HARES HILL ROAD BRIDGE
(Moseley's Wrought-Iron
Lattice Girder Bridge)
Hares Hill Road Spanning French Creek
Kimberton
Chester County
Pennsylvania

HAER No. PA-208

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

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Joseph E.B. Elliott, photographer, Summer 1991

PA-208-1	GENERAL VIEW LOOKING NORTH SHOWING SOUTH SIDE OF BRIDGE
PA-208-2	PERSPECTIVE VIEW LOOKING NORTHEAST SHOWING SOUTH SIDE AND WEST ABUTMENT
PA-208-3	VIEW ACROSS DECK LOOKING NORTHEAST FROM WEST END
PA-208-4	PERSPECTIVE VIEW ACROSS DECK LOOKING NORTHWEST FROM EAST END
PA-208-5	VIEW LOOKING EAST ACROSS DECK
PA-208-6	VIEW OF SOUTH TRUSS WHILE ON BRIDGE LOOKING SOUTHWEST
PA-208-7	VIEW OF SOUTH TRUSS FROM EAST END
PA-208-8	VIEW OF UNDERSIDE OF BRIDGE (BENEATH DECK)
PA-208-9	DETAIL VIEW OF LATERAL BRACING
PA-208-10	DETAIL VIEW OF LATTICE ON BRIDGE
PA-208-11	VIEW OF WEST ABUTMENT
PA-208-12	VIEW OF WEST ABUTMENT
PA-208-13	DETAIL VIEW OF WEST ABUTMENT AND BEARING SHOE
PA-208-14	DETAIL VIEW OF FLOOR BEAM UNDERNEATH DECK

PA-208-15	DETAIL VIEW OF LATTICE BRACING DETAIL
PA-208-16	VIEW OF LOWER CHORD DETAILS FROM UNDERNEATH BRIDGE
PA-208-17	DETAIL VIEW OF DIAGONAL BRACE CONNECTION TO UPPER CHORD
PA-208-18	VIEW OF DIAGONAL BRACE AT CENTER SPAN
PA-208-19	DETAIL VIEW OF DATE STONE, "Joseph F. Hill, Joseph Doan, Washington Hagerty, Commissioners, Abraham Taney, Contractor. Erected A.D. 1869."

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HARES HILL ROAD BRIDGE
(Moseley's Wrought-Iron Lattice Girder Bridge)

HAER No. PA-208

Location:	Legislative Route 15059 (Hares Hill Road) spanning French Creek, Kimberton, East Pikeland Township, Chester County, Pennsylvania UTM: 18.451590.4443340 Quad: Phoenixville, PA
Date of Construction:	1869
Fabricator:	Abraham Taney, East Vincent Township, Pennsylvania (masonry abutments, wing walls and parapets). Moseley Iron Bridge and Roof Company, Philadelphia, Pennsylvania (iron superstructure design) Moseley Iron Bridge and Roof Company, Boston, Massachusetts (superstructure fabrication).
Present Owner:	Commonwealth of Pennsylvania, Department of Transportation, Transportation and Safety Building, Harrisburg, Pennsylvania 20590 District 6 Office, 200 Radnor-Chester Road, St. Davids, Pennsylvania 19087
Present Use:	Single-lane vehicular traffic, 7-ton maximum load posting.
Significance:	The Hares Hill Road Bridge, probably best described as an arched girder with latticed webbing is the only known surviving example of Thomas W. H. Moseley's "Wrought Iron Lattice Girder Bridge" and closely resembles his patent of August 30, 1870 (No. 106,855). Though modified substantially since its initial construction, it

remains an excellent visual example of the proprietary vernacular designs that competed in the market for small highway bridges during the years immediately following the American Civil War.

The Hares Hill Road Bridge, together with three others by Moseley, were the first iron bridges built in Chester County. Collectively, they represent that community's first experiment with this "new" bridge type as an alternative to timber and stone masonry for bridge construction. The Hares Hill Road Bridge was one of only two identified as a "bowstring arch-truss" in an inventory of state-owned highway bridges conducted in 1982-1985 by the Pennsylvania Department of Transportation and the Pennsylvania Historical and Museum Commission. It is the only iron highway bridge surviving in Chester County that is still in public use.

Project Information:

Documentation of the Hares Hill Road Bridge was prepared by the Historic American Engineering Record (HAER), National Park Service, during the summer of 1991, as part of the Cast- and Wrought-Iron Bridge Recording Project, co-sponsored by the West Virginia Institute for the History of Technology and Industrial Archaeology, West Virginia University, Morgantown, West Virginia. This report was written by William P. Chamberlin. When citing this report, please credit the Historic American Engineering Record and the author.

I. DESCRIPTION OF THE BRIDGE

A. Site Description

The Hares Hill Road Bridge is a single-span bridge carrying Legislative Route 15059 (Hares Hill Road) over French Creek in East Pikeland Township, Chester County, Pennsylvania. East Pikeland Township flanks the south bank of the Schuylkill River in the northern portion of the county. It is bounded on the northwest by the Townships of East Vincent and West Vincent, on the southeast by the Townships of Charlestown and Schuylkill, and on the southwest by the Township of West Vincent. The area is semi-rural, characterized by a mixture of open farmland and suburban development associated with the nearby Borough of Phoenixville and the greater Philadelphia metropolitan area to the southeast. A prominent feature of the local architectural fabric is the abundance of agricultural and industrial buildings constructed of local stone, many dating from the eighteenth century. Hares Hill road serves primarily as a collector for the residences that now exist between Route 113, immediately southeast of the hamlet of Kimberton, and Route 23 to the northeast. French Creek is the major water course through East Pikeland and a tributary to the Schuylkill River at Phoenixville. The origin of the name, "Hares Hill", is unknown.

