

Durham Falls Bridge
Spanning the Oyster River on State Route #108,
.2 miles southeast of the intersection with
Main Street
Durham
Strafford County
New Hampshire

HAER No. NH-15

HAER
NH,
9-DUR,
6-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
MID-ATLANTIC REGION, NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HISTORIC AMERICAN ENGINEERING RECORD

HAER
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Durham Falls Bridge

HAER No. NH-15

Location: Spanning Oyster River, on State Route 108, 0.2 miles southeast of the intersection with Main Street, Durham, Strafford County, New Hampshire

UTM: 19.34390.4776900
Quad: Dover (USGS West Quadrangle)

Date of Construction: 1907

Engineer: Daniel Chesley
Durham, New Hampshire

Present Owner: New Hampshire Department of Transportation
Concord, New Hampshire

Present Use: Vehicular bridge

Significance: The Durham Falls Bridge is one of many single-span, I-beam bridges utilizing concrete jack arches supported by cut granite abutments still extant in the State of New Hampshire. Rebuilt from an earlier bridge in 1907, Durham Falls Bridge is one of the State's earliest examples of bridge, road and highway improvement which utilized the state aid to towns made available in the laws of 1905. The bridge is significant for its use of local materials, e.g., Durham granite, and local craftsmanship, Daniel Chesley, engineer and contractor. It typifies construction and technology which were being popularized during this time period in response to increasing auto traffic. Historically, the bridge is located at a significant 17th century crossing, one of the earliest known crossings in the State. The crossing provided an important link between the early settlement centers of Dover and Durham and Portsmouth and Concord.

Project Information: This documentation was undertaken in December 1988 and January 1989, in accordance with the Memorandum of Agreement among the Advisory Council on Historic Preservation, the New Hampshire State Historic Preservation Office, and the Federal Highway Administration as a mitigative measure prior to the replacement of the bridge in 1989.

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for the

New Hampshire Department of Transportation
Concord, New Hampshire

1. Historical Background of the Crossing

The Durham Falls Bridge is located on the Oyster River in the town of Durham, New Hampshire. Oyster River is one of five tributary rivers flowing together to make Great Bay, Little Bay and the large Piscataqua River basin, which flows through Portsmouth Harbor to the Atlantic Ocean [Appendix VIII]. This extensive water system transforms New Hampshire's small, 14-mile coastline into an historically significant maritime center.

The first European settlement in the region dates from 1623 (Wallace 1980). During the next hundred years, this section of what later became known as New Hampshire (until 1680, this area was part of the Massachusetts Bay Colony) was divided into four great "towns" or plantations of Portsmouth, Exeter, Hampton and Dover (Durham was part of Dover until 1732). Portsmouth developed as a rich mercantile center and a thriving commercial port [Wallace 1980].

The initial settlement of the town of Durham was at Durham Point, at the confluence of Oyster River with Piscataqua River. By 1640, the settlers reached the falls at Oyster River, and the first house was built above the falls in 1649. The business center of the town grew from this nexus. The mills employed the water power at the falls and gundalows (river boats) were constructed at the town wharfs for shipping down Oyster River to Portsmouth. Records distinguished Oyster River and Oyster River Freshet, the former being the tidal stream that comes to a head at the lowest falls in Durham Village and the latter the fresh water stream above these falls to its source [Thompson 1892:169].

In 1701, the town of Dover voted to create a landing place to the east of the present bridge over the Oyster River, and the settlement began to prosper as the center for lumbering as well as agriculture. Even though the settlement was part of Dover, it was a distinct one and had its own separate history. By 1651, it was called Oyster River Plantation, or sometimes the "Precinct of Oyster River." Oyster River settlement was made

a separate parish on May 4, 1716, and was incorporated as a township under the name of Durham by an act of the General Assembly passed on May 13, 1732. By 1767, Durham had a substantial population of 1,232 and was recognized as a port of entry to the interior region of New Hampshire by way of Durham landing. Another important linkage was the town's location on the first New Hampshire turnpike, which was built in 1796, from the western end of the Piscataqua Bridge (Portsmouth) to Concord, thus connecting Portsmouth, the chief seaport of the State, with the future State capital. The turnpike passed 0.2 mile north of the Oyster River crossing, forming an important intersection with the historic road between Exeter and Dover (New Hampshire Route 108). Besides the desirability of its location twelve miles from the ocean, the town benefited from its natural resources, such as the prevalence of white pine and granite near the river, and the seven-foot tides which helped the shipbuilding industry. [Stackpole 1973:219-239].

