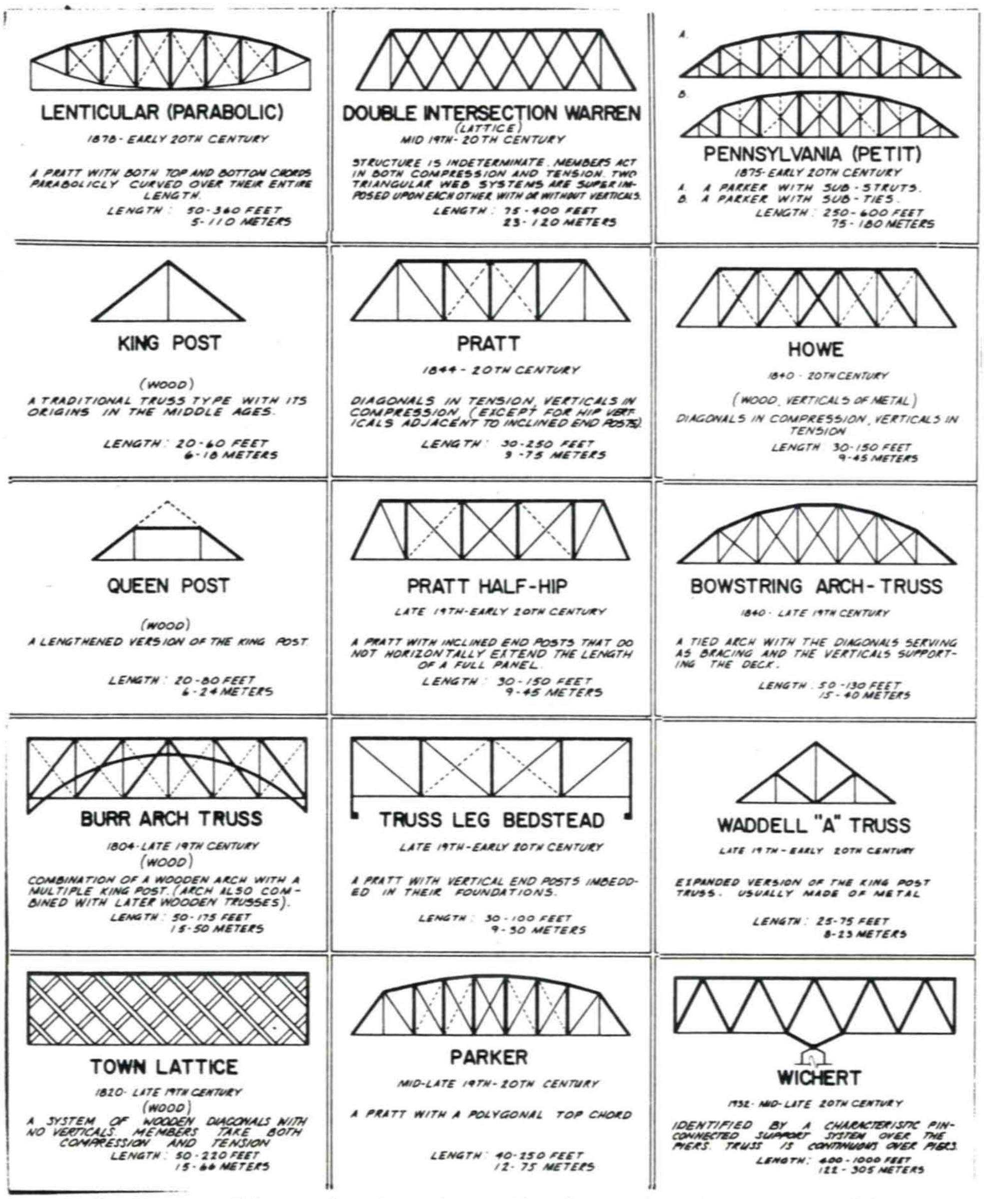
Although the nineteenth and early twentieth century metal truss bridges are rapidly disappearing from the landscape, many remain, Waddell thought:

> There is no reason why a well-designed iron highway bridge, when properly cared for, should not last forever, under loads which are light and slowly moving, compared to those of railroad bridges, the iron cannot possibly wear out; and, when properly protected from the weather, it cannot rust.[52]

We shall test Waddell's prophecy as the history of the Groton Iron Bridge Company is detailed, surviving bridges of its manufacture are described and the contemporary problems in the conservation of historic metal truss bridges are examined.

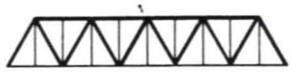
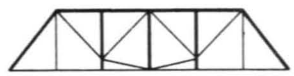
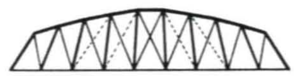
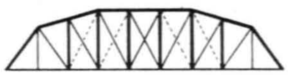
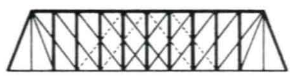
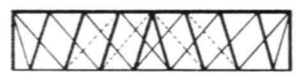
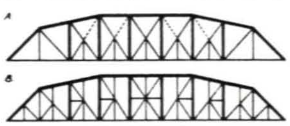
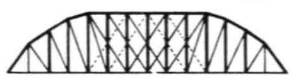
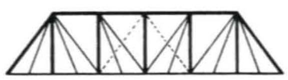
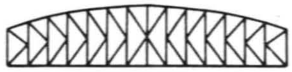
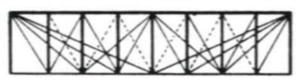
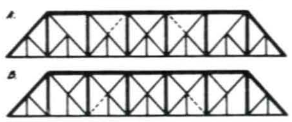
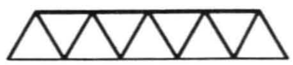
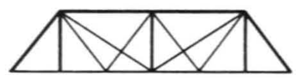
TABLE 1

TRUSSES



Source: Historic American Engineering Record, Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, Technical Information Project, 1976.

TABLE 1 CONTINUED

 **WARREN** WITH VERTICALS MID 19TH-20TH CENTURY DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. VERTICALS SERVE AS BRACING FOR TRIANGULAR WEB SYSTEM. LENGTH: 50-400 FEET 15-120 METERS	 **GREINER** 1894 - EARLY 20TH CENTURY PRATT TRUSS WITH THE DIAGONALS REPLACED BY AN INVERTED BOWSTRING TRUSS LENGTH: 75-250 FEET 23-75 METERS	 **PEGRAM** 1887 - EARLY 20TH CENTURY A HYBRID BETWEEN THE WARREN AND PARKER TRUSSES, UPPER CHORDS ARE ALL OF EQUAL LENGTH LENGTH: 150-650 FEET 45-195 METERS
 **CAMELBACK** LATE 19TH-20TH CENTURY A PARKER WITH A POLYGONAL TOP CHORD OF EXACTLY FIVE SLOPES LENGTH: 100-300 FEET 30-90 METERS	 **DOUBLE INTERSECTION PRATT** 1847 - 20TH CENTURY (WHIPPLE, WHIPPLE-MURPHY, LINVILLE) AN INCLINED END POST PRATT WITH DIAGONALS THAT EXTEND ACROSS TWO PANELS LENGTH: 70-300 FEET 21-90 METERS	 **POST** 1865 - LATE 19TH CENTURY A HYBRID BETWEEN THE WARREN AND THE DOUBLE INTERSECTION PRATT LENGTH: 100-300 FEET 30-90 METERS
 **CAMELBACK** WITH SUBDIVIDED PANELS LATE 19TH-EARLY 20TH CENTURY A. A PENNSYLVANIA TRUSS WITH A POLYGONAL TOP CHORD OF EXACTLY FIVE SLOPES B SAME AS A. WITH HORIZONTAL STRUTS. LENGTH: 100-500 FEET 30-150 METERS	 **SCHWEDLER** LATE 19TH CENTURY A DOUBLE INTERSECTION PRATT POSITIONED IN THE CENTER OF A PARKER. LENGTH: 100-300 FEET 30-90 METERS	 **BOLLMAN** 1852 - MID-LATE 19TH CENTURY (RARE) VERTICALS IN COMPRESSION, DIAGONALS IN TENSION. DIAGONALS RUN FROM END POSTS TO EVERY PANEL POINT. LENGTH: 75-100 FEET 23-30 METERS
 **KELLOGG** LATE 19TH CENTURY A VARIATION ON THE PRATT WITH ADDITIONAL DIAGONALS RUNNING FROM UPPER CHORD PANEL POINTS TO THE CENTER OF THE LOWER CHORDS. LENGTH: 75-150 FEET 23-30 METERS	 **K-TRUSS** EARLY 20TH CENTURY SO CALLED BECAUSE OF THE DISTINCTIVE OUTLINE OF THE STRUCTURAL MEMBERS. LENGTH: 200-800 FEET 60-240 METERS	 **FINK** 1851 - MID-LATE 19TH CENTURY (RARE) VERTICALS IN COMPRESSION, DIAGONALS IN TENSION, LONGEST DIAGONALS RUN FROM END POSTS TO CENTER PANEL POINTS. LENGTH: 75-100 FEET 23-45 METERS
 **BALTIMORE (PETIT)** 1871 - EARLY 20TH CENTURY A. A PRATT WITH SUB-STRUTS B. A PRATT WITH SUB-TIES LENGTH: 250-600 FEET 75-180 METERS	 **WARREN** 1848 - 20TH CENTURY TRIANGULAR IN OUTLINE. THE DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. A "TRUE" WARREN TRUSS HAS EQUILATERAL TRIANGLES. LENGTH: 50-400 FEET 15-120 METERS	 **STEARNS** 1890 - EARLY 20TH CENTURY SIMPLIFICATION OF FINK TRUSS WITH VERTICALS OMITTED AT ALTERNATE PANEL POINTS. LENGTH: 50-200 FEET 15-60 METERS

ENDNOTES, CHAPTER I

[1] Otto Mayr and Robert C. Post, Yankee Enterprise: The Rise of the American System of Manufactures (Washington D.C.: Smithsonian Institution Press, 1981) is instrumental in developing this concept.

[2] Telephone interview with William C. Chamberlin, Civil Engineer III, New York State Department of Transportation, Engineering Research and Development Bureau.

[3] David B. Steinman and Sara B. Watson, Bridges and Their Builders (New York: G.P. Putnam's Sons, 1941), p. 113.

[4] Steinman, op. cit., notes that the Roman civilization is the first about which history records significant bridge building activity. Roman bridges and aqeducts were known throughout Europe for their stability, strength and size. The concept of the truss, or structural triangle, had been tried much earlier, however. It is thought that Bronze Age men, the lake dwellers of Switzerland in 4000 B.C., were the first to use the truss system in building, resting beams on posts to support gabled roofs.

The earliest structural renderings of the truss are those of Palladio who published four systems in his Four Books on Architecture in 1520. Drawn were a stringer bridge using wooden piles with diagonal braces to support the horizontal beam, a true or Ciscome truss which combined the King and Queen post trusses, an eight panel truss using the King post, and a fourth using the curved upper chord of the Ciscome truss with bracing. "Bridges", Palladio wrote, "ought to have the self-same qualifications we judge necessary in all other buildings, that they be commodious, beautiful, and lasting."

[5] Ibid, p. 96.

[6] Steinman, op. cit., p. 104.

[7] Ibid, pp. 145, 152.

[8] Harry J. Hopkins, A Span of Bridges (New York: Praeger, 1970), p. 102.

[9] Theodore Cooper, "American Railroad Bridges", Transactions, Journal of the American Society of Civil Engineers, 418 Vol. XXL

(1899), p. 8.

[10] Ibid, p. 15.

[11] Hopkins, op. cit., p. 114.

[12] Cooper, op. cit., p. 15.

[13] Steinman, op. cit., p. 167.

[14] Squire Whipple of Utica, New York, patented his own iron truss system in 1840, an arch bridge known as the bowstring arch, which used cross ties over a curved upper chord to enhance the structural capabilities of iron. Trained as a mathematician, Whipple computed the strains each part of a bridge was subjected to and published his findings in A Work Upon Bridge Building in 1847. In 1872, his Elementary and Practical Treatise in Bridge Building was published and, also in that year, Whipple patented a lift-drawbridge for use over the Erie Canal.

[15] Allan T. Comp and Donald C. Jackson, "Bridge Truss Types: A Guide to Identifying and Dating", American Association for State and Local History Technical Leaflet 95, n. pag.

[16] Ibid.

[17] Comp and Jackson, op. cit.

[18] Engineering News, 23 August 1890, p. 173.

[19] Ibid, 4 August 1892, p. 11.

[20] Comp and Jackson, op. cit.

[21] Ibid.

[22] Joseph Gies, Bridges and Men (New York: Doubleday and Company Inc., 1963), p. 30.

[23] Engineering News, 20 January 1877, p. 19.

[24] Steinman, op. cit., p. 167.

[25] Gies, op. cit., p. 130.

[26] Llewellyn Edwards, A Record of History and Evolution of Early American Bridges (Orono, Me.: University Press, 1959), p. 103.

[27] Hopkins, op. cit., p. 122.

[28] Steinman, op. cit., p. 168.

[29] Ibid.

[30] Leonardo Benevolo, A History of Modern Architecture (Cambridge, Mass.: M.I.T. Press, 1977), I, p. 106.

[31] Record of steel exists as early as 1500 B.C. from India, according to Steinman. Its manufacture was performed in Europe by 900 B.C. and in China in 600 B.C. Bellows were added to the hearth furnace and powered first by water, then timber and finally, coal or coke. According to Carl Condit in his American Building Art: The 19th Century, (New York: Oxford University Press, 1960), steel was used in eye-bars in the United States as early as 1828.

[32] Steinman, op. cit., p. 173.

[33] Dan G. Diebler, Metal Truss Bridges in Virginia: 1865-1932 (Charlottesville: Virginia Highway and Transportation Research Council, 1975), I, p. 13.

[34] Steinman, op. cit.

[35] Ibid, pp. 269, 271.

[36] Antony Sealey, Bridges and Aqueducts (London: H. Evelyn, 1976), p. 135.

[37] Hopkins, op. cit., p. 252.

[38] Sealey, op. cit., 136-39.

[39] Published in 1984, Victor C. Darnell, A Directory of American Bridge-Building Companies 1840-1900 (Washington D.C.: Society for Industrial Archeology, 1984), p. 110.

[40] Diebler, op. cit., p. 13.

[41] John Alexander Low Waddell, The Designing of Ordinary Iron Highway Bridges (New York: John Wiley and Sons, 1884), p. 2.

[42] Engineering News, 6 April 1893, p. 331.

[43] Ibid, 18 January 1879, p. 20.

[44] Op. cit., 22 July 1879, n.p.

[45] Condit, op. cit., pp. 139, 143. Early testing machines were developed in 1867 and installed in the Phoenix Iron Company, the Key-

stone Bridge Company and the Carnegie Steel Company.

[46] Waddell, op. cit., p. 157.

[47] Ibid, p. 158.

[48] Waddell, op. cit., p. 169.

[49] Ibid, p. 116.

[50] These procedures were well described in Volume 3 of the Virginia study, 20-23.

[51] Waddell, op. cit., p. 196.

[52] Ibid, p. 210.

CHAPTER II

The History of the Groton Company

Groton, in the northeastern portion of Tompkins County, was settled in 1793. Lying in a valley along the Owasco Inlet in the headwaters of the Susquehanna basin and framed by hills on the east and west rising from 100 to 350 feet, the growth of the town was facilitated by its natural topography and soil for agricultural pursuits. It became accessible on transportation routes, at first a stage coach route from Albany to Cortland, to Groton, and on to Ithaca, sixteen miles away.

The town was primarily, in its earliest days, an agricultural community with a small center containing services for those in the outlying areas. In 1860, the population of the village center itself was 596; by 1866, it had grown to 700. The development of local industry in the last quarter of the century doubled the population in the village proper to 1,342 by 1897. The Town of Groton, which included the surrounding agricultural areas, reached a peak in population at 3,618 in 1840.[1]

Groton was always an industrious community. Local histories note, for example, that in 1853 the village contained three sawmills, a grist mill, five carriage shops, a furnace, a sash and blind factory, a foundry, four blacksmiths, a shoe manufacturer and a tannery.[2] Three larger industries, however, dominated the economic life of the town in the last quarter of the nineteenth century. Several of the carriage manufacturing shops, operating in the town since 1830, merged to become the Groton Carriage Works. The firm, which became a stock company in 1866, produced some 5,000 vehicles annually until its closing in 1908.[3]

The Crandall Machine Company, an antecedent of the Smith-Corona Typewriter Company, moved from Syracuse to Groton in 1887. Producing interchangeable type, this firm operated until 1900.[4] The largest company of the period was the bridge works.[5]

Sound investment of the profits of these active businesses helped create the conditions for future prosperity in the town, ultimately enabling the financing of additional expansion of the bridge company. In 1860, the First National Bank of Groton was established, largely through the efforts of Charles Perrigo, a founder of the bridge firm. Initial subscriptions of $100,000 were raised locally. Perrigo served as the president of the bank until 1890.

Telegraph service was established in 1865 and the local newspaper, The Groton and Lansing Journal, began publication in 1866.[6] The Southern Central Railroad was attracted to Groton in 1869 by local subscriptions of $50,000.[7] The line, which was later to become a part of the Lehigh Valley Railroad, ran from Fair Haven on Lake Ontario through the neighboring New York towns of Auburn and Moravia, to Groton and onto Dryden before terminating at Sayre, Pennsylvania. Its purpose was to link the coal producing region in the Lehigh Valley with the iron ore reserves of the Great Lakes. Other public improvements in Groton included the establishment of a waterworks in 1888 and the lighting of the town by 1900.[8]

The bridge company was formed by the merger of an agricultural machine manufacturing company with an iron foundry. The experience of these two firms in business management and their knowledge of nation-wide markets was instrumental in the immediate success of the new company. The agricultural machinery manufactury, the Groton Separator Works, founded in 1847 by Daniel Spencer, was operated by him in partnership with William Perrigo after 1859. In 1863, Perrigo purchased Spencer's share and formed Perrigo & Avery, a partnership with Frederick Avery.[9] The annual income of this company was $26,500 in 1867 and its markets had been extended to the States of Ohio, Pennsylvania, Iowa, Illinois, Indiana, Minnesota, Wisconsin, California, Mississippi and Maryland.[10]

The iron foundry, begun in 1849 as the Groton Iron Works with a capitalization of $2,000 by the brothers Charles and Lyman Perrigo, had earlier roots as a blacksmith's shop. Its markets included the State of California, other states in the west, the east, and New York State.[11]

Charles Perrigo was born in Canajoharie, New York, in 1817. At the age of nineteen he was apprenticed to a founder in Genoa, New York, where he worked for four years. Later, he worked in Skaneateles, New York, and Geneva, New York. His brother, Lyman, was a machinist who invented a spoke planer which was built and sold by their firm.[12] Oliver Avery, Jr., a mechanic, joined the Perrigo brothers' firm.[13] By 1867, sales amounted to $29,000 annually.[14]

The manufacture of iron bridges began in 1877 under the name "Charles Perrigo and Company."[15] Soon thereafter, the merger occurred and the new firm incorporated under the name of the Groton Iron Bridge Company. The first officers of the firm were Charles Perrigo, president; Ellery Colby, vice-president; William Williams, secretary; and Frederick Avery, treasurer and general business manager.[16] It was Colby who emerged as the chief operating officer, and his family that dominated the daily operations in the early period of the firm's history, from 1877 until 1887. Colby's son, Ray M., served as an agent; his brother, Henry P., was a draughtsman and erecting foreman; and brother Lauren Colby acted as an erecting foreman.

Four patents were issued to the Groton bridge builders; two for innovations in the building of bridge piers and two for innovations in the superstructure itself. The patents were issued variously to Ellery Colby, Oliver Avery, Caleb Bartholomew and Charles Perrigo.[17] The first patent to be granted was to Colby for the use of railroad rails as bridge piers, driven into the ground and capped by other rails placed horizontally. Iron stops were then placed on the piles and fastened to regulate how deeply they could be driven into the ground. These piers could be used to hold bridges or trestle work.[18]

The second patent involved making the top, or head-cap, of the piles and the shoe, or foot-block, one piece by means of a bolt or a strap. Filed in August 1876, this patent was granted to Avery and Bartholomew. The advantage of this scheme, according to the descriptions supplied with the publication of the patent, was to have the bridge itself work to hold the piles in line.[19]

The third patent, for an "Improved bridge", was filed by Avery and Bartholomew. Its objective was "to make a wrought-iron or steel bridge for common roads and railways."[20] Railroad bars were used to form the top chord of the truss, which was bent at angles and connected at plates to vertical braces and perpendicular rods. Plates above and below the bottom chords, which were themselves double H or T railroad bars, connected the bottom of the braces and rods. The edges of the bottom chords were serrated to join similarly serrated mortises in the foot-block. The bottom chords supported the timbers or metal beams holding the deck of the bridge. The top chord, foot-block and platform chord were bound by a strap or a bolt and a middle cross bar was bent upward to meet the base rod at nearly right angles, having the advantage, according to the inventors, of being a stiffer bracing system.[21]

The final patent, for a light arch, was filed by Colby in January, 1877.[22] The central feature of this invention was the bending of the arch only at a connection with the floor, or at regular intervals, leaving the sections straight between bends. The arch could be made of railroad rail, channel, T, H or I shaped beams or other iron or steel tubes. The bending was done, as described by the inventor, to maintain greater strength than a traditionally shaped semi-circular arch.[23]

The daybook for the company's operation between 1877 and 1885 has been left to the Regional and Local History Collection of the Olin Graduate Library at Cornell University. From this source, record of the location and price of 355 bridges built by the firm during this period is available. In the first five years of its operation, the company built an average of twenty-five bridges a year. In 1882, it built forty-seven bridges. Fifty-eight bridges were constructed in 1883 and ninety-seven in 1884. The record of business in 1885 is incomplete documenting the construction of only twenty-five spans that year.

Among the firm's suppliers during this early period were the Union Nut Company of Buffalo, the Elmira Rolling Mills and the Passaic (New Jersey) Rolling Mill. Nuts, iron and rails were purchased from the Marathon Bridge Company and the Union Nut Company. Railroad rails were obtained from the Southern Central Railroad, machinery from the Allen Rivet Machine Company, paint from the National Paint Company, coal from the Lehigh Valley Coal Company and oil from the Syracuse Oil Company.[24]

Payments as commissions to other bridge companies were recorded as early as 1881 with a $25 payment to the King Bridge Company. One pooling agreement to which the Groton firm was a party was signed in Chicago on April 26, 1886. These arrangements, often short-lived, were designed to stablize prices. Each firm would agree to a percentage of the market which it would receive and pay other firms who received less than their agreed upon share.[25] (Table 2)

In addition to revealing the volume of business, suppliers and the pooling practice, the daybook gives an idea of the charges for bridge construction during the period. An iron bridge erected in central New York by the firm in July of 1879 cost $400. This included charges for lumber of $66.50, work and hauling of $12.30, freight of $18.45 and blacksmithing of 75¢. Although this bridge did not have a latticed sidewalk, one erected in 1883 by the firm in Stockholm, New York did, for which the added charge was $128.

The Groton Bridge Builder, a monthly publication of the firm, was printed by the Groton and Lansing Journal. Five of the Bridge Builders, volumes number one to five, are probably all that were printed; they are all that are referenced in documentary sources. The content, in addition to providing examples of the firm's work, can be best described as containing the local brand of boosterism. The company's ease of access to major transportation routes was highlighted in the issue of May 1883:

> We are centrally located near the center of the State, on the Southern Central Railroad. Twenty-seven miles north we reach the Auburn branch of the New York Central, and 38 miles north we reach Weedsport, and form connections with the mainline of the New York Central, also have good facilities for transferring by the Erie Canal; and 58 miles north we reach Sterling Junction, where we form a junction with the Rome, Watertown and Ogdensburg Railroad, and at 60 miles north we reach Fair Haven. Here we have good facilities for transporting by boat to the northeastern part of the State.
>
> As we go south, at 6 miles we reach Freeville, where we form connection with the Utica, Ithaca and Elmira Railroad, and 40 miles south we reach Owego. Here we cross the Erie and the Delaware, Lackawanna and Western Railroad and at 60 miles south we reach Sayre, the northern terminus of the Lehigh Valley Railroad, thus giving us easy facilities for reaching any part of the State.[26]

The Groton Iron Bridge Company incorporated as the Groton Bridge and Manufacturing Company in 1887 with a capitalization of $100,000 raised locally through subscriptions of $100 each. The Charter described the purposes of the corporation as:

> Carrying on and conducting the manufacture of iron bridges, iron piling for bridges, portable steam engines, grain separators, hot air and steam air heaters, and to do a general repairing and job work.[27]

The first president of the new company was Ellery Colby, however, he soon left the community and in 1890, William H. Fitch, who had been elected the treasurer in 1888, became the president. Frank Conger became vice-president and Chester Barney the treasurer and secretary. Barney died, however, before the company began in its reconstituted form and Barnum Williams became secretary and Oliver Avery the treasurer.[28] Corydon W. Conger was elected treasurer in 1890.[29] When Fitch died, Frank Conger became president.[30] Eleven trustees governed the operations of the firm.[31]

In 1888, 150 men were employed by the company.[32] In 1891, the Groton Mechanics Indemnity Association was formed to provide insurance against accident and death of the men in the shops and yards of the company. No more than $60 was to be provided for any one illness and only $60 was to be paid in the event of a death.[33]

An 1892 advertisement in Engineering News revealed the company's branch offices to be located in Mt. Vernon, Ohio, Houston, Texas and Owosso, Michigan.[34] By 1894, offices were set up in San Francisco, California, Sunbury, Pennsylvania, Front Royal, Virginia, Knoxville, Tennessee and Fitchburg, Massachusetts as well as in the original towns.[35] By 1898, Council Bluffs had become the location for an office and the Pennsylvania office no longer existed.[36] The company stationary for 1899 indicated an office in New York City at 39 Cortland Street; in Fort Worth rather than Houston; and in Nashville rather than Knoxville.[37] The Iowa, Ohio and Virginia offices had closed and an office opened in Charleston, West Virginia. In 1905, the next year for which information is available, branch offices were located in Corry, Pennsylvania, Worcester, Massachusetts and Owosso , Michigan. By 1913, only one branch office remained, that located in Attleboro, Massachusetts.[38]

The experience in Nashville is illustrative of how branch operations were opened and closed. According to the city directories, a Groton Bridge and Manufacturing Company office existed there from 1891 until 1902. Mr. M.S. Hasie and Mr. W. T. Young were the agents. Young also served as agent for two other bridge companies; the Cotton States Bridge Company of Atlanta, Georgia, and the American Bridge Company of New York City. Young began his own firm, the W.T. Young Bridge Company in 1906. By 1922, that firm had disappeared and Young was listed as vice-president of the Nashville Bridge Company.[40]

William W. Williams served the Groton company as an agent and extant records document his travels throughout Central New York over a six month period in 1887. Among his papers is a 3 1/2" by 6" sketchbook on graph paper in which thirty-eight bridge truss models are drawn. Each is labeled according to the dimensions and type of member to be used and is accompanied by a pricing scheme. The notebook provides designs for Pratt trusses only, ranging in size from two to six panels. Some of these designs are indicated to have been submitted on particular bids.

Mr. William's account book, covering the period from March 24 to August 20, 1887, notes extensive travel, both by train and by stage or on horseback, to as many as five towns a day. Williams lists expenses for railroad fares, meals, livery, railroad guides, hotels, and "bus". In the first week of his recorded travels, for example, Williams visited eleven towns, including Union, Hancock, Walton, Rock Rift, Sidney, Owego, Cold Springs, Canandiagua, Housick Falls, Honeoye and Stafford, and made repeat visits to four.[41]

Agents were similarly engaged in Massachusetts, Michigan, Tennessee, Pennsylvania and Virginia and the record of the company's bids and subsequently awarded contracts supports the activity generated in these areas. Agent Ray Colby, for example, was highly successful in Maryland, Virginia, West Virginia and the District of Columbia. The agents presumably used the company newspaper, a small catalog published in 1883 and the company handbook "Thoughts and Suggestions About Roads and Bridges" in their sales attempts.[42]

The heart of the company's facilities in Groton was the foundry and the buildings which comprised the original Perrigo brothers iron works. From this beginning, the manufactury grew to include seventeen buildings on the east and west sides of Main Street at Elm, none of which survive today. The site had its own railroad station and was served by an internal hand cart circulating system laid on tracks.[43]

The foundry was located on the east side of Main Street near the intersection with Elm Street. In October of 1887, this complex included a machine shop and storage building with a dry kiln, a boiler, a bridge shop and another storage building. On the west side of Main was located the station near the Owasco Inlet, the railroad tracks, two storage buildings, a machine shop and three lumber storage areas. On the upper portion of this site, north of Railroad Street, was located the bridge painting building, a flask and storage shed and three other storage buildings.[44] (Figures 2.1-2.3)

Although limited, some documentary records indicate that there was on-going expansion at the site. In 1885, two new furnaces, one for heating rivets and one for eye-bars, were installed in October.[45] An office building was begun in 1887. In 1890, a new boiler house was built.[46] By all indications, as determined from fire insurance maps, in 1892 the lower western end of the site had become the center of activity. A hammer and rivet shop had been constructed, as had a woodworking shop, and storage capacity had been enhanced. The office building was complete by April of 1892. The upper portion of the western site was used entirely for storage and consisted of three sheds and two larger storage buildings.[48] In 1893, the assessed value of the plant was placed at $28,000.[49]

In 1896, the stockholders approved a mortgage of the company not to exceed $200,000. This provided capital for the expansion and remodeling of the plant which occurred by May of 1898.[50] In this period of development, the machine shop was expanded and a template room established on the lower portion of the western site and a paint and storage building added on the upper section.[51]

The decade of the 1890's was a busy and profitable one for the company. Entering the last years of the century, the company had capital stock valued at $100,000; $90,000 of which was owed by banks to the firm. The shops and plant were unencumbered and valued at $50,000.[52] In 1894, 150 men were employed and annual business had reached a level of $500,000.[53] In October of 1895, the firm reported that 360 bridges had been contracted for already that year.[54] At the end of the decade, in 1899, the company employed 160 men. Its officers were Frank Conger as president; Corydon W. Conger, his father, as vice-president; B.R. Williams, secretary; C. Fitch Cox, treasurer; E.A. Landon, a graduate of the Cornell University engineering program, engineer; H.C. Gilman, assistant engineer; and E.A. Watrous, superintendent.[55]

Throughout the decade, competition between bridge building firms had been fierce, particularly the efforts of the steel manufacturing interests centered in Pittsburgh to gain complete control over the market by limiting the supplies of steel. Obtaining the steel necessary to erect bridges became increasingly difficult for local bridge companies. In 1899, after not being completely successful in eliminating the competition from the local and regional bridge building companies, who were, in fact, doing business in a national marketplace, J.P. Morgan, in a massive financial transaction, purchased twenty-three of the regional bridge companies, including the Groton Bridge and Manufacturing Company, and formed the American Bridge Company. (Table 3). The major steel producing companies merged in 1901 to become the United States Steel Corporation, of which the American Bridge Company became a subsidiary.[57]

In Groton, the shop continued to be operated for one year. Frank

Conger was named as Vice-President for Highway Operations of the American Bridge Company.[58] The manufacture of engines and separators contonued in Groton under a new corporation, the Conger Manufacturing Company, which began in 1901 as a successor to the Groton Bridge and Manufacturing Company.[59] In the fall of 1901, the bridge plant at Groton was closed and its machinery dismantled.

In April of 1902, Groton interests repurchased their plant and new equipment and established business under the name of the Groton Bridge Company. The Groton and Lansing Journal reported on April 16th;

> The purchase of the shops was consummated the later part of last week and the formal transfer made on Monday by a representative of the American Bridge Company through Mr. E.A. Landon, Manager of the new Groton Bridge Company...considerable new and up to date machinery will be purchased.[60]

In 1905, the company was valued at $32,500 for insurance purposes including the office at $3,000; the rivet shop at $7,000; the hammer shop at $4,000; the engine and boiler house at $2,000; the contents of the machine shop at $4,000; $3,500 for machinery in the machine shop and $1,500 in stock.[61] Branch offices were opened in Corry, Pennsylvania; Worcester, Massachusetts and Owosso, Michigan and the company published an advertising journal, Good Roads and Bridges. Officers were Jay Conger, president; Benn Conger, vice-president; Lawrence J. Conger, secretary; B.S. Whitman, treasurer and D.J. Watrous, superintendent.[62]

In 1906, the company was awarded a major contract to build bridges on the Erie, Oswego and Champlain Canals, subsequently necessitating their filing suit against the State of New York seeking restitution for expenses incurred due to alleged state-caused delays.[63] A new iron and steel storage building was built near the Owasco Inlet by May of 1908.[64]

In 1913, the firm consisted of six departments; office, administrative, sales and purchasing; engineering and draughting; steel fabricating; field forces; safety tread manufacturing and the foundry. Five general sales agents were employed and four additional local agents covered regions near their homes. Seven engineers and draughtsmen were employed and six to eight erectors comprised the field forces.[65] During these years, the company continued to build bridges, but also enhanced its activities in other areas continuing work in the fabrication and erection of steel frames for buildings; construction of smoke stacks, water tanks, and cast iron and steel sluices; development of a steel and lead stair and car tread and the marketing of road building and highway maintenance equipment and supplies which it manufactured, including graders, concrete mixers and road drags. In 1913, the Ithaca Journal noted:

> Among the most noteworthy structures built here during the last few years may be mentioned a new 600 ton steel building for the International Harvester Company of Auburn, four swing bridges for Long Island, fifteen large spans across the new barge canal built for the State of New York, a large mill building in Syracuse and two in northern Pennsylvania, the steel work for the new Ithaca City Hospital, the Ithaca Post Office, and Rand Hall for Cornell University, and the new steel toboggan slide for the University Athletic Association. 66

In 1914, the company's fortunes turned and it began to rent out some of its buildings to other businesses.[67] By 1920, business was so diminished that the remaining equipment was sold to the American Bridge Company, even though a local publication stated; "the bridge business at the present time seems in for a period of increasing prosperity."[68] The 1926 Sanborn Fire Insurance Company map labeled the bridge company site as "to be the C.W. Conger and Company...not in operation."[69] The woodworking shop had become a garage, as had two storage buildings. The Smith-Corona Typewriter Company occupied the remainder of the western portion of the site and the foundry on the eastern portion had become a garage. Other buildings on the eastern portion of the site were demolished. In 1931, the Town of Groton purchased the remaining company buildings for $3,000. A fire in 1961 destroyed most of what survived and in 1971 the last remaining building, the foundry, was demolished.[70]

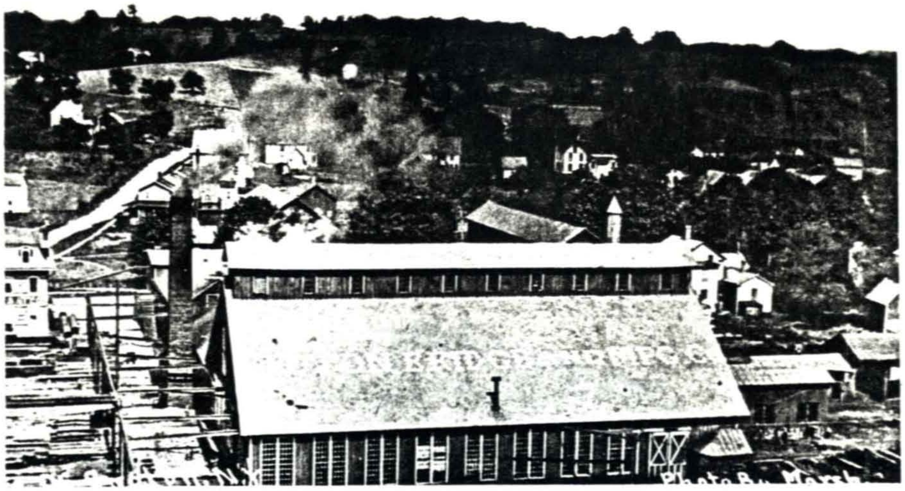
The directories of the American Iron and Steel Association published the annual production capacity in tons of iron and steel. The data were supplied by company management and gave some relative indication of the size of the various bridge building firms. In the yearbooks of 1894, 1896 and 1898, the Groton company ranked among the top twenty-three of the 119 firms on which data were published. It was third or fourth among the seventeen bridge building firms reporting in New York State. On a national basis, the Phoenix Bridge Company was largest, with the Pencoyd Iron Works second. Firms having a capacity similar to that of the Groton company included the Berlin

Iron Bridge Company, the Boston Bridge Works, the Brackett Bridge Company, the Wrought Iron Bridge Company, Penn Steel, the Pittsburgh Bridge Company and the Schultz Bridge and Iron Company. By 1903, the company's production capacity had fallen; fifty-one of the eighty-eight bridge building companies then reporting exceeded it in capacity.[71] (Tables 4-6)

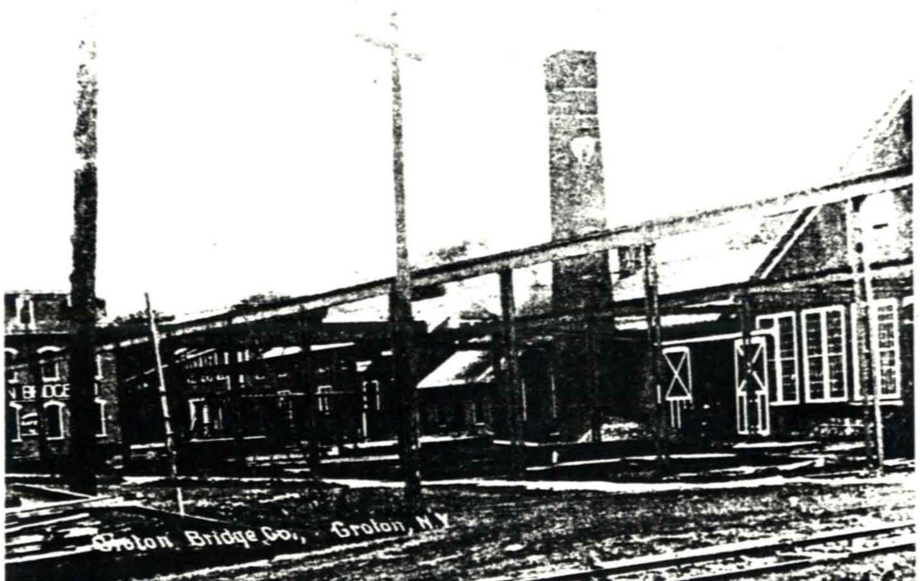
An analysis of the similarity of bids to determine the Groton company's closest competitors revealed that the King Bridge Company bid with the Groton firm on over one-half the construction opportunities on which the Groton firm bid. Out of 173 Groton firm bids recorded in Engineering News between 1877 and 1910, the King Company bid on 108. Other top competitors to the Groton firm were the Wrought Iron firm, Penn Steel, Berlin, Massillon, Toledo and Youngstown. (Table 7)

Most of the company's recorded business was in the Middle Atlantic States; New York State, Pennsylvania and New Jersey. However, a substantial business was done in New England, the South, Midwest, and the states in the upper Tidewater region. Business volume in the Midwest, Old South, and the Metropolitan Washington D.C. area was nearly equal and approximately half that done in New England. (Table 8) More bids were recorded for work in Pennsylvania and New York State, the latter having the highest number of recorded awards. (Tables 9-11)

The company profited by its work in New York State to a greater extent because of the volume of business it did there, however, large awards outside New York State were recorded. The largest contract known to have been received by the firm was for in excess of $350,000 for the construction of a bridge in Little Rock, Arkansas. Awards exceeding $100,000 were also recorded for construction in Washington D.C., Pennsylvania and New Hampshire. (Table 12) While the years 1888, 1889 and 1892 appeared to solidly profitable for the firm, the crest of the company's operation seems to have been reached between 1894 and 1900. Business diminished dramatically after the firm was purchased by the American Bridge Company in 1899.