B. Bridge Description

1. General

The Hares Hill Road Bridge is a single-span tied arch, without overhead bracing, seated on masonry abutments. Its approaches are rammed fill contained by masonry wing walls. The bridge's wrought-iron superstructure is 103'-4" in overall length with a clear span of 99'-8" measured between abutment faces at the seats. Each of its two unskewed arches is divided visually by a series of hangers into eight panels, six at 12'-0" plus two end panels at 15'-0" each. The arches are 15'-2-1/2" apart center to center and 9'-9" high at mid-span, measured from the bottom of the tie to the top of the horizontal plates that form the arch. The bridge supports an open, steel grate deck with a 14' clear roadway between timber curbs, approximately 14' above the stream bed.

In the earliest documents, the Hares Hill Road Bridge is referred to as the bridge at Heistands Ford, Heistands Ford Bridge, or simply Heistands Bridge, after the surname of the contiguous landowner at the time of construction, David Heistand. With changes in ownership of the land, the crossing was known for a

time as Rapps Bridge, but as the association with early landowners became more obscure, other names came into use. For instance, it has sometimes been referred to in County records as the Kimberton Bridge after the nearby hamlet of that name, and in the late 1950s and for an unknown period before it was known as Silver Bridge, reflecting the color of the paint used to protect against corrosion and to enhance night visibility. Curiously, even though the bridge has been painted a bright yellow in recent years, it is still referred to locally as the "silver bridge".

2. Superstructure

The most distinguishing feature of the Hares Hill Road Bridge is its superstructure, unique among surviving nineteenth century American bridges. Though a number of structural details contribute to this distinction, its visual impact results largely from its wrought-iron arches and the diagonally latticed infilling beneath them.

Each arch consists of a pair of side-by-side, 1/2" thick by 6" wide rolled and flanged plates ("Z-bars") riveted together at opposing flanges and sandwiching a 3/8" vertical "body plate", or diaphragm, that extends below the arch plates a distance of approximately 10". Except for splices, the body plate is continuous beneath the entire length of the arch to about the mid-point of the end panels where it forms fillets between the arch and the horizontal tie, also a continuation of the body plate. The tie, which is 14-1/2" deep, has been reinforced over its entire length by a 7-1/4" x 1/2" plate welded in place. The area between the tie and the arch is filled with diagonal latticing upon which are superimposed seven pairs of vertical back-to-back "T"s that, like the latticing, are riveted to the tie and to the body plate beneath the arch and to the tie. These verticals visually define the panels. They act in concert with the latticing to transmit loads from the floor of the bridge to its arches.

An unusual feature of the superstructure are pairs of 1-1/4" rods that extend diagonally from the bottom of the mid-span verticals to points on the body plate just beneath the arches, near panel points U1 and U7 (see HAER Drawing for this structure, sheet 1 of 2).

The bridge's open steel-grate deck is supported by thirteen 5" deep I-beam stringers that, in turn, are supported by thirteen transverse floor beams. The floor beams are of two distinctly different types that probably date from different periods. The shallower, seven in number and 10-1/2" deep, are suspended from

the ties by stirrups located at points directly beneath the vertical connections, and stiffened by queen post trusses welded to their bottom flange. Each of the seven floor beams extends 3' beyond the arch line on either side of the deck where they support diagonal "T"s positioned to brace the arch laterally. The other eight floor beams, each 15" deep, are positioned intermediate to the above and are bolted to the ties by an arrangement of brackets and gusset plates. The floor is braced conventionally by diagonal rods that connect to the 10-1/2" floor beams near the arch lines.

3. Masonry

The abutments, wing walls and parapets are constructed of mortared sandstone in the random rubble fashion and battered approximately 1/2" to the foot. Abutments are 20' wide at the base and rise approximately 12' above the stream bed at the southwest end, slightly less at the northeast. The original seats have been replaced with cast concrete pedestals. Wingwalls and parapets are angled slightly away from the arch lines at both abutments, extending approximately 60' beyond the abutment face on the southwest end and 20' on the northeast. Parapet walls follow the grade of the approach on both ends. A marble plaque set into the parapet of the southeast wingwall identifies the County Commissioners and the bridge's masonry contractor:

Joseph F. Hill
Joseph Doan
Washington Hagerty
Commissioners

Abraham Taney
Contractor

Erected A.D. 1869

II. HISTORY OF THE BRIDGE

A. Construction

The Hares Hill Road Bridge was erected in 1869 to replace a ford where the road between Kimberton and Spring City crossed French Creek. Its wrought-iron superstructure was fabricated by the Moseley Iron Bridge and Roof Company of Philadelphia, or its agent, and erected on stone abutments built by Abraham Taney, a mason and contractor from the neighboring Township of East Vincent.