By the first quarter of the 18th century, the area surrounding Durham Falls, as this area of Durham came to be known, was a thriving center. There were mills on the north and south banks of the river upstream on the west side of the bridge; and downstream on the east side were the shipbuilding industries and the busy landing. The meetinghouse and several substantial residences completed the village center. Most of these resources survived into the first part of the 20th century, but only the residences, and none of the businesses, are still extant [Appendices I and III].

Several early references were made to roads between various points and Oyster River Falls, such as one in 1659 describing a road which was presented at court because of its bad condition between "Oyster River Point" (now Durham Point) and "Hill's Mill" at the falls [Thompson 1892:67].

The crossing was first documented in 1732 [Anonymous 1945:14]. While the bridge may have been in place at an earlier date, there is no record of its use. It is likely that a bridge may have existed, given the dispersed settlement on either side of the river as early as the 1650s and given the limited nature of river fording at low tides [Kenyon 1983:22]. In 1744, the bridge was improved from a horse bridge to a cart bridge [Anonymous 1945:13]. This implies a widening of the bridge and transportation of large items by cart rather than by ferry. On June 29, 1744, there was an article in the town warrant to see if the town would build a bridge over the falls "where the old bridge now standeth", also, "what manner of bridge, whether a cart bridge or a horse bridge and what breadth the bridge shall be built" [Anonymous 1945:13]. It was voted to build a cart bridge fifteen feet wide.

The town's population reached its height around 1830 with 1,685 people, but began to decline as the town's importance as a trading center waned. This was due to the development of more towns in the interior of the State and the advent of the railroad in the 1840s. Shipbuilding ceased after 1845. A new historical and economical period for the town began when the New Hampshire College of Agriculture and Mechanic Arts was moved from Hanover to Durham in 1893. In 1923, this institution became the University of New Hampshire and, since that time, the interests of the town have been linked closely with those of the university [Hiatt 1979:17].

Although there are numerous historical references to bridges in this location, the specifics of their construction are not known. The annual town reports, which begin in the second half of the 19th century, show various expenditures for repairs on earlier bridges at this location. For instance, in 1864, \$100.99 was spent on repairs, including labor, new planks and spikes, and in 1867, \$30.97 was spent for the same sorts repairs. In 1871, a stringer was replaced for \$8.82. In 1873, F. B. Stephens was paid for "self and oxen, one day each on Durham Falls Bridge." In 1877, several repairs to the wood stringers and planks were made for a total of \$22.00 and, in 1879, they spent \$36.45. These small but frequent repairs indicate that the bridge was under a lot of activity and in wearing condition [Town of Durham 1833-1955].

In 1894, the town voted to spend \$1,554.37 for repairs and rebuilding of the Durham Falls Bridge. It appears in the annual report as follows [Town Durham 1894:4]:

DURHAM FALLS BRIDGE

S. S. Jenkins, for making plans and specifications...	\$35.00
S. S. Jenkins, changing plan and writing contract and bond.....	14.00
F. H. Pinkham, printing posters.....	1.75
G. J. Foster & Co., advertising proposals and notice.	4.00
Libbey & Scales, printing notices and specifications, and advertising.....	8.75
J. B. Folsom, oil and lead.....	3.45
C. L. Jenness, spikes.....	6.88
DeMeritt & Burnham, 109 feet railing.....	3.15
DeMeritt & Burnham, 5,206 feet plank at \$14.....	72.88
E. J. Coffin, lead and oil.....	1.08
Joseph S. Abbott, keeping open highway.....	75.00
Stephen Rand, 4 days' service.....	8.00
J. S. Abbott, stringers, 390 feet, at 45c.....	175.50
John S. Chesley, services.....	20.00
J. S. Abbott, railing, 190 feet at 40c.....	76.00
Joshua B. Smith, services.....	20.00