2.1 Groton Bridge and Manufacturing Company Yard.



2.2 Groton Bridge and Manufacturing Company Yard After 1902.

2.3 Groton Bridge Company office building.

TABLE 2

COMPANIES PARTICIPATING IN THE CHICAGO AGREEMENT[a]

BRIDGE COMPANY	PERCENTAGE OF MARKET
Clinton Bridge Company	1.70
Raymond & Campbell	1.95
Champion Bridge Company	2.00
Lomas Forge & Bridge Works	2.15
Dean & Westbrook	2.20
Groton Iron Bridge Company	2.50
P.E. Lane	2.70
Mt. Vernon Bridge Company	2.85
H.E. Horton	4.00
Pittsburgh Bridge Company	4.45
Columbia Bridge Company	4.45
Massillon Bridge Company	4.45
Berlin Bridge Company	4.50
Kansas City Bridge & Iron	4.50
Missouri Valley Bridge & Iron	4.50
Penn Bridge Works	4.50
Keepers & Riddell	5.30
Smith Bridge Company	7.65
Morse Bridge Company	8.25
Wrought Iron Bridge Company	12.70
King Iron Bridge Company	12.70

Source: Victor C. Darnell
118 Mooreland Road, Kensington, Connecticut 06037

[a] Agreement dated 26 April 1886.

TABLE 3

COMPANIES BOUGHT BY THE AMERICAN BRIDGE COMPANY

COMPANY	LOCATION
A. & P. Roberts Company (Pencoyd)	Philadelphia, Pa.
Carnegie Company (Keystone)	Pittsburgh, Pa.
Post & McCord	Brooklyn, N.Y.
J.B. & J.M. Cornell	New York, N.Y.
Elmira Bridge Company, Ltd.	Elmira, N.Y.
American Bridge Works	Chicago, Ill.
Union Bridge Company	Athens, Pa.
Edgemoor Bridge Works	Edgemoor, Del.
Lassig Bridge & Iron Works	Chicago, Ill.
Berlin Iron Bridge Company	Berlin, Conn.
Shiffler Bridge Company	Pittsburgh, Pa.
Detroit Bridge & Iron Company	Detroit, Mich.
Rochester Bridge & Iron Works	Rochester, N.Y.
Groton Bridge & Mfg. Company	Groton, N.Y.
Youngstown Bridge Company	Youngstown, Oh.
J.G. Wagner & Company	Milwaukee, Wisc.
Wrought Iron Bridge Company	Canton, Oh.
Toledo Bridge Company	Toledo, Oh.
Gillette & Herzog Mfg. Company	Minneapolis, Minn.
Lafayette Bridge Company	Pittsburgh, Pa.
Schultz Bridge & Iron Company	Pittsburgh, Pa.
Buffalo Bridge & Iron Works	Buffalo, N.Y.
Canton Bridge Company	Canton, Oh.
Bellefonte Bridge & Iron Company	Bellefonte, Pa.
Coke & Iron Works	St. Louis, Missouri
Alton Bridge & Construction Co.	Albany, N.Y.
Horseheads Bridge Company	Horseheads, N.Y.

Source: Groton and Lansing Journal, 20 September 1899, p. 1.

TABLE 4

RELATIVE PRODUCTION CAPACITIES OF LEADING BRIDGE COMPANIES

1894

COMPANY	UNITS OF 1,000 LONG TONS
Phoenix Bridge Company (Pa.)	50
Pencoyd Iron Works (Pa.)	40
Edgemoor Bridge Works (Del.)	30
American Bridge Works (Chicago)	30
Kellogg Iron Bridge Works (N.Y.)	26
Trenton Iron Works	24
Missouri Valley Bridge & Iron	20
Philadelphia Bridge Works	19
Keystone Bridge Works (Pa.)	18.5
King Bridge Company (Oh.)	18
Union Bridge Company (Pa.)	16.5
Elmira Bridge Company,Ltd.	15
Chicago Bridge & Iron	15
Lassig Bridge & Iron (Ill.)	15
Passaic Rolling Mill Company (N.J.)	15
Rochester Bridge & Iron Works	12
Detroit Bridge & Iron Works	12
Pennsylvania Steel Company	12
Groton Bridge & Mfg. Company	10
Berlin Iron Bridge Company	10
Boston Bridge Works	10
Stupp Bros. Bridge & Iron	10
Brackett Bridge Company	10
Wrought Iron Bridge Company	10
Pittsburgh Bridge Company	10
Schultz Bridge Iron Company	10
Shiffler Bridge Company	10

Source: Directory of the American Iron and Steel Association, 1894, as supplied by Victor C. Darnell.

TABLE 5

ANNUAL PRODUCTIVE CAPACITY-1896

COMPANY	UNITS OF 1,000 LONG TONS
Phoenix Bridge Company	50
Pencoyd Iron Works	45
Keystone Bridge Works	35
Edgemoor Bridge Works	30
American Bridge Works (Chicago)	30
Elmira Bridge Company	30
Trenton Iron Works	24
King Bridge Company	20
Philadelphia Bridge Works	19
Union Bridge Company	16.5
Pennsylvania Steel Company	16
Lassig Bridge & Iron Works	15
Pittsburgh Architectural Iron	14.3
Passaic Rolling Mill Company	13.5
Missouri Valley Bridge & Iron	12
Rochester Bridge & Iron Works	12
Detroit Bridge & Iron Works	12
Berlin Iron Bridge Company	12
Pittsburgh Bridge Company	12
Shiffler Bridge Company	12
Groton Bridge & Mfg. Company	10
Chicago Bridge & Iron Works	10
Indiana Bridge Company	10
Boston Bridge Works	10
Brackett Bridge Company	10
Toledo Bridge Company	10
Wrought Iron Bridge Company	10
Schultz Bridge & Iron Company	10

Source: Directory of the American Iron and Steel Association, 1896, as supplied by Victor C. Darnell.

TABLE 6

ANNUAL PRODUCTIVE CAPACITY-1898

COMPANY	UNITS OF 1,000 LONG TONS
Phoenix Bridge Works	50
Pencoyd Iron Works	50
Keystone Bridge Works	50
Edgemoor Bridge Works	40
American Bridge Works	40
Trenton Iron Works	30
Elmira Bridge Company, Ltd.	30
Pennsylvania Steel Company	27.5
Lassig Bridge & Iron Works	25
Union Bridge Company	25
Passaic Rolling Mill Company	24
King Bridge Company	20
Philadelphia Bridge Works	19
Schiffler Bridge Company	15
Rochester Bridge & Iron Works	12
Missouri Valley Bridge & Iron	12
Detroit Bridge & Iron Works	12
Berlin Iron Bridge Company	12
Groton Bridge & Mfg. Company	10
Chicago Bridge & Iron	10
Indiana Bridge Company	10
Boston Bridge Works	10
Brackett Bridge Company	10
Gillette-Herzog Bridge Company	10
Toledo Bridge Company	10
Wrought Iron Bridge Company	10
Pittsburgh Bridge Company	10
Schultz Bridge & Iron Company	10
Wisconsin Bridge & Iron	10

Source: Directory of the American Iron and Steel Association, 1898. Supplied by Victor C. Darnell.

TABLE 7

ANALYSIS OF GROTON COMPANY COMPETITORS[a]

COMPANY	# OF BIDS ON SAME CONTRACT
Groton	173
King Bridge Company	108
Wrought Iron Bridge Company	95
Penn Bridge Company	78
Berlin Iron Bridge Company	66
Massillon Bridge Company	66
Toledo Bridge Company	63
Youngstown Bridge Company	62
Pittsburgh Bridge Company	44
Canton Bridge Company	43
Variety Iron Works	38
New Jersey Iron & Steel	31
Dean & Westbrook	31
Owego Bridge Company	30
Edgemoor Bridge Works	28
Brackett Bridge Company	27
Boston Bridge Works	25
Hilton Bridge Construction Company	24
Nelson & Buchanan	22
Champion Bridge Company	22
Long (N.Y. Iron Bridge Company)	21
Milwaukee Bridge & Iron Works	19
New Columbus Bridge Company	18
Lafayette Bridge Company	17
Columbia Bridge Company	15
Hawkins (R.F.) Iron Works	15
Schiffler Bridge Company	15

Source: Engineering News, 1877-1910.

[a] 110 firms bid with the Groton company thirteen or fewer times.

TABLE 8

COMPOSITE ACTIVITY BY REGION

REGION	# OF BIDS AND AWARDS
Middle Atlantic: N.Y., Pa., N.J.	196
New England: Mass., Conn., R.I., Me., Vt., N.H.	60
Metropolitan D.C.: D.C., Md. Va., West Va.	29
Midwest: Oh., Mich., Ks., Ill., Ind., Kty., Minn., Wisc.	25
South: Tx., Ga., Tn., Ark., Fla. Missouri	25
South if D.C., Md., and Va. included.	51
West	1
Foreign	1

Source: Engineering News, 1877-1910.

TABLE 9

RECORDED AWARDS BY STATE

STATE	# OF AWARDS
New York	102
Pennsylvania	13
Massachusetts	7
Maryland	7
New Jersey	6
Michigan	5
Tennessee	5
Vermont	4
Maine	3
Virginia	3
Arkansas	3
West Virginia	3
Florida	2
District of Columbia	2
New Hampshire	2
Kentucky	1

Source: Engineering News, 1877-1910.

TABLE 10

RECORDED BIDS BY STATE

STATE	# OF BIDS
Pennsylvania	32
New York	28
Massachusetts	22
New Jersey	15
Ohio	12
Connecticut	6
Maryland	6
Rhode Island	6
Texas	6
Virginia	6
Georgia	5
Michigan	4
Alabama	2
Kansas	2
Maine	2
District of Columbia	1
Illinois	1
Indiana	1
Minnesota	1
Mississippi	1
New Hampshire	1
North Carolina	1
Washington	1
West Virginia	1
Wisconsin	1

Source: Engineering News, 1877-1910.

TABLE 11

COMPOSITE ACTIVITY BY STATE

STATE	# OF BIDS AND AWARDS
New York	130
Pennsylvania	45
Massachusetts	29
New Jersey	21
Maryland	13
Ohio	12
Michigan	9
Virginia	9
Connecticut	6
Rhode Island	6
Texas	6
Georgia	5
Maine	5
Tennessee	5
Vermont	4
West Virginia	4
Arkansas	3
District of Columbia	3
New Hampshire	3
Alabama	2
Florida	2
Kansas	2
Illinois	1
Indiana	1
Kentucky	1
Minnesota	1
Mississippi	1
North Carolina	1
Washington	1
Wisconsin	1

Source: Engineering News, 1877-1910.

TABLE 12

FINANCIAL ANALYSIS OF RECORDED AWARDS BY STATE

STATE	AMOUNT OF AWARDS
New York	$496,270
Arkansas	$390,022
Pennsylvania	$199,361
District of Columbia	$185,000
New Hampshire	$97,100
Tennessee	$94,320
Florida	$70,000
Maryland	$67,620
Massachusetts	$66,664
Michigan	$25,375
New Jersey	$14,480
Vermont	$8,900

Source: Engineering News, 1877-1910.

TABLE 13

FINANCIAL ANALYSIS OF RECORDED AWARDS BY REGION

REGION	AMOUNT OF AWARDS
Mid-Atlantic	$710,111
New England	$163,764
Metropolitan Washington	$252,260
Mid-West	$25,375
South	$554,342
South (with D.C., Md., Va.)	$806,602
West	no reports
Foreign	no reports

Source: Engineering News, 1877-1910

ENDNOTES, CHAPTER II

[1] John Selkreg, ed., Landmarks of Tompkins County (Syracuse: D. Mason & Company, 1894), p. 317.

[2] Lavena Court, A Salute to Groton's Heritage (Groton: privately printed, 1976), n. pag.

[3] Selkreg, op. cit., p. 322.

[4] Ibid.

[5] Another major business of the time was the mercantile house of Corydon W. Conger, a director of the bridge company. In addition to these larger businesses, late nineteenth century Groton contained two furniture factories, the Excelsior Skirt and Manufacturing Company, the Groton Marble Works, the Groton Sleigh and Cutter Works and the Groton Flouring Mills.

[6] Edgar Luderne Welch, Groton, N.Y. and Vicinity, Vol. VII, No. 10 of Historical Souvenir Series No. 6 (Albany: Grip's Valley Gazette, 1899), 54-55 and Selkreg, op. cit, p. 324.

[7] Selkreg, op. cit., p. 325.

[8] Welch, op. cit, 18-19.

[9] Selkreg, op. cit., p. 323.

[10] William M. Baldwin, "Historical Sketch of the Town of Groton", (1868, rpt. Groton Journal and Courier, 1923), p. 15.

[11] Welch notes that the "new storehouse" in 1856, belonging to Charles and Lyman Perrigo, was known as Fremont Hall and was the center for local political discussion, p. 57.

[12] Welch also notes that the Perrigo brothers made agricultural machinery from a shop at Main Street and Elm Street in Groton since 1840, p. 35.

[13] Baldwin, op. cit., p. 14.

[14] Ibid.

[15] Selkreg, op. cit., p. 322.

[16] Ibid. Frederick A. Avery was born in Groton on January 7, 1826. Welch notes on p. 53, in describing the building of a hotel in Groton in 1853, "Frederick A. Avery displayed great skill in managing so many men." Avery died on June 15, 1895.

Colby was born in Connecticut on May 18, 1846, one of twelve children. He died on March 30, 1925, in Owego, New York. His obituary in the Groton and Lansing Journal on April 25, 1925, read as follows:

> Ellery Colby, internationally famed as a bridge builder died in Owego...Mr. Colby came to Cayuga County (N.Y.) when a small boy. At the age of nine he went to live with an uncle in Onondaga County. When he attained his majority Mr. Colby moved near Groton and engaged in farming. He married Miss Hattie E. Cornwall...His youngest years being devoted to farm labor from the time he was old enough to work Mr. Colby was denied schooling.(sic) However while living received much schooling.(sic) Yet while living engaged in bridge construction, secured patent on two of his inventions, organized a bridge company, and achieved both fame and success.(sic) Later he sold his interests at Groton, went to Owego and there formed the Owego Bridge Company. This he sold ten years ago and engaged in the Contracting business and more recently in the retail coal business. His death was sudden...

[17] Specifications of Patents, 3 April 1877.

[18] 189,020 Bridge-piers, filed 11 August 1876, E.E. Colby, assignor of one-half his right to O. Avery, Ca. Bartholomew, and C. Perrigo.

[19] 189,171, Bridge-piers.

[20] 189,170 Bridges, filed 11 September 1876, Specifications of Patent, p. 135.

[21] Ibid.

[22] 187,513, Bridges, E.E. Colby, Groton, N.Y., assignor of one-half his right to O. Avery Jr., C. Bartholomew, and Charles Perrigo. File 20 January 1877. Specifications of Patents, 20 February 1877, p. 607.

[23] Ibid. Copies of these materials are contained in the Collection of the Groton Historical Society.

[24] Flora Williams Collection, Lot #315, Olin Graduate Library, Local and Regional History Department, Cornell University.

[25] The companies participating in the Chicago agreement are listed in Table 2, p. 42.

[26] Copies are available at the Office of the Town Clerk, Groton, N.Y. and in the Collection of the Groton Historical Society. The document was signed by twenty-three stockholders including William W. Fitch ($15,150); Corydon W. Conger ($16,650); Nelson Harris ($1,950); B.R. Williams ($1,300); E.A. Landon ($2,080); Benn Conger ($4,160); H.H. Underwood ($780); G.W. Davey ($650); W.E. Shepard ($2,400); Frank Conger ($10,930); Jay Conger ($4,650); H.G. (illegible) ($2,600); illegible ($780); Florence B. Conger ($1,000); Emily Buck ($1,800); Fannie A. Fitch ($1,000); E.W. Wolde ($1,000); D.H. Wilson ($5,000); Geo. B. Knickerbocker ($5,000); and illegible ($5,000).

[27] Abstract of the Charter, 7 May 1887.

[28] Welch, op. cit., p. 48. Williams was born on March 14, 1836. In 1856, he worked at the machine shop of Spencer and Perrigo.

[29] Conger was born in Ithaca in 1826. He farmed until the panic of 1857. In 1867, he led the effort to obtain the Southern Central Railroad through Groton and in 1870 he opened his general store. He helped originate the Groton Carriage Company in 1876 and invested in the bridge plant in 1887, becoming a director and member of the trustees. His sons were Frank, born in 1849; Jay, born in 1854; and Benn born in 1856. The Ithaca Journal of 14 February 1976 carries an article about the Conger family.

[30] Welch, op. cit., p. 30.

[31] The eleven trustees were Ellery Colby, Charles Perrigo, Frank Conger, E.A. Landon, C.W. Barney, D.H. Marsh, B.L. Buck, A. Underwood, Everett Smiley, O. Avery and H.P. Colby.

[32] Groton and Lansing Journal, 19 April 1888, p. 3.

[33] Welch, op. cit., p. 24.

[34] Engineering News, 29 December 1982, p. xxvii.

[35] Engineering News, advertisement, 1894, n. pag.

[36] Engineering News, advertisement, 1896, n. pag.

[37] Company letterhead, Collection of the Groton Historical Society.

[38] Arthur Clark, "Groton Bridge Company, Going, Going, Gone," Ithaca Journal, 26 August 1971, p. 14.

[39] Letter from Martha Carver, Environmental Planning Office, Department of Transportation, State of Tennessee quoting the original sources; Nashville City Directories and various county court records.

[40] Ibid.

[41] James B. French Papers, Lot #315, Olin Graduate Library, Local and Regional History Department, Cornell University.

[42] Ibid, on April 29 alone, Mr. Williams left Utica for Skaneateles, then went to Rochester, Albion and Spencerport. Most days Mr. Williams covered from one to three towns. He reported expenses such as fifty cents for dinner, fifteen cents for lunch, seventy-five cents for breakfast and thirty-seven cents to send a telegram. He spent one dollar twenty-five cents for a hotel room one night, two dollars in larger cities such as Scranton and three dollars and fifty cents on the occasion of a trip to Pittsburgh. Most local railroad fares were under one dollar.

[43] Other salesmen during this period included S.H. Clapp and B.L. Buck, according to an article on the firm in the Ithaca Journal, 22 August 1913, p. 9.

[44] The Groton and Lansing Journal reported on 28 May 1885, "Narrow guage track has been laid for the switch as the depot into the bridge shops. By means of a handcart, bridges can be run from the shop and loaded upon cars very readily and easily. The company is receiving numerous orders and business is booming at the shops.",(p. 3).

[45] Groton and Lansing Journal, 1 October 1885, p. 3.

[46] Ibid, 2 January 1890, p. 3.

[47] Previously the company used a school building on Main Street, constructed in 1853, as its offices.

[48] Library of Congress, Geography and Maps Division, Sanborn Map Company, entry number 5964, Groton, Tompkins County, N.Y., April 1892, 2 sheets, Bureau of Census Series 518.

[49] Selkreg, op. cit., p. 316.

[50] "Consent of the Stockholders to Mortgage," 11 January 1896,

Collection of the Groton Historical Society. Twenty-three stockholders, as indicated in endnote 26, signed this document.

51 Library of Congress, Geography and Maps Division, Sanborn Map Company, entry number 5964, Groton, Tompkins County, N.Y., May 1908, 4 sheets, Bureau of Census series 518.

52 Telegram #388, 17 October 1895, Collection of the Groton Historical Society.

53 Groton and Lansing Journal, 17 October 1895, p. 3 and Selkreg, op. cit., p. 323.

54 Ibid.

55 Welch, op. cit., p. 21.

56 Electrical World and Engineer, Vol. XXXVI, No. 1, July 1900, p. 38.

57 "The Bridges of Pittsburgh, Fortune Magazine, August 1957.

58 Frank Conger died in 1902. Welch notes on p. 38,

> Mr. Frank Conger, the business and financial head of the Bridge Works, is probably one of the best and most thorough businessmen in Groton. As a buyer for a small country store, for the development of which he was largely responsible, or as the head of a very large manufacturing business which he has erected on the foundation of a small manufacturing plant and which with its many branches and its hundreds of travelling salesmen all over the country is to-day a bridge plant without any superior rival, with a business extending over the entire world.

59 Papers, Collection of the Groton Historical Society.

60 Groton and Lansing Journal, 16 April 1902, p. 3.

61 Lot #315, Local and Regional History Department, Olin Graduate Library, Cornell University.

62 "Important Industry Which Gave Groton Much of Its Fame", Ithaca Journal, 22 August 1913, p. 9. Other officers included S.H. Clapp, head salesman; L.J. Conger, manager of the sales force and safety tread department; Richard I. Hodge, Attleboro, Massachusetts, office; H.H. Bassett, Cornell '01, chief engineer; E.R. Tucker, chief draughtsman; Charles Hamil, steel fabricating department; W.G. Evans,

supervisor of template makers; Glenn Collins, foreman, Safety Tread Department. This Department handled the Universal Safety Tread Company of 114 Milk Street, Boston. 80,000 to 100,000 square feet of tread, or 400 tons, annually were produced. Tread was shipped to Canada, South Africa, the Pennsylvania Railroad and the U.S. Government for battleship equipment.

The Superintendent of the iron foundry was D.J. Watrous, director E.E.Dye. The foundry manufactured sectional cast iron culverts, bridge nameplates and ornamental nameplates.

Jay Conger attended the Groton Academy and managed the family retail business and the First National Bank. Lawrence J. Conger was the son of Benn Conger and graduated from Cornell University as a civil engineer in 1901.

[63] The contract award was for $97,635. The legal action sought an additional $8,588.63. These materials are available in the Collection of the Groton Historical Society.

[64] Library of Congress, Geography and Maps Division, Sanborn Map Company, entry number 5964, Groton, Tompkins County, N.Y., May 1908, 4 sheets, Bureau of Census series no. 518.

[65] Ithaca Journal, 22 August 1913, op. cit., p. 9.

[66] Ibid. Businesses occupying the site included a manufacturer of hot air dryers; Begent's Garage; Dana Knapps' Trucking, Coal and Furniture; Date's Chevrolet and Garage; Paul McMahon Garage and the New York Telephone Company.

[67] Ithaca Journal, op. cit.

[68] Rural Index, Groton Township, 1920 (New York State), p. 12.

[69] Library of Congress, Geography and Maps Division, Sanborn Map Company, Groton, Tompkins County, N.Y., 1926, 9 sheets, Bureau of Census no. 518.

[70] Telephone interview with Mrs. Arlene Perrigo Brown, Groton, N.Y., 15 March 1983. Records in the Cornell collection reveal that after 1916 the Groton Bridge Company no longer carried insurance.

[71] These data were supplied by Victor C. Darnell, Kensington, Connecticut.

CHAPTER III

Notable Groton Bridge Commissions

Based upon the materials contained in the Groton Iron Bridge Company daybook of 1877 to 1885, the published announcements of bids and contract awards of the firm found in Engineering News issuances from 1877 until 1910 when such announcements were no longer carried, and written inquiries to the State Historic Preservation Officers and other bridge researchers, this investigation has formally documented 107 bridges built by the Groton company still extant. (Chapter Appendices A and B)

Contributing to the difficulty in certain location of Groton-built bridges is the lack of accurate public record in many jurisdictions identifying the builder of a given span. In New York State, for example, based upon county highway department or New York State Department of Transportation files, or the existence of an intact bridge plate, certain identification can be made for eighty percent of the state's surviving High Pratt trusses. One-third of these bridges are attributable to the Groton bridge firm.

The problem of certain identification of builder is more difficult when dealing with the pony truss bridge. Of the 240 low Pratt bridges which survive in New York State, makers for only thirty-one percent are known. Similarly, of the 273 low Warren trusses, certain identification of the makers can be made for only fourteen percent. The 124 High Warren trusses which survive are also problematic; certain builders for only thirty-eight percent of these spans are known. (Table 14)

Documentation for the through truss is more thorough and readily available than for the low truss. The engineering community has developed an ability to recognize the bridge company by its design distinctions, such as a particular portal, finial, column or plate shape. This has raised the certainty of identification where historic record does not exist. In addition, the completion of state inventories to identify historic bridges, about which more shall be said later, has increased knowledge of where, and how, the bridge companies operated. In New York State, research is going forward on a class by class basis, with the High Pratt being the first for intensive identification of maker. As researchers dig deeper into local newspapers, dates of construction and makers of bridges can be determined, this, however, is very slow and painstaking research when the date of construction is uncertain as well as the maker.

The record assembled for the Groton company indicates, for the most part, that the firm built High and low Pratt trusses, however, their work was by no means limited to this style. The company was clearly versatile in its bridge building and kept current with technological developments. Examples of a full range of bridge types have been found from Parker and Camelback trusses, the Pennsylvania Petit truss, swing and lift bridges, plate girders and concrete slab and arch bridges. In its early years, the company built even wooden bridges and the bowstring arch of its original patent. Later, as the diversity of the company's production capability grew, it bid on all types of spans ranging from small three paneled Pratt pony trusses to multi-spanned railway and highway crossings.

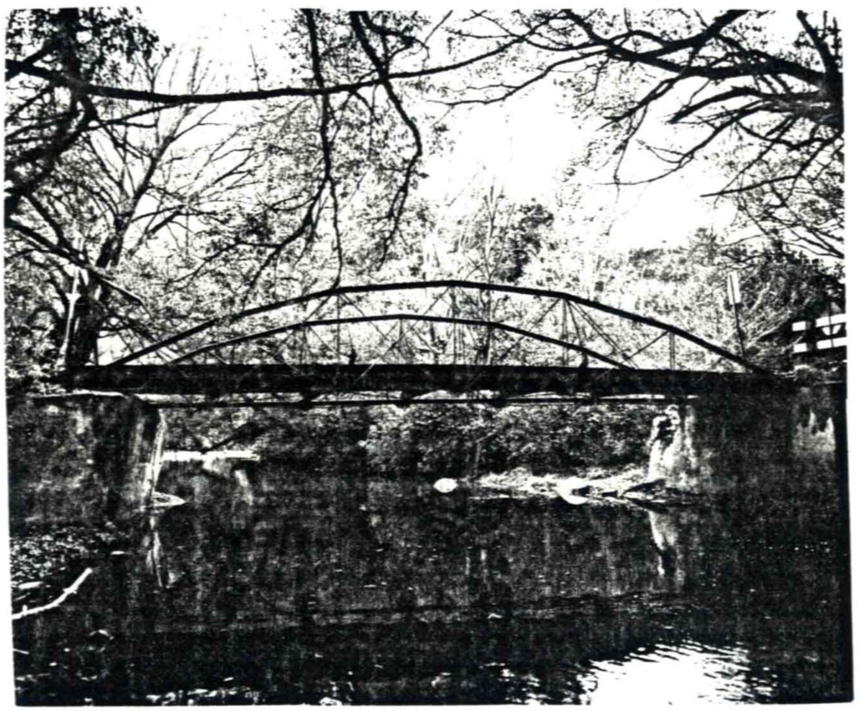
In the search for bridges built by the company which survive today, twenty-two have been identified outside New York State. Eighty-five bridges built by the firm survive within the state. Of this latter group, thirty-eight are High Pratt trusses, twenty-two are low Pratts or pony trusses, and one is a Camelback truss. Three Warren high trusses, six Warren pony trusses and two bowstring arch bridges are also identified as Groton-built spans. Completing the list of New York State surviving Groton bridges are four I-beam or plate girders and one concrete arch bridge. Seven of these eighty-five Groton bridges have initially been determinied potentially eligible for nomination to the National Register of Historic Places by the New York State Department of Transportation Engineering Research and Development Bureau. Five of all the bridges found were constructed between 1877 and 1880, fifteen between 1880 and 1890, thirty-six in the last decade of the nineteenth century, sixteen between 1900 and 1910 and three after 1910. The last surviving bridge found was constructed in 1917. (Table 15)

In this Chapter, several noteworthy examples, and some ordinary ones, are provided with a view toward describing representative samples of the range of the firm's work. Numerous views of the surviving bridges are also shown.

In March of 1981, the Nubia, New York bridge (Figure 3.1), one of the earliest of the company's manufacture, was moved to Groton from Champlain and McLean Roads in Nubia, New York. This bowstring arch, a unique use of railroad rail on the upper chord, is an example of the early Colby patent. The combined efforts of Tompkins County, the Town and Village of Groton, the Smith-Corona Typewriter Company, the Groton Historical Society and the T. and D. Bessemer Rigging Company achieved this example of historic preservation. It is planned to renovate the bridge, now located on the grounds of the Groton senior citizen's residence, and to install it in a park over the Owasco Inlet behind the Smith-Corona plant on land once owned by the Groton Bridge Company. Two other bowstring arch bridges of the company's manufacture remain in New York State.

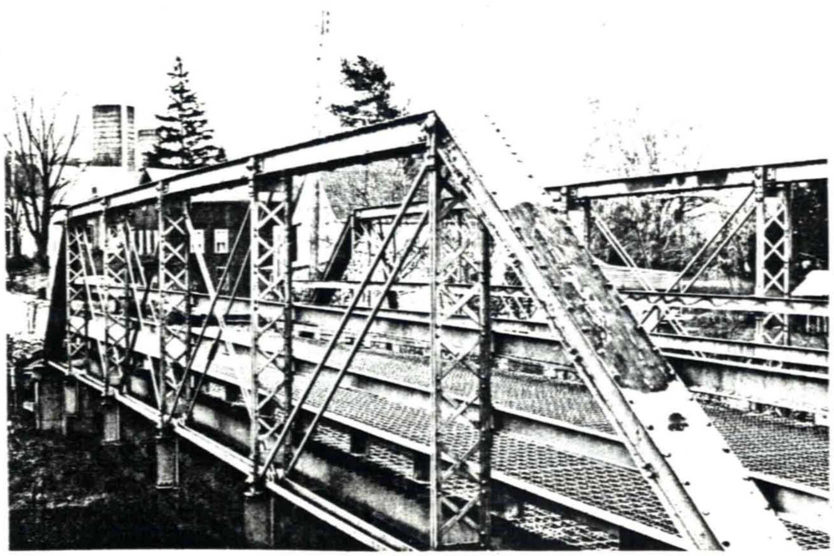
Three examples of the company's building during its first year of operation, using the Pratt truss form, were in Tompkins County, New York; the German Cross Roads Bridge in the Town of Ithaca, a seventy-four foot span now demolished (Figure 3.2); the Groton City Bridge in the Town of Groton, a seventy-three foot low Pratt span (Figure 3.3); and a ninety-eight foot High Pratt bridge on Pinckney Road in the Town of Dryden (Figures 3.4-3.6). The latter two bridges cross Fall Creek; the German Cross Roads bridge spanned the Six Mile Creek.

The company's Red Mill Road bridge (Figures 3.7-3.10) spanning Fall Creek in Freeville, New York, constructed in 1887, a decade later, is similarly a pin-connected span, and like the German Cross Roads bridge has the side-bar diagonal to the posts. This span is 120 feet in length and thirteen feet seven inches in width, as measured from curb to curb. The outriggers, or diagonal bars, have been

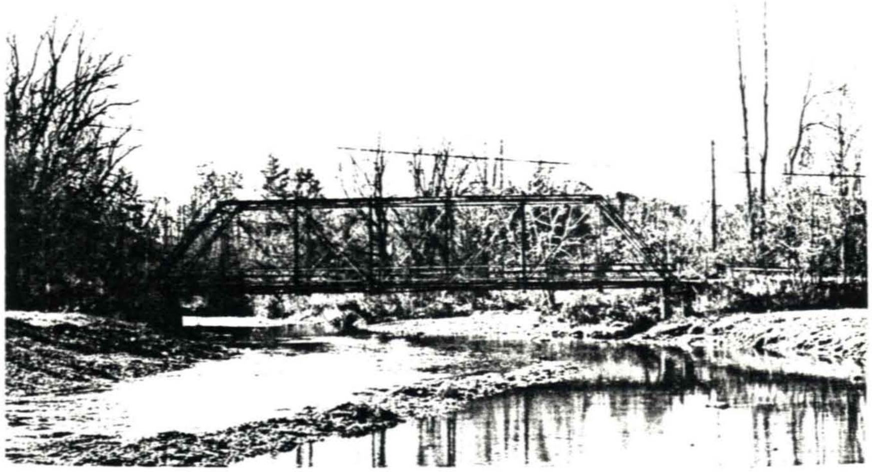


3.1 Groton, N.Y., Elm Street Extended, Fall Creek, bowstring arch, 1877, elevation.

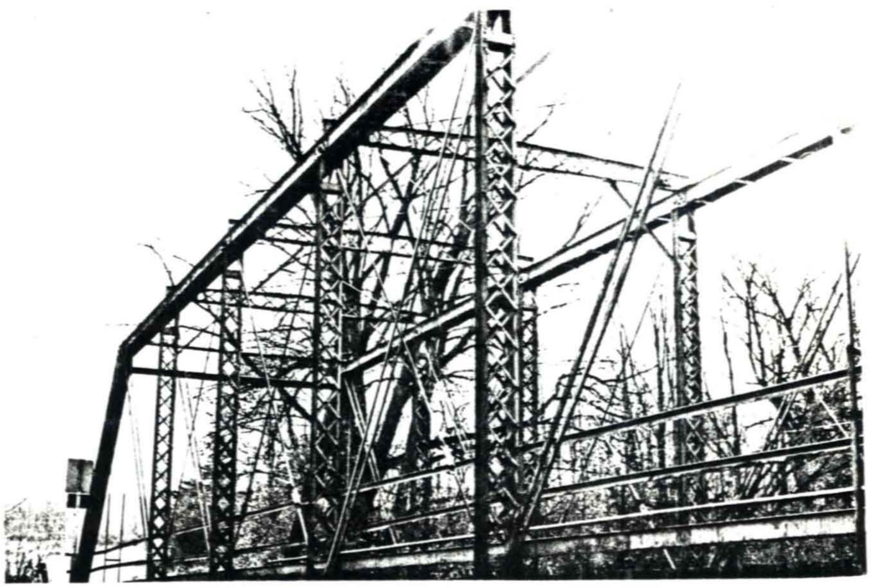
3.2 Ithaca, N.Y., German Cross Roads, Six Mile Creek, Pratt pony truss, 1877, elevation, demolished.



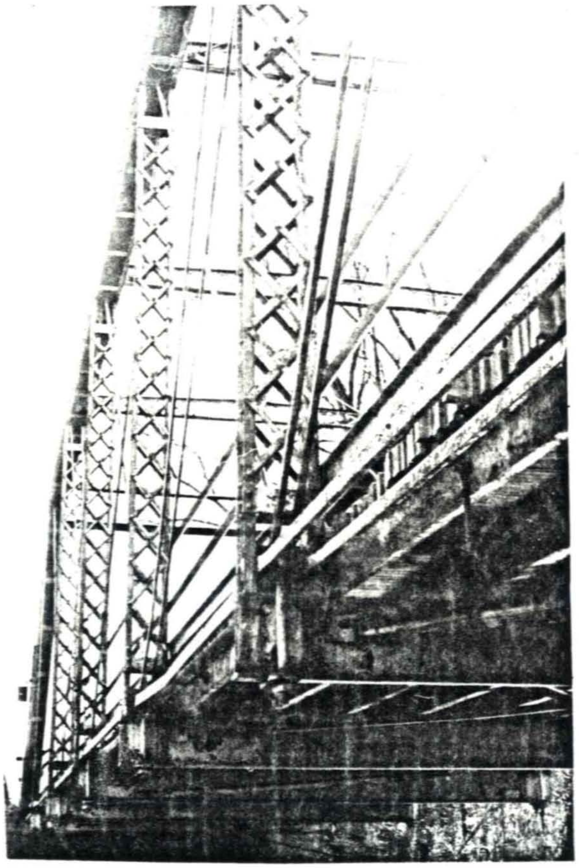
3.3 Groton, N.Y., Groton City Road, Fall Creek, Pratt pony truss, 1877, laced verticals.