Once called the "road to Springville," the "Springville and Kimberton Road," or simply "Springville Road," Hares Hill Road linked nearby Kimberton with a ferry that crossed the Schuylkill River at the site of present-day Spring City, six miles to the north. Kimberton had been an early crossroads hamlet since before the Revolution, but its importance was enhanced about 1740-1750 with the building of a grist mill upstream and about one-half mile west of the present iron bridge. By the 1850s, three mill seats were being exploited in the immediate vicinity of Kimberton, a thriving industrial and business community had evolved, and French Creek was being forded at three locations to provide access to the north and east. The most important of these fords was the Springville Road crossing because it served a greater area than the other two and was a direct route to Springville, by then a thriving business and manufacturing center in its own right, as well as the most convenient of the local Schuylkill River ferry crossings.[1]

However, the first bridge across French Creek near Kimberton was not built on Springville Road, but at a site about one mile upstream. Known as the "Kennedy Covered Bridge" after one of its two builders, it was built in 1856 to carry a local road that connected the Springville Road at a point near the old mill to the Seven Stars Inn, three miles north on present day Route 23.[2]

The first petition for a bridge at the Springville Road crossing, known then as Heistands Ford,[3] was filed with the Chester County Court of Quarter Sessions of the Peace on January 31, 1859.[4] The twenty-two signatories, mostly immediate residents and businessmen of the area, cited the inconvenience of the ford and the unreasonable cost to the Township of erecting their own bridge as justification for petitioning the county. The persons appointed by the Court to view the proposed site on behalf of the county concurred on both points but recommended a modest realignment of the roadway to permit crossing a short distance downstream from the ford taking advantage of the natural embankment on the north side of the creek at that location and thereby reducing the cost of the bridge.[5] For reasons unstated, the Court rejected this petition and deferred construction.[6]

Also in 1866, a second covered timber bridge was erected across French Creek near Kimberton (known now as Rapps Bridge), and the Court was again petitioned by local residents to replace Heistand's Ford with a bridge.[7] Viewers again concurred, this time with a revision to the realignment proposed in 1859 consistent with the "dog leg" that exists to this day in the crossing's eastern approach.[8] This time the Court concurred but

delayed construction until 1869, possibly owing to a depletion of funds following the Civil War.[9]

After visiting the proposed site on June 26, 1869, the County Commissioners agreed to build an iron bridge spanning 100'.[10] Proposals were invited through advertisements in local newspapers, and on July 23, 1869, county officials opened six bids for masonry abutments ranging from $997 to $1939.[11] The Commissioners unanimously agreed to award the contract to the low bidder, H. Burns.[12] However, Burns subsequently either withdrew, possibly concluding that he had mistakenly underbid the work, or was disqualified, and the contract was awarded to the second low bidder, Abraham Taney.[13]

A 49-year-old stone mason and millwright from the neighboring township of East Vincent,[14] Taney was paid $1,349.99 for his work, approximately one-third the entire cost of the bridge.[15] While county records show that he occasionally bid on other bridge work, he appears to have been successful in only one other instance during this period, suggesting that most of his income was derived from other pursuits.[16] A contemporaneous record described Taney's work on the bridge at Heistands Ford:

> " ... Abutments are built on rock, and are 20' long and 7' thick at the base, and 12' high above low-water line, built with a batter of 1/2" to the foot. All the stone work, filling, wing walls, guard walls, etc. were built by Abraham Taney in 1869 ...."[17]

Within a week of opening the bids for masonry, the Commissioners contracted with the Moseley Iron Bridge Company of Philadelphia, for three 16'-wide, iron superstructures: a 32' bridge in Kennett Borough for $594.00, a 42'-6" foot bridge at Paoli in Williston Township for $852.50, and the 103' bridge at Heistands Ford in East Pikeland Township for $2,948.50.[18] Another Moseley's iron bridge, of three spans (one 90' and two 45' superstructures) had been erected in Chester County in Newlin Township the previous year, for which the company was paid $3,747.50.[19] While these were the first Moseley bridges built by Chester County, they were not the first iron bridges. In 1860, two bridges, 36 and 42' long, had been fabricated by Isaac Harvey of Marcus Hook, Delaware, and erected in Upper Oxford and East Nottingham Townships, respectively; and in 1867, a 50' bridge was built by the Phoenix Iron Company over French Creek in Phoenixville.[20]

Abraham Taney was paid for his work in a lump sum, on January 31, 1870;[21] Moseley was paid in increments: $2,000 on May 23, 1870 and the balance one month later on June 22nd.[22] The record of

these transactions is contained on the office billhead of the Moseley Iron Bridge and Roof Company of Philadelphia, at its 147 South Fourth Street location, and identifies the superstructure as a "Moseley Wrought-Iron Lattice Girder Bridge.[23]

B. Alterations

During its 122-year existence, the Hares Hill Road Bridge has undergone at least three major rehabilitations to assure its structural viability. Even though each of these events significantly altered its as-built character, and to that extent compromised what preservationists describe as its structural integrity, the overall visual impact of the bridge, which is closely related to the appearance projected by its superstructure, remains substantially intact.