J. S. Abbott, planking bridge and stone work by day..	103.00
new stone south side, 3,426 ft. at 13c..	445.38
new stone north side, 259 ft. at 10c....	25.90
old wall, 5,680 feet at 8c.....	<u>454.40</u>
	\$1,554.37

Historic photographs taken in 1897 (date documented by the Durham Historical Society) show a single-span, wooden deck bridge, supported by granite U-abutments. These photographs also show the Jenkins mills and Frost's Store, that were still extant at the end of the 19th century. One interesting feature which helps document the age of these photographs is the wires which are strung over the bridge. The telephone-telegraph lines in town were run in 1894 [Brown 1985:17], and in 1900 the town voted "to light the streets of Durham Village" [Town of Durham 1900]. In 1902, the town paid the Newmarket Electric Light, Heat and Power Company to "string four street lights on the road from Durham to Newmarket" [Town of Durham 1902].

In 1905 and 1906, the New Hampshire legislature passed laws which changed the State's relationship with highway improvements. These laws called for a general highway survey of the entire State, designated certain roads as state highways, and elaborated on a new system of state road and state aid to towns. The new laws established regular, state highway appropriations which were shared with towns in proportion to amounts they were required to raise locally. The progressive town of Durham, site of the university, took advantage of this effort immediately.

2. Technological Design Context and Physical Description

The American bridge industry underwent a significant transition between 1890 and 1915. The Durham Falls Bridge is a typical example of these advances. These technological advances were necessary because of the need for increased stiffness and rigidity in superstructures due to the increasing weight, speed, and volume of the automobile. The first reinforced concrete arch bridge in America using the Melan system of I-beam reinforcement was constructed in Cincinnati, Ohio, in 1894. The first reinforced concrete slabs were made in France by Francois Hennebrique in 1880. Steel plants developed rolling mills, making rolled beams and I-sections. During the first half of the 20th century, there were advances in the use of reinforced concrete and steel. This popular configuration became nearly ubiquitous in modern highway systems [Jacobs et al. 1968:130-134].

The I-beam bridge was popular and widely used for crossing smaller streams. This was popular construction for short spans, because the crossing could

be made to fit the steel technology rather than vice versa. The abutments (usually granite) were increased to fit the length of the steel stringers. Because these bridges were easy to build, many of them were built across the State.

The existing Durham Falls Bridge is a single span, I-beam bridge of concrete jack arches bearing upon dry masonry, cut granite abutments. The two-lane structure, aligned on a north-south axis, is 24 feet 6 inches in length, with a deck width of 28 feet 5 inches.

The stringers consist of eight members which were rolled steel I-beams measuring 18 feet by 6 inches by $\frac{3}{8}$ inches. The corrugated metal forms, which were used to form the concrete jack arches, were left in place. The bridge deck is seated directly upon the stone masonry abutments. The wearing course consists of an average of 10 inches of surface-treated gravel. The road surface is asphalt. The "railings" on the east (downstream), and west (upstream) side of the bridge are different. The downstream side consists of steel posts and rails. The west side has a parapet of mortared fieldstone in a random pattern. It is about 3 feet high on the upstream side, leaving approximately 1-1/2-foot exposed along the roadway. This stone course runs to the end of the abutments. Between the abutments, connecting these two stone parapets, is a single steel pipe railing supported by three steel posts. Originally, both sides were treated with fieldstone like the west side. The steel railing on the east was added in 1962, when the fieldstone wall was removed and a sidewalk added for pedestrians. The four-foot sidewalk extension is supported by an I-beam girder connected to the outermost I-beam. Remnants of the fieldstone wall are visible on the east elevation under the existing steel railing.

The two, cut granite, dry-masonry abutments are massive in size. They are U-abutments with parallel wing walls. These abutments are of Durham granite and were built as part of the 1907 building campaign. They are approximately 14 feet high. The north abutment has a 30-foot wing wall on the east elevation. The wing wall on the west elevation is somewhat shorter, about 15 feet. The south abutment's wing wall tapers to meet the sharp grade of the slope.