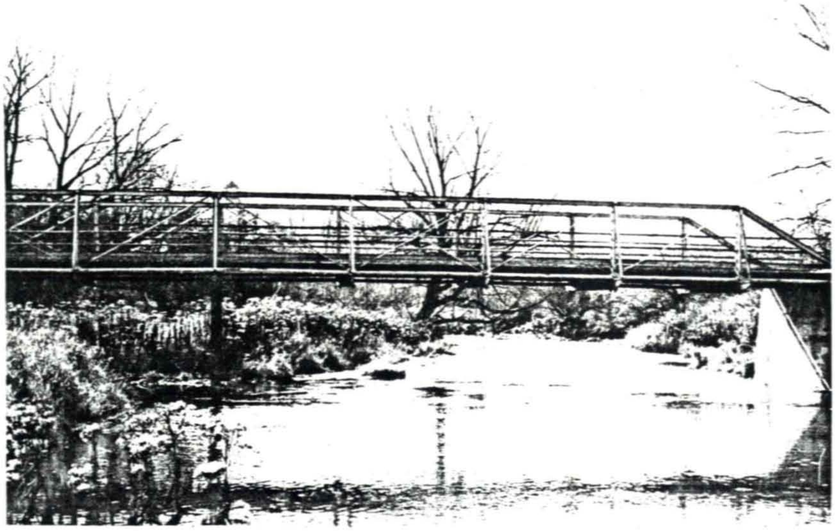
3.4 Dryden, N.Y., Pinckney Road, Fall Creek, Pratt through truss, 1877, elevation.



3.5 Dryden, N.Y., Pinckney Road, Fall Creek, Pratt through truss, 1877, latticed struts and vertical posts.

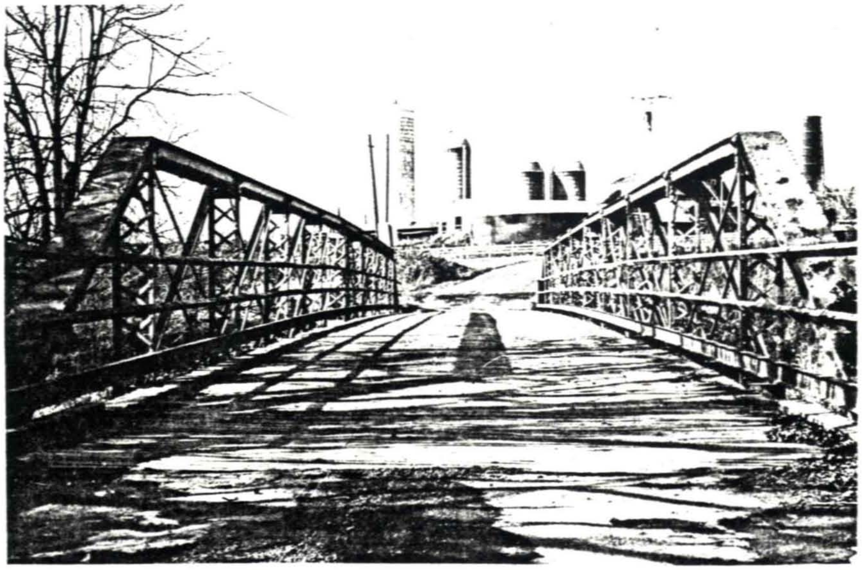


3.6 Dryden, N.Y., Pinckney Road, Fall Creek, Pratt through truss, 1877, floor beams and bottom lateral bracing.



3.7 Dryden, N.Y., Red Mill Road, Fall Creek, 2 span Pratt pony truss, 1887, longitudinal view showing pier.

3.8 Dryden, N.Y., Red Mill Road, Fall Creek, 2 span Pratt pony truss, 1887, outriggers.



3.9 Dryden, N.Y., Red Mill Road, Fall Creek, 2 span Pratt pony truss, 1887, plank decking.

3.10 Dryden, N.Y., Red Mill Road, Fall Creek, 2 span Pratt pony truss, 1887, bridgeplate.

identified as a characteristic of the company's work, although it is uncertain if they are original features.[1]

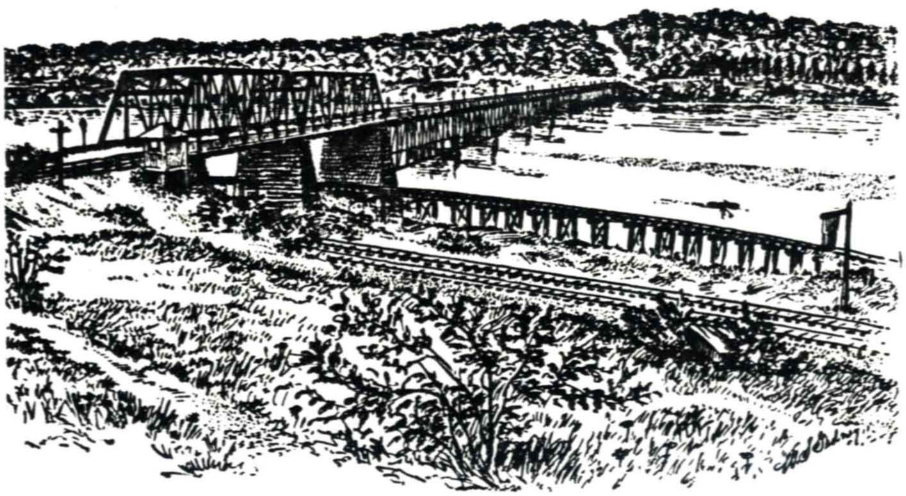
There are several indications that the company was a practiced builder of long span railroad bridges, having received large contract awards for such structures in Little Rock, Arkansas, for $350,000 in 1896; for a span over the Potomac River at Hancock, Maryland, in 1890; and several others. Perhaps the most visible was the Eastern Branch Bridge over the Anacostia River at Pennsylvania Avenue in Washington D.C. which opened in 1890. (Figure 3.11)

The story of this bridge begins with the announcement in Engineering News on June 11, 1887:

> A new bridge will replace the old structure over the Eastern Branch at Pennsylvania and Kentucky Avenues into Maryland; it will be 2,235 feet long and will consist of iron trusses and iron trestle work. The plans were prepared by Col. Peter C. Hains, U.S. Engineer Corps.[2]

Bids were received from four companies; the Smith Bridge Company of Toledo, Ohio, at $150,000; the Mt. Vernon Bridge Company of Mt. Vernon, Ohio, at $148,000 or $127,000 if an iron substructure was acceptable and the Pittsburgh Bridge Company at $123,000. The Groton bid of $105,000 was that chosen.[3] Later, the company was to receive an additional $40,000 for design changes necessitated by a legal dispute over the right-of-way raised by the Baltimore and Potomac Railroad. Two 151 foot through spans were subsequently substituted for one ninety foot through span and two 112 foot deck spans on the west end.[4]

The citizens of the area began a drive for a new bridge on the



3.11 Washington D.C., Pennsylvania Avenue, Anacostia River, long span railroad bridge, 1890, elevation.

the site as early as 1875; legislation authorizing the structure and appropriating $110,000 for the construction passed the Congress on February 23, 1887. An additional appropriation of $60,000 was made in May of 1888.

Delays on the work were encountered; floods deterred work for two years and the laying of a second western abutment required the use of a coffer-dam. What ultimately was built was a bridge 1510 feet in length with two overhead spans of 190 feet each and ten deck spans of 112 feet each, all of which rested on nine masonry piers supporting the bridge structure and the railroad track. The roadway was twenty-four feet wide and there were two four foot wide sidewalks. The masonry of the piers was of a brown stone and the bridge itself was painted a dark brown-like red. The floor was oak, a watch-box for watchmen was provided at the city end. Iron ornamental railings lined the sides of the bridge, which was lit by gas lamps across the entire length.

A major celebration on the occasion of the bridge opening, not an uncommon event, was held on August 25, 1890. In the program publication, "The New Era", prepared by the East Washington Citizen's Association, the bridge was described as "graceful and stable-looking, large and commodious."[5] The bridge was dismantled in 1939 and replaced with the present crossing, the John Philip Sousa Bridge.[6]

After the Johnstown Flood of 1889, the company was engaged to construct a bridge at Hancock, Maryland, linking the States of Maryland and Virginia and replacing the span destroyed in the flood. The bridge served to facilitate traffic in the region which also included the State of Pennsylvania. The span constructed by the Groton company was operated as a private toll bridge until 1925 when it was purchased by state authorities. The structure, which consisted of three Pratt through trusses of 262 feet in length each, was ultimately replaced after sustaining damage in the flood of 1936.[7]

The Arkansas Bridge at Little Rock, at $353,000, was the largest known contract received by the Groton Bridge and Manufacturing Company.[8] This bridge, which crossed the Arkansas River at Little Rock, was 1680 feet long and contained a channel span of 374 feet in length, two spans of 280 feet, and one span each at 220, 176 and 114 feet. Two fifty foot girders completed the crossing. All spans rested on masonry piers fifty feet above the water and 114 feet over bedrock. The roadway was twenty-four feet wide and the bridge had two five foot wide sidewalks. Two million pounds of steel; 600,000 feet of lumber; and 3,700 cubic yards of masonry were used to construct the span. The Groton company won the contract in a contest with more than thirty other bidders.

At the opening ceremony, in his acceptance speech, Edwin Thatcher, the Detroit engineer in charge of the construction, said;

> It has been thrown open to public travel within eight and a half months from the date of the contract or less than one-half the time allowed...In my long experience as an engineer and bridge contractor I have never known such a feat to be performed before and the Groton Bridge Company and the citizens of Pulaski have reason to feel proud of the result...a roadway of twenty-four feet is as great or greater than has been provided in a majority of bridges of this size.[9]

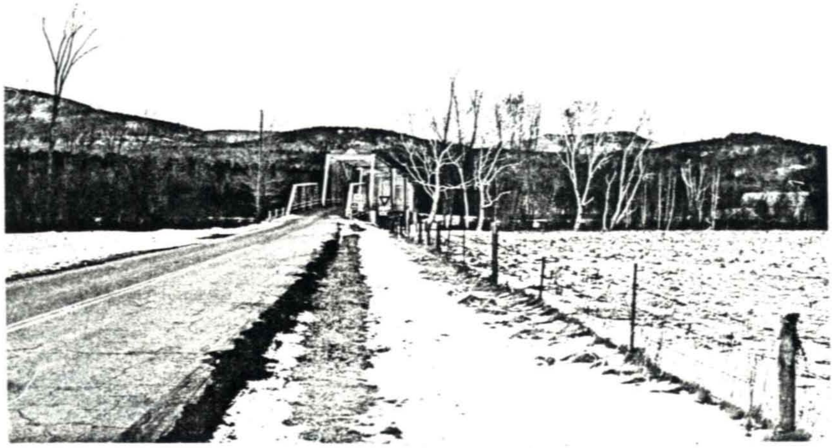
The dedication ceremony, in September of 1896, was also attended by Frank Conger who spoke on behalf of the company.

The Meadow Bridge of 1897 (Figures 3.12-3.19), crossing the Androscoggin River north of Shelburne, New Hampshire, is a product of the Groton company which has received special recognition for its delicate design. The five span structure has a total length of 504 feet three inches and consists of three six panel single-intersection pin-connected Pratt trusses framed by a seventy-one foot Pratt pony truss on the southern end and a twenty-five foot I-beam truss on the north.[10] The bridge has a width of fourteen feet nine inches and a clearance of seventeen feet four inches. Cylindrical steel piers supporting the bridge fourteen feet above the water are filled with concrete and fitted with ice breakers. The archaeological analysis of the bridge, conducted before its recent refurbishment, noted:

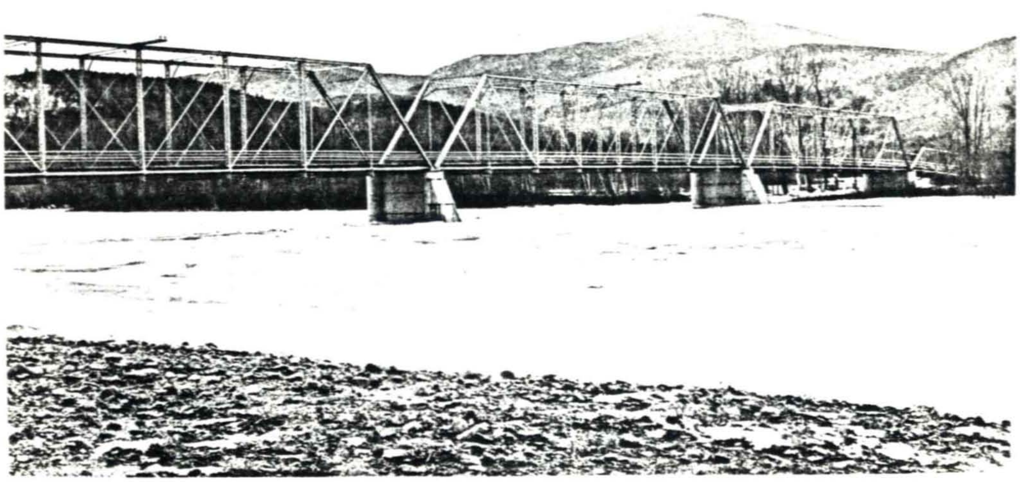
> Of particular interest is that the Groton Company often incorporated decorative motifs into their portal design. The finials, cresting and ornamental nameplate that highlight the Meadow Bridge are essentially a company trademark. This practice also correlates with the widespread introduction of artistic elements into engineering designs for aesthetic purposes witnessed through the later portion of the nineteenth century.[11]

The bridge cost $10,000 to construct; $3,500 of which was raised by local subscriptions. It is now listed on the National Register of Historic Places.

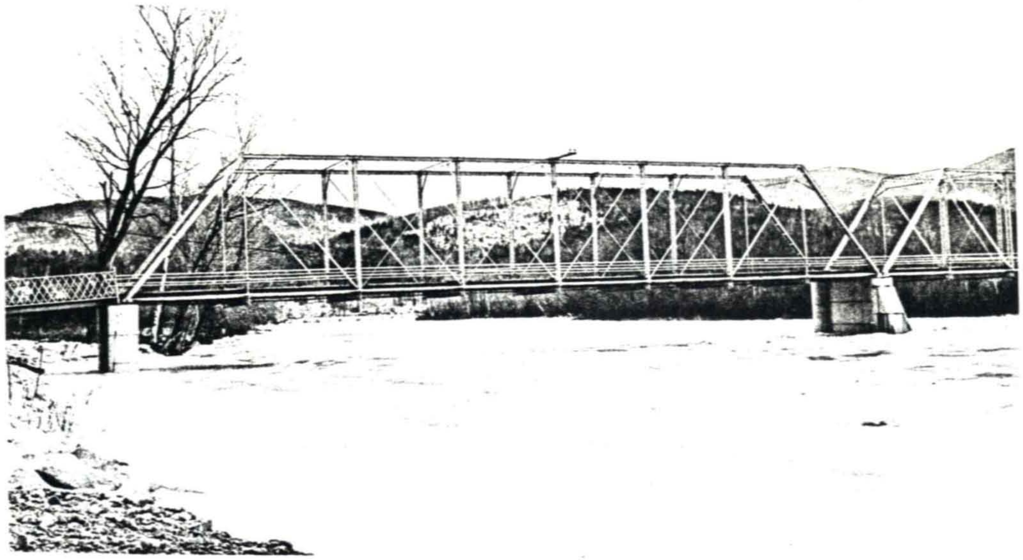
The company was praised in another forum for its design of the full Pratt truss. Howard Newlon, Jr., Associate Head of the Virginia Highway and Transportation Research Council described the Groton



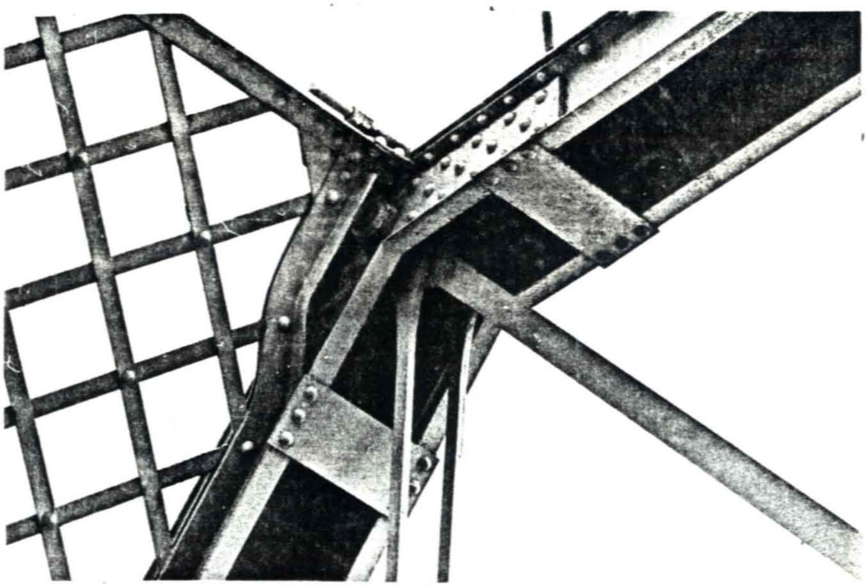
3.12 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, approach.



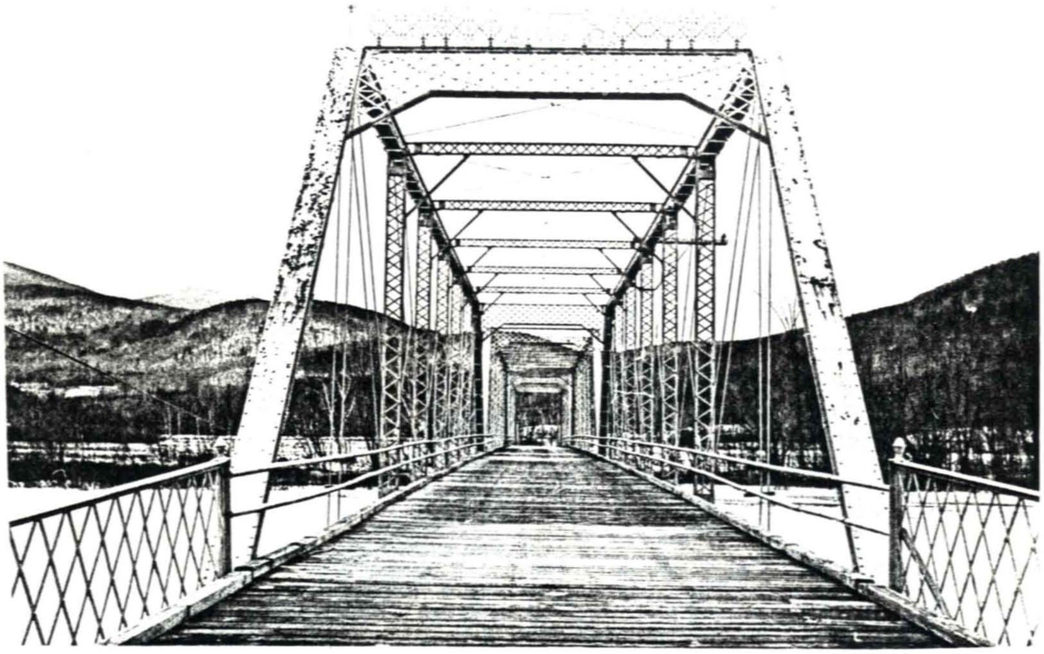
3.13 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, through trusses, end pony.



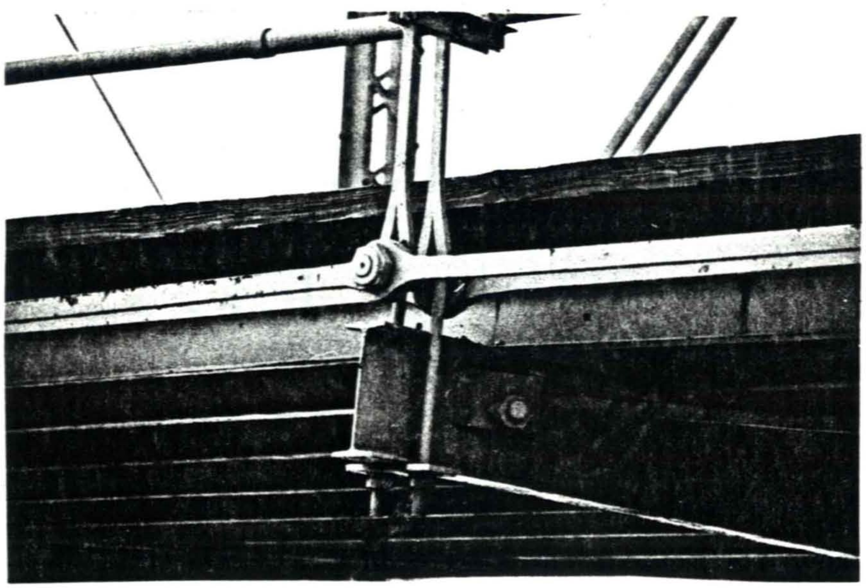
3.14 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, end I-beam truss.



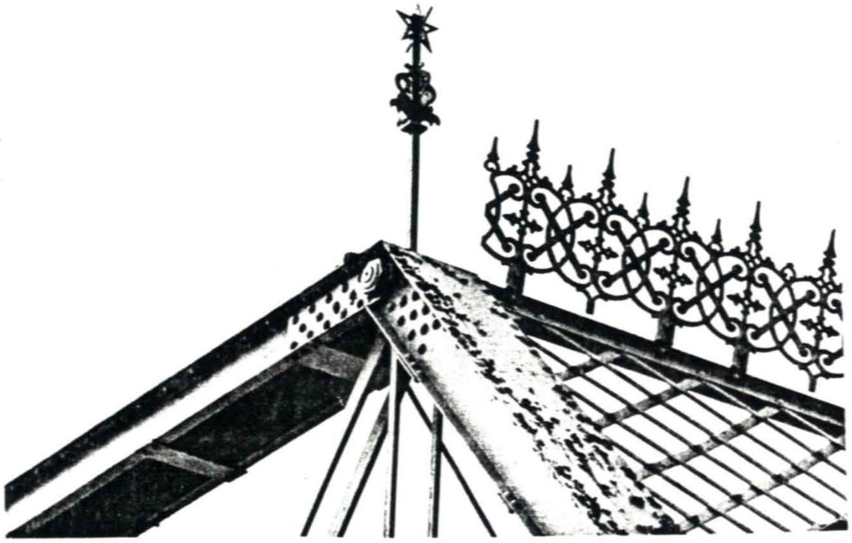
3.15 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, laced channel beams, pin-connection at portal.



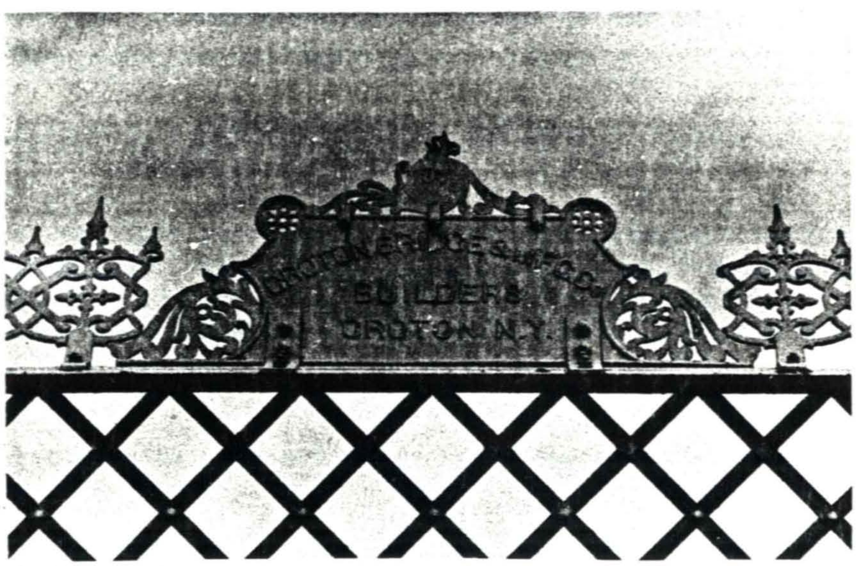
3.16 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, latticed sidewalk grill, decorated portal, latticed knee bracing, plank decking.



3.17 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, lower chord, eye-bar, pin-connection, hanger, I-beam, plank decking.



3.18 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, finial, decorative cresting, pin-connection at portal strut, end post.



3.19 Shelburne, N.H., North Road, Androscoggin River, 5 span Pratt truss, 1897, NR, bridgeplate.

manufactured bridge at the Town of Goshen in Rockbridge County, Virginia, which spans the Calfpasture River:

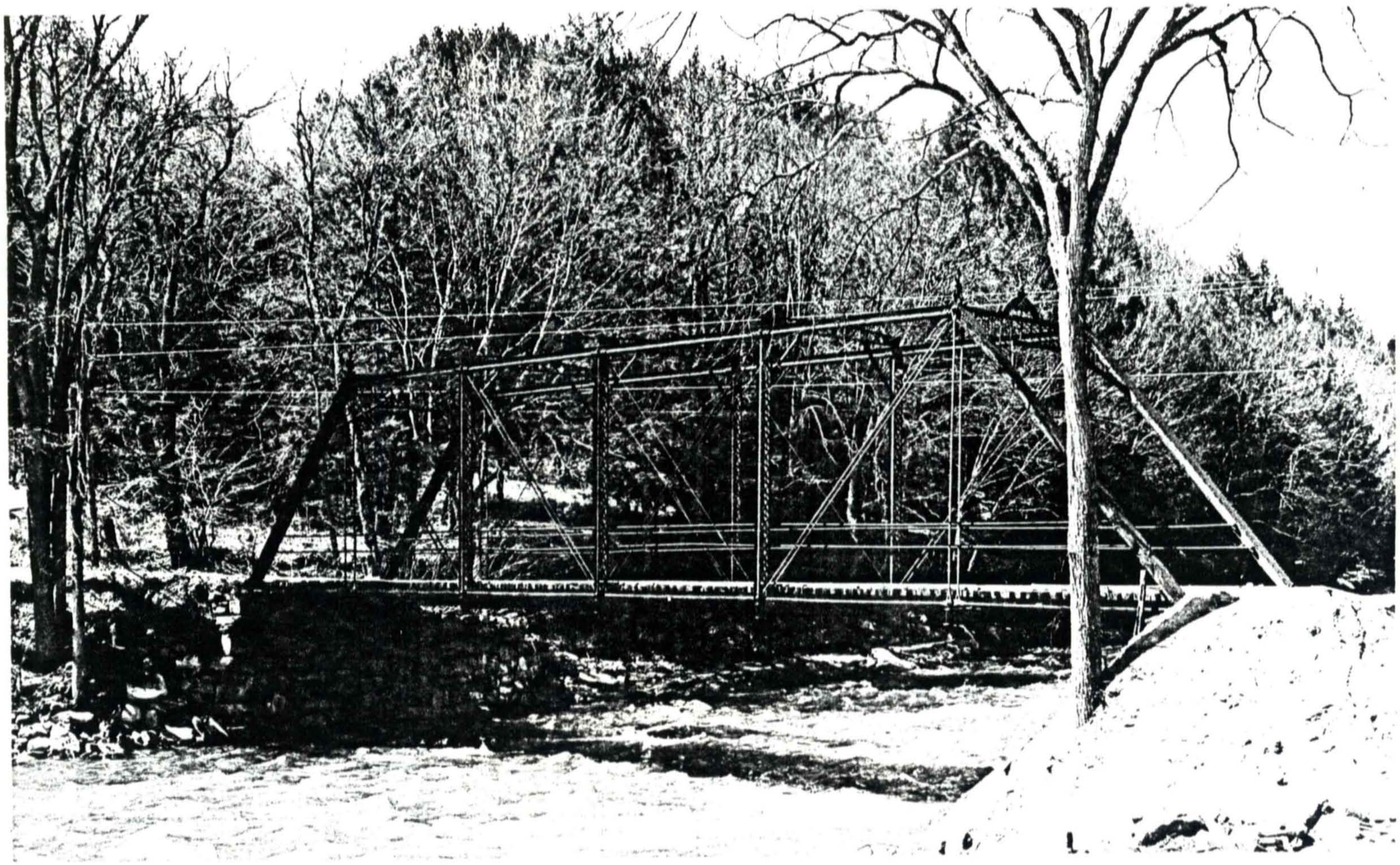
> Designation of the Groton Bridge and Manufacturing Company as an unusual and innovative designer is made largely on the basis of a structure built in Virginia in 1890 for the Goshen Land and Improvement Company...It is a multi-span, wide, and heavily skewed truss reflecting a significant design achievement for the period.[12]

Two Groton constructed bridges survive in Vermont and have been recognized by the state's Division of Historic Sites. Listed on the National Register of Historic Places, the Iron Bridge at Howard Hill in Cavendish (Figures 3.20-3.24) was constructed in the summer of 1890. This bridge is a single span, pin-connected, Pratt through truss fabricated of wrought iron and cast iron components. Although constructed at the advent of the use of steel in bridge construction, this bridge is of iron and one of the few remaining iron truss bridges in the state. The National Register nomination terms it:

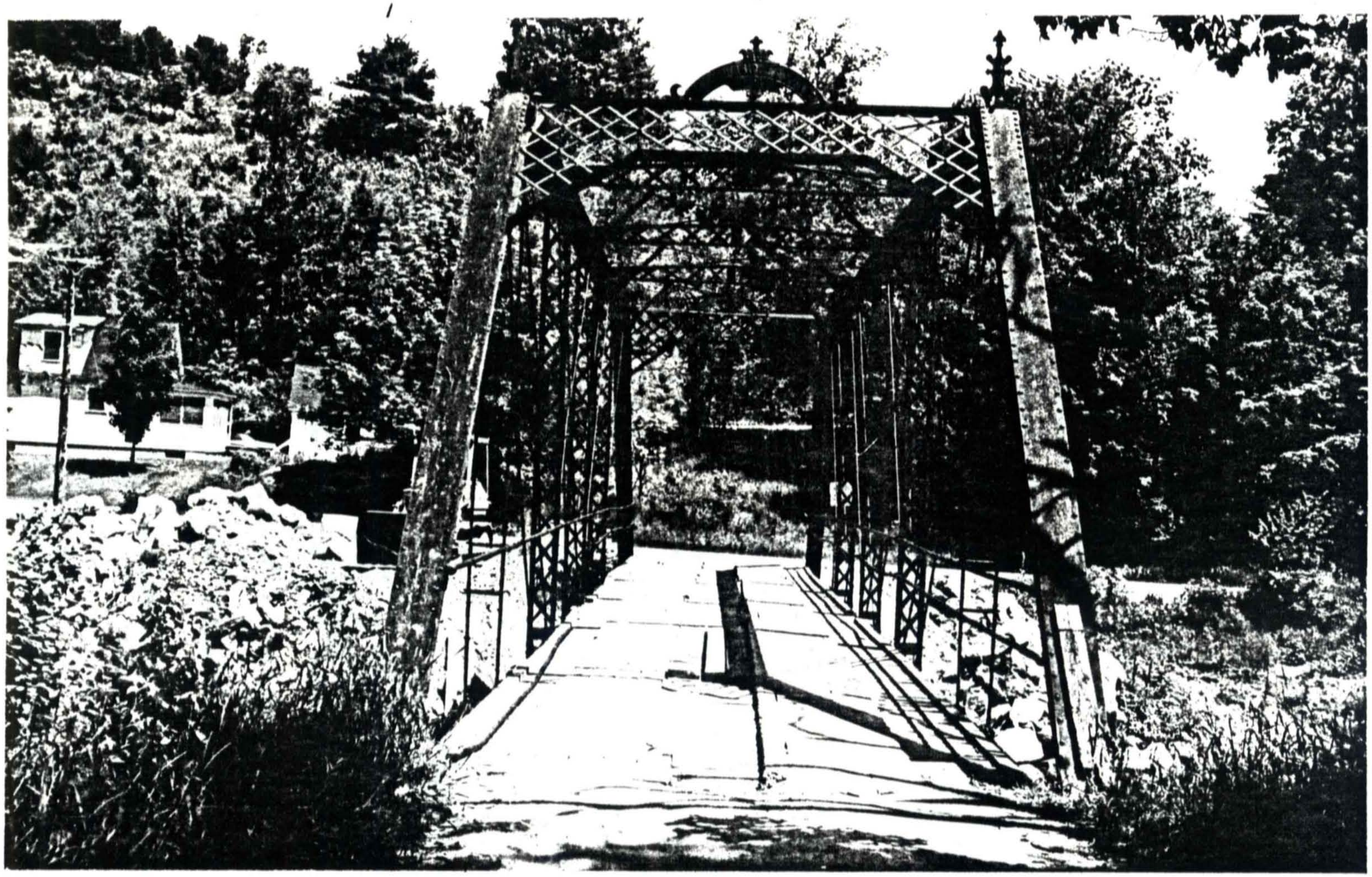
> ...the last generation of iron truss bridges...Furthermore, the Cavendish bridge retains intact its original design complete with decorative elements, making it an outstanding example of its type, period, and method of construction.[13]

The Town of Cavendish paid $850 for the bridge which has survived the years because of being lightly traveled. Locally, it is known as the "Iron Bridge".