Apparently, serious problems developed with the new bridge early in its life. By 1880, the Chester County Commissioners had become so displeased with its performance that they hired a Phoenixville contractor, Denithorne & Brothers, to remodel and rebuild it. The Denithorne's were paid $1,325, nearly one-half the cost of the original superstructure.[24] Commenting on the bridge's condition, the Daily Local News described the bridge as "tumbling down" and characterized the situation as "a shocking affair."[25]

It is reported that the Denithornes replaced existing "wooden joists" with "iron girders" and "braced and otherwise strengthened" the structure.[26] While it is clear that the floor system was extensively repaired at this time, the record does not indicate the specific nature of those repairs. However, it is possible that the 13 I-beam stringers found in the floor of the present bridge were added at this time, replacing an original timber floor and beam system, and that the present panel point I-beams (minus the trussing), thought to date from the original construction, were left in place to support the new stringers.[27]

What the record does indicate clearly is that the Denithornes were establishing a local reputation for responsible bridge work, based on their construction the year before of an iron bridge in East Coventry Township and their repair of the bridge at Heistands Ford.[28] Regarding the latter, The Daily Local News noted that:

> "This job has pleased the commissioners very much, and we have no doubt but it will lead to their having more of the shoddy Ohio bridges that have been built for the county repaired."[29]

At the very least, the Denithornes' reputation was not harmed by their work at Heistands Ford, as their name came to dominate metal-truss bridge building in Chester County for the next twenty years, accounting for at least 32 new bridges before the end of the century.[30]

In 1932-1933, coincident with the assumption of ownership by the Pennsylvania Department of Highways, the Hares Hill Road Bridge experienced its second structural rehabilitation. The record of this event, contained in maintenance files of the Chester County Engineering Department, consists of a journal of disbursements that include purchase of 6,160 lbs. of fabricated steel from the Phoenix Bridge Co., 597 pounds of steel stock from the Phoenix Iron Co. and three payments, totaling $453.42, to "Welding Engineers" for repairs to trusses and floor beams. It is likely that the eight 15" intermediate floor beams were added at this time as well as the welded queen-post trussing that stiffens the original and shallower panel point floor beams. The dimensions and unit weight of these beams are consistent with the 6,160 pound purchase noted above. It is also likely that the 597 pound purchase represents the reinforcing plates that are now welded to the outside of the tie.[31]

The third major rehabilitation occurred in 1958 when the Pennsylvania State Highway Department replaced the timber floor with an open, steel-grate deck. Township officials, including members of the local school board concerned with the safety of school buses and other traffic crossing the bridge, argued that, when wet, the timber deck was slippery and particularly dangerous for vehicles approaching from the south where the road turned abruptly as it approached the bridge.[32]

Prior to the 1958 repair, the Hares Hill Road Bridge had been posted for a 13-ton maximum load.[33] That posting remained in effect until 1986, when it was reduced to seven tons after inspection and structural analysis by State personnel. It remains at that level today.

C. Thomas W. H. Moseley and The Moseley Iron Bridge and Roof Company of Philadelphia

Thomas W. H. Moseley's name[34] first appears in the Philadelphia business directory of 1868-1869 as the Moseley Iron Bridge Company (147 S. 47th).[35] Living in Boston at the time, he had opened offices in Philadelphia and New York to exploit the post Civil War market for iron bridges in those areas.[36]

A civil engineer and prolific inventor, Moseley came to Boston in 1861 from Cincinnati, Ohio where he had been active since 1853 in the manufacture and marketing of corrugated metal roofs and iron bridges of his own invention. The Civil War seriously diminished his business, much of which had been in the south, and he responded to better opportunities in the northeast. In Boston, he organized the Moseley Iron Bridge and Roof Company, built a factory in Roxbury and, in 1864, a rolling mill eight miles south of Boston, at Readville.[37]

Moseley was one of the first Americans to experiment with the exclusive use of wrought iron for the principal structural elements of bridges and is generally credited with introducing the riveted tubular arch to the American market.[38] First built in 1854,[39] Moseley's tubular arch design evolved over a period of years and was the subject of two American patents.[40] In its most familiar form, Moseley's tubular arch was characterized by an arched upper chord fabricated from iron boiler plate riveted to form a hollow triangular tube, from which were suspended bars that supported the deck, and by counter arches that "draped" beneath the upper chord in each direction from its center to its ends.[41]

In 1867 or early 1868, Moseley opened offices in New York and Philadelphia,[42] coincident with the promotion of a new design that he marketed as "Moseley's Wrought-Iron Arch Girder Bridge."[43] This new bridge, apparently introduced to provide a less costly structure than the tubular arch for spans less than 100',[44] used a pair of side-by-side rolled and flanged plates ("Z-bars") for the arch, riveted together at opposing flanges and sandwiching a "body plate" that extended to the tie to which it was bolted. The overall appearance of this new design was that of a plate girder with a curved top flange, braced laterally in the same manner as the present Hares Hill Road Bridge. As with his tubular arch, Moseley's new design also had evolved from an earlier patent, this one granted in 1866.[45] A later version of this new design was marketed as "Moseley's Wrought-Iron Lattice Girder Bridge" in which the interior portion of the body plate was replaced by a series of verticals superimposed on a riveted lattice.[46] It is this version of Moseley's new design that is represented by the Hares Hill Road Bridge.

Historians who looked at the Hares Hill Road Bridge in the early 1980s described it as a bowstring truss, and from its outward appearance that is not a surprising characterization.[47] However, when examined from the point of view of how it carries loads, the question of structural form is somewhat more complicated.