The Durham Bridge is in poor structural condition. The concrete deck is spalling and leaking, with several longitudinal cracks. The superstructure is in worse shape with heavy rust and metal loss on the exposed lower flanges of the I-beams. The substructure (abutments) exhibits a few cracked stones and some voids at the base. The northeast section is bulging and settlement is evident in the wings. Erosion is undermining the abutments.

3. Construction and Evolution of the Existing Bridge

In 1907, Article 9 in the town warrant asked: "to see if the town will vote to build an iron bridge at Durham Falls and raise and appropriate a sum of money therefore," and Article 10, "to see if the town will vote to raise the abutments of Durham Falls Bridge, and raise and appropriate a sum of money therefore" [Town of Durham 1907:3]. The town must have voted affirmatively, because a year later in 1908, the financial reports for the 1907 "repairs" on the Falls Bridge are listed as follows [Town of Durham 1908:13]:

FALLS BRIDGE

Paid D. Chesley & Co. for steel bridge with concrete floor.....	\$ 700.00
D. Chesley & Co. relaying in Portland cement the north abutment.....	478.00
D. Chesley & Co., raising and repairing south abutment.....	<u>29.69</u>
	\$1,207.69

STATE ROAD

Paid D. Chesley & Co., building road, relaying side walls and railing the same, at Durham Falls.....	\$1,411.84
C. A. Smart, inspector.....	20.00
Samuel Runlett, land to straighten road.....	<u>20.00</u>
	\$1,451.84
State contribution to joint fund.....	\$ 366.40
Town contribution to joint fund.....	<u>916.50</u>
Total joint fund.....	\$1,282.90
Part of fund disbursed by state engineer....	<u>41.26</u>
Amount available for road construction.....	\$1,241.64
Additional expense on account of railing, inspection and land.....	<u>210.20</u>
	\$1,451.84

The builder of the 1907 bridge was Daniel Chesley, who is listed from 1898 in the Durham directories as a stone contractor and stone mason. By 1905, he advertised as "Daniel Chesley, Stone Contractor and Builder, Quarries and Office on the Dover and Durham Road, near the Durham line" [Durham 1905]. He is listed similarly until 1917, at which time he is listed in the Dover city directory as "D. Chesley & Co. contractors in brick, stone masonry, earth work, concrete construction, and building moving [Dover 1917].

The Honorable Daniel Chesley is profiled in the History of the Town of Durham 1913. He was born in the neighboring town of Madbury on October 11, 1859, and later lived on the Durham road on the family farm, which was one of the settlement farms of Durham. He was a successful farmer, as well as a general contractor. He served on the board of selectmen as representative to the legislature, and as a member of the state constitutional convention in 1902. He was state senator from 1913-1914 and chairman of the Committee of Towns and Parishes and Committees regarding military affairs, agriculture, the state hospital, fish and game. He belonged to the Odd Fellows, Knights of Pythius and Patrons of Husbandry. Clearly, he was considered a prominent citizen in the town of Durham [Stackpole et al. 1913:321].

Other persons mentioned in connection with the 1907 bridge were C. A. Smart and Samuel Runlett. C. A. Smart was referenced in the 1907 annual report as the inspector of the State road. He was listed in the Durham directories from 1899 to 1913 as a farmer with specialty in poultry and eggs, and also as a house painter and paper hanger. C. A. Smart served as state representative in 1906 and as selectman between 1906 and 1909. Samuel Runlett was the owner of the grist mill, saw mill, and shingle mill on the northwest corner of the bridge. He was paid \$20.00 for the land to straighten the road, and the land came from the parcel where the mill stood [Town of Durham 1907:13].

The earlier bridge was similar to the existing bridge, but comparison of photographs taken by the Department of Transportation in 1940 and postcards from c. 1910 with current photographs, and the photographs of the 1894 bridge, document that Daniel Chesley substantially rebuilt the earlier bridge in 1907 to form the existing bridge. The abutments were enlarged and the individual stones clearly differ in configuration and placement. There is some evidence that earlier stones may have been reused (e.g., photographs underneath the north abutment show a difference in the stones where the bridge was widened) indicating that the older abutments were incorporated in the new abutments.