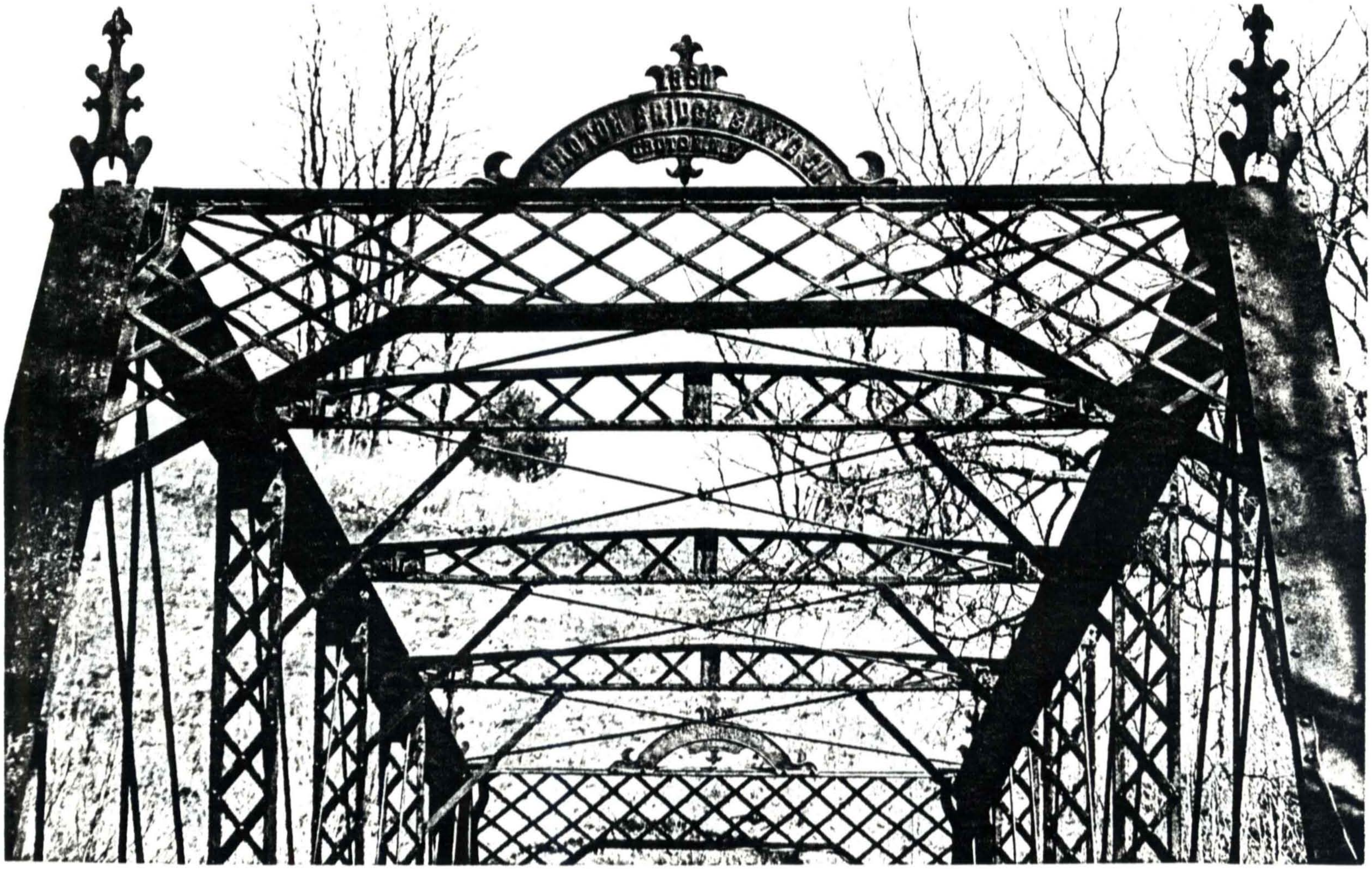
The Groton company bridge at West Woodstock, Vermont (Figure 3.25) is of steel. Constructed in 1900, the bridge crosses the Ottauqueechee



3.20 Cavendish, Vt., Howard Hill Road, Black River, Pratt through truss, 1890, NR, longitudinal view.

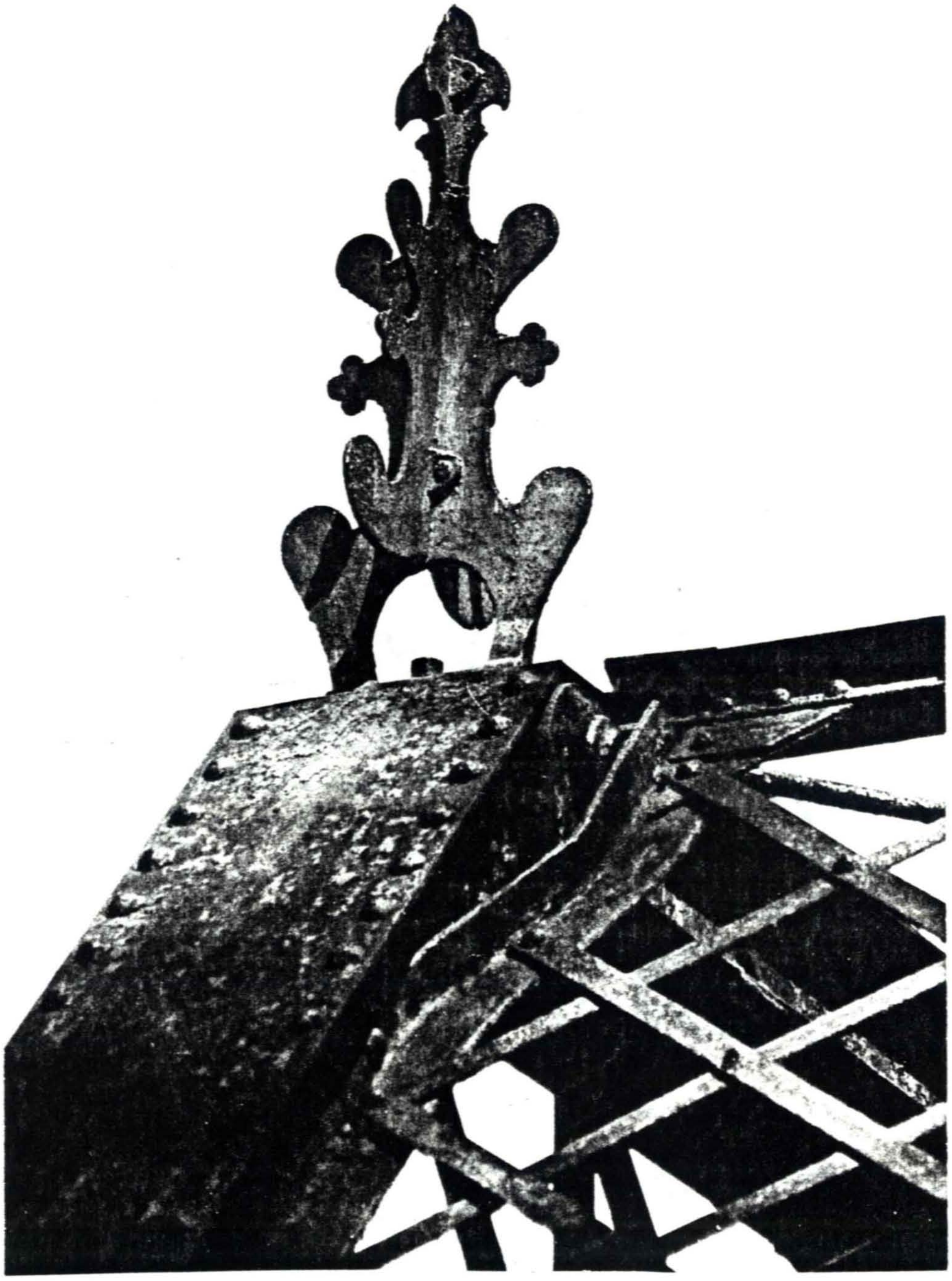


3.21 Cavendish, Vt., Howard Hill Road, Black River, Pratt through truss, 1890, NR, portal.

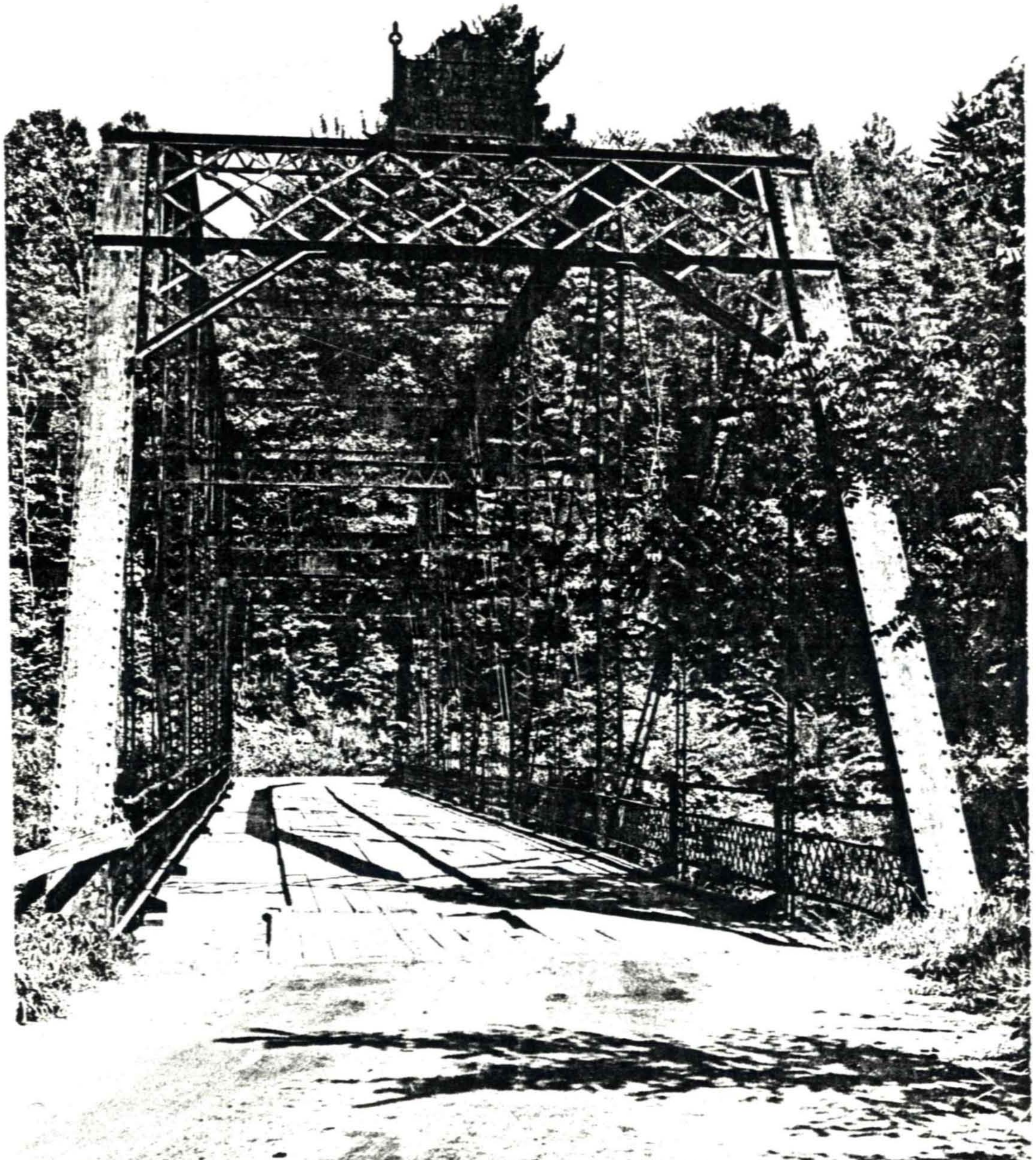


3.22 Cavendish, Vt., Howard Hill Road, Black River, Pratt through truss, 1890, NR, decorated portal.

3.23 Cavendish, Vt., Howard Hill Road, Black River, Pratt through truss, 1890, NR, bridgeplate.



3.24 Cavendish, Vt., Howard Hill Road, Black River, Pratt through truss, 1890, NR, finial.



3.26 Woodstock, Vt., Union Street, Ottauqueechee River, Camelback truss, 1900, portal, plank decking.

River in Windsor County. According to Charles M. Cobb, who chronicled the bridge construction for the Inter-State Journal in 1901, the company originally sold the bridge to Woodstock for a discounted price as a town in New York State declined to take the bridge which had been made for them. However, as it turned out, the New York town found a place for the bridge and the Groton company made good on the discounted price offered West Woodstock by fabricating a new bridge at the same specifications.[14]

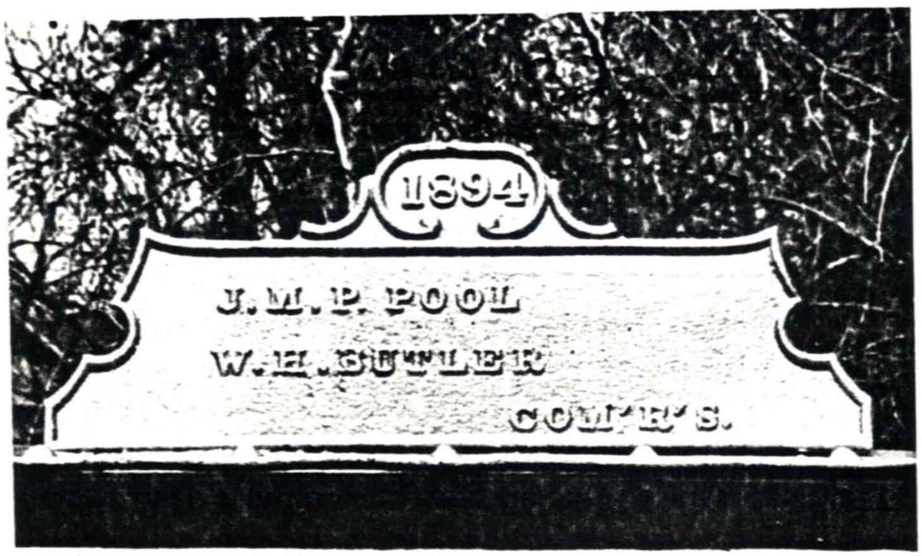
The bridge was placed on the improved abutments of an earlier span, the abutments have been said to date from 1789. Cobb noted that the structure would probably cost $6,000 and benefit the town economically:

> The greatest gain on account of it accrues to the farmers of School District No. 9 and others on the hill roads to South Woodstock, whose lumber and other products will be much more available that before and the value of all the farms will be considerably raised thus benefiting the town by increasing its grand list...But more than this the people of the valley nearly all wanted a highway bridge at this point for the addition it would make to the attractive 'drives' of the town, which is one of the most romantic and picturesque in New England.[15]

The work on the bridge began on November 14, 1900 and it was opened to travel on December 7, 1900.[16]

The Sugar Creek Bridge of Christian County, Kentucky (Figures 3.26-3.27), of 1894, is the only known Groton bridge surviving in the state. The Department of Transportation and the State Historic Preservation Officer; the Kentucky Heritage Commission, have both conducted surveys of the state's bridges. This bridge has been found to be the

3.26 Bainbridge, Ky ., State Route 124, Sugar Creek, bed post pony truss, 1894, elevation.



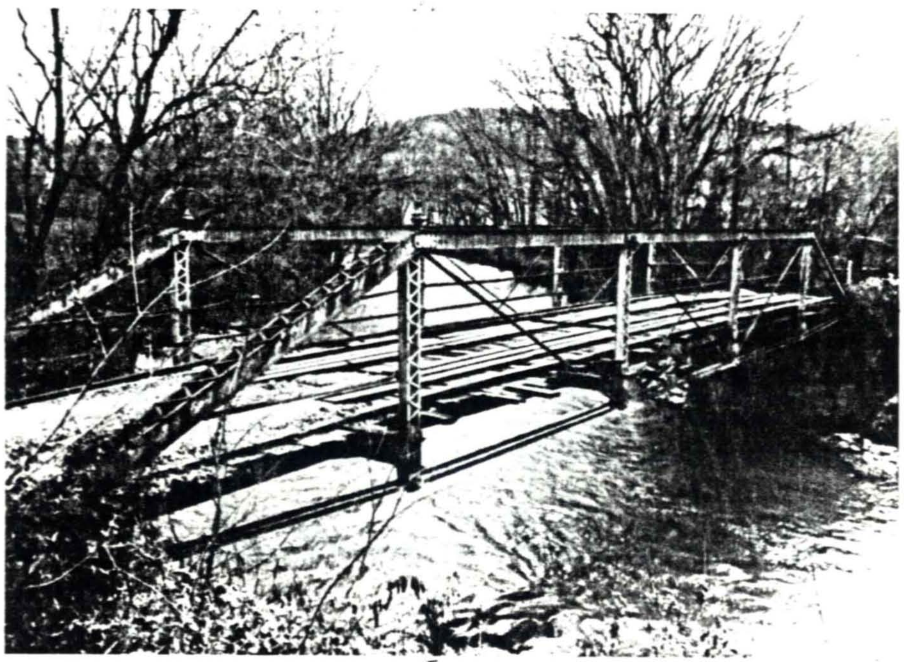
3.27 Bainbridge, Ky., State Route 124, Sugar Creek, bed post pony truss, 1894, bridgeplate.

oldest dated pony truss remaining in the state and is currently threatened with removal for the construction of a new span.[17] The bridge is located near Bainbridge and is a forty-eight foot bedpost truss with a width of nine feet seven inches and a surviving Groton bridge company plate. The pin-connected span with wooden floor is still in use, although posted at six tons.

In 1901, the Groton company built the New Middleton Bridge (Figure 3.28) on Bradford Hill Road over Mulhervin Creek in Smith County, Tennessee. The bridge was demolished within the last four years. A pony Pratt truss of eighty-five feet in length and twelve feet seven inches in width, the bridge was distinguished by its "fish-bellied" bottom chord, a curved chord, and its laced end posts, top chords facing the opposite direction from normal and decorative finials. It was pin-connected with a timber deck over steel I-beam stringers. The fish-bellied chord arrangement was cited in Milo Ketchum's The Design of Highway Bridges and the Calculation of Stresses in Bridge Trusses written in 1909. He stated, "the fish-bellied chord is a decided improvement...This bridge is very rigid..."[18]

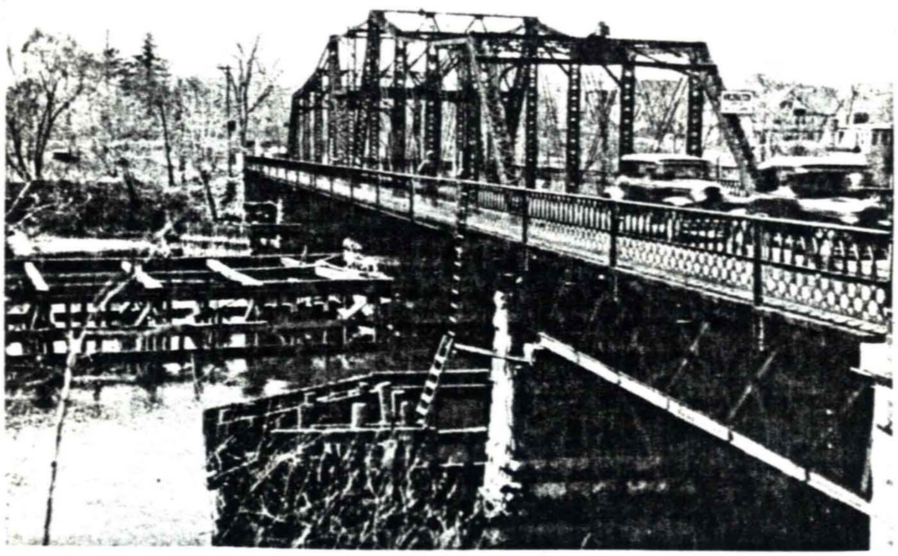
After its closing in 1979, a state bridge evaluation report recommended repairs to the stringers, the shoring of an abutment, a new timber deck, new railing and guard rail, narrow bridge warning signs and posting to five tons.[19] A replacement bridge was built, however, and this bridge taken down.[20]

The Union Avenue Bridge (Figures 3.29,3.30) over the Passaic River in Rutherford, New Jersey, constructed by the Groton Bridge and

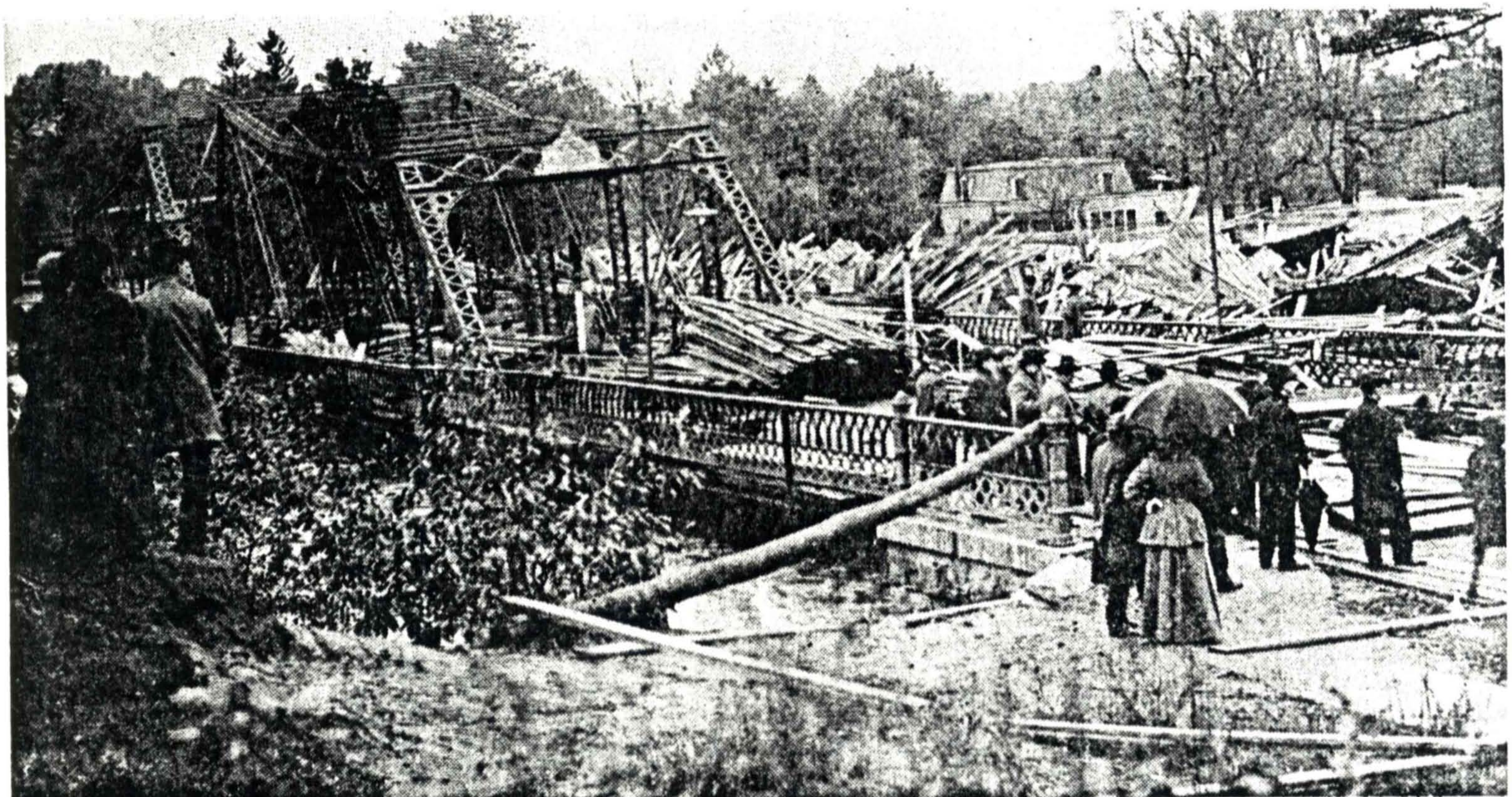


3.28 New Middleton, Tenn., Bradford Hill Road, Mulhervin Creek, 1901, demolished.

UNION AVENUE BRIDGE OVER PASSAIC RIVER, RUTHERFORD, N. J.



3.29 Rutherford, N.J., Union Avenue, Passaic River, swing bridge, 1896, historic longitudinal view.



3.30 Rutherford, N.J., Union Avenue, Passaic River, swing bridge, 1896, after flood of 1902.

Manufacturing Company in 1896, survives today. Originally fitted with manual turning machinery, an additional gear train driven by an electric motor was added in 1924. Repairs have since been made on the swing machinery, in addition to those made in 1924, in 1946 and 1961. The bridge links the Borough of Rutherford in Bergen County with the City of Passaic in Passaic County. It is a four span highway structure with an overall length of 285 feet and width of thirty-two feet, clearance of eleven feet and posting to the speed limit of ten miles per hour.

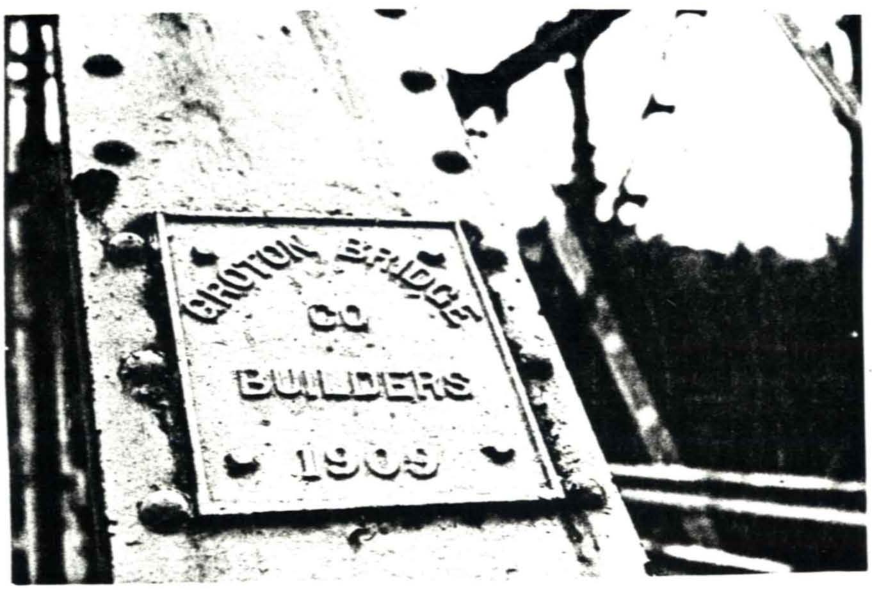
In addition to the damage sustained to the bridge in the flood of 1902, the bridge was hit by a barge in 1976 knocking an approach span pier out and dropping the structure into the water. The span was rebuilt by 1978. Presently, the County of Bergen Department of Public Works is conducting a feasibility study of the bridge.[21]

Examples of the company's work after its repurchase from the American Bridge Company and its reconstitution as the Groton Bridge Company in 1902 are interesting in their difference from earlier forms. Generally, the later Warren bridges are characterized by a heaviness of members not found in the earlier Pratt trusses praised for their delicate artistry. In addition, the Warren trusses are all steel. Several examples of this work are available in the Ithaca, New York area and include the Forest Home bridges (Figures 3.31-3.34) over the Fall Creek. The first, constructed in 1904, is a eighty-four foot Warren deck truss. The second, a Double Intersection Warren High Truss built in 1909, is 119 feet in length. The contract for this

3.31 Ithaca, N.Y., Forest Home Drive, Fall Creek,
Warren deck pony truss, 1904, elevation.

3.32 Ithaca, N.Y., Forest Home Drive, Fall Creek,
Warren Double Intersection through truss, 1909, elevation.

3.33 Ithaca, N.Y., Forest Home Drive, Fall Creek,
Warren Double Intersection through truss, 1909, portal.



3.34 Ithaca, N.Y., Forest Home Drive, Fall Creek,
Warren Double Intersection through truss, 1909, bridgeplate.

bridge at $3,998 was won over bids from the Weedsport Bridge Company and the United Construction Company.[22]

A concrete arch bridge (Figure 3.35) of the company's construction in the summer of 1911 is extant in Waterburg, Town of Ulysses, Tompkins County, New York. Record of the company seeking to build in concrete exists as early as 1906 in plans submitted to the City of Ithaca. Of the Waterburg bridge it was written in the Trumansburg Free Press and Sentinel:

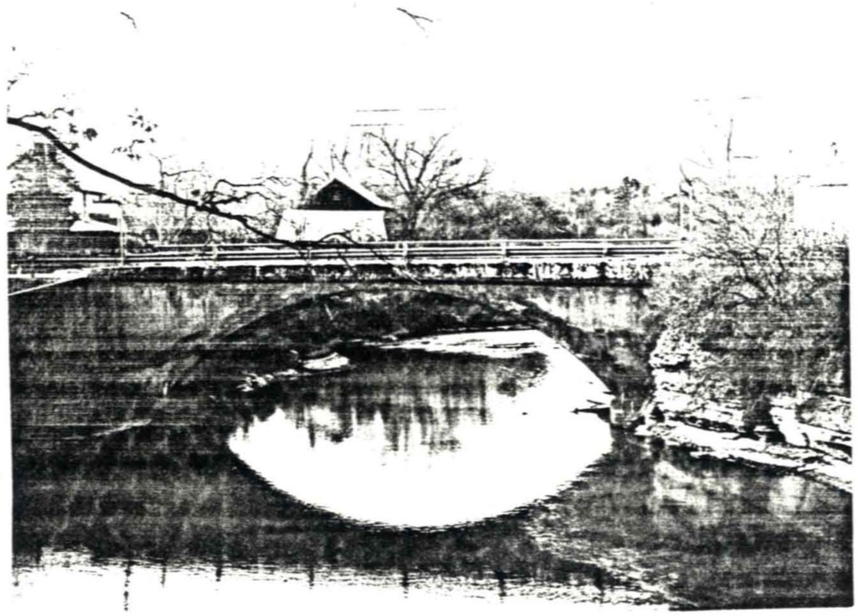
> ...this fine structure over the Halseyville Creek at Waterburg was built by the Groton Bridge Company in the late summer of 1911 to replace a steel bridge that had been pronounced unsafe under the new rules for bridge construction. This bridge is of reinforced concrete, of about sixty-five foot span, and a sixteen foot roadway. The contract price was $3,000.[22]

The Groton and Lansing Journal noted:

> It is a fine substantial looking structure, one that will not call for repairs in many years, if it proves as good as it looks it should cost practically nothing for maintenance for the next 100 years; and if it will go 100 years without repairs there is no reason why it should not be good for 1,000 years.[23]

With such confidence, there was no reason to question that business was booming for the company when the Groton and Lansing Journal reported in October of 1913 that the company was building a 193 ton bridge in the shops for the barge canal in Newark, New Jersey:

> ...the bridge is a 150 foot span, has a 32 foot roadway and two ten foot walks. The floor is to be of reinforced concrete. The total weight of the bridge is 193 tons, or 386,000 pounds. One piece of the lower chord alone weighs



3.35 Ulysses, N.Y., Waterburg Road, Taughannock Creek, concrete arch, 1911, elevation.

eight tons. Six carloads of the bridge have already been shipped, and it is estimated that it will take about eight more to complete the shipment.[25]

CHAPTER III, APPENDIX A

EXTANT GROTON BRIDGES OUTSIDE NEW YORK STATE

1. Bainbridge, Christian County, Kentucky, State Route 124, Sugar Creek, bedpost pony truss, 1894.

2. Kingston, Plymouth County, Massachusetts, Elm Street, Jones River, Pratt pony truss (pin-connections), 1889.

3. Village of Shattuckville, Franklin County, Massachusetts, Cross Road, North River, Pratt through truss (pin-connections), closed, 1887.

4. Portland, Ionia County, Michigan, Bridge Street, Grand River, Pratt through truss (2 spans, each 102' 1/2"), 1890.

5. Emmet Township, Calhoun County, Michigan, F Drive North, Kalamazoo River, Pratt through truss, closed, 1905.

6. Chippewa Township, Isabella County, Michigan, Shepherd Road, Chippewa River, Pratt through truss (101'), 1901.

7. Holland Township, Ottawa County, Michigan, Dolph Road, Pratt pony truss (75'), c. 1908.

8. Shelburne, Coos County, New Hampshire, North Road, Androscoggin River, Pratt through truss (5 span), National Register of Historic Places, 1897.

9. Wallpack Center, Sussex County, New Jersey, back road, .2 miles east of Wallpack Center, Delaware National Recreational Area at the Water Gap, Pratt pony truss (64'6" long, 11' wide, wood decking, surviving bridgeplate, modified supports, railings and tension members), 1889.

10. Warrington, Belvidere, Warren County, New Jersey, Hanesburg Road, Paulins Kill, Pratt pony truss, 1886.

11. Rutherford, New Jersey, Union Avenue, Passaic River, swing bridge, Pratt with polygonal top chord, 1896, rebuilt 1978.

12. Allenwood, Pennsylvania, State Route 44, West Branch Susquehanna River, Pratt through truss (5 span, steel, ashlar piers, 958' long), 1895, Stage One environment assessment performed in 1984.

13. Williamsport, Pennsylvania, Memorial Avenue, Lycoming Creek, Camelback truss, 1889, environmental review performed in 1984.

14. Pegram, Cheatham County, Tennessee, Harpeth River, Pratt through truss, moved from Hannah's Ford, Kingston, Harpeth River, 1898.

15. Nashville, Tennessee, Church Street Viaduct, girder (much altered), 1896.

16. Goshen, Rockbridge County, Virginia, State Route 746, Calfpasture River, Double Intersection Pratt (3 spans, 2 at 138'10", 1 at 120'10", 25'2" wide), 1890.

17. Goshen, Rockbridge County, Virginia, State Route 746, Calfpasture River, Double Intersection Pratt (2 spans, 1 at 139', 1 at 122', 12' roadway), 1896.

18. Staunton, Augusta County, Virginia, State Route 795, Christian's Creek, Single Intersection Pratt (105' long, 15' wide, posted at eight tons), 1896, scheduled for replacement in the fall of 1985.

19. Honaker, Russell County, Virginia, State Route 652, Clinch River, Single Intersection Pratt (2 spans, 1 at 112', 1 at 113', 11' wide), posted at eight tons, 1889.

20. North Charleston, Kanawha County, West Virginia, County Route 21/7, Pocatalico River, Pratt through truss (140' long), nominated to the National Register of Historic Places, closed to all but pedestrian traffic, 1898.

21. Huntington, Cabell County, West Virginia, County Route 17, Mud River, Pratt through truss (109'8" long), known locally as the "Blue Sulphur Bridge", posted at fifteen tons, 1888.

22. West Union, Doddridge County, West Virginia, County Route 52, South Fork Hughes River, Pratt pony truss (67'1" long), known locally as the "Oxford Truss", nominated to the National Register of Historic Places, posted at three tons, 1892.

Source: Responses from State Historic Preservation Officers when queried by letter, January 1983.

The following states responded that there were no surviving Groton-built bridges in their jurisdictions:

California

Georgia

Illinois

Indiana

Iowa

Maryland

Minnesota

North Carolina

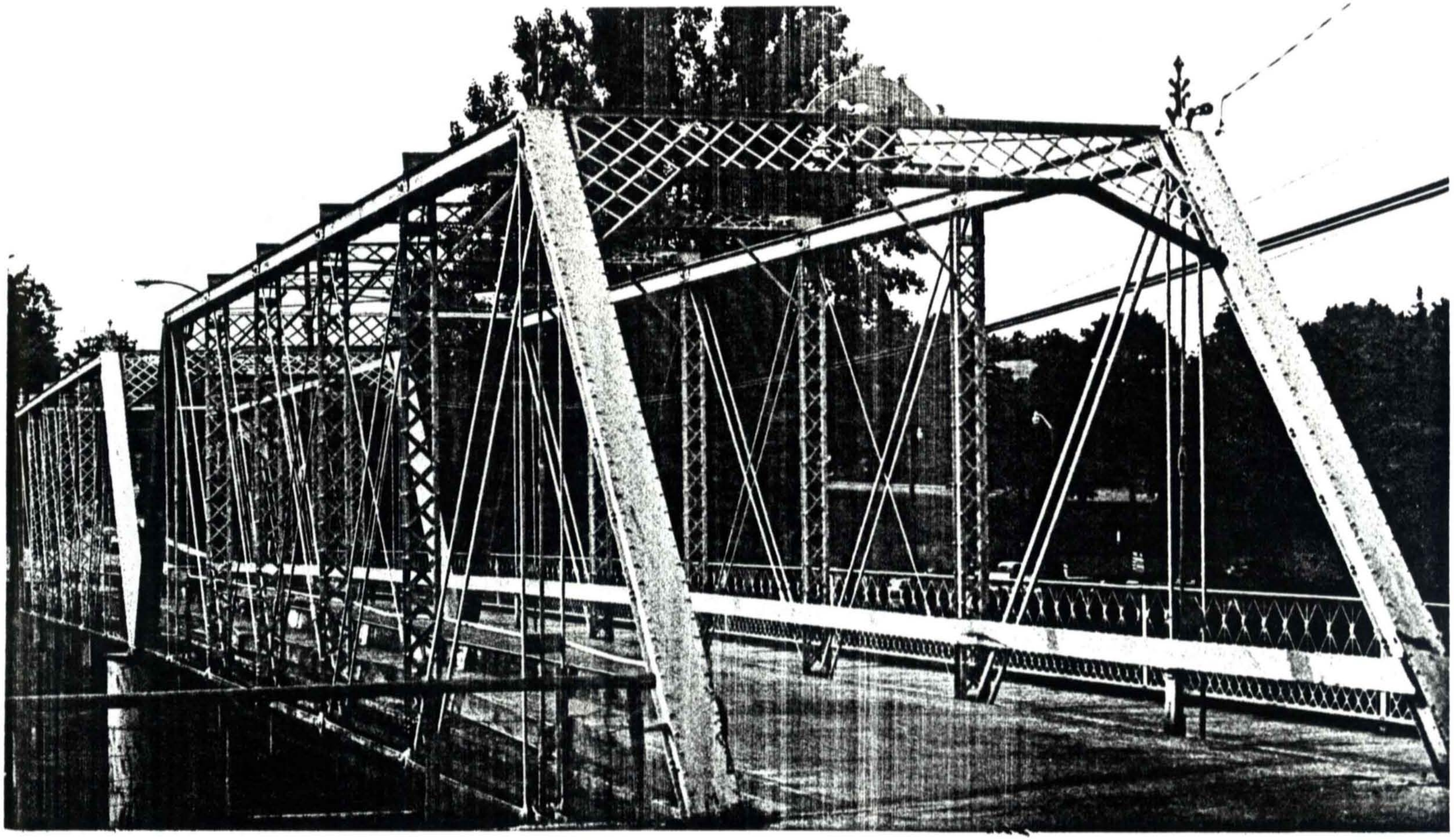
South Carolina

South Dakota

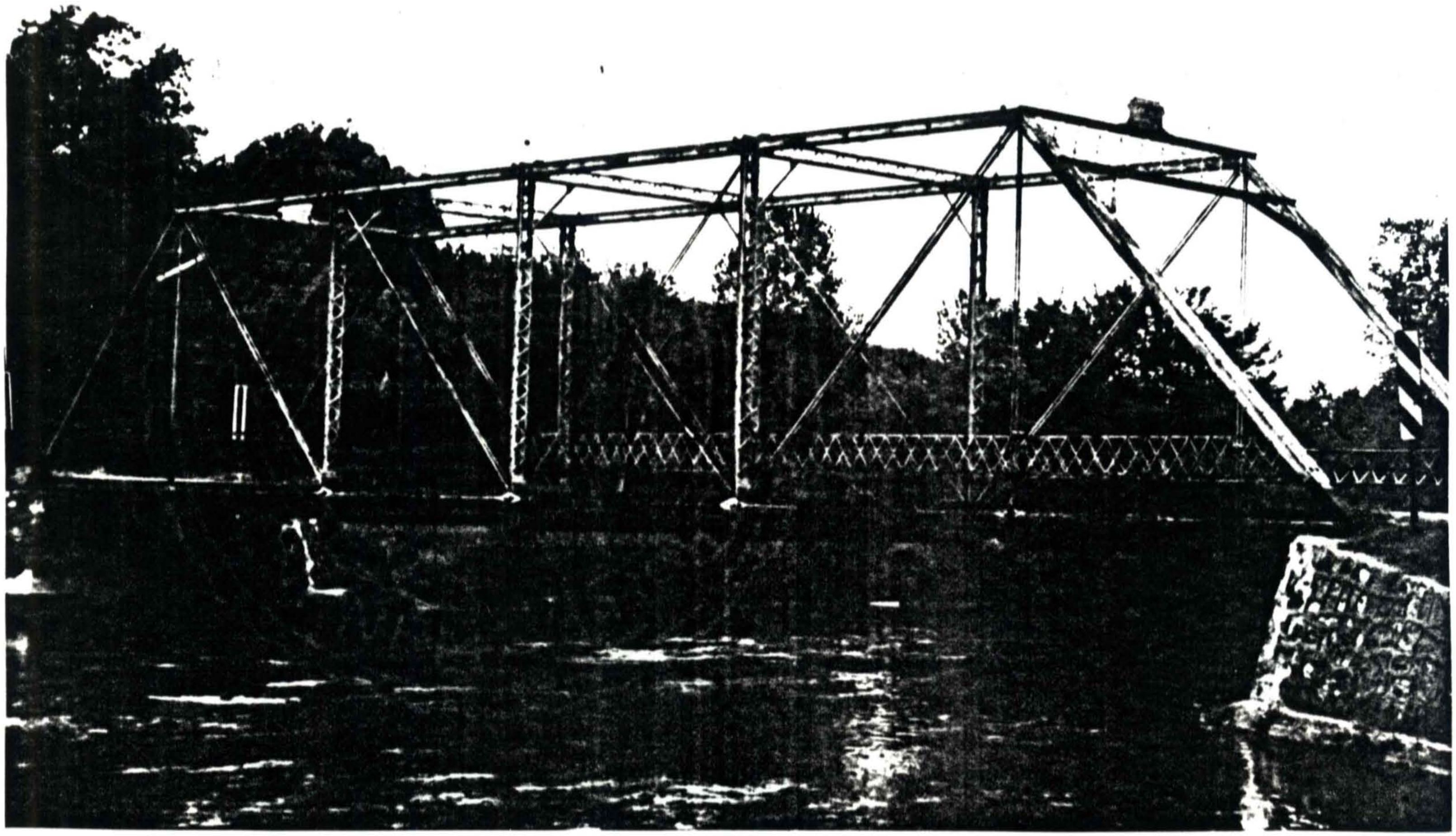
Texas

Wisconsin

*The Pennsylvania bridge inventory has not been tabulated by bridge company, although the field work has been completed. A reasonable estimate of the number of Groton-built bridges surviving in the state is twenty given the proximity of the state, the existence of company field offices there and the record of bids and awards in Engineering News.

