

A Forerunner in Iron Bridge Construction: An Interview With Squire Whipple

Preserving the accumulated knowledge based primarily in practice is an important part of furthering the profession of civil engineering.

FRANCIS E. GRIGGS, JR.

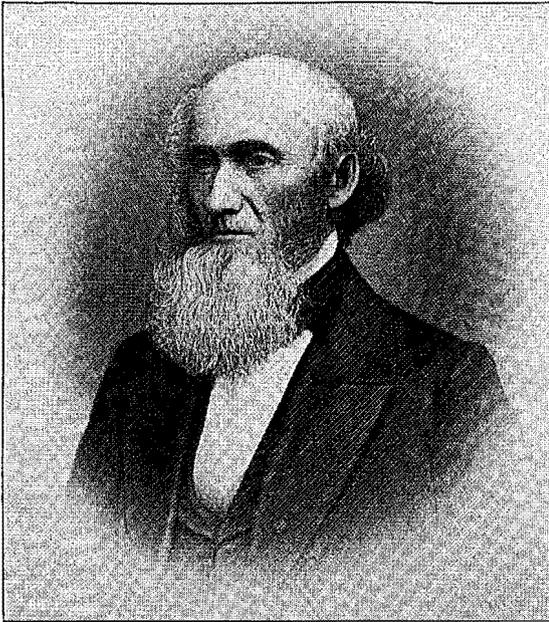
KKNOWN AS the “father of iron bridges,” Squire Whipple not only built hundreds of bridges himself in the middle of the nineteenth century, but also wrote a book in 1847 that for the first time anywhere described the methods by which a truss can be analyzed and designed. This book had a profound effect, changing the design and construction of truss bridges from an art to a science. He was the first man elected to honorary membership in the American Society of Civil Engineers (ASCE) after its rebirth following the Civil War. Whipple died in 1888 and was buried in the Albany Rural Cemetery in

Menands, New York, in accordance with his request to be laid to rest in “as quiet a manner as the law allows.” His book on bridge building remained current until the 1890s.

While this interview is fictitious, its intent, however, is that the civil engineering profession needs to document the thoughts, ideas and experiences of the senior members of our profession. Oral history is perhaps the most effective way of recording this information. Even though this interview never actually occurred, the facts and thoughts expressed are the result of careful research on Whipple and his times.

Griggs: Thank you for talking with me. As I told you earlier, it is important that future generations of civil engineers know about and appreciate the work done by men like yourself. Oral history is an excellent means of obtaining insights into the personality, character, experiences and associates of, in our case, Squire Whipple. May I call you Squire?

Whipple: You most certainly may, as much as I am used to people asking me where my manor is. You must remember though, that Squire was



Squire Whipple

not so unusual a name around 1800.

Griggs: Okay then Squire, let's begin. Could you tell me where you lived and the names of your wife and any children?

Whipple: I lived at 236 State Street, Albany, New York. My wife's name was Anna Case Whipple. We were not blessed with any children, although we did raise from childhood one of my wife's nieces.

Griggs: What was your childhood like? Who were your parents, your brothers and sisters? Where did you live, say up to the age of 17?

Whipple: My parents were James and Electra Whipple, and I was the ninth of ten children. I was born in 1804 in Hardwick, Massachusetts, just northwest of Worcester. My father ran a farm there until 1812, the year of the war with England, when he built a cotton mill in a small town called Greenwich on the Swift River in Massachusetts. He did well during the war. I worked with him in the factory when I wasn't in school. When the war ended and English cotton goods came back to the United States, he couldn't compete. In the end, he sold the mill and we moved to Otsego, New York, not too far

from Cooperstown, where we took up farming again.

Griggs: That must have been a major trip for you. How did you travel and what routes did you take?

Whipple: It was a long trip. We travelled by horse and wagon along the Western Turnpike — it's now called the Mohawk Trail.

Griggs: How did you cross the Hudson River?

Whipple: We went by way of Waterford, New York, and crossed the magnificent wooden arch bridge there. Much later in my life I found out that it was designed and built by Theodore Burr in 1803. It was the first major bridge that I had ever seen. The rest of the trip was along the south side of the Mohawk River, following what is now known as Route 20, until we arrived at Otsego.

Griggs: What happened after that?

Whipple: We farmed there for five years and I attended school during the winter months. In 1822, my father decided to move to Springfield Center, located on the northerly end of Otsego Lake, where he bought a new farm.

Griggs: So, at this time you were 17 years old with, I assume, many years of schooling behind you. You must have been ready to go on to college or to get a job, isn't that right?

Whipple: Well, not exactly. As I told you, I was one of the youngest members of my family. I had shown a great interest in learning and a certain ability, too. Since my father didn't need me in the fields, he encouraged me to pursue my studies, learn languages, play the violin and learn several trades such as carpentry and tinworking. I also had time to conduct my philosophical experiments.

Griggs: What were these philosophical experiments?

Whipple: Oh yes, you might not know what they are since you are one of the younger

generation. Well, we called what you call now physics, mechanics, electricity and such by the name natural philosophy.

Griggs: I see. What were some of your experiments?

Whipple: That was some time ago, but I do remember performing more than quite a few experiments on electricity and electrical phenomena.

Griggs: Did you attend college?

Whipple: Most certainly, I attended Hartwick Academy for several terms and studied under Dr. Hazelius. I also went to Fairfield Academy, located just outside of Herkimer, New York. I studied under Professor Avery there. It was at these academies that I first learned about Union College. At about 80 miles east of my home in Schenectady, New York, it was the best college in the area.

Griggs: So you went to Union?

Whipple: Yes. I first went to visit the campus and talked with Dr. Eliphalet Nott who was President of the College. He told me that many students came to Union to finish their college careers and that while I was a little older than most, 24 at the time, I could finish in one year if I did some self-study in Natural Philosophy, Law and other courses before enrolling in September of 1829.

Griggs: Did you look at other colleges, such as the Rensselaer School, which I understand was founded in 1824?

Whipple: Well, Rensselaer at that time was very small and Union was one of the larger schools in the country. President Nott had instituted a scientific option in 1828 which gave me the choice of pursuing something other than a classical course of studies.