Another way of dating the abutments was by studying the quarrying techniques, i.e., flat chisels were used pre-1830 and plug drills from 1830 to the present. Two pieces of granite in the north abutment were

split with flat wedges, but the other stones show the tubular marks of plug drills. The stones are dark, Exeter grano-diorite, which was quarried extensively in Durham, some of the earliest quarried in New Hampshire [J. Garvin, interview 1989]. It is not known for certain where the stones were quarried, but the color, quarrying techniques, and availability suggest the likelihood that the builder, Daniel Chesley, quarried the stones in his personal quarry in Durham.

No records survive to document where Daniel Chesley purchased the steel I-beams for the Durham Falls Bridge. Chesley is known to have built at least one other bridge. In 1927, he built an 85-foot plate girder bridge over the Suncook River on New Hampshire Route 4 in the town of Epsom. (It was replaced in 1971). This bridge was made of structural steel and reinforced concrete [NHDOT 1971]. The steel was purchased from the Kittredge Bridge Company in Concord, New Hampshire, that built other bridges in the State in the early 20th century.

While quarried granite was used for the structural areas of the abutments, the parapet walls were made of small, rough fieldstones or cobblestones which were mortared for a decorative effect. These parapets were further decorated with a rounded cap of even smaller fieldstones. Over the deck, the cobblestone walls were broken by a steel lattice fence and hand rail to prevent their cracking with the movement of the deck. The parapet walls on the east side of the bridge were removed in 1962 when the road was widened for a sidewalk.

It is not known if the cobblestone parapet walls were built by Daniel Chesley or a later contractor. A local resident, Thomas Moriarity, remembers that the steel bridge which was built in 1907 had wooden railings. However, no photographs were found to prove or disprove this memory. According to Moriarity, the parapet walls were built around 1919-1920 by George Langmaid, who built the Durham Point School [T. Moriarity, interview 1989]. The 1921 directories listed George K. Langmaid as a farmer living on Durham Point. Mr. Langmaid may have been helped by George F. Keniston, also a farmer on Durham Point [T. Moriarity, interview 1989]. The expenditures for these cobblestone parapet walls was not listed in the town reports between 1918 and 1925.

The 1907 bridge had a gravel-wearing surface. The bridge was first tarred in 1921, using Tar(B), and was resurfaced with Tar(B) in 1923. In 1924, the resurfacing was done with a substance called Tarvia, which was used again in 1928 and 1930. In 1932, plain tar was used on the bridge surface. Yet, a different substance, Rotar, was used annually on the bridge from 1933 through 1938 [NHDOT 1920-1940]. Differences in tar are unknown.

Work continued on the bridge through the 1970s. The road was widened in 1962. A memorandum in the bridge maintenance files of Public Works and

Highways estimated a \$3,000.00 expenditure to prepare the bridge for a four-foot sidewalk on the downstream side. The town of Durham raised funds at a town meeting to build a new sidewalk through the area.

In 1976, there was concern about the critical loss on the exterior steel beam on the downstream side. The memorandum from Edward T. Swierz, bridge engineer, to Bernard H. Langley, assistant chief engineer, stressed that there was critical metal loss on an exterior steel beam and urgent replacement required. "The original downstream exterior steel stringer of the bridge has suffered such heavy metal loss that replacement as expeditiously as possible is advised. The beam is just about at the sidewalk curb location and does not get full brunt of the highway traffic except for loads traveling close to the curb, nevertheless urgent replacement is required" [NHDOT 1976].

In 1981, there was concern that the retaining wall on the upriver side, or northwest corner of the bridge, had sustained constant movement outward over the years. It has been reinforced, but was not holding. Town officials were concerned about the aesthetic appearance of this site and requested a rip-rap wall for replacement [NHDOT 1981]. These repairs are shown in a photograph.

The maintenance record of the bridge over the years includes: 1968 - "repair to curb"; 1975 - "repaired rail"; 1976 - "broke out edge of deck and removed rusted steel beam and placed new beam and started deck forms"; also in 1976 - "formed deck section around new beam and poured deck. Also started pointing up stone, chinking up stone wings and retaining walls, also sandblasting and painting structural steel." In 1976 as well, "chinking up stone wings and retaining walls, also sandblasting and painting structural steel and chain link fence" [NHDOT 1968-1976].