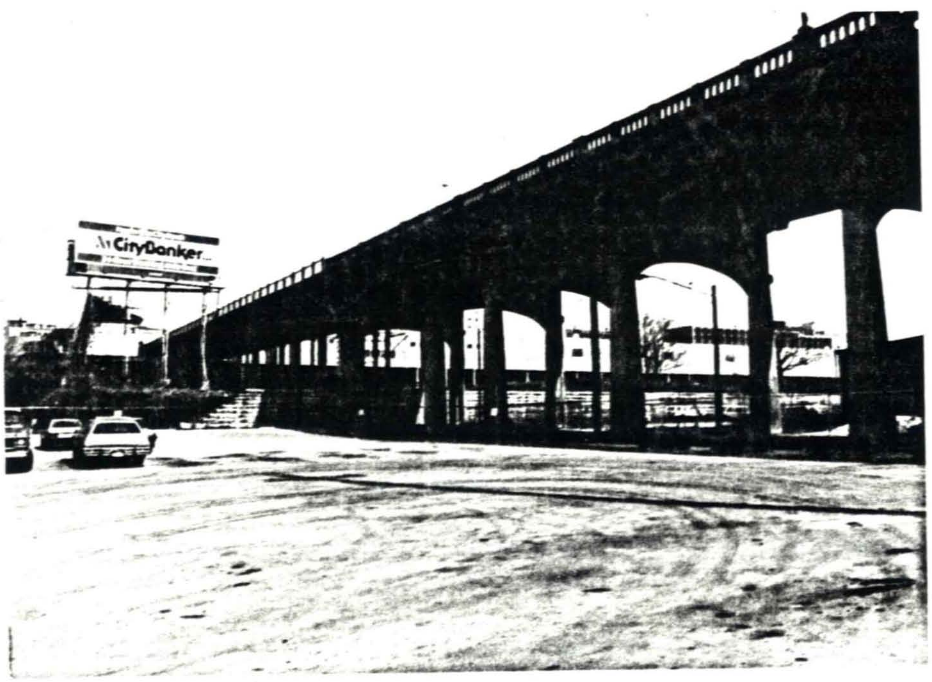


3.36 Portland, Michigan, Bridge Street, Grand River, 2 span Pratt through truss, 1890, portal view.



3.37 Emmet Township, Michigan, F Drive North, Kalamazoo River, Pratt through truss, 1905, elevation, closed.

3.38 Nashville, Tenn., Church Street Viaduct, girder, 1896, connection with modern structure.



3.39 Nashville, Tenn., Church Street Viaduct, girder, 1896, longitudinal view.

CHAPTER III, APPENDIX B

EXTANT GROTON BRIDGES IN NEW YORK STATE

REGION 1

1. Bridge Identification Number (BIN) 3-30130-0, Albany County, 1.5 miles south of Bush, Rowe Road, Onesquethaw Creek, low Pratt (1 span, pin-connected, 12'4" wide (W) proposed by New York State Department of Transportation (NYSDOT) Engineering Research and Development Bureau as potentially eligible for nomination to the National Register of Historic Places), 1882.

2. BIN 3-30184-0, Essex County, .25 miles east of Crown Point Center, Fish Hatchery Road, South Putnam Creek, Pratt pony (43'), 1908.

3. BIN 3-30235-0, Essex County, .2 miles north of the Village of Keene, South Lacy Road, East Branch Ausable, High Pratt through truss (pin-connected, 123' long (L), 10'W), 1895.

4. BIN 3-20060-0, Greene County, 2 miles southwest of the hamlet of Aera, Shinglekill, Bald Hills Road, Warren low truss (proposed as NR eligible), 1897.

5. BIN 3-20114-0, Greene County, 2 miles northeast of Jewett Center, East Kill, Mill Hollow Road, low Pratt (71'L), 1906.

6. BIN 3-30308-0, Greene County, 5 miles southeast of the Hamlet of Durham, CR 67A, Catskill Creek, Parker truss (pin-connected, 142'L, 16'2"W, decorative portals with bridgeplate over each), 1900.

7. BIN 2-20118-0, Greene County, Deming Road, Schoharie Creek, High Pratt (pin-connected, 94'L, 12'2"W), 1898.

8. BIN 3-30334-0, Rensselaer County, Johnsonville, CR111, Hoosick River, High Pratt (pin-connected, 198'L, 20'3"W), 1891.

9. BIN 2-2-286-0, Saratoga County, 4 miles east of Saratoga Springs, Burgoyne Road, Fish Creek, High Pratt (97'L,16'W), 1896.

10. BIN 3-30515-0, Warren County, 1 mile northwest of I87, Exit 24, River Road, Schroon River, low Pratt (89'L, plate survives), 1896.

11. BIN 3-30546-0, Warren County, .5 miles east Wevertown, Dillon Hill Road, Mill Creek, low Pratt half-hip (52'L, 11/1"W), 1889.

12. BIN 3-30573-0, Warren County, 2 miles west I87, Exit 23, CR 14, Milton Street, Schroon River, High Pratt (114'L,14'1"W), 1895.

13. BIN 4-41812-0, Washington County, Paynes Bridge over Champlain Canal, High Warren (156'L, p posed as NR eligible), n.d.

14. BIN 4-41813-0, Ridge Road over Champlain Canal.

15. BIN 4-41814-0, Washington County, Lock Six Road over Champlain Canal, low Warren (84'L,29'W), 1907.

16. BIN 9-20298-0, Schnectady County, abandoned road, Normanskill, low Pratt (60'L, plate survives), 1886.

REGION 2

17. BIN 3-30794-0, Herkimer County, .2 miles southwest of Wilmurt, Gray Wilmurt, Four Mile Creek, low Pratt half-hip (55'L, plate survives), 1895.

18. BIN 3-30795-0, Herkimer County, .1 mile south of Wilmurt, West Canada Creek, Gray Wilmurt, High Pratt (full-slope, pin-connected, 89'L, 18'W), 1895.

19. BIN 2-20524-0, Montgomery County, 2 miles northeast of Starkville, Moyer Road, Otsquago Creek, low Pratt half-hip (plate survives, 44'L), 1889.

20. BIN 2-20602-0, Oneida County, 2 miles north of Barneveld, Cook Road, Cincinnati Creek, High Pratt full-slope (140'L, 18'5"W), 1909.

21. BIN 3-31134-0, Oneida County, 3 miles northeast Lake Delta, River Road, Mohawk River, High Pratt full-slope (pin-connected, 88'L, 18'3"W), 1885.

22. BIN 4-42608-0, East Oneida over Barge Canal, Higginsville, Pennsylvania Petit truss (riveted, 300'L), 1908.

23. BIN 4-42609-0, East Oneida over Barge Canal, Cive Road, Pennsylvania Petit truss (riveted, 303'L), 1908.

REGION 3

24. BIN 2-20702-0, Cayuga County, 2 miles east of Genoa, Town Line Road, Little Salmon Creek, bowstring arch metal tied (21'L), date unknown.

25. BIN 3-31214-0, Cortland County, 4.5 miles east of Marathon, Landers Corners, Otselic River, High Pratt full-slope (pin-connected, 157'L, 13'9"W), 1890.

26. BIN 3-31231-0, Cortland County, 4.5 miles northeast of Cortland, East River Crossing, East Branch Tioghnioga River, Warren low truss with verticals (90'L, 16'5"W), 1913.

27. BIN 3-04745-0, Tompkins County, Ithaca, Forest Home Drive, Fall Creek, Double Intersection Warren (116'L, 16'W), 1909.

28. BID 3-20979-0, Tompkins County, Dryden, 1.5 miles northeast of Freeville, Red Mill Road, Fall Creek, low Pratt (2 spans of 59' each, bolted connections, pier added after originally built, plate survives), 1887.

29. BIN 3-31423-0, Tompkins County, Groton, Groton City Bridge, Fall Creek, low Pratt (70'L), 1877.

30. BIN 3-20987-0, Tompkins County, Dryden, Pinckney Road, Fall Creek, High Pratt, 1877.

31. BIN 3-21000-0, Tompkins County, Groton, Stevens Road, Owasco Inlet, rolled beam (34'L, altered), 1887.

32. BIN 3-04744-0, Tompkins County, Ithaca, Forest Home Drive, Fall Creek, low Warren with verticals (54'L), 1904.

33. BIN 3-31424-0, Groton, Champlain Road, Fall Creek, low Warren with verticals (68'L), 1910.

34. BIN 3-31440-0, Tompkins County, Ulysses, Waterburg Road, Taughannock Creek, concrete arch (76'L), 1911.

35. BIN 3-20999-0, Tompkins County, Groton, Old Stage Road, Fall Creek, plate girder (54'L), 1917.

REGION 4

36. BIN 3-32676-0, Livingston County, 3.2 miles northeast Reeds Corner, Everman Road, Canaseraga Creek, low Pratt (pin-connected, lattice railing, 74'L, plate survives), 1894.

37. BIN 3-31677-0, Livingston County, 2 miles northwest Danville, White Bridge Road, Canaseraga Creek, low Pratt (iron, wood plank deck, plate survives, 74'L), 1894.

38. BIN 3-31903-0, Orleans County, 1.5 miles northwest of Kent Bills Road, Marsh Creek, bowstring arch pony truss (47'L), 1878.

39. BIN 3-31968-0, Wyoming County, 1 mile north Pearl Creek, Crossman Road, Catka Creek, High Pratt half-hip (110'L, 14'W, proposed NR eligible), 1879.

40. BIN 4-44311-0, Monroe County, Lee Road, City Street, Erie Canal. Double Intersection Warren (155'L, 22'8"W, plate survives), 1907.

REGION 5

41. BIN 3-32252-0, Chautaugua County, 3 miles southeast Michais Ischua Creek, Reynolds Road, High Pratt (pin-connected, 97'L, 14'3"W), 1896.

42. BIN 2-21282-0, Chautaugua County, at Westfield, South Water Street, Chautauqua Creek, High Pratt full-slope (overhead bracing, end post decoration, 138'L, 16'W), n.d.

43. BIN 2-06091-0, Niagara County, Niagara Falls East, Pear Avenue, Cayuga Creek, High Pratt full slope (overhead bracing, pin-connected, 98'L, closed to traffic, open for pedestrians), n.d.

44. BIN 3-32319-0, Cattaraugus County, Bay State Road, Bay State Bridge, low Pratt half-hip (builder inferred by plate shape), 1896.

45. BIN 6-06485-0, Cattaraugus County, Cotton Road, Allegheny River, High Parker (2 spans, overhead bracing, pin-connected, 350'L, each span 173'L, 17'W), n.d.

REGION 6

46. BIN 2-21448-0, Allegheny County, .6 miles west of Caneadea, Caneadea Creek, Mill Street, High Pratt (pin-connected, decorative knee bracing, 116'L, 13'6"W), 1878.

47. BIN 3-33075-0, Allegheny County, Caneadea, Genesee River, East Hill Road, Camelback High Pratt (pin-connected, 246'L, 18'7"W, 1 span), 1903.

48. BIN 3-33071-0, Allegheny County, Ballard Road, Rush Creek, High Pratt (pin-connected, 119'L, 14'2"W), 1902.

49. BIN 2-21593-0, Schuyler County, 1 mile southeast Cayuta, Vern Dean Road, Cayuta Creek, low Warren (riveted, 57'L, lattice railing, 18'W), 1909.

50. BIN 2-21749-0, Steuben County, 1.6 miles south of Prattsburg, Waldo Road, Five Mile Creek, I-beam (early example, modified to I-beam, 38'L, 16'W), date in dispute.

51. BIN 2-21766-0, Steuben County, 3.2 miles west of Cambell, ext. of CR 12, Michigan Creek, low Pratt (39'L, plate survives), 1894.

52. BIN 2-21912-0, Tioga County, in Spencer, East Hill Road, Catatonk Creek, metal I-beam (37'L, bridge truss no longer connects to the working part of the structure), 1897.

53. BIN 2-21915-0, Tioga County, Waverly, Ithaca Street, Cayuta Creek, High Pratt (pin-connected, 107'L, 32'W, lattice on portal struts), 1880.

REGION 7

54. BIN 3-33571-0, Clinton County, 1.2 miles south Redford, CR 15 over Bed Road, Saranac River, High Pratt (109'8"L, 18'2"W, plate survives), 1898.

55. BIN 3-33578-0, Clinton County, Schuyler Falls, .9 miles southeast Cadyville, Goddeau Road, Saranac River, High Pratt (steel, 173'L, 18'3" W, paved wooden deck, plate survives), 1900.

56. BIN 3-33640-0, Clinton County, .1 mile southeast Mooers Forks, CR 25 Woods Falls, North Branch Great Chazy River, High Pratt (84'8"L, 25' W, open steel floor), 1887.

57. BIN 3-33471-0, Clinton County, 1.2 miles south Redford, Ore Bed Road, Saranac River, High Pratt (108'8"L, 18'2"W), 1898.

58. BIN 3-33739-0, Franklin County, 1.4 miles south Fort Covington, Little Salmon River, low Pratt (69'L, open steel floor, plate survives), 1890.

59. BIN 3-33762-0, Franklin County, 2.6 miles northwest of Malone, Corgin Road, Salmon River, High Pratt (78'L, 15'6"W, plate survives), 1900.

60. BIN 3-33842-0, Jefferson County, .9 miles northeast of Belleville, Ellisburg, Mather Hill Road, Sandy Creek, High Pratt (110'L,18'W, plate survives), 1894.

61. BIN 3-33857-0, Jefferson County, 4 miles north of Worth Centre, CR 95, South Sandy Creek, High Pratt (111'L, 16'5"W, proposed NR eligible), 1890.

62. BIN 3-33878-0, Jefferson County, 3 miles east of Adams Centre, Main Street, Sandy Creek, High Pratt (110'L, 15'5"W, timber deck), 1899.

63. BIN 3-34009-0, Lewis County, .6 miles west of Deer River, Miller Road, Deer River, low Pratt (57'L, plate survives), 1890.

64. BIN 3-34010-0, Lewis County, 2.3 miles south Deer River, Old State Road, Deer River, High Pratt (97'L, 16'W, decorative portal, plate survives), 1891.

65. BIN 3-34011-0, Lewis County, 2.3 miles northeast of Copenhagen, Vorce Road, Deer River, low Pratt (2 spans, 65'L, 56'L), 1890.

66. BIN 2-22083-0, St. Lawrence County, 2.5 miles northwest Stockholm Court, Munson Road, St. Regis River, High Pratt (2 spans, 234'L, plank flooring, pedestrian crossing and snowmobile use only), 1893.

67. BIN 2-22124-0, St. Lawrence County, 6 miles southwest of North Gouven, Little Bow Road, Oswegatchie River, High Pratt (104'L, 14'W, closed), n.d.

68. BIN 2-25935-0, St. Lawrence County, .2 miles north of Elmdale, Lockie Road, Oswegatchie River, High Pratt (119'L, 17'W, plate survives), 1885.

69. BIN 3-22170-0, St. Lawrence County, 1 mile from Wegatchie, Chisolm Road, Oswegatchie River, High Pratt (polygonal top chord, Parker truss, timber floor, 159'L, 17'W), 1899.

70. BIN 3-34107-0, St. Lawrence County, 1 mile northeast of Wegatchie, Kearney Road, Oswegatchie River, High Pratt (147'L, 18'5"W, proposed NR eligible), 1886.

REGION 8

71. BIN 3-34434-0, Orange County, 2 miles northeast Bloomingburgh, Petticaote Lane, Shawangunk Kill, High Pratt (98'L, 16'W, pin-connected), 1883.

72. BIN 3-34448-0, Orange County, 3.5 miles northeast Cuddesbackville, Paradise Road, Delaware and Hudson Canal, High Pratt (126'L, 12'W, pin-connected, latticed portal, laced verticals, bowed lateral struts), 1910.

73. BIN 2-22423-0, Ulster County, 2 miles northeast Lewbeach, Barnhart Road, Beaver Kill, low Pratt full-slope (86'L, pin-connected), 1895.

74. BIN 3-34723-0, Ulster County, 1.4 miles east Wawarsing, Fordemoor Road, Rondout Creek, High Pratt (150'L, 18'9"W, latticed portal), 1896.

REGION 9

75. BIN 3-34916-0, Broome County, 3 miles south Nineveh, CR 541, Susquehanna River, High Pratt (4 spans, pin-connected, 602'L, each span 150'L, proposed NR eligible), 1890.

76. BIN 3-35050-0, Chenango County, 3.4 miles northwest Guilford Center, Creek Fred Smith, Kent Brook, low Pratt full-slope (82'L, latticed railing), 1894.

77. BIN 3-35130-0, Chenango County, 1.6 miles north of Pitcher, Hydeville Road, Mud Creek, low Pratt (42'L), 1895.

78. BIN 3-35133-0, Chenango County, 3.1 miles southwest of South Otselic, Mill Road, Otselic River, low Pratt (82'L), 1883.

79. BIN 3-36043-0, Delaware County, Unadilla, Bridge Street, Susquehanna River, High Parker (210'L, 27'W, pin-connected), 1894.

80. BIN 2-22766-0, Otsego County, .6 miles northeast of Index, Phoenix Road, Susquehanna River, High Pratt (83'L, pin-connected), 1895.

81. BIN 2-22767-0, Otsego County, Village of Cooperstown, Mill Street, Susquehanna River, High Pratt (95'L, pin-connected), 1887.

82. BIN 2-22822-0, Otsego County, 5 miles northeast of Rockdale, River Road spur, Unadilla River, High Pratt (179'L, 16'6"W), 1890.

83. BIN 3-35334-0, Otsego County, CR 35, Cheng Valley Creek, low Pratt (59'L), 1895.

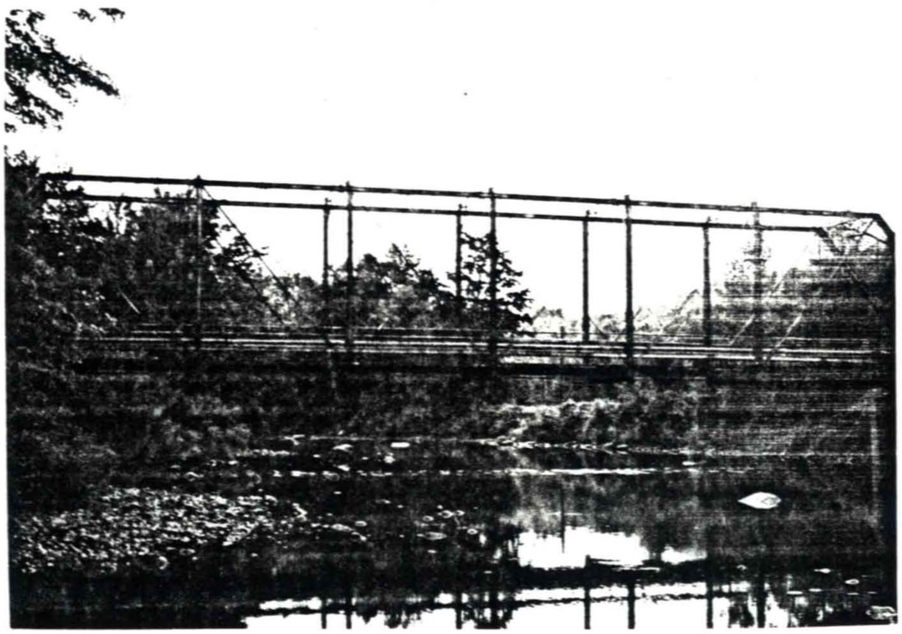
84. BIN 3-35653-0, Sullivan County, 1.8 miles northwest of Glen Wild, Grey Road, Neversink River, High Pennsylvania truss (196'L, 18'8"W, pin-connected), 1887.

85. BIN 3-35724-0, Sullivan County, at Lew Beach, TH 21, Mary Smith, Beaverkill, High Pratt (101'L, pin-connected), 1895.

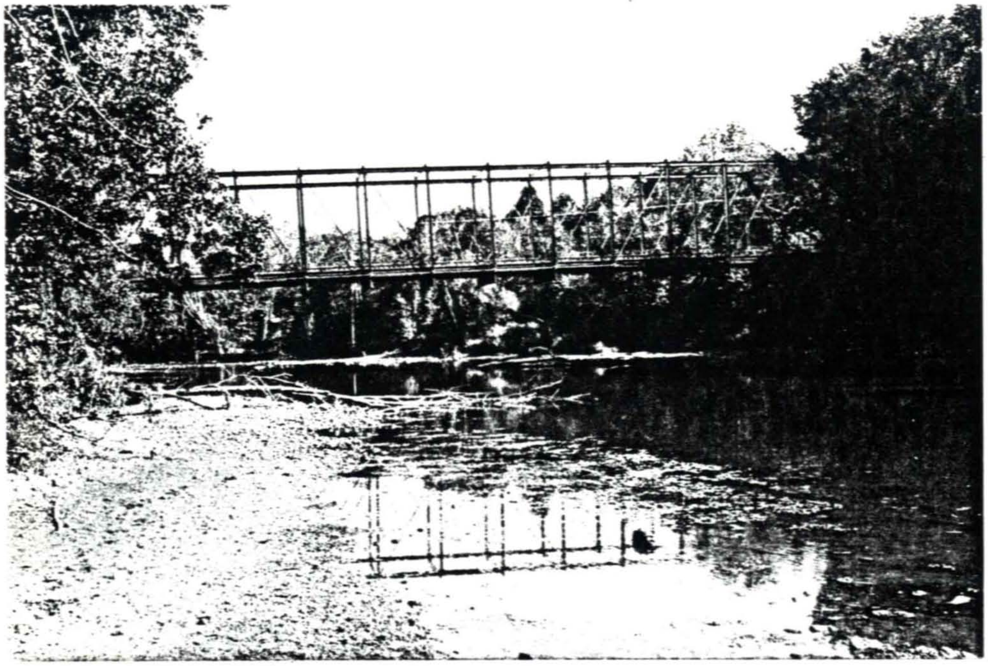
Sources: Engineering Research and Development Bureau
New York State Department of Transportation.

Tompkins County Highway Department.

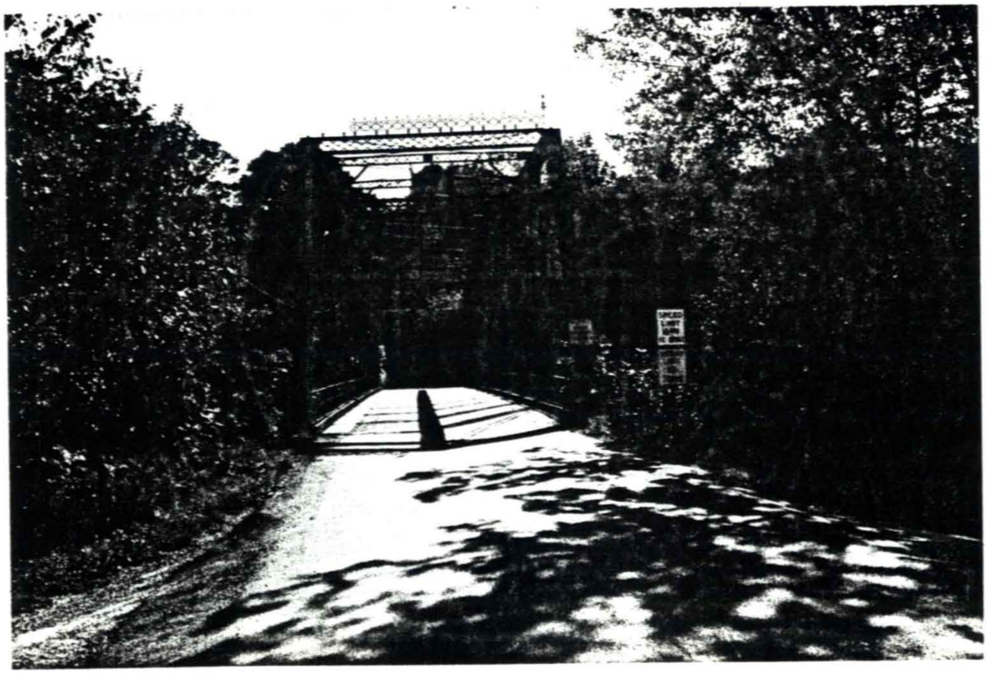
Canal Museum, Syracuse, New York.



3.40 Keene, N.Y., South Lacy Road, East Branch Ausable River, Pratt through truss, 1895, longitudinal view.

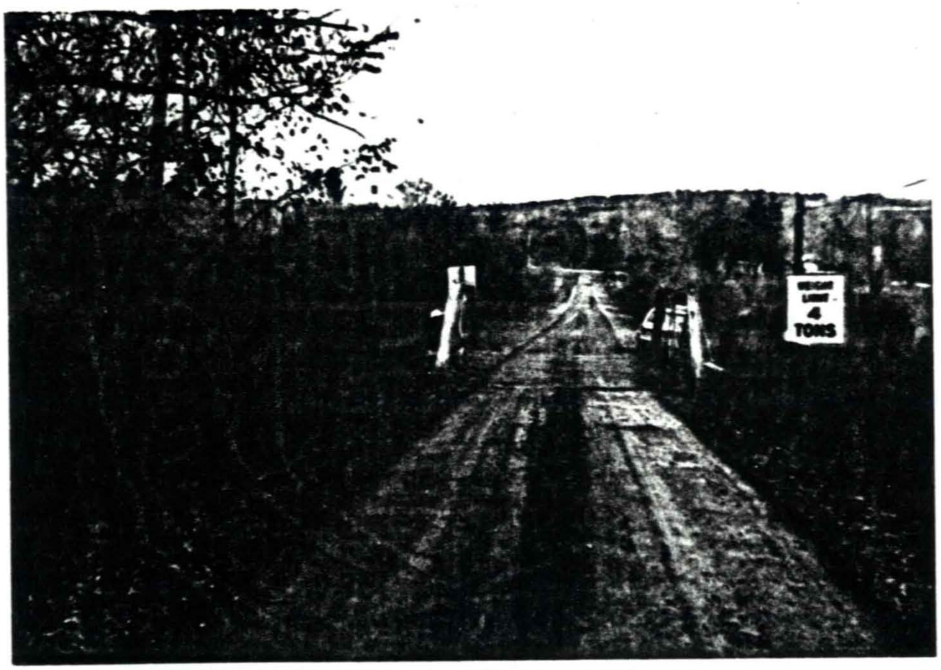


3.41 Johnsonville, N.Y., CR 111, Hoosick River, Pratt through truss, 1891, longitudinal view.

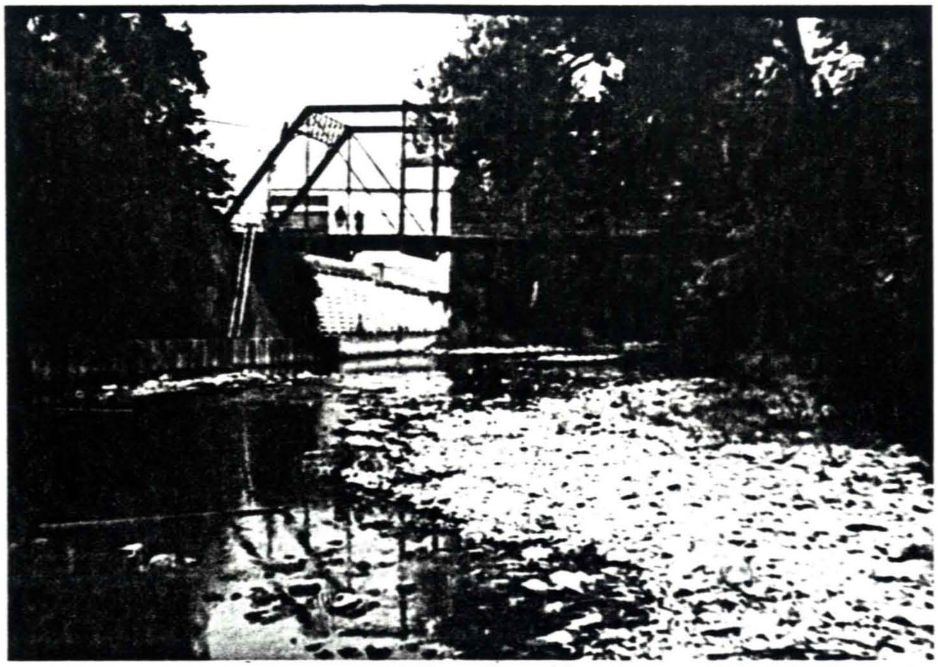


3.42 Johnsonville N.Y., CR 111, Hoosick River, Pratt through truss, 1891, portal.

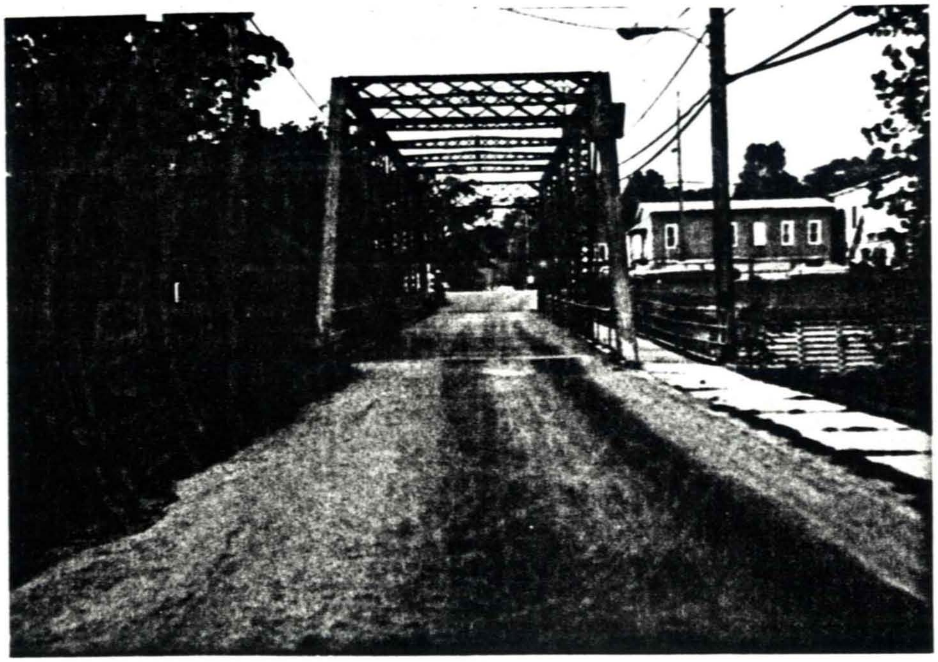
3.43 Genoa, N.Y., Town Line Road, Little Salmon Creek, bowstring arch, n.d., longitudinal view.



3.44 Genoa, N.Y., Town Line Road, Little Salmon Creek, bowstring arch, n.d., approach.

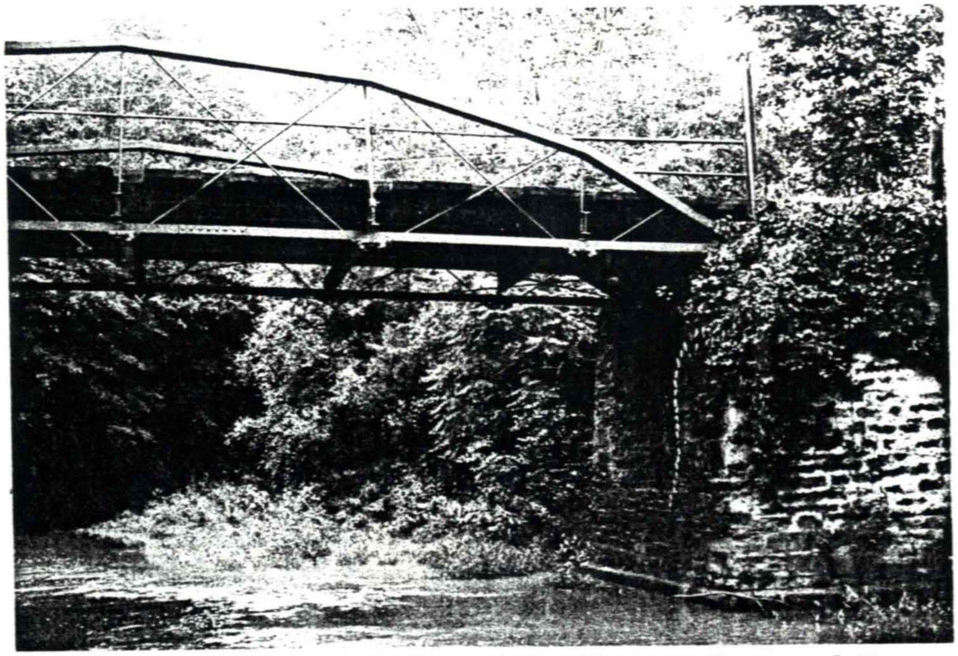


3.45 Landers Corners, N.Y., Otselic River, Pratt through truss, 1890, longitudinal view.

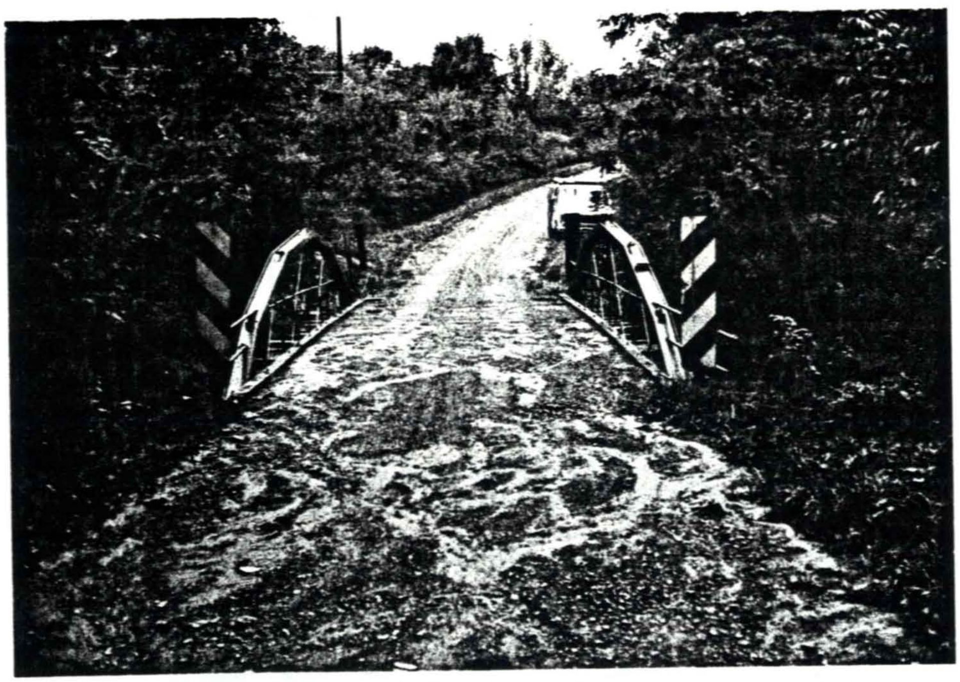


3.46 Landers Corners, N.Y., Otselic River, Pratt through truss, 1890, portal.

3.47 Groton, N.Y., Old Stage Road, Fall Creek, plate girder, 1917, bridgeplate.



3.48 Orleans County, N.Y., 1.5 miles northwest of Kent Bills Road, Marsh Creek, bowstring arch, 1879, elevation.

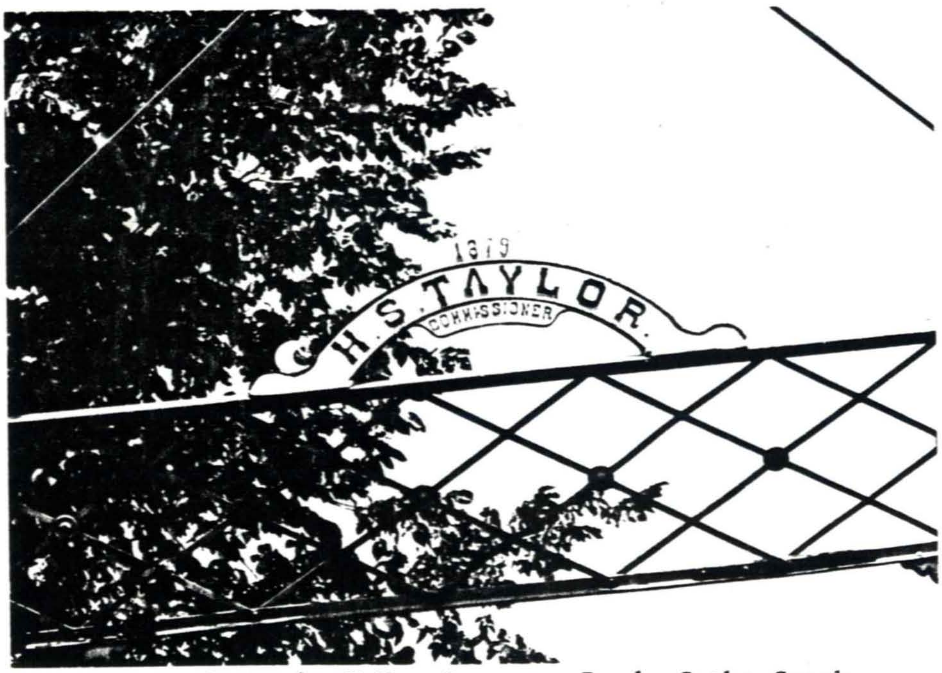


3.49 Orleans County, N.Y., 1.5 miles northwest of Kent Bills Road, Marsh Creek, bowstring arch, 1879, approach.

3.50 Pearl Creek, N.Y., Crossman Road, Catka Creek, Pratt through truss, 1879, potential NR, elevation.

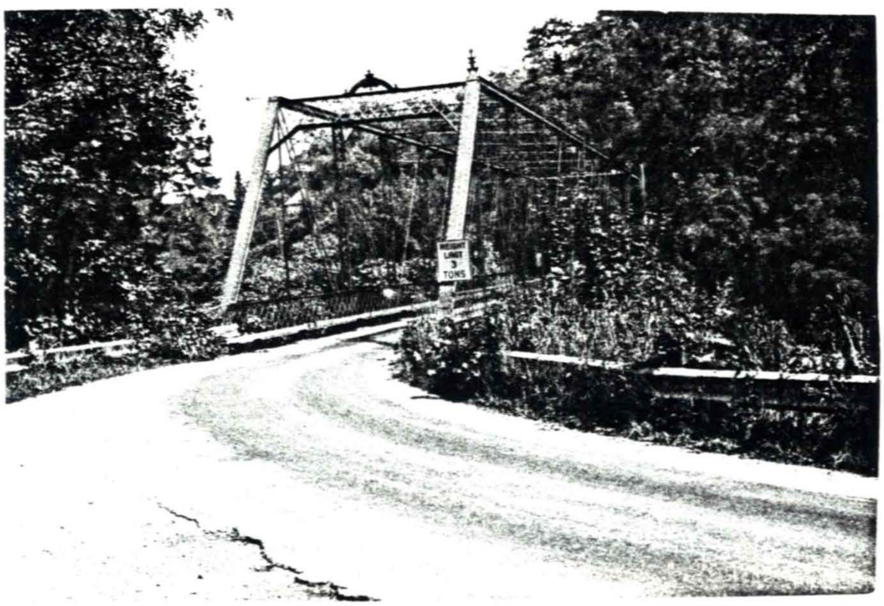
3.51 Pearl Creek, N.Y., Crossman Road, Catka Creek, Pratt through truss, 1879, potential NR, end approach.