Griggs: Tell me, what were your experiences at Union?

Whipple: As I said, I came into Union with ad-

vanced standing, so most of the courses I took were senior level courses. I took, for instance, differential and integral calculus; electricity, magnetism and optics; elements of criticism; astronomy; moral philosophy; chemistry; anatomy, *etc.*

As I recall, I excelled in every course. My strongest impression of the college was of its President, Eliphalet Nott. When you were in his presence, you just knew that he was something special. At this time he had already taken out several patents on wood stoves and was working on an anthracite burning boiler for the steamship Novelty. He was President of the college for 62 years, can you imagine that? Sixty-two years!

Griggs: When did you graduate?

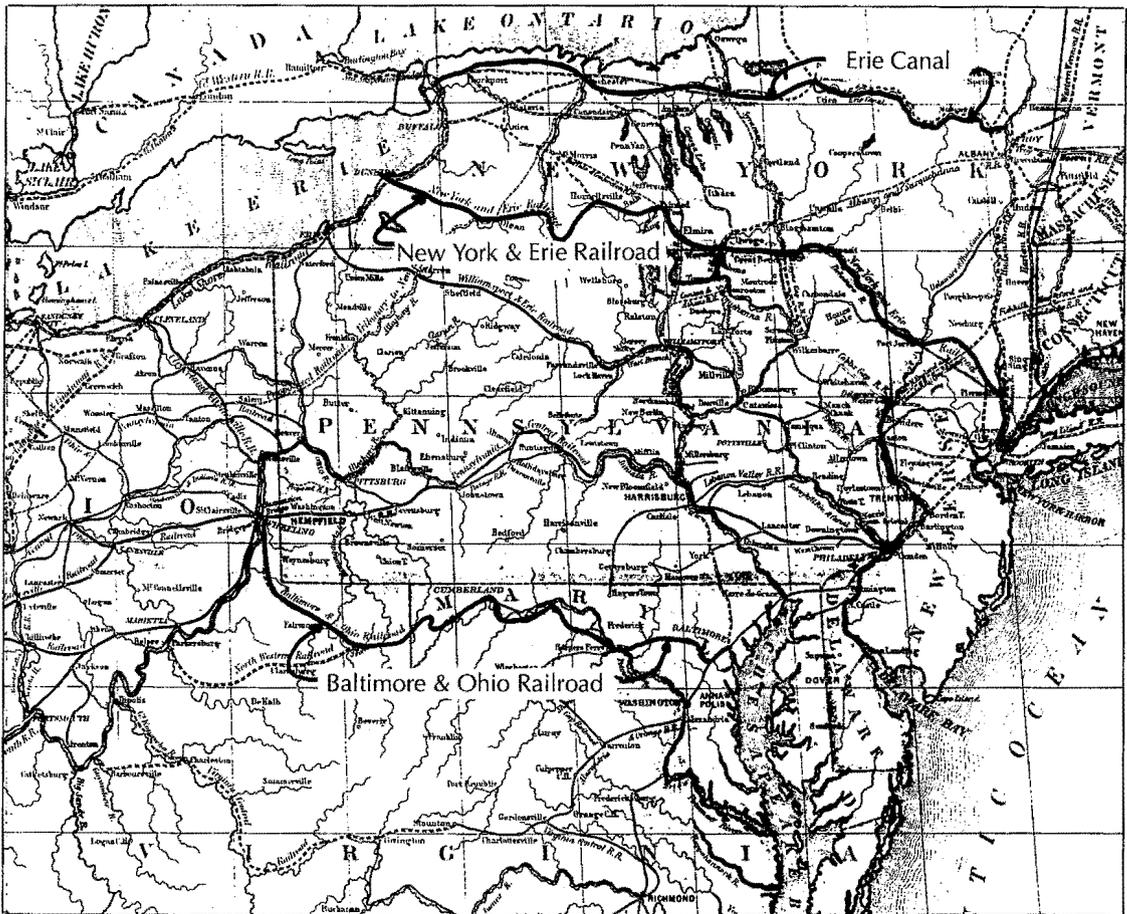
Whipple: I graduated in 1830. The graduation ceremony always was held on the third Wednesday of July. Each student had to deliver a talk on a topic of his own selection. I was very nervous about giving mine, which was incidentally on natural philosophy. While I feel comfortable putting my thoughts into writing, I was reluctant to speak in front of large groups — especially in front of President Nott and the other faculty.

Griggs: What did you do after graduation?

Whipple: By this time I knew that I wanted to go into the field we now call civil engineering and that meant into canal and railroad building. I talked with John Jervis, who obtained his early experience and reputation in the building of the Erie Canal, about working with him on the design and construction of the Mohawk and Hudson Railroad. It had a ground breaking ceremony only a short time after my graduation, and it was located only about a mile from the college.

Griggs: Can you tell me a little about the Mohawk and Hudson Railroad?

Whipple: Since Jervis already had a staff of assistant engineers that he had worked with on the canal, I didn't get the job, so I can't tell you first hand about it. I do know that it was built



A map showing the Baltimore and Ohio Railroad, the New York and Erie Railroad and the Erie Canal — all of which were projects Whipple worked on in the middle part of the nineteenth century.

to speed Erie Canal packet boat passengers from Schenectady to Albany. The canal was very slow along that stretch, since you had to go through the Waterford flight of locks and drop more than 200 feet from the Mohawk River to the Hudson River. As I remember it, Jervis used an inclined plane to come up out of Schenectady and to drop down into Albany. The first steam powered locomotive was the Dewitt Clinton, pulling the passenger coaches along the plateau between the inclined planes.

Griggs: Could you tell me a little more about Jervis?

Whipple: He was, like myself, a small man with an innate ability to look at a problem and come up with a reasonable solution. He started work

on the Erie Canal as an axeman and, I might say, as a protégé of Benjamin Wright. After that, he worked on the Delaware and Hudson canal, the Erie enlargement, many other canals and railroads, and finally the Croton Aqueduct Project, which fed water into New York City. I worked near him on many projects, but never for him.