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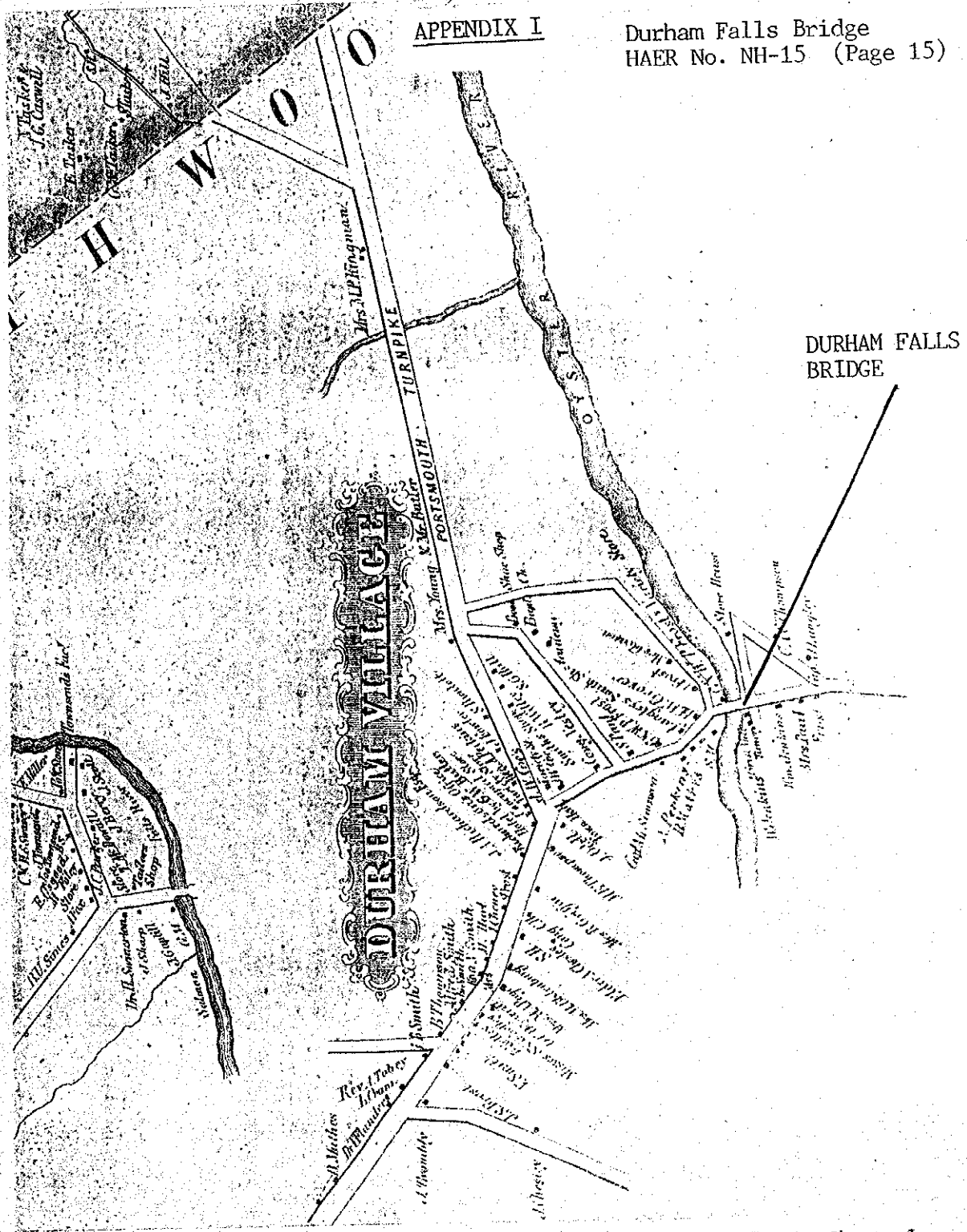
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APPENDIX I

Durham Falls Bridge
HAER No. NH-15 (Page 15)



Source: "Map of Strafford Co., New Hampshire". Drawn by J. Chace Jr.
Philadelphia: Smith & Bartlett, 1856.