3.52 Pearl Creek, N.Y., Crossman Road, Catka Creek,
Pratt through truss, 1879, potential NR, knee bracing.

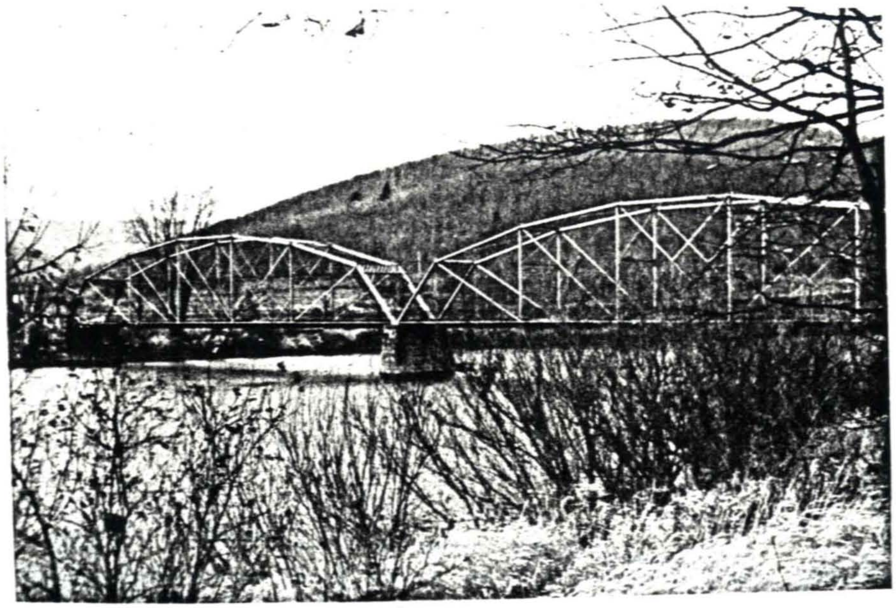


3.53 Pearl Creek, N.Y., Crossman Road, Catka Creek,
Pratt through truss, 1879, potential NR, latticed portal,
bridgeplate.

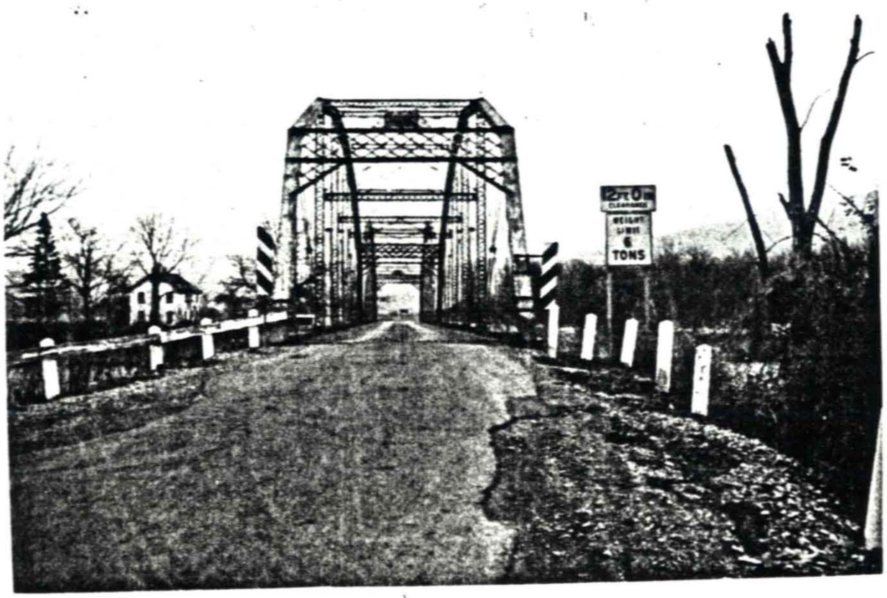
3.54 Westfield, N.Y., South Water Street, Chatauqua Creek, Pratt through truss, n.d., elevation.



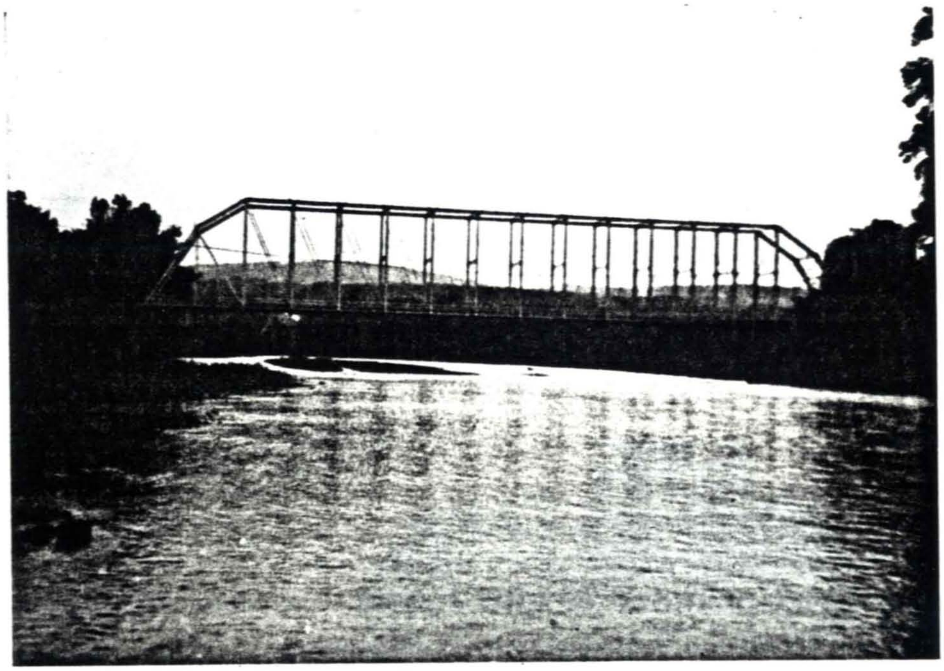
3.55 Westfield, N.Y., South Water Street, Chatauqua Creek, Pratt through truss, n.d., end approach.



3.56 Cattauraugus County, N.Y., Cotton Road, Allegheny River, Parker truss, n.d., elevation.



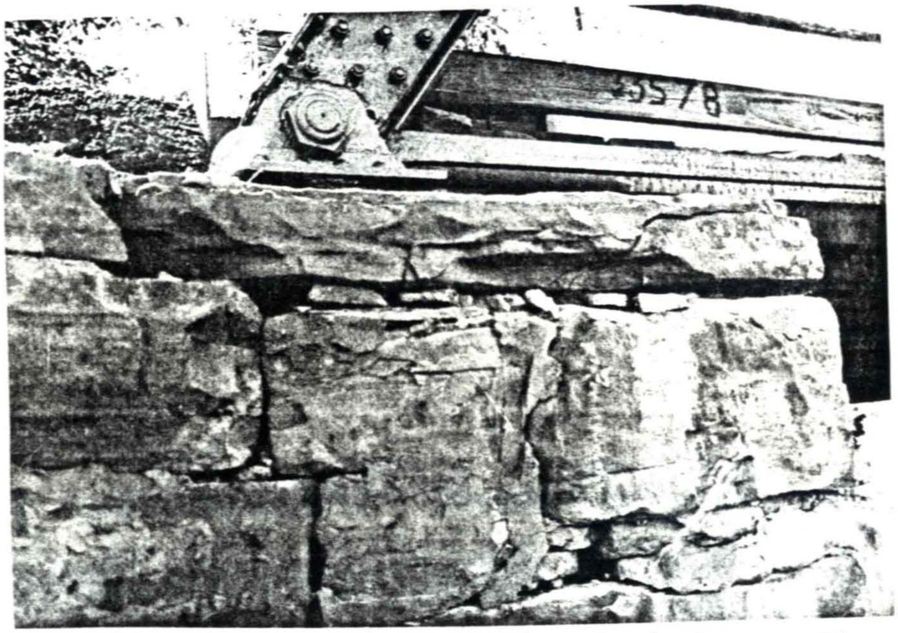
3.57 Cattauraugus County, N.Y., Cotton Road, Allegheny River, Parker truss, n.d., approach.



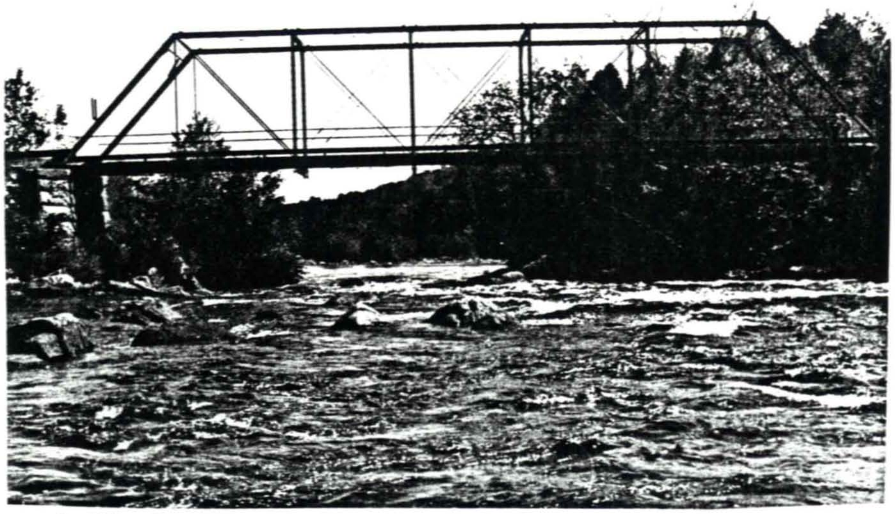
3.58 Caneadea, N.Y., East Hill Road, Genesee River, Camelback truss, 1903, elevation.

3.59 Schuyler Falls, N.Y., Goddeau Road, Saranac River,
Pratt through truss, 1900, elevation.

3.60 Schuyler Falls, N.Y., Goddeau Road, Saranac River,
Pratt through truss, 1900, approach.

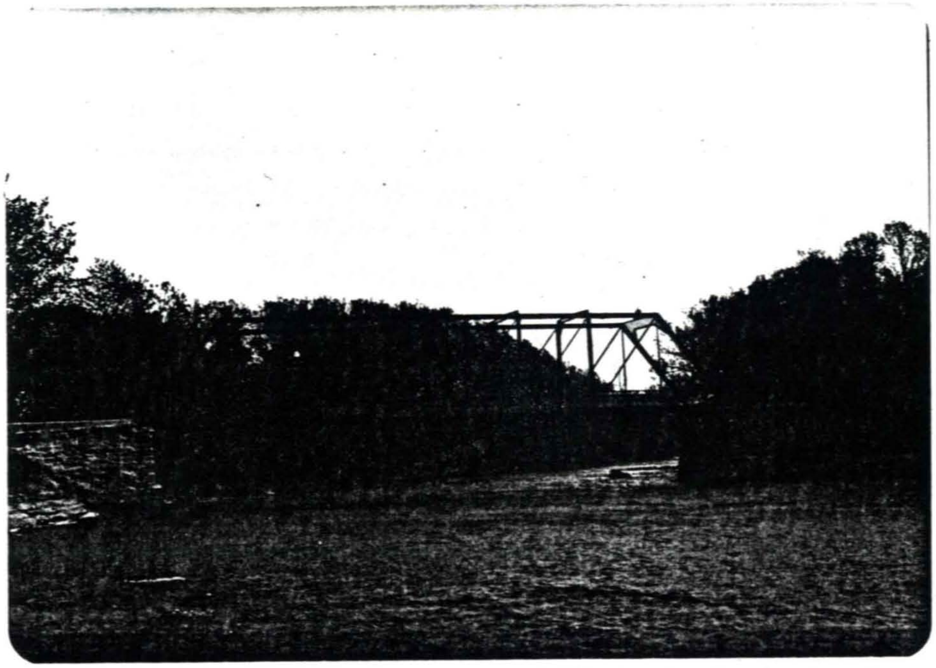


3.61 Schuyler Falls, N.Y., Goddeau Road, Saranac River, Pratt through truss, 1900, footing, stone abutment.

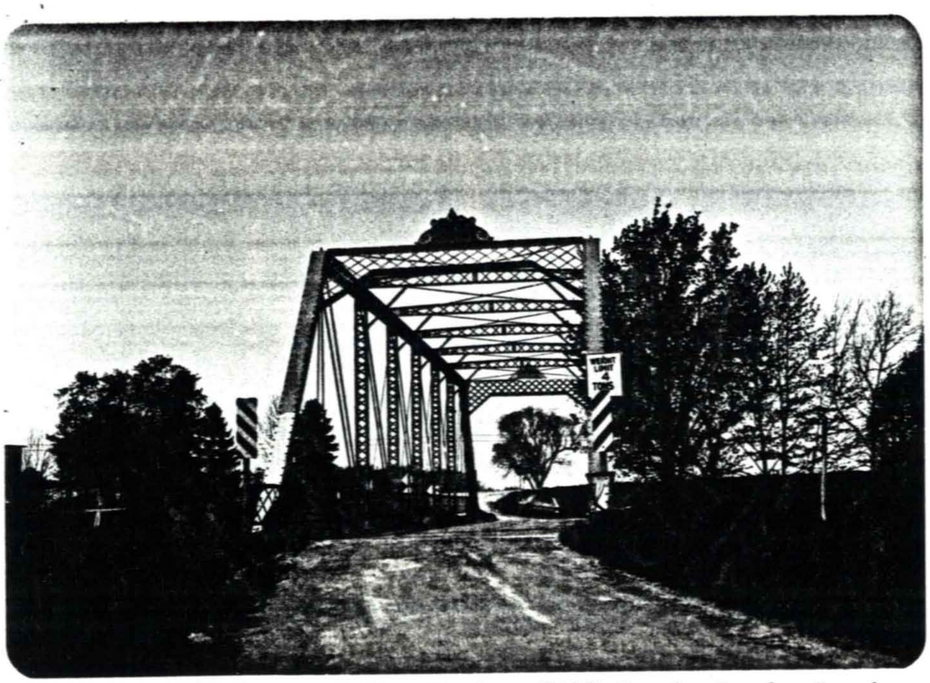


3.62 Saranac, N.Y., Ore Bed Road, Saranac River, Pratt through truss, 1898, elevation.

3.63 Saranac, N.Y., Ore Bed Road, Saranac River, Pratt through truss, 1898, approach.



3.64 Ellisburg, N.Y., Mather Hill Road, Sandy Creek, Pratt through truss, 1894, elevation.



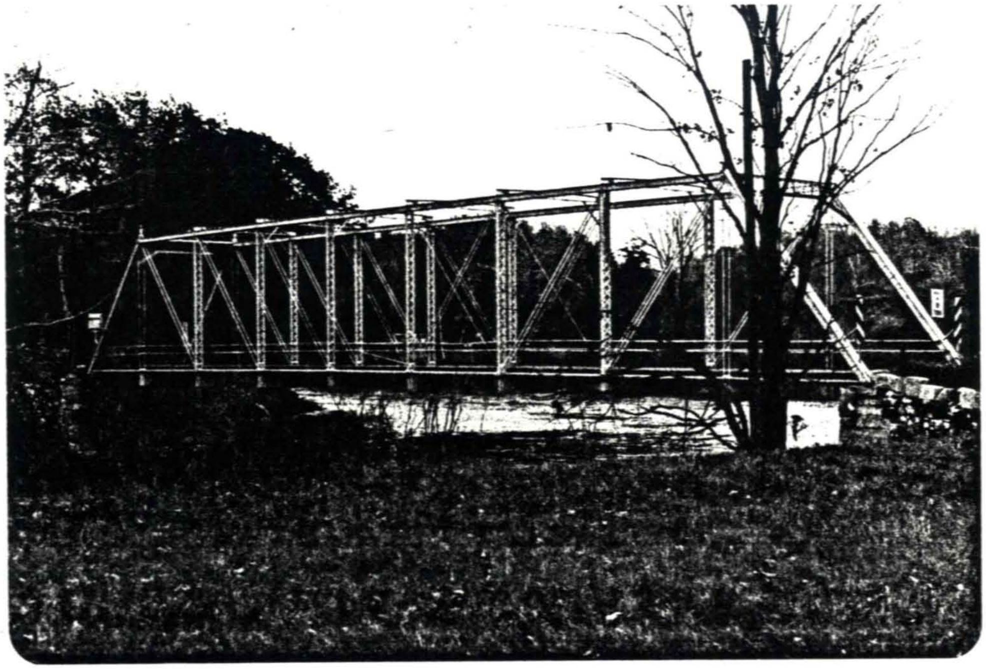
3.65. Ellisburg, N.Y., Mather Hill Road, Sandy Creek, Pratt through truss, 1894, approach.

3.66 Worth, N.Y., CR 95, South Sandy Creek,
Pratt through truss, 1890, potential NR, elevation.

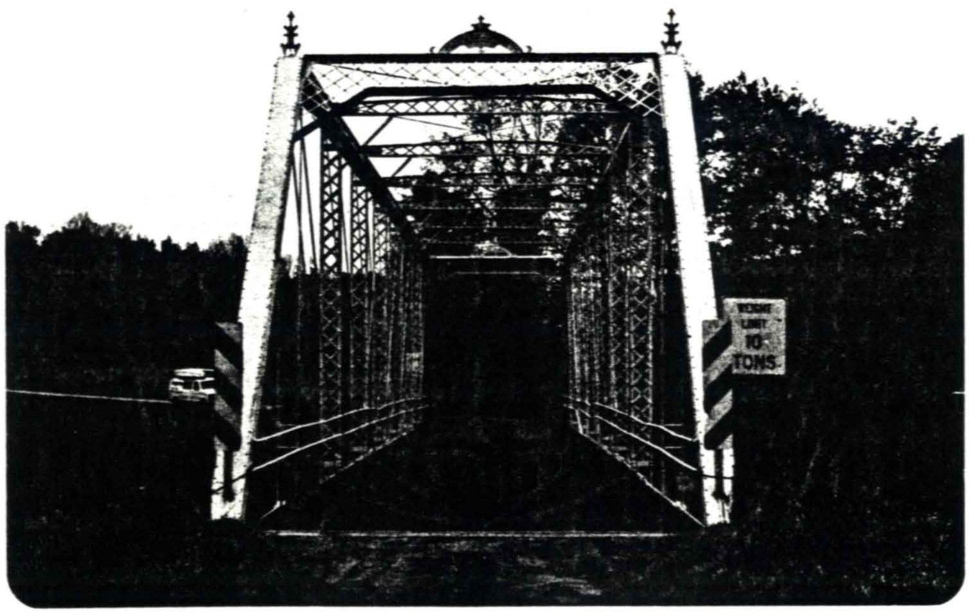
3.67 Worth, N.Y., CR 95, South Sandy Creek,
Pratt through truss, 1890, potential NR, approach.

3.68 Gouveneur, N.Y., Lockie Road, Oswegatchie River, Pratt through truss, 1885, elevation.

3.69 Gouveneur N.Y., Lockie Road, Oswegatchie River, Pratt through truss, 1885, portal.



3.70 Wegatchie, N.Y., Kearney Road, Oswegatchie River, Pratt through truss, 1886, potential NR, elevation.



3.71 Wegatchie, N.Y., Kearney Road, Oswegatchie River, Pratt through truss, 1886, potential NR, portal.

TABLE 14

IDENTIFICATION OF BRIDGE MAKER-NEW YORK STATE

GENERAL BRIDGE TYPE	TOTAL # OF BRIDGES	% IDENTIFIED
High Pratt	157	80%
Low Pratt	240	31%
Miscellaneous Pratt	147	82%
Low Warren	273	14%
High Warren	124	38%
Concrete Arch	217	2%
Masonry Arch	151	3%
Other:girder, slab, moveable,etc.	744	9%

Source: William C. Chamberlin, Civil Engineer III, Engineering Research and Development Bureau, New York State Department of Transportation.

TABLE 15

DATE OF CONSTRUCTION OF EXTANT BRIDGES

YEAR	# OF BRIDGES
1877	2
1878	2
1879	1
1880	1
1881	0
1882	1
1883	2
1884	0
1885	2
1886	2
1887	5
1888	0
1889	2
1890	7
1891	2
1892	0
1893	1
1894	6
1895	8
1896	5
1897	2
1898	2
1899	3
1900	4
1901	0
1902	0
1903	1
1904	1
1905	0
1906	1
1907	2
1908	2
1909	3
1910	2
1911	2
1913	1
1917	1

ENDNOTES, CHAPTER III

[1] New York State historian and engineering researcher, William C. Chamberlin, indicates that these features may have been added to the bridge in later years for strengthening, If original, in his view, the joint at the upper chord will form the shape of a St. Andrew's cross.

[2] Engineering News, 11 June 1887, p. 388.

[3] Donald B. Myer, Washington's Bridges (Washington D.C.: District of Columbia Department of Highways, 1956), p. 37.

[4] Ibid.

[5] East Washington Citizen's Association, The New Era: Program for the Grand Celebration of the Opening of the New Bridge, Penna. Ave. S.E. Washington D.C., Monday, August 25, 1890 (Washington D.C.: East Washington Citizen's Association, 1890), p. 37.

[6] Myer, op. cit., p. 37.

[7] Ibid.

[8] Engineering News, 6 August 1896, p. 44.

[9] Ibid.

[10] Roger A. Brevoort, Architectural/Historical Evaluation of Meadow Bridge, Shelburne, New Hampshire (Concord, N.H.: New Hampshire Department of Public Works and Highways, February 1981), p. 1.

[11] Ibid, p. 4.

[12] Howard Newlon, Jr., Criteria for Preservation and Adaptive Use of Historic Highway Structures (Charlottesville: Virginia Highway and Transportation Research Council, January 1978), p. 13.

[13] Vermont Division of Historic Sites, National Register of Historic Places Inventory-Nomination Form: Iron Bridge at Howard Hill Road, Cavendish, Vermont (Montpelier: Vermont Division of Historic Sites, July 1982), p. 2.

[14] Charles M. Cobb, "An Iron Bridge at West Woodstock, Vt.", Inter-State Journal, 2, No. 3 (1901), 11 p. , n. pag.

[15] Ibid.

[16] Cobb, op. cit.

[17] Letter from Stephen C. Gordon, Senior Historian, Kentucky Heritage Council, 2 February 1983.

[18] Milo S. Ketchum, The Design of Highway Bridges (New York: McGraw Hill, 1908), p. 39.

[19] Kimley-Horn and Associates, Inc., Knoxville, Tennessee, Bridge Evaluation Report to the Tennessee Department of Transportation, Bridge No. 80-A200-0.47, 19 November 1979.

[20] Ibid, Bridge Evaluation Report to the Tennessee Department of Transportation, Bridge No. 80-A241-3.77, 18 February 1980.

[21] Letter from Frank M. Linardi, Supervisor of Roads, Operations Division, Department of Public Works, County of Bergen, N.J., 14 April 1983.

[22] Ithaca Journal, 8 November 1909. Weedsport bid $4,293 and United Construction bid $4,075, p. 3.

[23] Groton and Lansing Journal, 3 January 1912, p. 1.

[24] Ibid.

[25] Groton and Lansing Journal, 22 October 1913, p. 1.

CHAPTER V

Case Studies and Practical Problems in Bridge Preservation

By far and away the most common option for the preservation of an historic bridge exercised today is the demolition of the span and the salvaging of the nameplate, which is then either given to a historical society or retained in the headquarters of local highway officials. This strategy, while having ample basis in practice, has no real basis in law. Mitigation, using the Advisory Council on Historic Preservation procedures under Section 106 of the National Historic Preservation Act of 1966, is the most commonly used preservation alternative when a bridge is eligible for or listed in the National Register of Historic Places and if federal funds are involved in the construction of the replacement span. Additionally, if another federally funded project has an impact on the historic bridge, the Advisory Council involvement may be triggered. For the most part, what results from this involvement is a solution which allows the demolition of the span while requiring that it be recorded, often to the standards of the Park Service.

A number of other options are available for consideration by state and local governments wishing to preserve an historic bridge. Eleven strategies have been outlined by the Virginia Highway and Transportation Research Council in its report, Methods of Modifying Historic Bridges for Contemporary Use, published in 1980, including upgrading the bridge at its present site, modifying by widening, supplementing the bridge by another historic span or a parallel replacement, changing from vehicular use, moving the bridge to a less demanding setting in terms of traffic flow, using the features of the old bridge in the construction of the replacement, storing the bridge for potential reassembly, declaring the bridge an "historic ruin", documentation, adapting the bridge as a bike path or developing some other adaptive use plan. The adaptive use possibilities for which the study provided designs include a pedestrian crossing, fishing pier, historic landmark, picnic shelter, restaurant, souvenir shop, play structure, camp shelter, roadside information building, museum or museum piece.[1]

DeLony has grouped preservation options for historic bridges into five catagories; restoration for continued use in situ, restoration in situ for pedestrian or some other adaptive use, relocation and rehabilitation at a new site, retention of the features of the bridge in a new span and documentation and recording prior to demolition.[2] Newlon and Zuk agree with the hierarchy of preferred actions as presented by DeLony.[3]

A most important recent example of bridge restoration is that of the Second Street Bridge in Allegan, Michigan, significant in that local officials were able to garner the use of federal funds for the restoration work, even though the finished restoration would not meet modern standards. The federal funding used was from the Rural and Secondary Roads program rather than the Critical Bridge Fund, a decision designed to reduce the precedent setting nature of this federal funding.[4] The span is an 1886 King Bridge Company wrought iron double intersection Pratt (Whipple-Murphy) truss, 225 feet in length and eighteen feet wide.

Using ultrasonic testing of the pinned connections and truss members, the engineering firm of Wilkins and Wheaton found the structure to be sound. The deck, however, was found to be weakened and there was found to be corrosion of the vertical members.[5] Replacement of the bridge, nominated to the National Register of Historic Places in February of 1980, was estimated to cost $1.2 million. Its restoration, approved for funding by the Federal Highway Administration in January of 1981, will cost $480,000. The project includes the replacement of floor beams, stringers, the wooden deck, vertical web members and several bottom chords. The original diagonals and top chords and the remainder of the bottom chords will remain. The bridge will carry one-way traffic out of Allegan.[6]

Other efforts to restore bridges for continued use have been reported. Upon pressure from the Kent County Council for Historic Preservation, the City Commission of Grand Rapids, Michigan agreed to repair the 1886 Sixth Street Bridge, rather than to replace it at a cost of $1.2 million.[7] Citizens of Newbury, Vermont and Haverhill, New Hampshire raised $60,000 for a surety bond and $1 million in liability insurance within four days to avoid the demolition of the Bedell Covered Bridge of 1866 planned by the State of New Hampshire.[8]

Epoxy wood flours were tested and used to repair the Meem's Covered Bridge, set on fire on Halloween of 1976, rather than to demolish it. The bridge, ten miles north of Mt. Jackson in Shenandoah County, Virginia, at 200 feet in length, is Virginia's longest covered bridge and the only one of the two remaining which carries traffic. This Burr Arch truss was privately built in the 1890's. The restoration work was directed by Dr. Emory E. Kemp of West Virginia University.[9]

In Pittsburgh, a city and surrounding county of 1,700 bridges, Allegheny County began a five year repair, replacement and redesign program in 1976 to study the 400 county-owned bridges. Two hundred of the spans were deemed deficient. The continuous maintenance program adopted by the county has been successful enough for the Commonwealth of Pennsylvania to consider its use in other jurisdictions.[10] The problem of bridge repair in the nation's largest cities is particularly acute because of the number of bridges involved and the cost of their rehabilitation.

Other citizen's groups have championed preservation options which involved the relocation of the span. The Miami Purchase Association for Historic Preservation, for example, led the fight to dismantle a King Bridge Company bowstring arch truss of 1871 at Todd's Ford Creek, Baldwin Crossing, Ohio. The work took fourteen hours and cost $9,000. It is planned to restore the bridge and relocate it to Sharon Woods Village, a nineteenth century museum town.[11]

The City of Beacon, New York dismantled a seventy foot bowstring arch truss built by the Phoenix Bridge Company over the Fishkill Creek at Churchill Street. This bridge has been painted and placed in storage for later relocation.[12] Federal funds to be used for the replacement span necessitated the involvement of the Advisory Council on Historic Preservation and a Memorandum of Agreement was reached which specified the replacement of the bridge.[13]

The Little Pipe Bridge of c.1875, a bowstring arch truss built by the Wrought Iron Bridge Company, was moved from its setting in Detour, Maryland to the Cunningham Falls State Park north of Catoctin, Maryland.[14] Similarly, the Virginia Department of Transportation moved a King bowstring arch truss of c.1878 from Roaring Branch Run in Bedford, Virginia to a state park.[15] This is a popular option for the preservation of the smaller historic bridges and successful because the legal issue of change in ownership is avoided.

The Dehmel Road Bridge of 1907, a 151 foot Pratt truss built by the Joliet Bridge and Iron Company was moved to a new location by citizens in Frankemuth, Michigan.[16] One citizen in Washington State used her savings to forestall the demolition of the Pasco-Kennewick, or Golden Rivet Bridge. The cause was joined by the National Trust for Historic Preservation in an amicus brief. The legal action was decided in favor of the preservation of the span and the Federal Highway Administration has been directed by the U.S. Court of Appeals to reexamine alternatives to the demolition of the span and to develop a preservation plan for the bridge.[17]

In certain instances, features of the bridge can be retained. This is the case with the Elm Street Bridge of 1870 in Woodstock, Vermont which was slated to be replaced at a cost of $400,000. Because the local area had been designated as the Woodstock National Historic District, all the protections of federal law applied. However, after the processes provided for under the law were completed, the decision was made to build a new span with the old trusses attached to the side of the new bridge.[18]

The Keysville Road Bridge, a 1873 two-span bowstring arch truss built by the Wrought Iron Company and nominated to the National Register of Historic Places, was demolished in 1977. The bridge was stored and the parts later used in the reconstruction of a single span bowstring arch in Maryland's Cunningham Falls State Park. The Society of Industrial Archeologists recorded the bridge with measured drawings and photographs prior to its demolition.[19]

The Central New York Park and Recreation Commission has made a commitment to the use of period iron bridges for pedestrian walkways in the Old Erie Canal State Park. The Canajoharie Creek Bridge, a two span sixty-two foot segmented bowstring arch was so relocated. This bridge was built in 1875, it is thought by the Phoenix Bridge Company.[20]

There have been interesting adaptive use plans suggested for historic bridges but few actual examples to cite. One, at Hancock, New York, which has been undertaken is the conversion of one span of a multi-span deck truss of the Orange and Western Railroad to the Arthur Zegger restaurant.[21]

In larger cities, proposals have been advanced for the conversion of bridges to multi-use commercial districts. The Big Four Bridge of 1929, a five-span Pratt truss of 2,525 feet in length carrying the Cleveland, Cincinnati, Chicago and St. Lawrence Railroad over the Ohio River at Louisville, Kentucky, has been planned for in that regard. It has been proposed that the bridge be used for shops, offices, housing and pedestrian malls. The scheme was advanced by Corrando Associates Engineering Planning Consultants of Louisville.[22] Architect I.M.Pei designed a cinema to be housed in the vaulted arches of the abutments of the Manhattan side of New York City's Queensboro Bridge of 1899.[23]

Lacking the ability to rehabilitate a bridge or retain it for some use other than transportation service, documentation of the span prior to its demolition is encouraged. One of the most sophisticated documentation plans was developed for the Sutcliff Bridge in Iowa City. Built in 1898 by the Iowa Bridge Company at a cost of $12,000, this bridge, at 527 feet, is the longest of the eleven surviving Parker trusses. Its replacement was approved by the State Historic Preservation Officer in January of 1980 and it was determined eligible for the National Register of Historic Places in August of 1981. Documentation to cost from $4,000 to $6,000 was agreed to after federal involvement mandating a research report, schematic drawings and large format photography. This plan for documentation was approved by the federal government, who sanctioned the contractor, Dennett Muessig and Associates, Ltd. of Iowa City, and will be paid for by the county.[24]

Research to determine the techniques for the preservation and rehabilitation of historic bridges is extremely important and the dissemination of the findings of such engineering studies to the professional engineering community will advance the cause of bridge retention. As they led the way in the inventory of historic bridges, Howard Newlon and his colleagues at the Virginia Highway and Transportation Research Council have begun this work. The Federal Highway Administration has also contracted for similar research.[25]

Newlon's publication, Criteria for Preservation and Adaptive Use of Historic Highway Structures, A Trial Rating System for Truss Bridges and the later Methods of Modifying Historic Bridges for Contemporary Use, the more technical of the two, have broken ground for the engineering community. Newlon cautions highway engineers against attempting to widen an historic through truss; "widening of such trusses is extremely difficult and impractical."[26] Additionally, strengthening the bridge to carry modern loads is difficult, according to Newlon. To do this four techniques, arrived at by computer simulation of the stresses placed on truss members using various improvement schemes, have been suggested by Newlon's research: the use of an auxiliary truss; reinforcement under the deck with long beams; post-tensioning, the addition of rods along lower chords and added reinforcement and individual reinforcement of selected members as needed.[27] They warn, however, "In the case of a very important historic bridge, even the most discrete reinforcement might be undesirable."[28] If reinforcement is to be done, Newlon recommends using elements that are clearly recognizable as new, rather than modifying weak truss members on a case-by-case basis.

Newlon's research recommends a hierarchy of choices for the preservation of a bridge with its rehabilitation for use at its present site being the preferred option. If this is not possible, Newlon calls for the construction of a second parallel span if traffic requires it and moving the bridge for continued use under conditions of lighter traffic. Beyond these vehicular uses, Newlon and his staff suggest adaptive use to an "architectural use", preservation of the bridge as an historic ruin, disassembly and marking for storage and finally, the recording of the bridge if it must be demolished.[29]

The 1978 study by consultants to FHWA, Extending the Service Life of Existing Bridges by Increasing Their Load Carrying Capacity, also contributes to the body of literature available to the engineering community. Examining rehabilitation techniques to increase load capacity; improve geometrics including visibility, width and height, and alignment; and to correct mechanical deficiencies of historic bridges, the consultants, the engineering firm of Byrd, Tallamy, McDonald and Lewis of Falls Church, Virginia, also concluded that widening is not a practical solution.[30] In agreement with Newlon and his colleagues, Byrd Tallamy et al suggest post-tensioning, the addition of floor beams or stringers or the modification of the floor system from a simple to a continuous one and the replacement of defective members. In addition, they propose the use of a King Post truss system under the floor beams for strenghtening of the span.[31] Geometrics can be improved by adjustments to the portal and sway frames of a through truss or actually by lowering floor systems to provide greater vertical clearance, they suggest.[32] The study also recommends the reduction of dead load, or the weight of the bridge itself, by the use of lighter weight deck materials and the replacement of heavy concrete parts such as parapets, sidewalks, curbs and median barriers.[33]

In examining 140 bridges in five states, the firm found the principal reasons for structural deficiencies were inadequate maintenance because of a lack of funds, wear from environmental exposure and general usage and design defects. They noted:

> In steel structures, paint system breakdown permits corrosion of the base metal to begin. Once started, the process accelerates as larger areas become exposed. Eventually the metal corrosion can result in section loss serious enough to have an impact on the load-carrying capacity of the member. If left uncorrected, the process will continue, resulting in the collapse of the bridge.[34]

Additional research is needed, they suggest, to develop new techniques for strengthening bridges, decision criteria for judging what repairs to undertake and for choosing between rehabilitation and replacement and new geometric standards for bridge safety based on the volume and type of use.[35]

ENDNOTES, CHAPTER V

[1] Howard Newlon and William Zuk, Methods of Modifying Historic Bridges for Contemporary Use (Charlottesville: Virginia Highway and Transportation Research Council, June 1980), pp. 6-7, 24-5, 27-36.

