Lowthrop Truss Bridge
On West Main Street, over the south
branch of the Raritan River
Clinton
Hunterdon County
New Jersey

HAER No. NJ-19

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10-CLIN,
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
National Park Service
U. S. Department of the Interior
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Lowthrop Truss Bridge

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Location: On West Main Street, over the south branch of the Raritan River
Clinton, Hunterdon County, New Jersey

Designer: Francis C. Lowthrop

Fabricator: William and Charles Cowin of Lambertville, New Jersey

Present Owner: Hunterdon County Department of Highways

Significance: The Lowthrop Truss Bridge represents an early type of iron truss that dominated bridge construction from the 1850s to the 1870s. Fabricated in 1870 by William and Charles Cowin of Lambertville, New Jersey, the bridge follows the Pratt configuration in the arrangement of its trussing members. It is of composite construction, with all compression members made of cast-iron and all tension members made of wrought-iron. In the Pratt truss, the vertical posts and horizontal upper chord are in compression and are made of cast-iron; the diagonals and bottom chord are in tension and are made of wrought-iron. Cast-iron members and lower chord connections are based on truss bridge patents received by Francis C. Lowthrop of Trenton, New Jersey, during the 1860s and 1870s.

After 1870, engineers and fabricators favored bridges made exclusively of wrought-iron, as this material performed equally well whether subjected to tensile or compressive stresses. After 1890, wrought-iron was supplanted by the stronger material steel. Lowthrop Truss Bridge, one of few known surviving examples of this type, is representative of the short-lived era (20 years) of composite cast and wrought-iron bridge construction. The Lowthrop Truss Bridge has been in service for over 100 years with only minor modifications, thus attesting to the soundness of its design, quality of craftsmanship and care of maintenance. It remains a distinctive feature of the town of Clinton, New Jersey. The following article was taken from the November 11, 1920, Engineering News-Record and contains much information on the history of F. C. Lowthrop. Please note that two

Lowthrop trusses in Clinton, New Jersey, are discussed, one dating to 1859 and the other to 1870. Only the 1870 structure survives.

Project Information: This recording project is part of the Historic American Engineering Record (HAER), a long-range program to document historically significant industrial and engineering sites in the United States. The HAER program is administered by the National Park Service, U. S. Department of the Interior.

Fieldwork on the bridge was completed during the summer of 1975 by the National Park Service, under the general direction of Douglas L. Griffin, Chief of HAER. Measured drawings, historical reports and photographs were prepared under the direction of Eric DeLony, Principal Architect, HAER. The 1975 measuring team consisted of Robert M. Vogel, Curator, Division of Mechanical and Civil Engineering, Museum of History & Technology, Smithsonian Institution; Arnold David Jones, HAER Architect; student architect R. Belmont Freeman (University of Pennsylvania) and volunteer Robert K. Holton, Essex Falls, New Jersey. Student architect Carolyn Givens (University of Kansas) completed measured drawings of the bridge during the summer of 1985. Formal photography was done by Jack E. Boucher and historical research was conducted by Donald C. Jackson, HAER Historian/Engineer.

Transmitted by: Jean P. Yearby, HAER, 1987

In response to a letter of inquiry regarding Mr. Lowthorp and his bridges addressed to his son Francis C. Lowthorp, Counsellor at Law, Trenton, N. J., the latter has given many interesting details. From his letter the following extracts are taken:

My father, born 1810 in New York City, died June 1, 1890. He was a delicate child and was placed under the care of his uncle, the late Dr. John Lilly, of Lambertville, who succeeded in making a rugged man of him, putting him into an outdoor life as a surveyor and engineer. He worked under Ashbel Welch on railroad and canal construction for a time. He went into the service of the Lehigh Coal & Navigation Co. and designed and superintended construction of some locks in its canal with a great lift. Afterwards he became bridge engineer for the Lehigh Valley R.R. Co. Among other bridges he designed the first railroad bridge across the Delaware at Easton, connecting the Lehigh Valley R.R. with the New York Central and the Belvidere & Delaware R.R., a structure carrying tracks on two levels. In 1857, acting as engineer for Cartwright & Co., the contractors for the Catasauqua & Foglesville R.R., he completed the Jordan Creek bridge, not far from Allentown, Pa. This was very adversely criticised by some other engineers, and the prediction was made that it would fall with the first train to attempt its passage. It turned out to be one of the longest-lived bridges he ever built; I think it stood for about fifty years, despite the constantly increasing weight of rolling stock.

Some years after the completion of that bridge my father started into the engineering and contracting business on his own responsibility. He used compressive members of cast iron, as you know, and held to that plan for many years despite the competition of others who used wrought-iron (and afterwards steel) compressive members.