It is clear from his nomenclature that Moseley thought of the parent design, that is, the one in which the web (or body plate) is continuous between the arch and the tie, as a girder (understood today to mean a deep beam), and he referred to it as such in his promotional literature.[48] In fact, many years later, Frank W. Skinner, a consulting engineer and associate editor of The Engineering Record encountered one of these "curious old" bridges surviving near New Brunswick, Connecticut and described it as a "bowstring plate girder".[49]

However, while a remnant of the web plate of this arch-girder bridge remained in the later design, the structural character is considerably more complex. Bowstring trusses of the period typically employed an upper chord that conformed to a circular or parabolic curve tied together by a lower chord in tension (tied arch) from which regularly spaced verticals supported the deck, and diagonal rods (trussing) that extended from the top of each vertical in both directions to the bottom of the next to help support non-uniform (live) loads. Because diagonals are absent in the Hares Hill Road Bridge, it has been described here as a tied arch with latticed infilling. With possibly equal justification, it could also be described as a "lattice truss with curved upper chord." The distinction between these two characterizations depends on how the deck loads are actually distributed between the verticals that rise at the panel points and the latticing, an issue not easily analyzed. The point here is that the design represented by the Hares Hill Road Bridge is difficult to describe using conventional terminology.

The issue of labeling is complicated further by the pairs of rods that extend from the ends of the upper-chord to the bottom of the center post. These are suggestive of an inverted king-post truss, at least to the extent that the center post can carry compression.

Viewed in the context of Moseley's career as an inventor/builder of iron bridges, the Hares Hill Road Bridge is consistent with an apparent long-term fascination with combining redundant structural forms in the same bridge. The rudiments of this were present in his earlier tubular arches with their draped counter arches, for which he is best known. It culminates in an 1870 patent in which he declares his invention to be "... a combination of the ... king post, truss, arch and girder, the object being to avail the use of all in a single structure...."[50] The Hares Hill Road Bridge is rooted firmly in this tradition, combining elements of a girder, a tied arch, a lattice truss and a king-post truss.

In the evolutionary sense, the fits into a continuum of designs that Moseley conceived over a five-year period, presumably to penetrate and remain competitive in a market that was attracting more entrepreneurs each year. The sequence of these related designs is inferred below from available information:

1) The 1866 patent (No. 59,054), filed April 2, 1866, described above, and consisted of continuous iron web plate(s) riveted between an upper chord of opposing Z-bars and a pair of iron straps that form the lower. There is no evidence that a bridge of this specific design was ever built.[51]

2) Moseley's Wrought-Iron Arch Girder Bridge embodied the essential features of the 1866 patent but with the addition of lateral bracing to the upper chord and a redesigned shoe. A 15', full-scale prototype and a 38' highway bridge of this model were built in 1867 or earlier and, as noted, the design was advertised heavily between 1867 and 1870. No record of a bridge of this design having been built in Pennsylvania before 1868 has been found[52].

3) In Moseley's Wrought-Iron Lattice Girder Bridge, (ie., the Hares Hill Road Bridge), most of the body plate found in the arch girder was replaced by a diagonal latticing on which was superimposed a series of verticals built up from angles or "T"s. Deformation at the haunches was resisted by pairs of rods bolted to the quarter points of the upper chord and anchored at the bottom of the center post in the manner of a king post truss. It appears that this design displaced the former and became Moseley's principle product by the early 1870s or before.

4) In Moseley's "New Bridge," the upper chord of the lattice girder was replaced with a square tube formed from four plates flanged and riveted at their edges; the strap-iron lower chord was replaced by a pair of back-to-back angles; and the web plate was diminished even further, leaving only a modest remnant extending from the arch downward as a stiffener. A prototype of this design was erected and loaded to failure at the Reaney & Co. shipyard near Chester, Pennsylvania, probably in late 1869 or early 1870. The bridge was probably not built commercially because of modifications made as a result of the load test.[53]

5. The 1870 patent (No. 103,765), was probably the result of the above-mentioned. There is no record of a bridge of this type having been built.

By 1870, Moseley's company had built in excess of 160 arch girder and lattice girder bridges, in eight different New England and middle states, including fifty-six in Pennsylvania alone.[54] Whether Moseley, through his promotional activities, was in any way responsible for the new popularity of iron superstructures in the counties of southeastern Pennsylvania, or was merely the entrepreneur best positioned to take advantage of a course already set, he was the first post-Civil War bridge builder to be awarded a succession of contracts by Chester County. However, his tenure was short lived. After contracting with Moseley for four bridges (six spans) in 1869, the Commissioners awarded the next four contracts to Joseph Henszey's Continental Bridge Company, also of Philadelphia. Henszey, a local hardware merchant and long time Philadelphia resident, had formed a company to market a wrought-iron bridge of his own invention, just one year after Moseley had opened his own office in that city.[55]

Though the relationship between Moseley and Henszey is obscure, they most certainly were competitors.[56] In two other southeastern Pennsylvania counties for which bridge records were examined in connection with this research, the pattern found in Chester County is repeated. After selling a small number of bridges (1868-1869), Moseley was succeeded by Joseph Henszey as the vendor of choice, who then also sold a small number of bridges (1870-1871) before being succeeded himself.[57]

The reason for Moseley's loss of favor is not recorded and can only be surmised. Given the formative nature of the iron bridge industry at this time and the limited experience of the counties with its new structural forms, decisions favoring Henszey may have resulted from nothing more complicated than the Commissioner's inclination to experiment with a local builder's new product, in much the same way they had experimented with Moseley's new bridge the year before. Unlike the masonry and earthwork, which during this period were contracted for on the basis of competitive bidding, iron superstructures were typically procured through invited proposals in which the Commissioners, after inspecting an example of the proposed vendor's work, would invite him to submit a price for a bridge of specific length.