[2] Eric N. DeLony, "Conflicts Between Structurally Deficient and Historically Significant Bridges" (Washington D.C.: International Association of Bridge and Structural Engineers, September 9-10, 1982, unpublished remarks).

[3] Newlon and Zuk, op. cit, p. 38.

[4] Letter from Martha Bigelow, Ph.D., SHPO, to Michigan DOT, 8 November 1979.

[5] Engineering and Testing Laboratories of Western Michigan, Inc., "Inspection Report of Second Street Bridge, Allegan, Michigan", 16 April 1979.

[6] Delony, "Bridges That Have Been or are Proposed to be Restored, REhabilitated, Relocated, or Adaptively Reused and the Engineers or Engineering Firms Involved When Known", unpublished listing, June 1982.

[7] National Trust for Historic Preservation, Preservation News (Washington D.C.: June 1976), p. 13.

[8] Ibid, March 1974, p. 8.

[9] AE Concepts on Wood Design, No. 37, July/August 1981, pp. 8-9, 19.

[10] APWA Reporter (American Public Works Association), March 1982,22-24.

[11] Society for Industrial Archeology Newsletter (Washington D.C.: Spring 1982), p. 4.

[12] Ibid, March 1979, p. 7.

[13] Ibid.

[14] DeLony memorandum, op. cit.

[15] Ibid.

[16] Ibid.

[17] National Trust for Historic Preservation, Western Regional Office. "U.S. Court of Appeals, Ninth Circuit, in support of Plaintiff-Appellant, the Benton Franklin Riverfront Trailway and Bridge Committee, No. C-81-3617".

[18] Preservation News, May 1976, op. cit., p. 13.

[19] Society for Industrial Archeology Newsletter, March 1979, p. 11.

[20] William P. Chamberlin, "Report of Progress, Road and Bridge History Project" (Albany:NYSDOT, May 16, 1975).

[21] DeLony memorandum.

[22] Ibid.

[23] Sharon Reier, The Bridges of New York (New York: Quadrant Press, 1977), p. 50.

[24] Iowa City Press Citizen, July 23, 1982, p. 1.

[25] FHWA-RD-78-33, Extending the Service Life of Existing Bridges by Increasing Their Load Carrying Capacity (Washington D.C.:June 1978).

[26] Newlon and Zuk, op. cit., p. 11.

[27] Ibid, p. 23.

[28] Newlon and Zuk, op. cit., p. 23.

[29] Ibid, p. 38.

[30] FHWA-RD, op. cit., p. 47.

[31] Ibid, pp. 27-8, 37, 42-3.

[32] FHWA-RD, op. cit., p. iii.

[33] Ibid, pp. 37-9.

[34] FHWA-RD, op. cit., p. 17.

[35] Ibid, p. 71.

CONCLUSION

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Bridges are important structures to the economic viability of a society. They change the relative accessibility of places and open areas for development and uses not previously available. They reduce the time and effort of travel. Bridges are among the most critical structures in the man-made environment.

The history of bridges is a long one, having begun in ancient times. The stature of empires past was often measured by their bridges and other transportation structures, and thus bridges have generated some of the most significant monuments remaining from periods of man's history.

In addition to their practical importance, bridges are awesomely exciting physical structures, evoking primitive fears at the same time as stimulating man to higher technological possibilities. Bridges are landmarks; the most famous bridges are known throughout the world and cities are known for their bridges. Bridges are as much landmarks as are important buildings or statues and the ordinary citizen can appreciate the engineering and technological skill required to build such important structures as the Golden Gate or Brooklyn Bridge. Bridges tickle the fancy and excite the mind. They have shape, they soar, they elevate and they have beauty. Bridges as structures on the landscape contribute to a nation's heritage and are to be counted among its important cultural resources.

Bridges and other transportation improvements were critical in shaping the development of the United States and as such are deserving of much more of our attention than they have been given. In reviewing their history, it has been found that bridges have shaped development and made other construction possible. This thesis has attempted to prove that position and advance it by a detailed review of one late nineteenth century bridge firm whose activities are not of negligible importance in the context of others operative at the same time. The skills at marketing and prefabrication of the Groton firm are what the preceeding pages reveal.

The history of technology and industry of the age has been shown by a detailed study of an organization such as the Groton Bridge Company and much more has been learned about the organization of the iron and steel industry in an emerging industrial economy. This critical period of the development of our economy allows us to rise above the study of the Groton Bridge Company to give a larger significance to this work and understand industrializing America. This was a period characterized by changing technology and changing organization of economic activity.

Why were so many bridges built during this period? Incomes had risen after the Civil War in the United States and counties were able to build bridges to open areas. Raw materials were plentiful and, therefore, the price was low. There were economic justifications for putting bridges were they were built. Communities celebrated bridge openings for good reason--they meant business, communication and prosperity. What makes the period in which the Groton Bridge Company operated so interesting is the entreprenuerial talent these firms displayed and the pace of the era--slashing through the nation on iron rails, crossing boundaries, linking natural resources to places of production and moving products to markets. The Groton Iron Bridge Company, and its sister firms, were basically small town family enterprises that managed to operate profitably in national marketplaces by taking advantage of the nation's new infrastructure they helped create. The success of the firm itself was critical to the health and economic viability of the Groton community, its people and its growth.

What does this study mean in itself and what is its value in the larger context? First, it puts in one place most of the evidence available from documentary sources about the firm and its operation. This thesis is more than a history however, as it locates and describes the bridges constructed by the firm which still survive. The information assembled thus provides a basis for informed decision-making by those who are evaluating what remains from the era of iron and steel truss bridge building.

Data from this study has already been used in Stage One environmental assessments by engineering firms evaluating the historic significance of an older bridge when the construction of a new span is being contemplated. Ultimately these reviews will lead to decisions about whether the historic span will be retained. This thesis now allows Groton Bridge Company bridges to be compared to one another and to those built by other firms. We know the number of a specific type that remain, their asthetic qualities and the rarity or scarcity of form and design that they exhibit. These data have the most obvious implications for bridge preservation in New York State because of the number of Groton spans there and the importance of the firm in the overall history of bridge building in the State, however, the information will also be useful to decision-makers in other states.

In the most conservative of terms, it can be estimated that the Groton Bridge Company built over 3,000 bridges. 355 were built between 1877 and 1885. We know that the company had contracts for 396 bridges in the Fall of 1896 alone. If we assume that 300 bridges were built by the firm each year in the last decade of the nineteenth century, then many more than 3,000 were constructed by the Groton company, yet only 107 remain, perhaps four percent.

This thesis also discusses the range of possibilities for the retention of historic bridges within the framework of existing federal and state systems of protection and has found that system to be inadequate. While greater attention has been given to bridges as elements of the nation's architectural and industrial heritage, much more can and should be done. While more state inventories of bridges are being carried out and their findings published, the percentage of bridges being identified as historic and worthy of protection is pitiously small. Laxity in following up with nominations of bridges to the National Register of Historic Places or state registers when the findings of the inventories recommend them is also evident. Federal law and administrative interpretation allowing the use of federal funds for historic bridge maintenance remains deliberately murky.

Case examples have been presented which demonstrate that bridge restoration can be a cost effective and safe practice. However, the sanction of the federal government is needed to assure those communities who wish that funds are available to retain historic spans in a way that does not interfere with economic needs or the smooth flow of transportation.

What does the future hold? Efforts need to be made to promote the adaptive use of bridges, to develop a national exchange system--perhaps based on the model Tennessee "Adopt-A-Bridge" program, to further develop the technology for the repair of historic bridges and to disseminate it and to determine standards which are acceptable both to engineers and to historic preservationists for the repair of an historic bridge. This latter effort is beginning under the sponsorship of the Transportation Research Board at a two day meeting called for May 8-9, 1985. When the art of the possible is known, there will be hope for the retention of more of these rapidly disappearing resources, symbols of an earlier era yet still functional and meaningful in modern life.

AWARDS OF RECORD BY YEAR

1877

PLACE	PROJECT	PRICE
Rochester, N.Y.	wooden bridge	$28,000
Sandusky, N.Y.		$850
Mexico, N.Y.		$550
Parma, N.Y.		$900
Derringler, N.Y.		$584.36
Chipromah's Creek, N.Y.		$375
Throops, N.Y.	bridge and piling	$400
Alabama, N.Y.	bridge and piling	$800
North Pitcher, N.Y.		$445
Marathon, N.Y.		$190
Venice, N.Y.		$1,300
Loraine Creek, N.Y.	iron bridge	$1,050
North Lansing, N.Y.		$396
Philadelphia, Pa.		$1,800
Glenarn, Fishkill, N.Y.		$400
Fishkill, N.Y.		$400
Canadiagua, N.Y.		$200
Hermitage Creek, N.Y.		$300
Otselic, N.Y., Otselic Creek		$432
Lapeer Bridge, N.Y.		$390
Penn Yan, N.Y.		$855
Van Natta Mill, Ithaca, N.Y.		$500

1878

PLACE	PROJECT	PRICE
Varna, Dryden, N.Y.	wrought iron truss, 140'	
Groton bridges, Tompkins County, N.Y.		$900
n.p.	wooden bridge	$15
Carleton, N.Y.		$500
Elmira, N.Y.		$200
Groham, N.Y.		$445
Linklaen, N.Y.		$215
North Parma, N.Y.		$365
Lima, N.Y.		$225
Jamesville, N.Y.		$808
Rookwood, N.Y.		$150

Pine Plains, N.Y.	$400
Truxton, N.Y.	$625
Onondaga, N.Y.	$750
Canadia, N.Y.	$1,425
Homer, N.Y.	$475
Ames Creek, N.Y.	$368
West Groton, N.Y.	$240
Mexico Creek, N.Y.	$600
Georgetown, N.Y.	$185
Venice, N.Y.	$360
Penn Yan, N.Y.	$885
Marshville Creek, N.Y.	$723
Locke, N.Y.	$240
Geneva, N.Y.	$1,200

1879

West Groton, N.Y.	$240
Webster Creek and Groton City, N.Y. (2)	$700
Groton, N.Y.	$310
Fessenden Chp., N.Y.	$1,219
Clrmen (?) Creek, N.Y.	$368
Paterson Creek, N.Y.	
Mexico, N.Y.	$600
Georgetown, N.Y.	$455
Ancrane, N.Y.	$400
Venice, N.Y.	$360
Antwerp, N.Y.	$740
Salmon Creek, N.Y.	$975
Bryon, N.Y.	$340
Moravia, N.Y.	
Lima and West Bloomfield, N.Y.	$1,450
Geneo, N.Y.	
Skaneateles, N.Y.	$180
Theresa, N.Y.	$975
Parma, N.Y.	$460
Honeoye, N.Y.	$680
Homer, N.Y.	$297
Richville, N.Y.	$2,925
Gorham, N.Y.	$1,050
Livonia, N.Y.	$410
Summer Hill, N.Y.	$269

1880

Tioga County, N.Y.	Pratt through truss	
Ithaca Street over Cayuta Creek Locke, N.Y.	pin-connected 32'wide	$950

Pearl Creek, N.Y.		$950
Pearl Creek, N.Y.		$1,700
East Carleton, N.Y.		$2,030
North Lansing,N.Y.	repair bridge	
Ossmiss (?)		
n.p.	30'bridge and piling	
Waverly, N.Y.		$850
East Waverly Creek		
Dansville, N.Y.		$315
Lima, N.Y.	piling for 3 bridges	$360
Asbury, N.Y.	48'	$432
North Lansing, N.Y.	32'	$228
Town of Hartland,Jeddo, N.Y.		$31,350
Reids Corner, N.Y.		$220
Canajoharie, N.Y.		$508
Pitcher, N.Y.		$610
Danby, N.Y.		$300
Rushford, N.Y.		$330
Penn Yan, N.Y.		$555.95
Locke, N.Y.		$470
DeKalb Junction, N.Y.		$560
Carleton, N.Y.		$1,450
Avon, N.Y. Clarks Mills		$600
Antwerp, N.Y.		$975

1881

Wellsville, N.Y.		$1,000
Morts Corners, N.Y.		$365
Ithaca, N.Y.		$500
Cincinnati, Oh.		$338.82
Camillus, N.Y.		
Southport, N.Y.		$1,607
Slaterville Creek, N.Y.		$600
Bethlehem Plank Road Company		$925
Moravia, N.Y.		$800
Dryden, N.Y., Willow Glen		$930
Lubins, N.Y., Apulia	2 bridges	$600
Homer, N.Y.		$400
Lima, N.Y.		$300
Lima and Bloomfield, N.Y.		$1,400
Germantown, N.Y.		$1,550
Franklin, N.Y.		$627
Commission Bridge		$775
Georgetown, N.Y.		$700
Hartland, N.Y.	3 bridges	$2,175
Amboy Bridge		$1,700
Messena, N.Y.		$5,616
Springville, N.Y.		$2,620
Adams Station, N.Y.		$125

1882

Alfred Center, N.Y.		$670
Little Salmon Creek, N.Y.		$440
Portlandville, N.Y.		$1,100
Ithaca Corporation, N.Y.		$2,300
Buffalo, N.Y.		$665
McGranville, N.Y.		$369
Van Gertie's		$933
Van Ettens		$803
contract, March 1882		$800
Cornell University	iron and labor	$3,475
Sherman, N.Y.		$950
Groton, N.Y.		$200
Fulton, N.Y.		$1,200
Cuba, N.Y.		$300
New Scotland, N.Y.		$1,700
Byersville, N.Y.		$1,166.68
Fryinggham (?), Mass.		$775
McLean, N.Y.		$635
Northville, N.Y.	2 spans, 150'ea.	$8,000
Scandaga River	18' roadway	
Canadia, N.Y.		$265
Hartland, N.Y.		$850
Alfred, N.Y.		$385
Little Valley, N.Y.		$925
Garoya, N.Y.		$700
Otselic, N.Y.		$330
Johnson's Creek, N.Y.		$340
Cazenovia, N.Y.		$459
Russell, N.Y.		$1,965
Dryden, N.Y.		$450
New Burlington, N.Y.		$625
Theresa, N.Y.		$200
Ellensburgh, N.Y.		$950
Dryden, N.Y., Freeville		$450
Venice, N.Y.		$625
Starkey, N.Y.		$725
Locke, N.Y.		$500
Hornellsville, N.Y.		$2,225
Root, N.Y.		$1,825
Medina, N.Y.		$700
Horseheads, N.Y.		$1,330
Schuylerville, N.Y.		$2,600
Linklaen, N.Y.		$790
Otselic, N.Y.		
Dundee, N.Y.		
Moscow, N.Y.		$450
Burlington Flats, N.Y.		
Groverville, N.Y.		

1883

Porter, N.Y.		$525
Malone, N.Y.		$215
Westville, N.Y.	stonework	$2,950
Oriskiny, N.Y. Powells Mills		$1,200
Marcellus, N.Y.		$700
Erin, N.Y.		$220
Otego, N.Y.		$500
Lebanon, N.Y.		$240
Starkille, N.Y.		$525
Cazenovia, N.Y., Woden Mill Company		$425
Danube, N.Y.		$270
Warsaw, N.Y.		$500
Ludlowville, N.Y.		$150
Freeville, N.Y.		$650
Moravia, N.Y.		$800
Lima, N.Y.		$1,950
Lake Hill, N.Y.	3 bridges	$1,575
Campbell Hall, N.Y.	2 bridges	$950
West Fulton, N.Y.		$600
Pitcher, N.Y.		$960
Fulton, N.Y.		$600
Campbell Hall, N.Y.		$950
Posten, N.Y.		$400
Mt. Morrisony, N.Y.		$600
Charlton, N.Y.		$550
Richmond		
Schnectady, N.Y.		
Elmira, N.Y.		$1,100
Genoa, N.Y.		
Newfane, N.Y.		$3,175
Seneca Falls, N.Y.		$300
Cazenovia, N.Y.		$410
Ellicottville, N.Y.		$535
Cohocton, N.Y.		$2,000
Rushford, N.Y.		$1,175
Tabery, N.Y.		$440
Ransomville, N.Y.		$420
Middleport, N.Y.		$350
Little Valley, N.Y.		$350
Ischnor (?), N.Y.		$410
n.p.		$3,200
Chylerville (?), N.Y.		$730
Honeoye, N.Y.		$800
Cattaraugus, N.Y.		
Rushville, N.Y.		$150
Prattsburg, N.Y.		$1,635
Governeur Bridge (N.Y.)		$2,550
Stockholm Bridge (N.Y.)		$2,628

Homer, N.Y.		
Barton, N.Y.		$2,300
Davison, Mich.		$540
Alden, N.Y.		$350
Merewith, N.Y.		$540
Rishford, N.Y.		$1,175
Glenville		

<u>1884</u>

Bloomfield		
Springport		
Homer		
East Waverly, N.Y.		$300
Lansing, N.Y.		
Waterloo, N.Y.		$785
Wells, N.Y.		$1,500
n.p.		$490
Otselic, N.Y.		$375
Buffalo, N.Y.		$1,282.50
Canandiagua, N.Y.		$762.50
Dauneelius Station, N.Y.		$425
East Bloomfield, N.Y.		$1,150
Schnectady, N.Y.		$3,075.70
Otselic, N.Y.		$275
n.p.	1 bridge	$2,300
Catturaugus, N.Y.		$3,000
Weedsport, N.Y.		$6,600
Cato, N.Y.		$1,650
Richmond Creek, N.Y.		$800
Fort Ann, N.Y.		$625
		$825
Goshen, N.Y.		$1,000
Potter Center, N.Y.		$1,235
Moravia, N.Y.		$225
Lima and Bloomfield, N.Y.		$1,850
Groton, N.Y.		$800
Lockport, N.Y.		$994
Canadia, N.Y.		$425
Pultney, N.Y.		$1,280
Throops, N.Y.		$266
Cazenovia, N.Y.	2 bridges	$565
Union, N.Y.		$225
McGrawville, N.Y.		$1,100
Union Valley, N.Y.		$150
Alabama, N.Y.		$1,850
Towles, N.Y.		$750
Murray, N.Y.		$300
Lockport, N.Y.		$150
Westleydon, N.Y.		$1,170

Crittenden, N.Y.	2 bridges	$1,300
Stanwishes Corners		$950
Niles, N.Y.		$627
Eaton, N.Y.		$310
Summit Station, N.Y.		$165
Lansing, N.Y.		$175
Summit Hill, N.Y.		$275
Trenton, N.Y.		$180
Antwerp, N.Y.		$750
Owasco and Fleming N.Y.		$750
Sherburne, N.Y.		$425
Penn Yann, N.Y.		$475
Nassau, N.Y.		$425
New Woodstock		
Willissy		
Porter		
Medina		
Peruville, N.Y.		$650
Trumansburg, N.Y.		$275
Davison, Mich.		$490
Lockport, N.Y.	scale girder, carriage girder 4-10' beams 6" beams under carriage roadway	$6,377.20
McLean, N.Y.		$155
Trenton, N.Y.		$600
North Parma, N.Y.		$400
n.p.	1 bridge	$1,000
Scott, N.Y.		$200
Port Byron, N.Y.		$1,550
Throops, N.Y.		$404
Canadea, N.Y.		$2,450
Canadea, N.Y.		$770
Canadea, N.Y.		$8,000
Pikes, N.Y.		$500
Geneseo, N.Y.		$85
Rushford, N.Y.		$1,075
East Bloomfield, N.Y.		$80
Geneseo, N.Y.		$375
Lima, N.Y.		$250
Macedonia, N.Y.	3 bridges	$1,800
Youngstown, N.Y.		$855
Russia, N.Y.		$600
Macedonia, N.Y.	3 bridges	$6,850
Lawrenceville, N.Y.		$350
Truxton, N.Y.		$500
Bliss, N.Y.		$340
Westfield, Pa.	2 bridges	$1,400

Andover, N.Y.		$325
Etna, N.Y.		$2,109
Royalton, N.Y.		$336
Shelly, N.Y.	4 bridges	$734
Medina, N.Y.	2 bridges	$750
Champlain Canal[2]	improving prism and banks	
Champlain Canal[2]	bridge abutment and superstructure and canal improvements	

1885

Elmdale, N.Y.[3]	through truss	
Oriskay, N.Y.		$140
Royalton, N.Y.		$270
Wilson, N.Y.		$360
Murray, N.Y.		$350
Otsego, N.Y.	2 bridges	$990
Cattaraugus, N.Y.		$2,525
Drakeville, N.Y.		$800
Governeurs, N.Y.		$800
Earlville, N.Y.		$950
Port Byron, N.Y.		$700
Jessups Landing, N.Y.		$150
n.p.	bridge	$250
Starkville, N.Y.		$250
Ludlowville, N.Y.		$625
Carleton, N.Y.		$1,100
Venice, N.Y.		$500
Moravia, N.Y.		$200
Watten, N.Y.		$350
n.p.	bridge	$2,210
Stockholm, N.Y.	3 bridges	$1,325
n.p.	2 bridges	$900
New Scotland, N.Y.		$250
Hammondsport, N.Y.	2 bridges	$600
Mansfield, Pa.[4]	Tioga River	$200

1886[3]

Owego, N.Y.[4]	Owego Creek	
Greeley, Col.[4]		$33,000
Mt. Morris and Castile, N.Y.	3 spans and abutments	
Angelica, N.Y.	through truss, Angelica Creek	
Wegatchie, N.Y.	through truss, Oswegathcie River	
Belvidere, N.J.	pony truss	
Smith County, Tn.	pony truss	$1,050
Duanesburg, N.Y.	59' Pratt	

1887

Ithaca, N.Y.	Buffalo Street	$2,500
Ithaca, N.Y.	Varna Bridge replacement	
Great Barrington, Ma.	iron bridge	
Philadelphia, Pa.		$1,800
Groton, N.Y.	Pratt pony truss 78', Judge Davis Road over Fall Creek	
Shattuckville, Ma.	Pratt through truss	

1888

Washington D.C.	Pa. Ave. over Anacostia River	$105,000
Cazenovia, N.Y.	iron bridge, 1 span 184', 1 span 42', Cazenovia Creek	$3,488
Cabell County, West Va.	Pratt through truss, 109'8"	

1889

Ithaca, N.Y.	Stewart Avenue over Cascadilla Creek for Ithaca Gas and Water	
Frankfort, N.Y.	iron bridge	$2,294
Binghamton, N.Y.	Tompkins Street Susguehanna River	$40,000
Ithaca, N.Y.	Buffalo Street swing bridge over Cayuga Inlet	$2,500
Laurel, Md.	bridge piers	$590
Ellicott City, Md.	iron bridge Patuxent River	$1,900
Bainbridge, N.Y.	Susquehanna River	$20,000
Gowanda, N.Y.	iron bridge	$7,796
Bangor, Me.	Kenduskeag Bridge eastern span	$2,350
Frederick, Md.	2 spans, 107' each, 16' rodaway	$14,370
Rutherford, N.J.	iron bridge 3 spans, each 100' wrought iron truss 2 abutments and piers	$6,290
Indian Castle, N.Y.	4 iron bridges	
Ellicott City, Md.	iron bridge Patuxent River	$1,900
Cattaraugus, N.Y.	iron bridge 153'	$11,000

Moers Forks, N.Y.	through truss, Great Chazy River
Angelica, N.Y.	through truss, Angelica Creek
Gouveneur, N.Y.	through truss, Oswegatchie River
Wallpack Center, N.J.	pony truss, Delaware Water Gap National Recreation Area
Smith County, Tn.	steel bridge $2,900 85'x12'
Williamsport, Pa.[5]	Memorial Avenue Bridge

1890

Jacksonville, Fla.	viaduct over Bridge Street, 1100' long, 60' wide, 834' main bridge, 2 roadways, 2 streetcar tracks, 4 spans, iron and steel trestle work, one large span over S.F. and W. tracks, 2 smaller ones.
Groton, N.Y.[4]	iron bridge between Groton Bridge & Manufacturing Company and Groton Carriage Works
Auburn, N.Y.[4]	Genessee Street Bridge
Hancock, Md.	Potomac River $35,000
Centre Village, N.Y.	through truss, Susquehanna River
Cavendish, Vt.	through truss, Black River
Rockdale, N.Y.	through truss, Unadilla River
Goshen, Va.	3 span Double Intersection Pratt, Calfpasture River
Rockbridge Co., Va.	Double Intersection Pratt
Portland, Mich.[5]	2 span Pratt through truss, 102'6" each, Bridge Street over Grand River
Erie Canal, N.Y.[2]	east of Lock 42
Cortland, N.Y.[2]	wrought iron bridge, east of Lock 42

1891

Caribou, Me.	3 span bridge, each span 159', 18' roadway
Wytopitlock, Me.	2 spans at 81' each
Brazoria Co. ,Tx.	4 spans; 76',82',108', 126', 2 are drawspans
Shenandoah Co., Va.	228'
Newago, Mich.	4 110' spans
Marble Falls, Tx.	4 span bridge; one at 270',2 at 150', one at 110'
Washington D.C.	redesign, Anacostia River $40,000
Jacksonville, Fla.	through truss, Hoosick River
Fish's Eddy, N.Y.	through truss, East Branch Delaware River
Pittstown, N.Y.	through truss, 196'

1892

San Francisco, Cal.[4]		
Lower Catasaugua, Pa.	2 span bridge 165', 140', 25' roadway, 5' sidewalks, with masonry and infills, Lehigh River	$11,595
Knoxville, Tn.	13 50' spans, 2 150' spans, 1 260', 20' roadway, 2 6' sidewalks, iron substructure, built for Cherokee Land Company, Tennessee River	$69,332
Knoxville, Tn.	Oak Street	$21,000
Doddridge Co., West Va.	Pratt pony truss, 67'1"	

1893

Fitchburg, Ma.	plate girder, 98', 38' roadway, 2 5' sidewalks, River Street	$10,987
Unadilla, N.Y.		
Ithaca, N.Y.[4]	iron work, Opera House	

1894

Tampa, Fla.	Hillsboro River	$70,000
Unadilla, N.Y.	2 through trusses Susquehanna River	$24,000
Christian Co., Kty.	bed post pony truss, Sugar Creek	
Elkton, Md.	7 bridges	$13,500
Williamsport, Pa.	rebuilding Market Street Bridge, 5 spans	$38,800
Stueben Co. N.Y.	Pratt pony truss, 40', pin-connected, 13'8" wide, Michigan Creek	
Cohoes, N.Y.[2]	iron bridge, High Street, Erie Canal	

1895

Salamanca, N.Y.	iron bridge Main Street	$3,000
Albany, N.Y.	High Street, Cahoes River	$3,722
Keene, N.Y.	Pratt, 124'	

1896

Union City, Pa.	plate girder, 80', 34' roadway, 2 8' sidewalks, stone abutments	
Manchester, N.H.	steel bridge Merrimac River	$97,100
Little Rock, Ark.		$350,000
Fort Plain, N.Y.	steel bridge 2 spans 216', 20' road, one 5' walk, masonry pier and abutments, Mohawk River	$27,000
Palo Pinto Co., Tx.	bridge of several spans	
Ithaca, N.Y.	South Plain Street, Six Mile Creek	
Guilford, Vt.	pony truss, Broad Brook	
Sloansville, N.Y.	long single span arch, Schotone Creek	
Burgoyne, N.Y.	through truss, "Bryart's Bridge", Fish Creek	
East Hickory, Pa.	through truss, Hickory Creek	
Lin Lithgo, N.Y.	through truss "Dale's Bridge", Roeliff Janseny Kill	
Augusta Co. Va.	Single Intersection Pratt	
Saratoga, N.Y.	Pratt, 96'	
Binghamton, N.Y.	4 span plate girder Ferry Street	$61,000
Watertown, N.Y.	steel arch Mill Street, Black River	$17,499
North Adams, Ma.	plate girder, 76', 32' roadway, sidewalks 7' and 5',	$5,677

	buckle plate flooring carrying pavement	
Port Huron, Mich.	swing bridge, 220' 230' steel trestle approaches	$19,000
Ithaca, N.Y.	Fall Creek	
Lobachsville, Pa.	iron bridge, 50'	$359
Schultzville, Pa.	iron bridge, 60'	$508
Williamsport, Pa.	steelwork, Duboisetown	$599
Riverton, N.J.	iron bridge Pompass Creek	$1,028
Riverton, N.J.	iron bridge Swede's Run	$857
Cortland, N.Y.	70' bridge, 16' wide, Rickard Street, Tioughnioga River	
Victory Mills, N.Y.	pony truss Fish Creek	
Shelburne, N.H.	5 span Pratt "Meadow Bridge" Androscoggin River	
Tioga Co., N.Y.	Pratt pony truss, 37' long, 15'1" wide, East Hill Road, Catatonk Creek	
Cairo, N.Y.	Warren truss, 76'	
Chohes, N.Y.[2]	High Street, Erie Canal	
Syracuse, N.Y.[2]	lift bridge, Salina Street, Erie Canal	
Utica, N.Y.[2]	lift bridge, Whitesboro Street, Erie Canal	
Ithaca, N.Y.	South Plain Street Six Mile Creek	
Ithaca, N.Y.	deck bridge, Campus Road, Fall Creek	

1898

Greenwood, Tn.	iron drawbridge Yazoo River	$23,988
Plattsburg, N.Y.	repair Catherine Street Bridge	$1,600
Saranac, N.Y.		$4,788
Redford, N.Y.		$1,962

Owosco, Mich.	West Main Street	$10,375
Hart, Mich.	steel, 1200' 20' wide on steel tubing and concrete substructure	$6,000
New Hackensack, N.Y.	steel, 50', 20' wide	$1,095
Nashville, Tn. [4]	viaduct Church & Broad Streets	$32,344
Tupperlake, N.Y.	steel, 160', 16' roadway, 100 lbs. pressure per square foot in four cylindrical piers	
Little Rock, Ark.	deck bridge	
Pochahantas, Ark. [4]		$40,000
Lowell, Mass.		
Plymouth, Mich.		
Ellenville, N.Y.		
St. Johnsville, N.Y.		
Kanawah Co. West Va.	Pratt through truss, 140'	
Buffalo, N.Y. [6]	roof trusses, Buffalo Power House, Buffalo Street Railway Company	
Cheatham Co., Tn.	Pratt through truss, steel, 2 steel I-beam approach spans, 222', 10'9' wide, Harpeth River	

<u>1899</u>

Ithaca, N.Y. [4]	Stewart Avenue, Ithaca Gas and Water Company	
Nazereth, Pa. [4]	steel work for cement mills	
Binghamton, N.Y. [4]	Tompkins Street	$35,000
Camden, N.J.	Penshankin Creek	
Frederick Co., Md.	Catoctin Creek, Leatherman's Ford	
Sunbury, Pa.	iron bridge Susquehanna River	$140,000
Reading, Pa.	Coalbrookdale over Swamp Creek	
Middleburg, Pa.	iron work on new bridge at Meiserville	

Bridgehamton, N.Y.	steel, 420' Sagaponack Lake	$5,000
Rochester, N.Y.	steel cantilever, 50' wide, 30' railroad, lower Genessee River	$185,000
Ithaca, N.Y.	repairs Stewart Avenue bridge	
Kingston, Mass.	Pratt pony, Jones River	
Jewett, N.Y.	Pratt, 93'	
Montpelier, Vt.	Main Street Winooski River	
Hot Springs, Ark.	3 spans, 1 at 219', 2 at 79', 16' wide, trusses 34' high in center, cylindrical piers 5' in diameter, 37' high with 12'4" plate connectors	

1900

Barre, Vt.	steel bridge, 30' includes removing present structure, Blackwell Street	$4,200
Fitchburg, Mass.	Fitch to Howard Street	$50,000
Hepburn, Pa.	2 iron bridges Hepburn River and Mill Creek	
Fulton, N.Y.	steel super-structure and paving	$103,950
Camden, N.J.	steel, Cooper's Creek	$7,162
Wilmington, Del.	Marshalltown, Red Clay Creek	
Port Bryan, N.Y.	bridge, stone abutments Owasco Creek	$2,600
Durham, N.Y.	through truss, 142'	
West Woodstock, Vt.		

1901

Smith Co., Tn.	steel	$1,150
Isabella Co., Tn.	Pratt through truss 101', Shepard Road, Chippewa River, Chippewa Township	

1902

No awards of record.

1903

Allegheny Co., N.Y.	Camelback through truss, 253', pin-connections, 18'7" wide, East Hill Road, Genesee River.	

1904

Warren, Pa.	bridge, 170'	

1905

East Berkshire, Vt.	steel riveted bridge Missiqua River	$4,700
Emmet Township, Mich.	Pratt through truss, 110', F Drive North, Kalamazoo River	

1906

Ithaca, N.Y.	iron bridge Cascadilla Creek	
Albany, N.Y.	steel bridge 4th Street	$97,635
Waterford, N.Y.	Champlain Canal Ridge Road Payn's Bridge Station 6776, Erie Canal Sylvan Beach Misquito Point Buffalo Road	

	Lee Road Spier's Road	
Jewett, N.Y.	Pratt, 71'	

1907

No awards of record.

1908

Crown Point, N.Y.	Pratt, 43'	

1909

Ithaca, N.Y.	Forest Home Bridge Fall Creek	$3,998
Schuyler Co., N.Y.	Warren pony truss, riveted, 57', 18' wide, Vern Dean Road, Cayuta Creek	

1910

No awards of record.

1911

No awards of record.

1912

Waterburg, N.Y.[4]	concrete arch

1913

Long Island, N.Y.[6]	4 swing bridges
N.Y.S. Barge Canal[2]	15 spans including Newark, N.Y. 150', 32' roadway, 2 10' walks, reinforced concrete, total weight of 193 tons and Rome, N.Y. 260', 2 50' spans, 1 160' span, concrete abutments
Ithaca, N.Y.	Renwick Park, Auburn Short Line Railroad
Auburn, N.Y.[6]	600 ton steel building, International Harvester Company
Syracuse, N.Y.[6]	mill building
Northern, Pa.[6]	2 mill buildings

Ithaca, N.Y.	steel work for: Ithaca City Hospital Ithaca Post Office Rand Hall, Cornell University tobaggen slide, Cornell University Athletic Association

1914

Groton, N.Y.	concrete, Creek Road
Edwards Village, N.Y.	pony truss, 2 spans, lower Oswegatchie River

1915

West Henniker, N.H.	through truss, Contoocock River
Allegheny Co. N.Y.	Pratt through truss, 121', pin-connected, 14'2" wide, Ballard Road, Rush Creek

1916

No awards of record.

1917

No awards of record.

1918

No awards of record.

1919

No awards of record.

1920

No awards of record.

1921

No awards of record.

1922

No awards of record.

1923

Lansing, N.Y.	concrete, Locke Road

Source:

[1]Groton Iron Bridge Company Daybook.
[2]East Division Financial Accounts,
Canal Museum, Syracuse, N.Y..
[3]Engineering News.
[4]Groton and Lansing Journal.
[5]Personal communication.
[6]Collection of the Groton Historical Society.

BIDS OF RECORD BY YEAR

1885

New Baltimore, N.Y.	iron highway bridge, 90', 14' wide, iron floor beams and joists, 2 1/2" oak floor plank, moving load 80 lbs. per square foot, $15,550; 9 other bids.

1886

St. Cloud, Mn.	Stearns County and Clearwater Bridge, Paynesville and Grove Bridges, each 144', 9 other bids.
Lockport, N.Y.	low bid rejected on defect, Main Street and Cottage Street bridges, $15,000 and $2,075; 7 other bids.

1887

Norristown, Pa.	iron bridges, Perkiomen Creek and Swamp Creek, 12 other bids.
Lancaster and Chester Counties, Pa.	Octoraro Creek, truss, $1,285; 6 other bids.
Boston, Mass.	Charles River, Harvard Bridge between Boston and Cambridge, $189,000; 12 other bids.
Conowingo, N.Y.	3 bridges: Mill Creek at Ressler's Mill, Leinbach's Mill over Cocalico Creek near Reamstown, Wood's Mill over Conowingo-Fulton Turnpike, $1,146; $874; $1,297; 5 other bids.
Poughkeepsie, N.Y.	iron span over Fall Kill; $2,260.
Rome, N.Y.	$2,249; 3 other bids.

Rome, N.Y.	Patrick Bridge; $1,640; 3 other bids.
Fond du Lac, Wisc.	highway bridges; $585, $700, $780, $875; 9 other bids.
Hammond's Ferry, Md.	highway bridge over Patapsco River; $9,987; 10 other bids.

<u>1888</u>

Easton, Pa.	wrought iron bridge over LeHigh Railroad, Northampton County; $24,960; 7 other bids.
Parkersburg, West Va.	wrought iron bridge over the Little Kanahwa River, Whipple Double Intersection truss, 296', 20' roadway, 2-5' sidewalks.

<u>1889</u>

Ithaca, N.Y.	iron swing bridge, $2,795; 4 other bids, contract deferred.
Waterford, N.Y.	lift bridge over canal at Broad Street, $7,280; 2 other bids.
Holyoke, Mass.	10 spans, 160' each, $34,975; 14 other bids.
Frederick, Md.	Patuxent River, 6 other bids.
Leaksville, N.C.	$5,114; 5 other bids.
Clarion, Pa.	Clarion River, highway bridge, 224', $10,400; 16 other bids.
Fort Monroe, Va.	Mill Creek, iron pile bridge, $17,500; 2 other bids.
Mahwah, N.J.	$1,664; 7 other bids.
Fultonville, N.Y.	Main Street, informal bid, 3 other bids.
Oswego, N.Y.	46' riveted iron girder over hydraulic canal, $2,020; 5 other bids.
Providence, R.I.	Manlon Village, $4,100; 12 other bids.
Atlanta, Ga.	Chattahoochee River, $14,920; 13 other bids.

1890

Grand Isle, Ontario	200' iron draw span, $5,180; 6 other bids.
Atlanta, Ga.	Chattachoochee River, $14,000; 11 other bids.
Milford, Conn.	79' plate girder and superstructure, $2,295; 12 other bids.
Utica, N.Y.	viaduct plate girder, $68,160; 11 other bids.
Holyoke, Mass.	plate girder, $28,000; 9 other bids.
Shelburne Falls, Mass.	Deerfield River, $16,750; 11 other bids.