Griggs: Where did you start your engineering career?

Whipple: I started as a rodman on the construction of the Baltimore and Ohio Railroad. They were just outside of Baltimore when I joined. They were building a staff of engineers to handle the detail layout and the design of the right of way. Col. Stephen Long and Jonathan Knight conducted the original surveys, and deter-

mined that it was feasible to build a railroad between the city of Baltimore and the Ohio River.

Griggs: It is very hard to read anything about the early days of engineering in the United States without constantly coming across those two men. Can you tell me a little about them?

Whipple: I knew Jonathan Knight on a personal level, since he was the engineering supervisor during the two years I worked on the railroad. What I could tell you about Col. Long is purely second hand. He left the railroad just before I arrived, so I never got to work with or for him.

Griggs: Why did Col. Long leave the railroad?

Whipple: The Government in 1824 assigned members of the Army with engineering or surveying experience to work with private companies who were building the canals and railroads to provide better access to the interior of the United States. The reason for this was that about the only school in America training men in this area was the military academy at West Point. Long was not a West Point man, I think he went to Dartmouth College, but his knowledge of mechanics and surveying got him a commission in the Army. He spent most of his early Army career as an explorer out west, especially around the Rocky Mountains and the Yellowstone River. When he was assigned to the Baltimore and Ohio Railroad at a level equal to Jonathan Knight, he got along very well in the early survey period. When they started construction, however, they had a major disagreement.

Griggs: What was the disagreement about?

Whipple: It seems that some members of the company went to England to look over what the English had done with their railroads and locomotives. They paid particular attention to George Stephenson and his work on the Stockton and Darlington Railroad. They noted that Stephenson had used masonry for all of his bridges. When they came back to the States, Knight and his assistant Caspar Weaver were convinced that all bridges on the Baltimore and Ohio should also be of masonry. Col. Long was

equally convinced that the overpass structures should be made of wood, since they would be faster and cheaper to build. Since no one knew how the railroad would develop, they could be discarded without great financial loss.

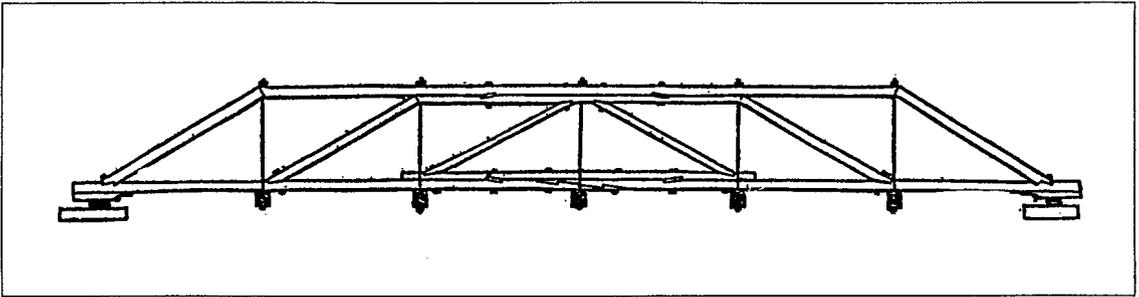
Griggs: What happened then?

Whipple: Long was given authorization to build a bridge of wood and Weaver to build one of masonry. Long built a wooden truss bridge which he called the Jackson Bridge in honor of President Andrew Jackson, and Weaver built the Carrolton Viaduct in honor of Charles Carrol of Carrolton, the last remaining person alive who had signed the Declaration of Independence, and who incidentally was at the ground breaking ceremony on July 4, 1828.

Both structures were magnificent, but I was amazed at Long's bridge because it seemed like a spider web in the sky with very light truss members. It was very different from the Burr Bridge at Waterford or the Timothy Palmer Bridge I passed in Easton, Pennsylvania. Long said that he simply used the law of the parallelogram of forces to size the members. At the time I didn't pursue this idea, but I always kept it in the back of my mind. The directors of the company decided to go with the Knight and Weaver masonry bridges, so Long decided to leave the project, with a great deal of chagrin, I might add.

Griggs: I've heard it said that the men of the Baltimore and Ohio really were attending the first school on railroading in the U.S. Is that true?

Whipple: We didn't call it that at the time, but in a sense it's true. When the excavation for the road was started, we didn't know what kind of rail or sleepers we were going to use or whether the cars would be horse drawn or drawn by steam locomotives. We didn't know what the maximum grade was that a horse or a locomotive could pull a carriage up, and we didn't know if we would be using inclined planes or not. When we started laying track, we set up test sections. These sections consisted of various ways of attaching the rail to the road bed to see which systems worked best. Before very long we determined that a wooden tie crossing



Whipple wood truss adopted by the Erie Canal Commissioners as the standard farm bridge to cross the canal (from *A Treatise on Bridge Building*).

under both rails was the cheapest and fastest method. As it turned out, that system was more than adequate for the job. I'll never forget seeing Peter Cooper, a great man by the way, and his Tom Thumb steam locomotive racing a horse drawn carriage back in 1830.

Griggs: How about the other engineers who worked on the railroad?

Whipple: It was a remarkable group. In addition to Jonathan Knight, Benjamin Henry Latrobe, Jr., Wendell Bollman and Albert Fink (all names I am sure you are familiar with) worked on the railroad. At that time, Bollman was a carpenter and Latrobe's brother also worked with us. This group had a very long career with the Baltimore and Ohio, with each making a contribution to iron bridge building. I didn't like their trusses, because I thought mine were more efficient, but nonetheless many Bollman trusses and Fink trusses were built in the 1850s.

Griggs: How about Latrobe? We've heard a great deal about him.

Whipple: Latrobe's father was one of the leading architect/engineers in the U.S. in the early nineteenth century. Since he had been educated in England, his talents were in great demand when he came here. Benjamin, Sr., sent his two sons off to college, Benjamin, Jr., to be a lawyer, and his brother to be an engineer. Much to his surprise, as Benjamin, Jr., told me after their graduation from college, they switched careers and both became important to the company. Benjamin was Chief Engineer and his brother

was Company Attorney, Historian, Painter and more. I can't recall a time in my career in which I worked with such an impressive a group of men. They were all dedicated to their work, intuitive and imaginative. And, above all, they were all good friends.