However, it is also possible that Moseley simply lost the local market to a more competitive supplier. His bridges may have been more costly because they were not fabricated locally, or there may have been deficiencies inherent in his designs that became apparent after a short period of use.[58] The latter hypothesis is consistent with what, in fact, turned out to be a rather poor service record for Chester County's Moseley bridges. Of the six

spans Moseley built in the county, only the single span in Williston Township survived unaltered into the twentieth century.[59] The Hares Hill Road Bridge was described after only eleven years (1880) as "shoddy" and "tumbling down", and was rebuilt;[60] the three spans in Newlin Township were described after thirteen years (1881) as "worn out" and were replaced by two covered timber spans;[61] and the single span in Kennett Borough was replaced after nineteen years (1888).[62]

Possibly because of an inability to compete with larger, better-capitalized companies that were beginning to market nationally, Moseley sold his Boston plant in 1871.[63] Listings for "The Moseley Iron Bridge And Roof Company" in Philadelphia directories ceased after that year and, perhaps significantly, coincided with the beginning of listings for Joseph G. Henszey, bridge builder, which continued until 1878.[64] Except for two unexplained listings in 1876 and 1877 for the Moseley Iron Bridge Company, Moseley seems to have shifted focus to his other business interests. Various directories between 1872 an 1877 listed the Moseley Pennsylvania Building Company or the Moseley Composite Building Company, both operating out of his office at 147 South 4th Street.

If Moseley ever actually lived in Philadelphia, it was only for a short interval. His 1870 patents were filed from Boston,[65] and he had no personal listing in Philadelphia directories until 1875, about the same time he is reported to have become a resident of Scranton.[66] His business listings ceased in 1878 but a personal listing for "W. H. Moseley, engr.," continued until 1881. Moseley died in Scranton on March 10, 1880 at the age of 65. While citing his accomplishments as inventor of the Moseley Tubular Wrought- Iron Arch Bridge, his obituaries made no mention of the Philadelphia or New York offices nor of his Wrought-Iron Arch Girder and Lattice Girder Bridges.[67]

IV. SIGNIFICANCE

Built in 1869, the Hares Hill Road Bridge is the only known surviving example of Thomas W. H. Moseley's "Wrought-Iron Lattice Girder Bridge." Though modified substantially, it remains an excellent visual example of the proprietary vernacular designs that competed in the highway bridge market during the years immediately following the American Civil War. It was one of the first iron highway bridges built in Chester County and is the only one still in public use. In 1978, it was placed on the National Register of Historic Places, and in 1986 was listed in Historic Highway Bridges in Pennsylvania (Index No. MA-6), an inventory of state-owned historic highway bridges compiled by the

Pennsylvania Department of Transportation and the Pennsylvania Historical and Museum Commission.[68] In a broader context, the Hares Hill Road Bridge is one of a small and diminishing number of iron bridges, located mostly in the industrial states of the northeast and midwest, that survive from the 1840-1875 period, when American bridge building was evolving from a craft-based to an engineered technology. The conventional wisdom holds that hundreds of designs were conceived during this period, some patented and some not. Most were never built, and of those that were, many either proved incapable of supporting the requisite load or for other reasons failed to attract a market. The Hares Hill Road Bridge is one of a small number of tangible artifacts suggesting the diversity of bridge design and construction of that period. The historical evidence suggests that Moseley's design evolved over a short period of time in response to a ready post-Civil War market; that it embodied both the proven and the fanciful; and that it had a brief commercial success soon eclipsed by competitors. In Chester County, that competition was first represented by a local builder, but eventually by large well-financed, technologically advanced manufacturers from out of state.

Given the modest longevity of Moseley's other Chester County bridges, survival of the Hares Hill Road Bridge to the present is taken more as testament to the ingenuity of those that have maintained and repaired it through its 122 years than to its inherent integrity.

ENDNOTES

1. Abstracted with permission from notes prepared by Estelle Cremers, Historical Land Research, Pottstown, PA. Also, Estelle Cremers, 30,000 Acres, Vincent and Pikeland Townships, 1686 to 1850, Eastern Litho Corporation, Philadelphia, 1989, pp. 77-80, 101-103.

2. Bridge No. 190, Chester County Bridge Records, Chester County Engineering Department, West Chester, PA.

3. Heistand's Ford takes its name from the contiguous landowner who had a residence on the west bank of French Creek at the fording site. The spelling used here is that which appears most frequently in contemporaneous Chester County records pertaining to construction of the bridge (n. 4, 10 and 12, below), though these records are by no means consistent (Heistand, Hiestand and Histand all being found, in that order of frequency). One of the signatories of the 1859 petition signed his name John Histand, and the residence of a David Histand appears near the ford location on an early map of the township (see Atlas of Chester County, Pennsylvania. A. R. Witmer, Philadelphia, 1874), lending support to that spelling as possibly being more historically correct. In contrast, a David Hiestand signed an affirmation of public posting of the County's 1866 notice of intent to build.