1891

Washington Township, Oh.	Freeville Pike, Banta Creek.
Birmingham, Conn.	Housatonic River, iron bridge, 60 bids.
Holyoke, Mass.	Dwight Street and Cabot Street bridges, 6 other bids.
Holyoke, Mass.	Connecticut River between Holyoke and Chicopee, $86,501; 19 other bids.

1892

Rochester, N.Y.	East Main Street over N.Y.C. and H.R. Railroad, 5 trusses, each 118', $42,750; 5 other bids.
Cambridge, Mass.	Huron Street Bridge, 93', 60 other bids.

1893

Bridgeport, Conn.	Housatonic River between Stratford and Milford, iron and steel drawbridge, $90,650; 12 other bids.

1894

Little Falls, N.Y.	rebuild bridge at Ann Street, Erie Canal, $2,574; 3 other bids.
Rochester, N.Y.	Ford Street, Erie Canal, rebuild bridge,

	$4,205; 8 other bids.
Amsterdam, N.Y.	Erie Canal, rebuild bridge at Bridge Street, $3,345; 3 other bids.
Syracuse, N.Y.	Clinton Street, superstructure, Erie Canal, $8,035; 3 other bids.
Columbia, Tx.	7 other bids.
Tacoma, Wash.	$88,000; 7 other bids.
Cincinnati, Oh.	West Park Street Creek, Llewellyn Street, $3,550; 14 other bids.
Woonsocket, R.I.	Blackstone River, wrought iron deck bridge, $198,340; 8 other bids.
Houston, Tx.	Factory Street over Buffalo Bayou, $40,795; 12 other bids.
Cambridge, Mass.	Cambridge Creek, 137' iron drawbridge, $4,840; 5 other bids.
Augusta, Ga.	Greene and 15th Streets, iron bridge, 10 other bids.
Williamsport, Pa.	rebuilding 4 bridges swept away by flood: $21,100; $16,000 and 2 for $10,700; 8 other bids.
Natchez, Mississippi	Adams County, Catherine's Creek, steel bridge, $10,200; 13 other bids.
Cambridge, Oh.	Wells Creek, 106' iron highway bridge, 18 other bids.
Barrington, R.I.	Barrington River, 350', $5,050; 6 other bids.
Lansing, Mich.	Grand River, Michigan Avenue, $71,000; 16 other bids.
Concord, N.H.	Horse Hill Bridge, $4,339; 11 other bids.
Williamsport, Pa.	Maynard Street Bridge and log basin, Pratt trusses, $19,975 and $9990; 8 other bids.
Birmingham, Ala.	Warrior Bridge, $11,000; 15 other bids.

Pittsburgh, Pa.	Monongahela River at South 22nd Street, $435,100; 6 other bids.
Scranton, Pa.	Linden Street Bridge, $56,794 (wooden plank); $74,328 (asphalt); 23 other bids.
Houston, Tx.	Buffalo Bayou at Factory Street, $41,977; 10 other bids.
Scranton, Pa.	Roaring Brook Bridge, $95,552 (asphalt); $66,985 (plank); 15 other bids.

<u>1895</u>

Buffalo, N.Y.	Scajaquada Creek, Niagara Street, iron bridge, $12,688; 12 other bids.
Port Huron, Mich.	Black River, steel swing bridge, 160' swing, 18' roadway, 6' sidewalk, 220' steel trestle approaches, $22,222; 16 other bids.
Gloversville, N.Y.	11 other bids.
Ogdensburg, N.Y.	steel plate girder, $48,883; 15 other bids, won by Melan.
Cincinnati, Oh.	viaduct superstructure, West 8th Street over Boldface Road, 23 other bids.
Clarion, Pa.	Clarion River, Piney Creek, $8,900; 17 other bids.
Chester, Mass.	Westfield River, $8,390 for 2 spans of 80' each; 10 other bids.
Norristown, Pa.	iron bridges at Park, Schwenksville, Wiss-ahickan, Swamp and Perkiomen: $998; $4,014; $1,700; $1,475; $998; 16 other bids.
Hempstead, Tx.	Brazos River, $19,998; 9 other bids.
Ithaca, N.Y.	Six Mile Creek, Line A-300' in length, Line B-360', 70' above creek bed, 24' roadway, 2-5' sidewalks, A-$18,999; B-$21,999; won by the Owego Bridge Company.
Carlisle, Pa.	all bids rejected, iron bridge over Condoquin-et Creek at Wolf's Road, Middlesex Township, substructure and superstructure, filling

	approaches, 15 other bids.
Easton, Pa.	rebuilding 2 steel bridges, Synders Bridge and Kutz Bridge, bids submitted on each and both: $4,200; $1,300; $5,500.
Pittsburgh, Pa.	Panther Hollow, $175,000; 6 other bids.
Patterson, N.J.	iron bridge, 3 spans each at 98', Passaic River at Fifth Avenue, $11,995; 9 other bids.
Doylestown, Pa.	substructure for 3 bridges: Kulp's, Fink's and Trauger's: $2,000; $2,300; $6,000; 8 other bids.
Irontown, Oh.	Storm Creek, Elm Street, iron bridge, $6,700; 10 other bids.
Johnstown, Pa.	superstructure Maple Avenue Bridge, all bids rejected, Plan A-$15,100; Plan B-no bid submitted; 8 other bids. Plan A-City Engineer, Plan B-Company Plan.
Bridgeport, N.J.	iron drawbridge, Cohonsey River at Broad Street, bids submitted using the old piers and for building with new piers, $13,800; $15,800; 9 other bids.
Lowell, Mass.	Moody Street, $57,500; 17 other bids.
Indianapolis, Ind.	Meridiam Street Bridge over Pleasant Run, plate girder, 75', 30' roadway, 2-6' sidewalks, girds 7'6" deep, $5,500; 13 other bids.
Mobile, Ala.	3 steel spans and approaches, buds submitted on masonry and steel approaches, $6,245; $6,760; 14 other bids, won for construction with steel approaches.
Houston, Tx.	Buffalo Bayou at Shepherd's Dam, 3 miles north of the city, 85', 18' roadway, $3,219; 10 other bids.

1896

Youngstown, Oh.	Mahoning River, superstructure, $53,600; $51,500; 9 other bids.

Chillicote, Oh.	3 spans each 154', Sciolo River, $9,600; 20 other bids.
Whaley, Mass.	3 plate girder spans, $1,100; 10 other bids.
Gloversville, N.Y.	$1,360; 4 other bids.
Junction City, Ks.	iron bridge, 400', $7,131; 12 other bids.
Freesmansburg, Pa.	Lehigh River, $26,000-$25,000; 8 other bids.
Harrodsburg, R.I.	Chaplin River, steel bridge near Dixville, $457, 6 other bids.
Lexington, Va.	iron bridge, 110', $1,967; 6 other bids.
Lasalle, Ill.	Big Vermillion River, 280', $6,000-$6,775; 17 other bids.
Lewiston, Me.	steel highway bridge, Androscoggin River, $155,000; 13 other bids.
New Haven, Conn.	iron superstructure, Quinnipiac River, Grand Street, $72,400; 18 other bids.
Sandusky, Oh.	steel bridge, Vermillion River, $2,682; 13 other bids.
Norristown, Pa.	steel bridge over Stoney Creek at Airy Street, $22,425; 10 other bids.
Carthage, N.Y.	Black River Bridge, $16,900; 7 other bids.
Patterson, N.J.	steel arch bridge, $59,600; 9 other bids, Melan chosen.
Painesville, Oh.	Grand River, Main Street, $26,600; 5 other bids.
Marlboro, Md.	2 spans, Little Paint Branch, Vansville and Northwest Branch, Queens Chapel Road, Bladensburg, $3,795; 7 other bids.
Easton, Pa.	highway bridge, $4,285; 6 other bids.
Baltimore, Md.	George's Run, Schomberger's Mill, iron bridge, $1,525; 7 other bids.
Norfolk, Va.	highway bridge, $5,475; 12 other bids.

Hagerstown, Md.	Sideling Hill Creek, iron bridge, $1,565; 8 other bids.
Wichita, Ks.	225' steel bridge, each company submitting plans, $4,985; 10 other bids.
Cincinnati, Oh.	Mitchell Avenue Aqueduct, $68,000; 14 other bids.
Houston, Tx.	Greens Bayou, 4 spans each 105', $6,739; 6 other bids.

1897

Elkton, Va.	Shenandoah County, steel or iron bridge, $8,250; 20 other bids.
Albany, Ga.	Flint River, 280', bids on wood or steel joists, $13,885; 13 other bids.
Glen Falls, N.Y.	bridge at Glen Street over feeder of Champlain Canal, $4,159.
Millers Falls, Mass.	iron and steel bridge, $3,932; 20 other bids.
Youngstown, Oh.	Mahoning River at Spring Common, bids on wooden or paved floor, $27,000; $32,700; 15 other bids.
Springfield, Oh.	Buck Creek, 120' steel; $5,000; 15 other bids.
Syracuse, N.Y.	Onondaga Creek, Temple and Seymour Streets, steel girder bridge; $4,315; $5,246; 6 other bids.
Flandreau, S.D.	3 steel spans on steel tubular piers, 18' high, 110', 65' and 34' spans, 16' roadway, $42,000; 16 other bids.
Ebensburg, Pa.	65' steel span, $1,140; 10 other bids.
Mt. Morris, N.Y.	Genesee River between Mt. Morris and Leicester, $25,137; 2 other bids.
New Bedford, Mass.	middle portion of the New Bedford and Fair Haven Bridge, $108,500; 8 other bids.
Doylestown, Pa.	Ruth's Ford Bridge, New Britain Township,

	$3,500; 10 other bids.
Framingham, Mass.	steel girder bridge, $2,900; 13 other bids.
Albany, N.Y.	Oswego Canal, $25,293; 4 other bids.
Milltown, Pa.	110' steel bridge, 18' roadway, $1,787; 7 other bids.
Tom's River, N.J.	65' iron bridge, 24' roadway, 2-7' sidewalks, $10,834; 11 other bids.
Plattsburg, N.Y.	Saranac River, Kent's Falls, single span iron bridge, 18', $3,082; 6 other bids.

<u>1898</u>

Lowell, Mass.	plate girder, 105', 50' wide, $6,900; 16 other bids, won by Long at $5,612.
London, Oh,	Madison County, 3 bridges, $2,650; $1,269; $986; 24 other bids.
Woonsocket, R.I.	Peters River, steel bridge, $2,300; 15 other bids.
Saginaw, Mich.	Court Street, 160' fixed span and 218' draw span, $29,572; 11 other bids.
Olean, N.Y.	steel bridge, $5,795; 13 other bids.
Camden, N.J.	Cooper's Creek at State Street, steel bridge, informal bid, $22,000; won by B.F. Sweeten & Son, Camden, for $22,776.
Tuckahoe, N.J.	steel bridge, 120', $4,430; 14 other bids, won by Nelson & Buchanan at $3,990.
Northfield, Mass.	Connecticut River, bids given for wooden stringers, steel stringers, and for the abutments and piers, $27,400; $29,900; $2,400; won by New Jersey Steel and Iron.
Westfield, Mass.	Little River, Main Street, $5,847; 19 other bids.
Lorain, Oh.	Black River at Erie Avenue, lift bridge, $148,000; 13 other bids.

1899

Chester, Pa.	iron bridge, 163', 52' wide, Chester Creek at 9th Street, $54,850; 6 other bids, won by King at $44,963.
Norfolk, Va.	substructure and superstructure, steel highway bridge on Smith's Creek between York Street and Atlantic, $71,000; 15 other bids.
Brookhaven, Mass.	Hemochitto River, steel bridge, $7,748; 10 other bids.
Newport, R.I.	Van Zandt Avenue, steel bridge, $4,800; 10 other bids, won by Masillion at $4,390.
Macon, Ga.	steel truss, 2 spans, 185', 196', $50,000; with creosoted base, $53,000 with a metal and concrete base; 11 other bids.
Boston, Mass.	Malden Bridge over the Mystic River, $11,500; 12 other bids.
Hartford, Conn.	East Hartford Meadows, steel bridge, $135,000; 20 other bids.
Washington D.C.	Rock Creek Park, $14,216; 11 other bids.
Cumberland, Md.	10 steel bridges, $4,510; 11 other bids, won by Toledo at $3,950.
Cape May, N.J.	Schellenger's Landing, bridge and abutments, $6,162; 9 other bids; won by Long at $5,950.
Williamsport, Pa.	bridge over Texas Creek in Pine Township, $2,385.
New Brunswick, N.J.	Cheesequakes Creek, Morgan's Station, iron drawbridge, $12,600; 7 other bids, won by Wrought Iron at $9,997.
Eagle River, Pa.	Hoosick Falls, Hoosick River, $10,800; 4 other bids.
Smithton, Pa.	Youghiogheny River, steel bridge, 133', 18' roadway, $60,500; 15 other bids, won by Pittsburgh at $59,500.

1900

Hoboken, N.J.	Old Pennsylvania Railroad at Baldwin Avenue, Jersey City Heights, $35,800; 8 other bids.
Auburn, N.Y.	Owasco River at Lizette Street, all bids rejected, $18,875.
Camden, N.J.	steel bridge at Cooper's Creek, all bids rejected, $12,900; 8 other bids, contract readvertised and the Groton Company won.
North Adams, Mass.	steel superstucture, one bid to include the old bridge as payment, the other not, $12,505; $13,115; 5 other bids.
Buckingham, Va.	90' steel, 12' roadway, $10,075; Virginia Bridge Company won at $1,047.
Slatington, Pa.	Trout Creek, lower Main Street, $15,000; $14,884; 4 other bids, won by Penn for $15,995.
Reading, Pa.	iron bridge over Tupekicken near Krick's Mills, $1,045; 6 other bids.
Bangor, Me.	steel bridge, Kenduskeag Stream over Franklin Street, Plans A and B, $7,487; $9,200; 8 other bids, won by Berlin at $7,390-Plan A.

1901

No bids recorded.

1902

Franklin, Pa.	repairing Valley Bridge, $88,987 and $77,000; 7 other bids, won by Penn at $65,861.
North Adams, Mass.	Greylock Bridge, $12,000 and $2,000; 2 other bids, won by Owego at $10,700 and $1,590.

1903

Camden, N.J.	Cooper's Creek, Baird Avenue, all bids rejected, drawbridge, $38,850; 9 other bids.

Magnolia, N.J.	2 steel bridges on the Pleasantville Highway, $27,900; 4 other bids.
Ramapo, N.Y.	$10,194; 4 other bids.
Penn Yan, N.Y.	Swathout Gully, $3,345; 9 other bids.

1904

Harrisburg, Pa.	rebuilding substructure and superstructure Lehigh Valley Railroad at Allentown, $230,000; 17 bids, won by Penn.
Grand Rapids, Mich.	Wealthy Avenue Bridge, bridge and turn-table 350', drawspan 234', and 180' fixed span, $32,285; 10 other bids.
Avondale, N.J.	duplicate cables for drawbridge, pavement and wood blocks; $137,700; $136,000 and $150,000; 11 bids.

1905

Springfield, Mass.	bridge over the Connecticut River between Chicopee and West Springfield, $50,000; 19 bids, won by R.F. Hawkins of Springfield.
West Newton, Pa.	Main Street, highway bridge, $88,500; 12 bids.
Harrisburg, Pa.	substructure and superstructure, Susquehanna River between Brwick and Nescopec, $222,000; 27 bids; won by York at $209,500.
Boston, Mass.	drawspan at Atlantic Avenue, $68,950; 7 other bids.
Boston, Mass.	Brookline Street Bridge, steel superstructure, $17,900; 10 other bids, won by H.P. Converse of Boston.

1906

Albany, N.Y.	Erie Canal at Saratoga Avenue, $22,252; 3 other bids, won by M. Fitzgerald, Hoosic Falls, N.Y.

1907

Albany, N.Y.	barge canal work, steel highway superstructures, \$67,491; 7 other bids, won by United Construction Company.
Scranton, Pa.	Scranton Street, Lackawanna Avenue and Cedar Avenue, Linden Street, Green Road Street, 7 other bids, 3 in concrete.

1908

Albany, N.Y.	barge canal, steel highway bridge superstructure, \$26,478; 10 other bids.

Source: Engineering News. Listings of bids on bridge work were no longer published after 1910.

BIBLIOGRAPHY

PRIMARY SOURCES:

Conger Family Historical File, Groton Public Library, Local History Collection, Groton, New York.

Flora Williams Estate Papers, Account #315, Olin Graduate Library, Cornell University, Ithaca, New York: Daybook, Groton Iron Bridge Company, 1877-85; W.W. Williams Memorandum and Accounts, 1886-7; W.W. Williams Memorandum and Accounts, 1887.

Groton Historical Society, Groton Bridge & Manufacturing Company, miscellaneous papers, primarily xeroxed materials.

Groton Bridge & Manufacturing Company, "Thoughts and Suggestions About Roads and Bridges", Groton, N.Y., 1899, Collection of the Groton Historical Society.

James B. French Collection, Account #315, Olin Graduate Library, Cornell University, Ithaca, N.Y., Groton Manufacturing Company, Davenport, Iowa, Account Book, 1882.

State of New York Court of Claims, "Groton Bridge Company Against the State of New York", G.M. Stoddard, Attorney for Claimant, Groton, N.Y. Dryden, N.Y.: Stilwell and Ross Low Printers, 1909.

United States Patent Office, Letters Patent: 1. 187,513 Bridges E.E. Colby, Groton, N.Y. Assignor of one-half his right to O. Avery, Jr., C. Bartholomew, and Chas. Perrigo, 20 Feb. 1877; 2. 189,020 Bridge-Piers E.E. Colby, Groton, N.Y., assignor of one-half his right to O. Avery, C. Bartholomew and C. Perrigo, 3 April 1877; 3. 189,170 Bridges O. Avery, Jr., Groton and C. Bartholomew, Etna, N.Y., 3 April 1877; and 4. 189,171 Bridges-Piers O. Avery, Jr., Groton and C. Bartholomew, Dryden, N.Y., 3 April 1877.

SECONDARY SOURCE MATERIALS-LOCAL HISTORY:

"Eugene Ashbel Landon M. Am. Soc. CE Died March 23, 1933". American Society of Civil Engineers (ASCE) Transactions, Vol. 99 (1934).

Baldwin, M.M. "The Beginnings of Groton", address to Groton Library Association. 1868; rpt. Groton: The Journal and Courier, 1923.

Bell, Barbara. "Glances Backward-Big on Industry." Ithaca Journal. 29 Nov. 1969.

Brevoort, Roger A. "Architectural/Historical Evaluation of Meadow Bridge, Shelburne, New Hampshire." New Hampshire Department of Highways and Public Works: Report of Investigation #67, Feb. 1981.

Burr, David H. Map of the County of Tompkins 1828. Albany: Rowden, Clark & Co.

----------. Map of the County of Tompkins 1838. Ithaca: Wm. P. Stone.

Clark, Arthur. "Last Remnants Groton Bridge Company-Going, Going, Gone." Ithaca Journal. 26 Aug. 1971.

Court, Lavena. " A Salute to Groton's Heritage." Groton: 1976.

Groton Centennial Publication. Groton: 12 Aug. 1960.

Hermanson, Marjorie. The Interrelationship Between the Typewriter Industry and the Cortland-Groton Area of Central New York State. Master's Thesis. Cornell University 1982.

Ithaca Journal. 5 May 1887, 7 Mar. 1889, 16 Mar. 1889, 25 June 1889, 7 Sept. 1889, 11 Sept. 1896, 1 July 1897, 31 July 1897 "Groton Bridge Company History", 2 Aug. 1897, 17 No. 1897, 10 Feb. 1898, 4 Dec. 1900, 8 Nov. 1909 and 11 Nov. 1909.

New York State. Rural Index, Groton Township. 1920.

----------Tompkins County Railroad Maps.

Pierce, Henry B. Histories of Tioga, Chemung, Tompkins and Schuyler Counties, N.Y. Philadelphia: Everts & Ensign, 1878.

Selkreg, John H. "Town of Groton." In Landmarks of Tompkins County, N.Y. Syracuse: D. Mason & Co., 1896, pp.312-25.

Uhl, Charles. "An Examination of Five Bird's Eye Views of Upstate New York." Cornell University 1980.

Welch, E. "Grips" Valley Gazette: Historical Souvenir of Groton and Vicinity. Vol. III No. 10. Albany: Historical Souvenir No. 6, 1899.

Wilson, Robert J. "History of the First Baptist Church, Groton, N.Y., 1886-1956." Groton: 1956.

GENERAL REFERENCES ON BRIDGES AND BRIDGE BUILDING:

Allen, Richard S. Covered Bridges of the Middle Atlantic States. Brattleboro: The Stephen Greene Press, 1959.

----------. Covered Bridges of the Northeast. Brattleboro: The Stephen Greene Press, 1957.

American Society of Civil Engineers. America's Greatest Suspension Bridges. Special Issue. New York City: ASCE, July 1976.

----------. Long Span Suspension Bridges: Report 3590. New York City: ASCE, April 1979.

----------. Report on Highway and Bridge Surveys. New York City: ASCE, 1962.

Billington, David P. Robert Maillart's Bridges: The Art of Engineering. Princeton: Princeton University Press, 1979.

Brangwyn, Frank and Walter Shaw Sparrow. A Book of Bridges. London: John Lane, 1940.

Casson, Sir Hugh. Bridges. London: British Landmark Series, 1965.

Congdon, H.W. The Covered Bridge. New York: Alfred A. Knopf, 1948.

Edwards, Llewellyn N. A Record of History and Evolution of Early American Bridges. Oreno, Me.: University Press, 1959.

Gies, Joseph. Bridges and Men. Garden City, N.Y.: Doubleday & Co., Inc., 1963.

Great Britain, Ministry of Transport. The Appearance of Bridges. London: Her Majesty's Stationery Office, 1964.

Hammond, Rolt. The Forth Bridge and Its Builders. London: Eyre-Spottiswoode, 1964.

Hopkins, Harry J. A Span of Bridges. New York: Praeger, 1970.

Kassler, Elizabeth. The Architecture of Bridges. New York: Museum of Modern Art, 1949.

McCullough, David. The Great Bridge. New York: Avon, 1972.

Myer, Donald B. Building the Potomac Aqueduct, 1830. Washington D.C.: Commission on Fine Arts, GPO, 1967.

Plowden, David. Bridges: The Spans of North America. New York: Viking Press, 1974.

Rosenberg, Nathan and Walter G. Vincenti. The Britannia Bridge: The Generation and Diffusion of Technical Knowledge. No. 10. London: Society for the History of Technology; Cambridge, Mass.: The MIT Press, 1978.

Scott, Quinta and Howard S. Miller. The Eads Bridge. Columbia, Missouri: University of Missouri Press, 1979.

Steinman, David B. and Sara B. Watson. Bridges and Their Builders. New York: G.P. Putnam's Sons, 1941.

Trachtenberg, Alan. Brooklyn Bridge: Fact and Symbol. New York: Oxford University Press, 1965.

Whitney, Charles S. Bridges: A Study in Their Art, Science and Evolution. New York: Wm. Rudge, 1929.

Zuk, William. Concepts of Structures. Huntington, N.Y.: Robert Kreiger Publishing Company, Inc., 1972.

Zucker, Paul. American Bridges and Dams. New York: H. Wolff, 1941.

TREATISES AND OTHER HISTORICAL MATERIALS:

Album of Designs of the Phoenixville Bridge Works. Philadelphia: Clarke, Reeves & Co.; J. Lippencott & Co., 1873.

Boller, Alfred P. Practical Treatise on the Construction of Iron Highway Bridges for the Use of Town Committees. 2nd edition. New York: J. Wiley, 1878.

Cooper, Theodore. General Specifications for Iron and Steel Highway Bridges and Aqueducts. 5th edition. New York: Engineering News Publishing Company, 1890.

Haupt, Herman. General Theory of Bridge Construction. New York: Appleton, 1851.

Kahn Building Products and Trusses Concrete Steel Co. Kahn System Standards: A Handbook on Reinforced Concrete. 5th edition. Detroit: 1919.

Ketchum, Milo S. The Design of Highway Bridges. New York: McGraw Hill, 1908.

Keystone Bridge Company Illustrated Album. Philadelphia: Allen, Lane and Scott, 1874.

Waddell, J.A.L. Designing Ordinary Iron Highway Bridges. New York: J. Wiley, 1884.

----------. A Pocket Book for Bridge Engineers. New York: J. Wiley, 1898.

----------. Bridge Engineering. New York: J. Wiley, 1916.

----------. Economics of Bridgework. New York: J. Wiley, 1921.

Whipple, Squire. A Work on Bridge Building. Utica, N.Y.; private printing, 1847, rpt. 1969.

----------. An Elementary and Practical Treatise on Bridge Building. New York: D. Van Nostrand, 1873.

STATE AND LOCAL BRIDGE INVENTORY REPORTS AND HISTORIES

Abbott, Diane, ed. The Lower Peninsula of Michigan: An Inventory of Historic Engineering and Industrial Sites. Washington D.C.: Historic American Engineering Record; GPO, 1976.

Danko, George. The Development of the Truss Bridge 1820-1930 with a Focus Toward Wisconsin. Madison, Wisc.: State Historic Preservation Office; State Historical Society, August, 1967.

Diebler, Dan G. A Survey and Photographic Inventory of Metal Truss Bridges in Virginia, 1865-1932. Vol. 1. Charlottesville, Va.: Virginia Highway and Transportation Research Council, May, 1975.

District of Columbia Highway Department. Washington's Bridges: Historic and Modern. Washington D.C.: 1948.

----------. Washington's Bridges. Washington D.C.: 1956.

Fore, George. North Carolina Inventory of Metal Truss Bridges: North Carolina's Metal Truss Bridges: An Inventory and Evaluation. Raleigh, N.C.; North Carolina Division of Archives and History, Department of Cultural Resources; North Carolina Division of Highways/DOT, March, 1979.

Fortune Magazine. "The Bridges of Pittsburgh". August, 1967.

Historic American Engineering Record. Rhode Island: An Inventory of Historic Engineering and Industrial Sites. Washington D.C.: GPO, 1978.

----------. The Upper Peninsula of Michigan: An Inventory of Historic Engineering and Industrial Sites. Washington D.C.: GPO, 1978.

Georgia DOT and Georgia Department of Natural Resources. Historic Bridge Survey. Altanta, Ga.: September, 1981.

Leroux, Charles. "Chicago's Amazing Bridges: A History in Motion". Chicago Tribune, 7 July 1982.

Myer, Donald. Bridges and the City of Washington. Washington D.C.: Commission on Fine Arts; GPO, 1967.

----------. Cabin John Bridge: A Washington Landmark. New York: ASCE, Meeting Report No. 1873, February, 1973.

Ohio DOT in cooperation with the Federal Highway Administration. The Ohio Bridge Inventory, Evaluation and Preservation Plan. Columbus, Ohio: 1983.

Quivak, Fredric L. "Montana's Minneapolis Bridge Builders". A paper presented at the Annual Meeting of the Society for Industrial Archeology, St. Paul, Mn., 14 May 1983.

----------. Historic Bridges in Montana. Washington D.C.: Historic American Engineering Record; GPO, Spring 1982.

Shank, William H., P.E. Historic Bridges of Pennsylvania. Memphis, Tn.: Buchart-Horn Consulting Engineers and Planners, 1966.

South Carolina Archives and History Department. South Carolina Bridge Inventory. Chapters 2, 3 and 5, draft. Columbia, S.C.: 1983.

Zambala, Dennis M. Elm Street Bridge. Woodstock, Vt.: Woodstock National District Commission, 1977.

BRIDGE PRESERVATION, EVALUATION, RESTORATION OR ADAPTIVE USE:

Berryhill, Dr. James J. Bicycling Historic Bridges. Washington D.C.: Heritage Conservation and Recreation Service, n.d.

Chamberlin, William P. Historic Bridges-Criteria for Decision Making. Washington D.C.: Transportation Research Board, National Research Council, October 1983.

Gorr, Marsha Scott. "Troubled Bridges: The Solution is Fast, Cheap and Distinctly Bucknell". Bucknell World. Bucknell, Pa.: October, 1983.

National Trust for Historic Preservation. "Legislative Initiatives to Protect Historic Bridges" Unpublished memorandum. Washington D.C.: September, 1983.

Newlon, Howard, et al. Criteria for Preservation and Adaptive Ise of Historic Highway Structures: A Trial Rating System for Truss Bridges. Charlottesville, Va.: Virginia Highway and Transportation Research Council, January, 1978.

----------. Methods of Modifying Historic Bridges for Contemporary Use. Charlottesville, Va.: Virginia Highway and Transportation Research Council, June, 1980.

Texas Historical Commission. Preserving Historic Bridges: Texas Preservation Guidelines. Austin, Tx.: August, 1983.

U.S. Department of Transportation, Federal Highway Administration, Office of Research and Development. FHWA-RD-78-133, Extending the Service Life of Existing Bridges by Increasing Their Load Carrying Capacity. Washington D.C.: June, 1978.

OTHER MATERIALS OF THE FEDERAL GOVERNMENT:

Advisory Council on Historic Preservation. "Memorandum to the State Historic Preservation Officers: Federal Special Bridge Replacement Program". Washington D.C.; 9 August 1976.

General Accounting Office. Report to the Honorable James R. Sasser, United States Senate: Better Targeting of Federal Funds Needed to Eliminate Unsafe Bridges. Washington D.C.: GPO, 11 October 1981.

----------. Report to the Congress: Solving Corrosion Problems of Bridge Surfaces Could Save Billions. Washington D:C: GPO, 19 January 1979.

----------. Report to the Congress: Unsafe Bridges on Federal-Aid Highways Need More Attention. Washington D.C.: GPO, 21 July 1975.

U.S. Department of Transportation. Highway Bridge Replacement and Rehabilitation Program: Third Annual Report of the Secretary of Transportation to Congress. Senate Document 97-33. Washington D.C.: GPO, July, 1982.

----------. The Status of the Nation's Highways: Conditions and Performance: Report of the Secretary of Transportation to the United States Congress. Washington D.C.: House of Representatives Committee on Public Works and Transportation, 74-308-0, Print 97-2, January, 1981.

----------. The Historic Bridge Inventory Summary. Washington D.C.: Federal Highway Administration, 1981.

----------. "Federal Highway Administration Memorandum to Regional Highway Administrators on Historic Bridges". Washington D.C.: 5 September 1980.

----------. America on the Move: The Story of the Federal-Aid Highway Program. Washington D.C.: GPO, January, 1980.

----------. The Surface Transportation Assistance Act of 1978.

----------. 6th Annual Report of the Secretary of Transportation: Special Bridge Replacement Program. Senate Document 95-101. Washington D.C.: GPO, 1978.

ARTICLES:

Anderson, Kenneth B. "Historic Bridge Inventories: Status and Methods". Report prepared for Transportation Research Board Subcommittee A1B103(1) Historic and Archeologic Considerations in Transportation, Current Issues in Historic Preservation as Related to Transportation. Washington D.C.: Federal Highway Administration, Office of Environmental Policy, 21 January 1982.

----------. "Bridges: States, Feds, Take A Closer Look." Preservation News. Washington D.C.: National Trust for Historic Preservation, October, 1980.

APWA Reporter. "County and Consultants Rehabilitate Bridges." Pittsburgh: March, 1982.

American Society for Civil Engineers. Guide to History and Heritage Programs. New York: 1974, rpt., 1979.

----------. Kojha, Surenda and Joseph Womelsdork. "Inspecting Town Bridges in Connecticut." New York: July, 1982.

Chamberlin, William P. "History of Road and Building Technology in New York State: A Report of Progress on Research Project 80-14 Through March 31, 1975." Albany, N.Y.: New York State Department of Transportation, March, 1975.

City of Allegan, Michigan. National Register of Historic Places Inventory-Nomination Form, Second Street Bridge. Allegan, Michigan: 27 February 1979.

----------. Wilkins & Wheaton Engineering Company. Second Street Bridge Restoration. Allegan, Michigan: 16 April 1981.

----------. Ibid. Inspection Report of Second Street Bridge. Allegan, Michigan: 16 April 1979.

----------. City of Allegan. Critical Bridge Program: Second Street Bridge. Allegan, Michigan: 5 September 1979.

----------. Cost Effective Analysis of Alternatives for Second Street Bridge and Summary of Structural Analysis. Allegan, Michigan: n.d.

Comp, T. Allen and Donald Jackson. "Bridge Truss Types: A Guide to Dating and Identifying." Technical Leaflet 95. Nashville, Tn.: American Association for State and Local History, May, 1977.

Darnell, Victor. "Lenticular Bridges from East Berlin." Industrial Archeology, Vol. 5, No.1 (1979), pp. 19-33. Washington D.C.: Society for Industrial Archeology.

DeLony, Eric N. "Conflict Between Structurally Significant and Historically Significantly Bridges." Paper delivered at the International Association of Bridge and Structural Engineers Meeting, Washington D.C., 9 September 1982.

----------. "Bridges That Have Been or Proposed to be Restored, Rehabilitated, Relocated, or Adaptively Reused and the Engineers or Engineering Firms Involved When Known." Washington D.C.: unpublished listing, June, 1982.

----------. Rev. of Metal Truss Bridges in Virginia, 1865-1932. Industrial Archeology. Vol. 3, No. 1 (1977), pp. 67-8.

----------. "Bridge Replacement." 11593-Information Related to the Responsibilities of the Secretary of the Interior. Vol. 2, No. 5. Washington D.C.: Office of Archeology and Historic Preservation, October, 1977.

----------. "The 19th Century Iron Bridge: 32,000 Bridges Determined Structurally Deficient or Functionally Obsolete." Newsletter of the Society of Industrial Archeology, November, 1975, p.4.

Engineering News. "Notes from the American Bridge Shops: Elmira Bridge Company." Vol. XXXIX, No. 9 (3 March 1898), p. 149.

Hewitt, Abram S. "The Meaning of the Brooklyn Bridge." Nevins, Allan, ed. Selected Writings of Abram S. Hewitt. Columbia University Press:1937; rpt. Port Washington, N.Y.: Kennikat Press, Inc., 1965.

Iron Bridge Gorge Museum Trust. The Iron Bridge: A Short History of the First Iron Bridge in the World. Museum Guide No. 3.01, n.p.,n.d.

Jackson, Donald. Information Sheet No. 36. Saving Historic Bridges. Washington D.C.: National Trust for Historic Preservation, July, 1984.

----------. "Bridges: Are They on a Road to Nowhere?" Preservation News, May, 1979, p. 6.

----------. "Historic Bridge Preservation at the Community Level." 11593-Information Related to Responsibilities of the Secretary of the Interior. Vol. 3, No. 2. Washington D.C.: Office of Archeology and Historic Preservation, May, 1975.

Kouwenhoven, John A. "The Designing of the Eads Bridge." Technology and Culture, Vol. 23, No. 4 (1982), pp. 535-69.

Mairs, David H. A Century of Bridges: The History of the Champion Bridge Company and the Development of Industrial Manufacturing in Wilmington, Ohio. Paper prepared for the Clinton Historical Society for presentation March 26, 1972. Wilmington: Cox Publishing Company.

McCullough, David. "The Great Bridge and the American Imagination." New York Times Magazine, 27 March 1983, pp. 28-40.

National Trust for Historic Preservation. Amicus-Curiae. U.S. Court of Apppeals for the Ninth Circuit. In Support of Plaintiff Appellant The Benton Franklin Riverfront Trailway and Bridge Committee vs. Drew Lewis, Department of Transportation, City of Pasco, Washington and City of Kennewick, Washington Defendents-Appellees. No. C-81-3617.

Preservation News. "Unsafe Bridge Holds Against Five Blasts," January, 1983, p. 1.

----------. "Corning Rescues 1921 Bridge,", October, 1983, p. 2.

----------. "Michigan, Vermont Fight to Save Bridges,", May, 1976, pp. 1, 13.

----------. "Two States Work to Save Bridge," March, 1974, p. 8.

Peterson, Charles E. "Inventing the I Beam: Richard Turner, Cooper and Hewitt and Others." Association for Preservation Technology Bulletin, Vol. 12, No. 4 (1980), pp. 3-28.

Princeton University, Department of Civil Engineering. The Eads Bridge: An Exhibition Catalogue. Art Museum, 1974.

Schuyler, Montgomery. "Bridges Rationalistic Engineering" American Architecture and Other Writings. Vol. II. rpt. Cambridge, Mass.: Belknap Press of Harvard University, 1961, pp. 331-72.

Simmons, David. "Bridge Preservation in Ohio." Ohio Cities and Villages, August, 1979, pp. 13-8.

Walters, Jonathan. "Silver Threads vs. Golden Rivets: 11th Hour Devine Intervention Saves Bridge." Preservation News, June, 1982, pp. 1, 3.

Weitzman, David. "A Conversation with Bridge 3." Historic Preservation, Vol. 31, No. 5 (1979), pp. 10-7.

INDUSTRIAL ARCHAEOLOGY:

Condit, Carl. American Building. Chicago: University of Chicago Press, 1968.

----------. American Building Art. New York: Oxford University Press, 1960.

Mayr, Otto and Robert C. Post. Yankee Enterprise: The Rise of the American System of Manufactures. Washington D.C.: Smithsonian Insitution Press, 1981.

Peterson, Charles E., ed. Building Early America. Radnor, Pa.: Chilton Book Company, 1976.

Sande, Theodore A. Industrial Archeology: A New Look at the American Heritage. Brattleboro, Vt.: The Stephen Greene Press, 1976.

Trachtenberg, Alan. The Incorporation of America: Culture and Society in the Gilded Age. New York: Hill and Wang, 1982.

Weitzman, David. Field Guide to Industrial Archeology. New York: Scribners and Sons, 1980.