Griggs: Why did you leave the Baltimore and Ohio?

Whipple: We were making good progress and were converging on Point of Rocks, Maryland, but so was the Chesapeake and Ohio Canal. The route on the south side of the Potomac River that we both wanted to go through was very narrow, and it was thought by some that both a canal and a railroad would not fit through it. It turned out that the Chesapeake and Ohio had more friends in the Congress than the Baltimore and Ohio did, so we were stopped from proceeding further. Actually, work stopped from sometime in 1832 to the middle of 1833. After we had installed our track as far as we could go, there was very little work to do so I resigned and headed back home to New York.

Griggs: Could you have stayed on?

Whipple: Yes, but I wanted to get on with my career and I heard that plans were being made to enlarge the Erie Canal. A fair number of engineers were needed on that project. Another factor was that my father had been killed when his team of horses had run away and overturned his wagon. I thought that my mother could use my support.

Griggs: Anything else about the Baltimore and

Ohio before we move on to the Erie Canal enlargement?

Whipple: Well, in addition to the experience I obtained and the men I worked with, I also had the opportunity to work with the first transit made in the United States. It was made by a man named Young from Philadelphia, I think. It was much lighter than the English theodolites we had worked with before. It also gave me the idea that I might be able to make a better transit.

Griggs: So then you went back to work on the Erie Canal?

Whipple: Yes, I moved to Utica, New York, and worked in the offices of Holmes Hutchinson. We surveyed the existing canal and prepared plans for enlarging the canal from the original 40' × 24' × 4' prism to 78' × 50' × 7'. The locks were also increased in size to handle larger barges. In addition to his being a good friend, Holmes was a great man to work for. His experience on the original Erie and other canals since then was unmatched.

I also did a great deal of surveying for building lots in and around Utica in my spare time, and oh, before I forget, I almost died of smallpox in 1833 during an epidemic. You probably noticed the pox scars on my face. I started wearing a beard after that to cover up some of the marks. Some people think my beard is a little shaggy. What do you think?

Griggs: I think it is distinctive. How long did you work on the enlargement?

Whipple: I was there, on and off, until 1836.

Griggs: What do you mean by "on and off"?

Whipple: In those days there was very little security in your job. When work was slow, you were let go.

Griggs: What did you do in those slow times?

Whipple: I tried my hand at making mathematical instruments and surveying instruments that were better than those currently available.

So, in my spare time, I designed and sold all kinds of instruments to other engineers. I also built myself a house up on Steuben Street on a lot that George Hooper gave to me as a part of the fee for my survey and subdivision of his father's estate.

Griggs: Was there anyone else you worked with on the enlargement project that made an impression on you other than Holmes Hutchinson?

Whipple: Oh, yes. There was John Jarvis again, Julius Adams, John McAlpine and, maybe the most important, Edwin F. Johnson. He was a Norwich University graduate and he became one of the great railroad engineers of my generation. I had the good fortune to work with him on several railroad projects.

Griggs: By this time in your career you had worked on a major railroad project and a major canal project. Did you have any thoughts at that time as to which of the two would win out in the end?

Whipple: Time has answered that, of course. But in the 1830s no one was sure of the potential of the railroad and particularly of the steam locomotive. We also had a great deal of experience with canals as did the English. We knew what a canal could do and weren't sure, then, what a railroad could do. So yes, I think the enlargement plans for the canal made a lot of sense.

Griggs: Do you want to take a break for a while?

Whipple: No, I find this to be very stimulating. Even though I came into this interview with some misgivings, I am really enjoying talking about my career and the people I've met along the way.

Griggs: Okay, let's talk about your next position.

Whipple: That would be on the New York and Erie railroad. I went as Edwin Johnson's assistant to lay out the railroad. It was planned to run from a point just north of New York City at



Whipple bowstring truss restored on the campus of Union College. It was originally built across the Erie Canal and later built across a stream in Johnstown, New York. It has been designated a National Historic Civil Engineering Landmark.

a town called Piermont along the southern border of New York state up to a point on Lake Erie. The preliminary surveys had been conducted by Benjamin Wright and by a man who was just starting to make his mark in the engineering profession, Charles Ellet. In 1835, they had made a report to the directors stating that a railroad could be built and gave a preliminary route and a working budget.

I never met Ellet at this time, but from his report and writings, I knew that he was a man to watch. We had the job of surveying the final route the road was to take between Piermont and Painted Post. After a fast start in 1836, money ran out in early 1837 and Johnson had to lay us all off. That was my experience with the New York and Erie until I was to build a few iron bridges for them in the late 1840s.

Griggs: What did you do then?

Whipple: I moved back to Utica, married Anna Case in 1837 and was employed on and off doing canal work, small railroad jobs, local surveying and instrument making. In 1839, I began work with Johnson again on a survey for a railroad running from Ogdensburg to Lake Champlain in New York. I had the easterly portion to survey and lay out, and H. Lee had the piece out of Ogdensburg.

The road was eventually built, but not along my route. I mentioned in my report that the gradient would be much better if the easterly terminus point were not on the west shore of Lake Champlain at Plattsburg but should be shifted north into Canada. That recommended route was eventually followed.

Another interesting point I could make, and few people know this fact, is that I inscribed two cross hairs on the lens of my level in such a way that I could measure distances from the level to the rod without the use of chainmen. Today they're called stadia hairs, but I did it in 1839 and mentioned in my report to Johnson that it was an excellent technique to use in preliminary surveys.

Griggs: As I understand it, it was in 1840 that you started working on your own. Is that true?

Whipple: Yes it is. If I may express a little self-satisfaction, I think that this was to be the most creative decade of my life.

Griggs: Can you give me some examples?