According to the same authority, Mr. Lowthorp designed more than a score of bridges for the Newark & New York R.R. when this was built, and most of the bridges on the New York & Long Branch R.R. These latter included the Raritan Bay crossing, containing a swing span that was probably the longest ever built up to that time. He also built the original Newark Bay draw of the Central R.R. of New Jersey, besides other bridges on that road, and several bridges for the New York, New Haven & Hartford R.R.

Mr. Lowthorp took out patents on his designs of swing bridge centers and turntables; the latter in particular came into wide use, some twelve being furnished to the Union Pacific alone.

While the Raritan Bay draw was replaced after very short use, its removal and replacement by another bridge was not chargeable to any defect in the design or any structural objection to the bridge, but resulted from competitive railroad policy. Immediately after its erection, litigation developed, in the interests of the Pennsylvania R.R., which was engaged in a campaign to obtain an interest in or control over the Long Branch road to secure access to the seashore resorts. The claim was made that the bay crossing constituted an obstruction to navigation. After the success of the campaign, the bridge was replaced by a new structure.

Distribution of Snake River Water During Greatest Drought

Continuous Flow Supercedes Intermittent Flashes —One Man Handles Storage and Natural Flow Like Train Dispatcher

THE Snake River in Idaho is one of the State's greatest resources since it supplies water to a large percentage of the total irrigated area. Policing the stream and distributing the water to the respective users in accordance with their rights is one of the most important duties of the state. From Jackson Lake storage reservoir on the headwaters in Wyoming to the Milner dam, by which the two Twin Falls irrigation companies divert the last of the stored water, the distance is 300 miles. Intervening are more than 50 headgates, which

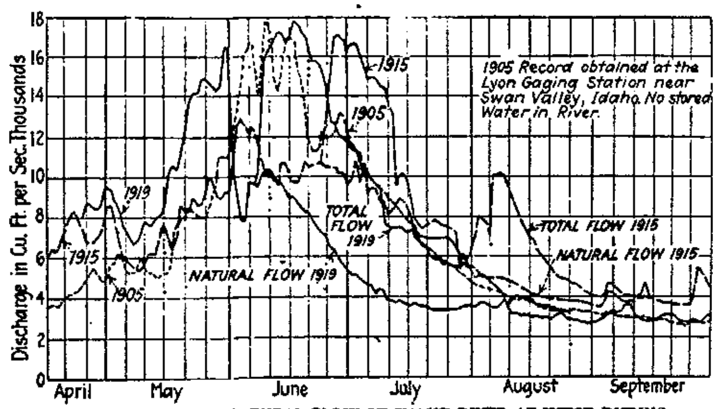


FIG. 1—TOTAL AND NATURAL FLOW OF SNAKE RIVER AT HIESE DURING THREE YEARS OF DROUGHT

by court decrees have priority rights of various dates. To apportion the stored water and natural flow properly to the rightful owners when there is not enough to go around and late decrees must be cut off in successive order is a difficult task. It requires an intimate knowledge of the hydrography of the river, backed up by daily readings at the numerous gaging stations, and necessitates frequent changes of the canal headgates and storage reservoir outlet gates. Like a train dispatcher, the officer in charge of the distribution turns loose in a continuous flow a definite quantity each day and must order the proper number of gates opened to care for it as well as the natural flow, plus or minus the amounts gained or lost in transit. Unlike the train dispatcher, his container as well as cargo must all be delivered at the end of the run.

Only within the last two years has one man been placed in complete control of the whole river but the results have been so satisfactory it is not likely multiple control will again be revived. By a co-operative arrangement effected with the U. S. Geological Survey, it became possible to centralize under the control of one man both the hydrometric or stream measurement work and the distribution. This consolidation of State and Federal functions is a departure from the old method and has a distinct advantage in that there is no lost motion in obtaining the fullest and most complete information concerning all phases of the river work. Another