4. Chester County Clerk of Courts, Original Bridge Papers, Vol. 6, pp. 229-237. Chester County Archives and Records Services, West Chester, PA., January 31, 1859

5. Op. Cit., March 23, 1859.

6. Op. Cit., April 28, 1859.

7. Op. Cit., September 20, 1866.

8. Op. Cit., October 10, 1866

9. Op. Cit., October 31, 1866.

10. Minutes of the Commissioner's Office, Chester County, Pennsylvania, June 26, 1869, Chester County Archives and Records Services, West Chester, Pennsylvania.

11. "Notice to Bridge Builders." The Jeffersonian, July 3, 1869. Newspaper Clipping File (bridges), Chester County Historical Society, West Chester, Pennsylvania.

12. Commissioner's Minutes, July 23, 1869.

13. Court House Expenses, Commissioners'/Treasurer's Bridge Records, 1870-1904, p.117. Chester County Archives and Records Services, West Chester, Pennsylvania.

14. 1860 Federal Census, Chester County, Pennsylvania (Twp. East Vincent).

15. Commissioner's/Treasurer's Bridge Records (n. 13, above).

16. Pay Order Book, County Commissioners' and Treasurer's Accounts, 1873. Chester County Archives and Records Services, West Chester, Pennsylvania.

17. Commissioners'/Treasurer's Bridge Records (n. 13, above).

18. Commissioners' Minutes, July (undated), 1869.

19. Commissioners'/Treasure's Bridge Records, p. 81 (n. 13, above). Moseley claims to have erected a total of eight spans, other than tubular arches, in Chester County by 1870 (Iron Bridges Roofs, Buildings, &c. Manufactured by the Moseley Iron Building Works, Boston, 1870). Records of only the six cited spans were found, suggesting that Moseley's claims may be been exaggerated.

20. Commissioners's Minutes, September 25, 1860. It is interesting that the two bridge contracts awarded to Isaac Harvey were done so simultaneously and in competition in which proposals for both wood and iron superstructures were solicited. Of the seventeen proposals from ten hopeful contractors, only Isaac Harvey and the Trenton Locomotive and Manufacturing Company (fabricator of Fink trusses, see HAER NJ-18) included superstructures of iron. Both had been asked to submit proposals after the Commissioner's inspection of an iron bridge in a neighboring county (Commissioner's Minutes, September 11-13, 1860) and neither were the low bidders. Clearly, the commissioners were disposed to experiment with iron at this early date. Unfortunately, the Civil War intervened and it would be 1867 before another iron bridge was built by the county.

21. Chester County Treasurer's Bills, 1870, No. 81, Chester County Archives and Records Services, West Chester, Pennsylvania.

22. Op. Cit., No. 323.

23. Ibid.

24. The Daily Local News, May, 11, 1880. Newspaper Clipping File (Bridges), Chester County Historical Society, West Chester, Pennsylvania.

25. The Daily Local News, May 11, 1880 and July 3, 1880 (n. 24, above).

26. The Daily Local News, May 11, 1880 (n. 24, above)

27. This argument is supported by a contemporaneous illustration of the prototype design for this bridge ("Wrought Iron Arch Girder Bridge", The Manufacturer and Builder. Western & Company, New York, Vol. 1, No. 6, 1869, p.181) The probable configuration of the original floor system consisted of wood planks laid parallel to the arches and supported by timber beams suspended from the ties by stirrups every two feet, plus rolled I-beams at the "panel points," and by the dimensions of the stringers and "panel point" floor beams, suggesting they were probably manufactured by the Phoenix Iron Company during the periods in question. (Ferris, Herbert W. Iron and Steel Beams, 1873 to 1952. American Institute of Steel Construction, New York, 1953, pp.129-141).

28. The Daily Local News, May 11, 1880 (n. 24, above).

29. The Daily Local News. July 13, 1880 (n. 24, above). The reference to "Ohio bridges" was probably inadvertent and prompted by the predominance of county bridges built during the previous decade by the King Iron Bridge Company of Cleveland (eight bridges, 1872-1876) and the Canton Iron Bridge Company of Canton (four bridges, 1877-1882).

30. Chester County Bridge Records (n. 2, above).

31. Chester County Bridge Maintenance Journal, Bridge 189, 1932 and 1933. Chester County Engineering Department, West Chester, PA.

32. The Daily Republican, August 24, 1957 - October 16, 1958. Newspaper Clipping File (Bridges), Chester County Historical Society, West Chester, Pennsylvania.

33. The Daily Republican, December 12, 1957 (n. 32, above).

34. Born November 28, 1813, Moseley was named Thomas William Henry Harrison Moseley by his mother, in honor of the military leader under which his father was then serving, but used Thomas W. H. Moseley most of his life. (Moseley, Robert B., "Thomas the Engineer and Inventor". Genealogical notes concerning the

Moseley family, 1948; typed manuscript curated at the Virginia Historical Society, Richmond, Virginia).

35. Gopsill's Philadelphia Business Directory, 1868-1869. James Gopsill, Philadelphia. Two listings appeared in the 1869 edition, "Moseley American Wrought Iron Bridge Company" (410 Walnut) and "Moseley Iron Bridge and Roof Company" (147 S. 4th), the latter continuing through the 1871 edition.

36. Genealogical notes (n. 34, above).

37. Ibid.

38. Simmons, David A. "Bridges and Boilers: Economics in Mid-Nineteenth Century Ohio and the Invention of the Tubular Iron Bridge," unpublished manuscript.