Whipple: First of all, in August 1840, I had been thinking about the sad condition of the wooden bridges that crossed the Erie Canal and the speed at which the wood would rot. The lifetime of a wooden bridge was only 8 to 15 years. I also thought back to Long's Jackson Bridge and his parallelogram of forces idea. Having read in the English journals what they were doing with cast and wrought iron, I started to work on a method to design an iron bridge. In almost no time I had a design method and an estimate of the cost for a bowstring truss that used cast iron for the compression members and wrought iron for the tension members, and had a wooden deck that could be replaced without affecting the strength of the bridge.

I went to visit Oliver Shipman, an ironmaker in Springfield Center who incidentally had married my sister Sophronia, to talk about making castings to my plan. He said that it would be an easy task. I then tried to convince the Erie Canal Commissioners to fund the construction of an iron bridge to my design over the canal. They would not take a chance on it so, after applying for a patent, I took \$1,000 of my own money and built my first bowstring truss. I placed it on a lot adjacent to the drug store in Utica, so that the Canal Commissioners and the public could see what I had in mind. It was a beautiful sight and everyone who saw it gave me their support, except of course for the Canal Commissioners.

I received the patent in 1841 which was good for 14 years. Around that time Earl Turnbull built an iron bridge across the canal at Frankfort, a small town east of Utica. It was a cast iron beam with wrought iron suspension rods much like the English used and was called a trussed beam. Due to poor bracing, it fell into the canal shortly thereafter. Fortunately for me another wooden bridge fell into the canal, and the Commissioners gave me a contract for about \$700 to put my bridge across the canal at Newville near Rome, New York.

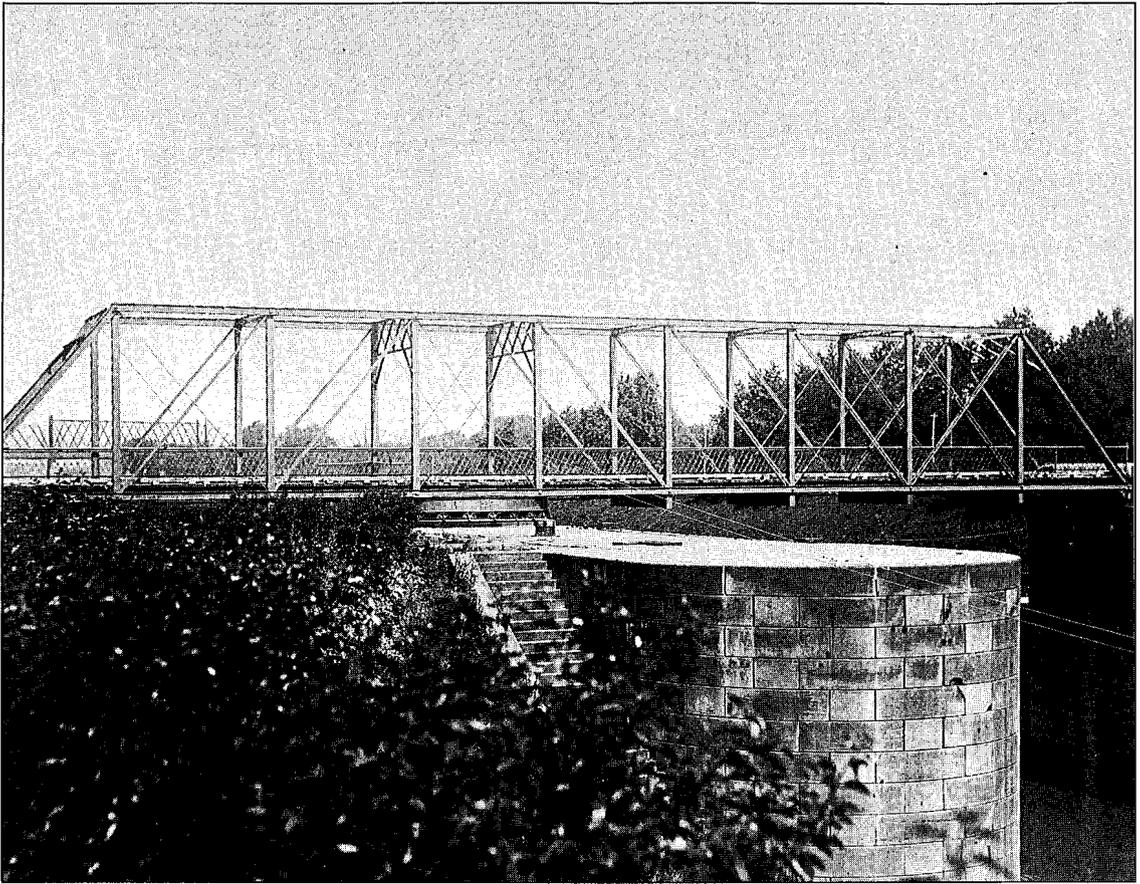
Griggs: So that's how you got into bridge building?

Whipple: Yes, and I might also mention that in 1841 I received a \$10,000 contract to design and build the first weigh lock scale on the enlarged Erie Canal. This scale, which was to be installed in a new weigh lock building in Utica, had to be able to weigh a boat of up to 300 tons. I didn't apply for a patent on this scale, but it worked fine and is still working today I might add, and was the scale adopted for other weigh locks built on the canal.

Griggs: This is fascinating. What else did you do during that time?

Whipple: Well, in 1842, I set out to prove to myself by using my scientific analysis of trusses, which no one else in the world knew, or had written about, that the bowstring was the best possible truss from a cost and load carrying standpoint. To my amazement, and later satisfaction, I found that a trapezoidal truss with double-cancelled diagonals was more efficient for long spans that were heavily loaded. Thus was born what I called the Whipple Trapezoidal Truss that also used cast iron for compression members and wrought iron for tension members. I then built several bowstrings across the canal and issued licenses for others to build my bridge for a fee, of course. Some people tried to go around my patent by making small changes, but most of these structures were unsuccessful because they did not know how to analyze them scientifically.

Griggs: And that is why you decided to write a



Swing bridge built over the Portland Canal at Louisville, Kentucky, in 1865. It is similar to one built in Buffalo, New York (photo courtesy of the Filson Club).

book to inform the world about your bridge-making method?