Sixty-Year-Old Iron Bridge in a New Jersey Village

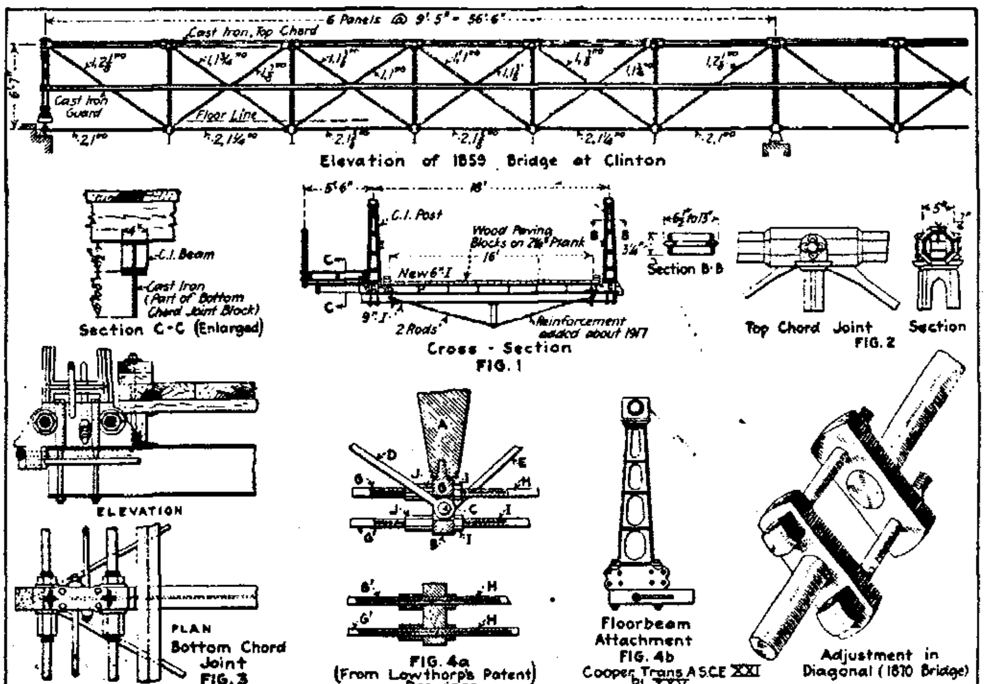
Oldest of Several Lowthorp Truss Highway Crossings of Raritan at Clinton and High Bridge Carries Regular Road Traffic—Floor Recently Strengthened—F. C. Lowthorp a Pioneer Iron Bridge Builder

By R. Fleming
American Bridge Co., New York City

IN THE village of Clinton, N. J., are two iron bridges built in 1859 and 1870, respectively, that interest the engineer not only by their age but also by their type. The older of the two, though it has seen full sixty years of service, is still in excellent condition, with no discoverable change of importance except a recent strengthening of the floor system. These structures represent an early type of iron bridge, now long extinct but at one time extensively used; little mention of the type is found in the writings of our standard authorities on bridges, though Francis C. Lowthorp, its originator, was a prominent bridge builder of his day. The type furthermore is an excellent representative of the combination structure of cast and wrought iron which played so large a part in bridge construction about fifty years ago, dominating the field for a time.

Both the bridges mentioned cross the South Branch of the Raritan River; the 1859 bridge consists of three spans of 56½ ft. each, and the 1870 bridge of two 85-ft. spans. Two other Lowthorp bridges over the same stream at High Bridge, some miles distant, bear the dates 1867 and 1868. Most of the illustrations given in the following, however, relate to the older of the two bridges at Clinton.

As shown by the drawing Fig. 1, made from measurements taken at the site by the writer, a Pratt web system is used in the bridge (the Pratt patent was issued in 1844). The compression members (top chord and posts) are of cast iron, while the tension members are of wrought iron. In sections of the top chord is cast the inscription, "Built for Hunterdon County by Wm. & Chas. Cowin, Lambertville, N. J., 1859. Lowthorp's Patent June 30 & Nov. 3, 1857." Because of the increasing traffic loads, the floorbeams were reinforced by kingpost trussing in 1917 or '18, as shown in the cross-section, and steel joists were added. As the road was being macadamized, wood paving blocks were laid on the plank floor. So far as determinable, all the rest of the bridge is old.



FIGS. 1 TO 5. LOWTHORP HIGHWAY BRIDGE OVER SOUTH BRANCH OF RARITAN RIVER AT CLINTON, N. J., BUILT IN 1859

Fig. 2 shows a top-chord joint and Fig. 3 a bottom-chord joint. This same bottom-chord joint is shown in the photograph of an intermediate post, Fig. 6. Mr. Lowthorp's patent of June 30, 1857 was based on a bottom chord joint as shown in Fig. 4a (reproduced from Patent Office Report, 1857). The claim of the patentee is, "The straining piece *B*, in combination with the rods *G* and *H*, when the latter are connected to the plate substantially in the manner set forth, and when the said plate is arranged to receive the vertical or verticals *A* and *D*, *E* of iron truss frame bridges."

The floor beams are 9-in. wrought iron I's with 4-in. flanges and ½-in. webs, now reinforced by trussing. They are fastened at each end with 4 bolts to the cast iron "straining piece." The beams bear the imprint, "Patented Dec. 1, 1857." The main and counter diagonals have screw adjustment at the lower ends, and the bottom-chord rods are connected longitudinally with screw "swivels" or sleeve nuts at each panel-point. All screw ends are enlarged. The diagonal bracing in the plane of the bottom chord consists of a pair of rods in each panel.