39. Moseley, Thomas W. H. Iron: New Enterprise in Its Manufacture and Application to Building. Boston, 1863, pp.11-12.

40. Letters Patent No. 16,572, February 3, 1857 and No. 103,765, May 31, 1870

41. Iron Bridges, Roofs, Buildings &c Manufactures by the Moseley Iron Building Works. Boston, T. W. Rip, 1867, pp.3-8. See also HAER No. MA-122, Upper Pacific Mills Bridge, Lawrence, Massachusetts, 1864.

42. A small business envelope in the author's collection is hand stamped "Moseley Iron Bridge & Corrugated Roof Co., No. 116 William St., N.Y." and dated June 5, 1867.

43. Iron Bridges, pp. 9-12 (n. 41, above). Also, The Manufacturer and Builder, p. 181 (n. 27, above) plus advertisements between April 1869 and March 1870.

44. Ibid.

45. Letters Patent No. 50,054, October 23, 1866.

46. No advertisement specific to the version which Moseley referred to as his "Wrought-Iron Lattice Girder Bridge" has been found, but the name appears on a number of billheads issued by the Moseley Iron Bridge and Roof Company during the 1868-1870 period, including that cited in n. 23, above.

47. "Hares Hill Road Bridge", Index No. MA-6, Historic Highway Bridges in Pennsylvania. Pennsylvania Historical and Museum Commission and Pennsylvania Department of Transportation, 1986, p. 103.

48. Iron Bridges, pp. 11-12 (n. 41, above); and The Manufacturer and Builder (n. 27, above).

49. Skinner, Frank W. Details of Bridge Construction. McGraw Publishing Company, New York, 1906, pp. 359-360.

50. Letters Patent, No. 106,866, August 30, 1870.

51. Application for letters patent, Patent Correspondence Files, Letters Patent 59,054, curated at the National Archives Records Center, Suitland, Maryland.

52. The Manufacturer and Builder (n. 27, above).

53. "The New Moseley Bridge", The Railroad Gazette. Vol. XIV, No. 20, August 13, 1870, p. 460.

54. Iron Bridges (n. 19, above).

55. See: Henszey's Wrought-Iron Bridge, HAER No. PA-209, Wanamakers, Lehigh County, Pennsylvania. Held at the Prints and Photographs Division, Library of Congress, Washington, D.C.

56. Speculations are offered on the relationship between Moseley and Henszey in HAER No. PA-209, "Henszey's Wrought Iron Arch Bridge - 1869/1870."

57. Pay Order Books, 1869-1873 (n. 16, above).

58. In the absence of any record that Moseley's commercial ventures occupied more than a single office in Philadelphia, it is assumed that all of his bridges were actually fabricated in the Boston area, even though he apparently did consider establishing a rolling mill and shop along the Delaware River, 1-1/2 miles below Chester (see The Railroad Gazette (n. 53, above). However, this matter is far from resolved. Family tradition holds that in 1869 plants existed in both New York and Philadelphia (Genealogical Notes, n. 34, above), and circumstantial evidence suggests that bridges marketed from his Philadelphia office may have been fabricated by Loftus Sykes, a local industrialist. Sykes had moved his business from Wilmington, Delaware to Philadelphia (The Industries of Pennsylvania. Richard Edwards, Philadelphia, 1881, p.254), about the same time that Moseley opened his office in that city. He

manufactured nuts and bolts, as the Kensington Nut and Bolt Works, until Moseley's death when he then began to advertise himself in Philadelphia directories as a builder of bridge and roofs, Moseley's old fortes. However, Sykes had been building bridges since at least 1877, the last year of Moseley's business directory listing. A full page advertisement taken in 1881 (Industries of Pennsylvania, p. 254) speaks glowingly of his "long ... established ... reputation as a producer of scientifically-made Iron Trusses for bridges, railroad depots, churches, factory buildings and other large buildings..."; and a bridge profile with details that seem to combine elements of Moseley's lattice girder design, his "new Bridge" and the 1870 patent is represented schematically in a Sykes letterhead of September 24, 1877 (private collection of the author).

59. Commissioners'/Treasurer's Bridge Records, pp. 63, 81, 117 and 165 (n. 13, above).

60. The Daily Local News, May 11, 1880 (n. 24, above).

61. Commissioners'/Treasurer's Bridge Records, p. 81 (n. 13, above).

62. Op. Cit., p. 63.

63. Simmons (n. 38, above).

64. Gopsill's Directory, 1871-1878 (n. 35, above).

65. Letters Patent (n. 40 and 50, above).

66. T. W. H. Moseley, obituary, Boston Journal, March 16, 1880,p. 3, col. 1. It is reported (Genealogical Notes, n. 34, above) that he lived in Philadelphia in 1875 but that he moved to Scranton five years before he died.

67. Ibid.

68. Historic Highway Bridges (n. 47, above).

ADDENDUM TO
HARES HILL ROAD BRIDGE
(Moseley's Wrought-Iron Lattice Girder Bridge)
Spanning French Creek
Kimberton
Chester County
Pennsylvania

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(P. 3)

PA-208-1 through PA-208-19 were previously transmitted to the Library of Congress.

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All color xeroxes were made from a duplicate color transparency.

Joseph E.B. Elliott, Photographer, Summer 1991

PA-208-20 (CT) GENERAL VIEW LOOKING NORTH SHOWING SOUTH SIDE OF BRIDGE