Whipple: I felt that if truss bridge building, and particularly iron bridge building, was ever going to be accepted, the bridge builders must be able to put away their "cut and try" methods and adopt a scientific method which I, and only I, knew. So in 1847 I published my *Treatise on Bridge Building*. It was a little book, but I am confident that it had a major impact on my chosen profession.

I was particularly pleased that my old friend Edwin Johnson reviewed the book in the *American Railroad Journal*, which was the journal that was most read by my fellow engineers. You may not know this, but I also wrote another book in 1847 entitled, *The Way to Happiness*, which in my opinion was a first rate little book, but one that did not have much impact at the

time. But I was pleased for having done it. In it I described my philosophy on life and what it takes to make yourself and those around you happy. You ought to read it. Union College still has a copy, I think.

Griggs: Could you summarize the message of *The Way to Happiness*?

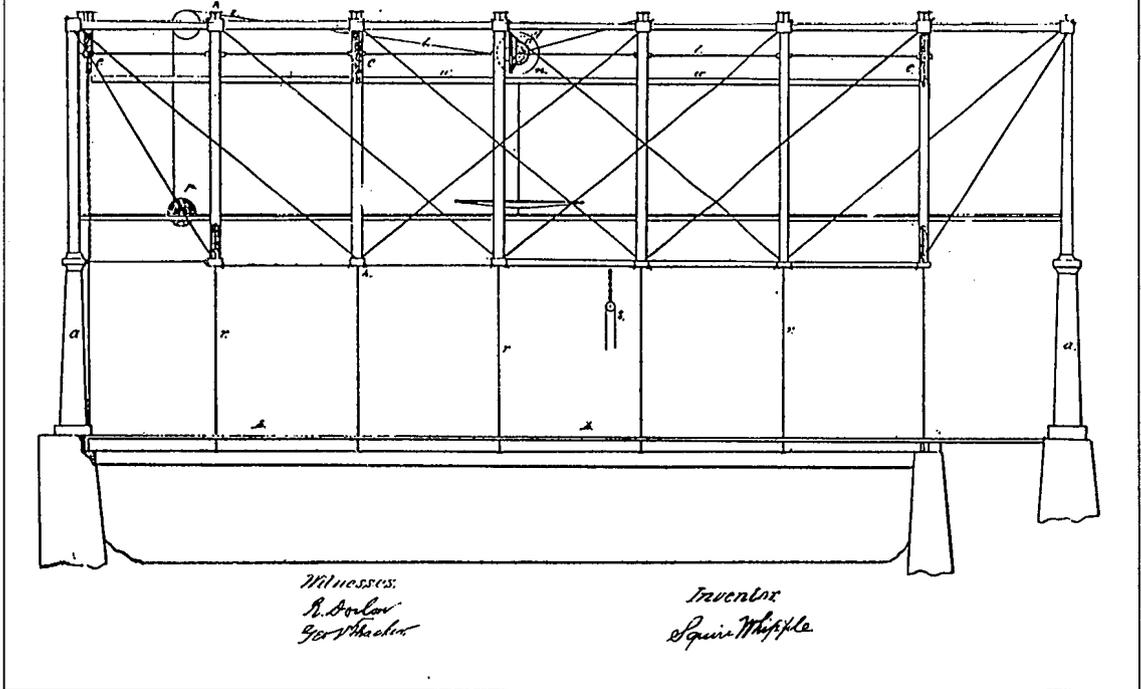
Whipple: That's a tall order, but I think that a quote from my concluding chapter sums up my philosophy fairly well. It reads: "If all would labor reasonably, spend economically, associate freely and extensively, all might enjoy plenty, all might, and would probably be enlightened, polite and agreeable, all might enjoy to the full, the sweets of social intercourse, and the benefits of private study and reflection, the pleasing alternations of labor and ease, and be in all respects as happy as is consistent with the

S. WHIPPLE.
Lift Draw-Bridges.

No. 134,338.

Patented Dec. 24, 1872.

Fig. 1.



Patent drawing of the vertical lift span built across the Erie Canal at Hotel Street, Utica, New York, in 1871-1872. Its design was copied by many along the canal.

nature of things. What more can the heart of man wish or hope?"

Griggs: Those are some excellent thoughts. So that was it for the 1840s?

Whipple: Well, not entirely. I decided that it was time that iron bridges were given a try on the railroads. Fortunately, my old friend Julius Adams, whom I had met on the Erie Canal enlargement, was Resident Engineer on the Newburgh Branch of the New York and Erie Railroad that was then making rapid progress. Adams had faith in my ideas, so he gave me a contract to build four iron bridges on the Newburgh branch. I built a bowstring, a trapezoidal and two so-called Warren Girder Deck bridges in 1848 and 1849.

They were all designed for a load of 2,000 pounds per foot and worked fine up until 1850 when, as a result of an iron bridge failure on the

New York and Harlem railroad, the company decided to replace all iron bridges on the line with wooden ones. This bothered me greatly since I had written letters to newspapers and the *American Railroad Journal* stating that a bridge I had inspected just like the one that collapsed, a Rider Bridge, was unsafe and very deficient in member size. So when the Directors of the New York and Erie ordered my bridges removed in 1850, even though they were performing perfectly, I felt I had to make my position clear in another letter, this time written directly to the Board of Directors with a copy to the New York City newspapers. Needless to say, I did not receive any more calls from them to build iron bridges.

Griggs: That brings us to the 1850s — the decade in which the Erie Canal enlargement was finally funded. Did you play a role in the enlargement?

Whipple: As I mentioned earlier, I did build several iron bridges over the canal in the 1840s and they all had performed very well. When the Canal Commission was considering a new method of funding the enlargement, I urged them to specify that all major bridges — that is, not farm bridges — should be made of iron. In 1852, they made the decision to go with iron bridges. As a part of a “big letting,” they put out to bid at one time all of the work remaining on the enlargement. I, of course, placed a bid to build iron bridges using my bowstring plan. Other firms that had virtually no experience in iron bridge building also submitted proposals for various plans of bridges. To my dismay, a contract to build all of the iron bridges went to Erastus Corning’s firm located in Albany. The decision of the Canal Commissioners was, as they stated, purely political. So even though my bid was lower, it was rejected in favor of Corning’s. I might add that he was now my neighbor, since I had moved to Albany, New York, in early 1850.