The workmanship of the bridge was excellent. This is evidenced by the fact that it has lasted 60 years and is still in good condition. The bridge presents a much better appearance today than the majority of pony trusses built at a later date. It is, however, frequently overloaded. During the two hours while measurements were being taken there passed over the bridge 35 automobiles, 2 auto-trucks and 2 teams, and later in the day a large moving van from a city 50 miles distant. The writer was told of an auto-truck that crossed a day or two before loaded with 12 tons of cement. Even allowing for exaggeration in this statement, it confirms the writer's opinion that auto-truck loading unless more effectively restricted than at present will result in the failure of this and other old highway bridges.

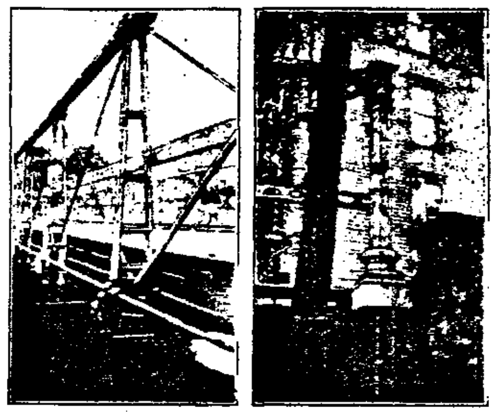
As well as can be judged, the bridge was probably designed to carry a moving load of 50 lb. per sq.ft. on the roadway. The floorbeam reinforcement and the wood paving blocks add 12 or 13 lb. per sq.ft. to the original dead load. Considering the total dead weight of the present bridge to be 900 lb. per lin.ft. (of which 525 lb. is carried by the walk truss) the reader can easily make his own calculations for permissible loading. The heavy moving loads of today were unknown 60 years ago.

The 1870 bridge, "built by Wm. Cowin, Lambertville, N. J.," is of the same type as the 1859 bridge. The truss that was measured is 9 ft. deep center to center of chords and is divided into 8 panels of 10 ft. 7½ in. each. The diagonals in each panel are of two rods instead of one as in the older bridge, and pins are used in bottom as well as top chord. An occasional pair of main diagonals has the adjustment in one rod shown in Fig. 5. Just when this peculiar form of adjustment at irregular intervals throughout the four trusses was made is not clear.

It may be fitting to give some general facts regarding the Lowthorpe bridge, of which type a considerable number were built in the '60s and '70s. They were designed in accordance with correct engineering principles. The type of truss, known as the Lowthorp Trapezoidal Truss, was of either Pratt or Whipple web arrangement, and had counters in all except the end (sometimes the end two) panels. The compression members were of cast iron and the tension members of wrought iron.

Mr. Lowthorp was a firm believer in the merits of cast iron. A paper, "On the Use of Cast Iron for Compressive Members of Iron Bridges," read by him at the second annual convention of the American Society of Civil Engineers, held June, 1870 (*Transactions A. S. C. E.* Vol. 1, page 228) closes with an interesting expression of opinion: "The practical experience of most engineers and builders will justify me in the assertion that there is much more to be feared from defects in wrought iron used for tensile than in cast iron used for compressive purposes."

A commission appointed by the city of Philadelphia (Ashbel Welch, J. Edgar Thompson and John C. Cresson) in 1858 offered a premium for the best design of an iron bridge truss. In awarding the first premium to Mr. Lowthorp it said of his design, "It is well porportioned in all its parts, which are so disposed as to afford a maximum of strength with the smallest amount of material, having such arrangement for adjustment as to give each and every part its proper function to perform, without requiring great experience for its care."



FIGS. 6 AND 7. INTERMEDIATE POST AND ABUTMENT POST

In 1856-7 Mr. Lowthorp designed and built his first railroad bridge. The bridge crossed the valley of Jordan Creek on the line of the Catasauqua & Fogelsville R.R. near Allentown, Pa. It consisted of 11 spans with a total length of 1,120 ft., supported on piers of cast and wrought iron varying in height from 30 to 54 ft. anchored to masonry foundations, making a total height in places of nearly 90 ft. The trusses, of the double-intersection type, 12 panels each, were 16 ft. high and were spaced 10 ft. apart center to center. At the time of its completion this was one of the longest if not the longest of iron bridges in the United States.

An interesting feature in many of the Lowthorp bridges was the hip vertical, where for uniformity in appearance a cast-iron member similar to the posts was used. Inside of this member was placed a wrought-iron rod to take the tensile stress from the floor beam.

While most of the Lowthorp bridges have been replaced as they were outgrown by the traffic loads, a 60-ft. deck span of three trusses, with 34-ft. roadway and two 7-ft. walks, still exists at the Jackson Ave. crossing over the tracks of the Central R.R. of New Jersey in Jersey City. A trolley traverses the bridge, but the trolley tracks, laid long after the bridge was built, are trussed beams extending from abutment to abutment