Griggs: Did he build them all?

Whipple: No, fortunately for me and, I think, for the State, the State Supreme Court declared that the method of financing the enlargement was unconstitutional. All of the contracts were therefore voided. I then bid on the bridges, and with my nephew James M. Whipple we built a hundred or so across the canal. All of these bridges performed well. I also licensed several other firms to use my plan for a fee. As a result, my bridge was almost the standard iron bridge on the canal. I might add that the Canal Commissioners also accepted my design for wooden farm bridges that crossed the canal. So, in answer to your earlier question, I would say yes, I played a role, quite possibly a major one, in the enlargement of the Erie Canal.

Griggs: Did that occupy you for the entire decade?

Whipple: Oh, no. I was also building roadway and railway bridges across the state. One of my most visible bridges was a five-span bridge to Goat Island just above Niagara Falls that was built in 1851. It was during that project that I

met John Roebling. He was starting the construction of his suspension bridge just below the falls.

Griggs: You knew Roebling?

Whipple: Oh, yes. I first became aware of him through his letters and articles in the *American Railroad Journal*. He, for instance, wrote to the journal commenting on the failure of the Astabula Railroad Bridge as I had also done. So we knew each other through our writing, but I met him for the first time at Niagara Falls.

A funny thing was that in my 1847 book on bridge building I inserted a small section on suspension bridges in which I wrote that while I hadn’t spent much time on this type of bridge, I had heard about plans to span the gorge with such a bridge that was to carry both rail and wagon traffic. Several engineers submitted plans and proposals for this bridge and all of them had one very wide deck with rail and wagon traffic side by side with pedestrians. Charles Ellet received the contract, but after building only a foot bridge, he was discharged and the contract was given to Roebling. Well, getting back to my point, I had suggested in my book that the bridge be made a double deck bridge with rail traffic above and pedestrian and wagon traffic below. It seemed to me that this would make for a much stiffer deck. Well, when Roebling got the contract, he recommended to the Board that he be allowed to build a double deck bridge, which of course he did, and it’s still standing today.

Griggs: What kind of a man was Roebling?

Whipple: He was completely absorbed by his work and he was a man who did not suffer fools well. We got along very well, because in addition to our technical backgrounds, we both fancied ourselves to be philosophers of sorts and we both were musicians of sorts, too. Even though it was early in his career, and he had only built a few small bridges in Pittsburgh and on the Delaware and Hudson canal, I knew that Roebling had unlimited potential. His Brooklyn Bridge that opened after 14 years of construction, and 14 years after his death, is a fitting capstone to his career.



Whipple double intersection truss built in 1871 near Sing Sing, New York. His wife, Anna Case Whipple, is the woman standing near the center of the bridge. This bridge was one of the last that Whipple designed and built (photo courtesy of the Texaco Co.).

Griggs: Did you know Charles Ellet, one of Roebling's greatest competitors?

Whipple: I never met the man, but of course I know of his Fairmount Suspension Bridge as well as his Wheeling and Niagara Bridges. I also had read his articles in the railroad journal and his report on the location of the New York and Erie Railroad. It is a shame he had to die at such a young age in the Civil War.

Griggs: Did you do any more work on railroad bridges in the 1850s?

Whipple: Oh, yes. I almost forgot, but I did build two trapezoidals of long span in 1852 and 1853. The first bridge was on the Utica and Black River line where it crossed the Mohawk River near Utica, and the other one was for the Troy and Schenectady Railroad near west Troy, New York, across a branch of the Hudson River. These bridges have both served very well up to this day even though the loads on them are much larger than I designed them to hold. I would suspect that they will have to be removed soon since the size of locomotives is very rapidly increasing.

Griggs: Is there anything else you would like to tell us about that decade?

Whipple: Maybe this is a small thing, but it may give you an appreciation of the state of engineering in the 1840s and 1850s. Many iron bridges were falling down during this time. The primary reason was that few people knew how to design them scientifically. It seemed that my book did not reach that many bridge engineers. I then decided to write a series of articles for the *American Railroad Journal* and *Appleton's* magazine in which I described my methods of bridge design. The articles were very well received, and I hope they made a contribution to the science of bridge building. I might add in passing that my friend Julius Adams was then serving as editor of *Appleton's*.

Griggs: That sounds like a very full decade and one in which you, by your efforts, advanced the science of iron bridge building from an experimental stage to an accepted technology. You must have felt very pleased with yourself.

Whipple: Thank you. I probably feel better about it now looking back than I did then.

Griggs: Why is that?

Whipple: I never liked the business end of bridge building. It seemed I was always trying to get clients to pay me, fighting patent infringement cases in court, or collecting fees from people who had agreed to pay me for the use of my patent. It seemed to me then that it was very burdensome and did not give me much satisfaction. So I decided in 1860 to retire from the practice of bridge building and turned the business over to my nephew J.M. Whipple.

Griggs: That is almost like retiring at the peak of your career. As a relatively young man of 56, what did you do with your life for, say, the following twenty years?

Whipple: During the Civil War and thereafter, I spent a lot of my time writing and printing pamphlets on various topics and preparing an appendix to my 1847 bridge building book which I published myself in 1869. I also spent a

lot of time in the courts trying to receive payment for work I had done in the 1850s, but I became a little restless and decided to take on a few bridge building jobs. I built an iron swing bridge over the Portland Canal near Louisville, Kentucky, several trapezoidal bridges in southern New York and some lift and swing bridges over the Erie Canal in the early 1870s.

Griggs: Can you tell me about the lift bridges?

Whipple: Of course. I had seen that as our cities along the Erie Canal grew and the boats kept getting larger, that fixed bridges made it difficult to improve on the streets and stores along the street. I then conceived of designing an iron lift bridge with a movable level deck that would solve the problem nicely. I received a patent on this type of bridge and built the first one on Hotel Street in Utica in the early 1870s. Many people copied the design and used it on the canal, but I never received any patent fees. I was getting too old and tired to enter in a legal fight again. I was just happy that I had done it and that it had worked and is still working well today.

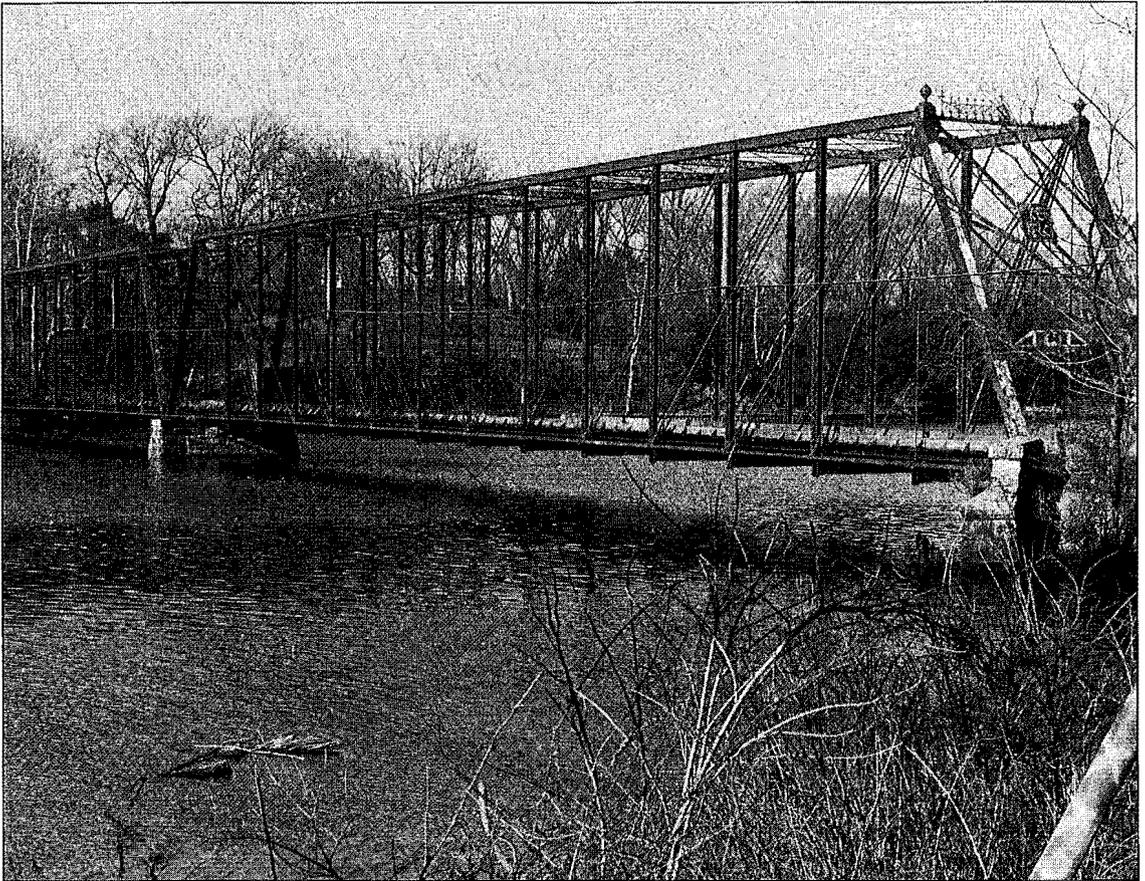
Griggs: What else did you do after that?

Whipple: I continued to write, worked on my philosophical experiments, read the technical journals and, on occasion, attended meetings of the American Society of Civil Engineers.

Griggs: Were you a member of ASCE for long?

Whipple: When the Society was first formed in 1852 I was so busy with my own work that, unfortunately, I did not have time to travel to distant meetings. That was the case with other civil engineers, so the Society disbanded just before the Civil War. After the war, however, I was not as busy, and I started attending meetings and, much to my surprise and pleasure, I was elected an honorary member in 1867, the first person to be so honored after the reconstitution of ASCE. John Jervis was elected an honorary member shortly after me.

Griggs: As I understand it, you wrote a great deal then, becoming a fairly regular contributor



A Whipple double intersection truss built in the 1880s in Indiana (photo courtesy of Donald Ward).

to the transactions of ASCE?

Whipple: Yes. I felt then as I had in the 1850s that if successful practicing engineers shared their knowledge and skill with other members of the profession, we would all be the better engineers for it. Perhaps my best contribution was in a series of articles that James Eads and I did on the most efficient bridge structure to use—whether an arch like he had used in St. Louis, or a long span truss which I was proposing.

Griggs: I read those articles. I think that you proved your point well as you seemed to have done throughout your long and distinguished career. Before we close this interview would you give us a list of those men you were associated with that you felt made the greatest contributions to civil engineering practice in the nineteenth century?

Whipple: That is a big order, but the names that come to mind, not in any rank or order are: John Roebling, Charles Ellet, James Eads, Edwin Johnson, Holmes Hutchinson, Julius Adams, Benjamin Wright, Canvas White and Benjamin Latrobe. There are many more that I will probably think of as soon as you leave, but those men stick out in my mind.

Griggs: Thank you, Squire, for taking the time to talk with me. I am sure that your fellow engineers will be appreciative of the thoughts and words you have expressed in this interview and the perspective you have given them on the period of time from 1830 until 1880. I only wish that I had the opportunity to talk with some of those engineers that you mentioned. The profession would be a better one if we took more time in tapping the wisdom of our senior members. Thanks once again.

Whipple: Thank you for listening to an old man talk about the way it was. I wish you luck on your future interviews.

NOTE — *The Committee on the History and Heritage of American Civil Engineering (CHHACE) of ASCE urges local sections to institute programs that will lead to the building of a tape library of conversations, much like that with Squire Whipple, to be housed in the Engineering Societies Library in New York City. For information on the details of interviewing, recording and making your tapes, contact Herb Hands at the American Society of Civil Engineers, 345 E. 47th St., New*

York, NY 10017-2398, (212) 705-7496.



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