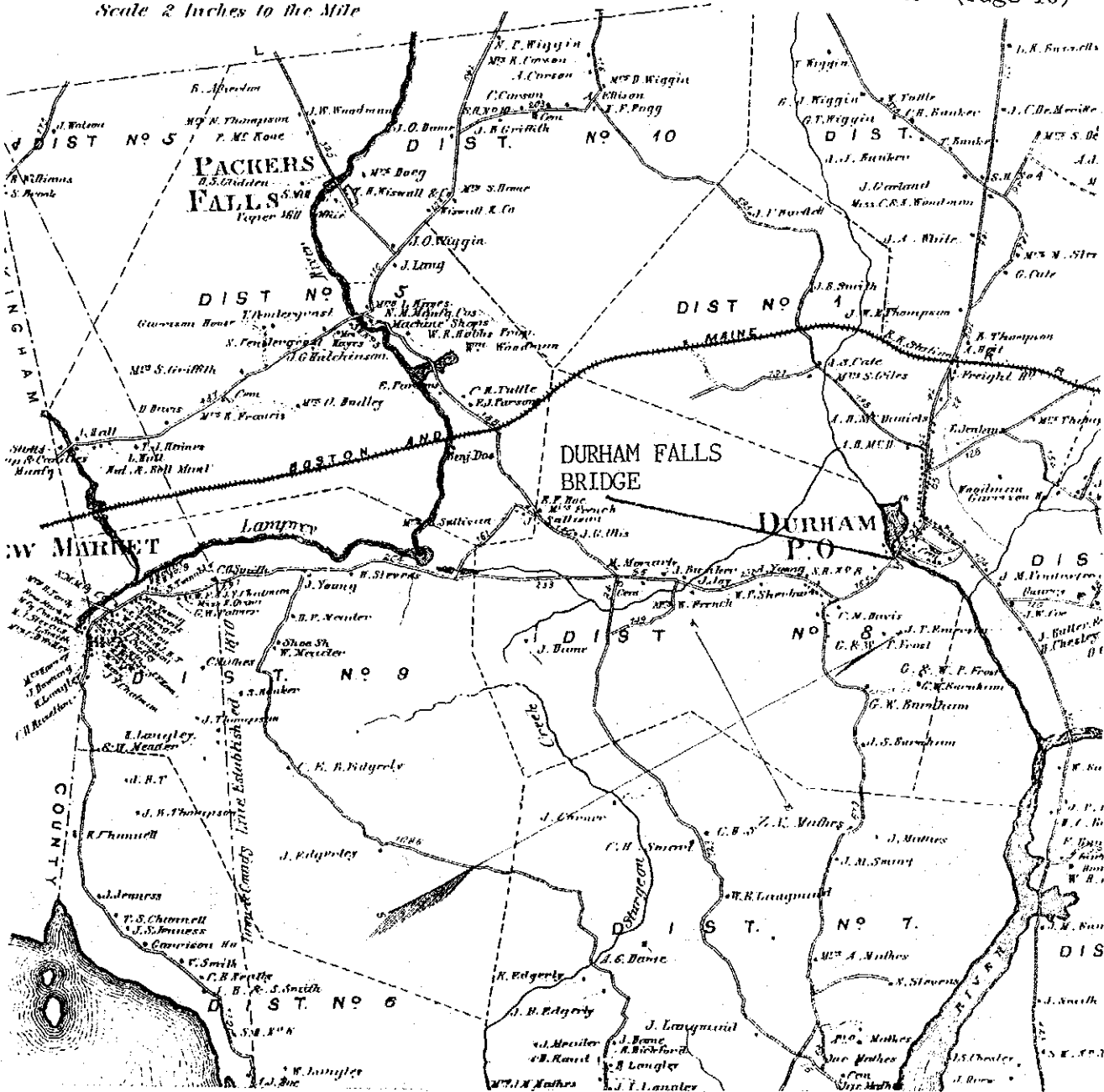
DURHAM

CIRCA 1871

Scale 2 Inches to the Mile

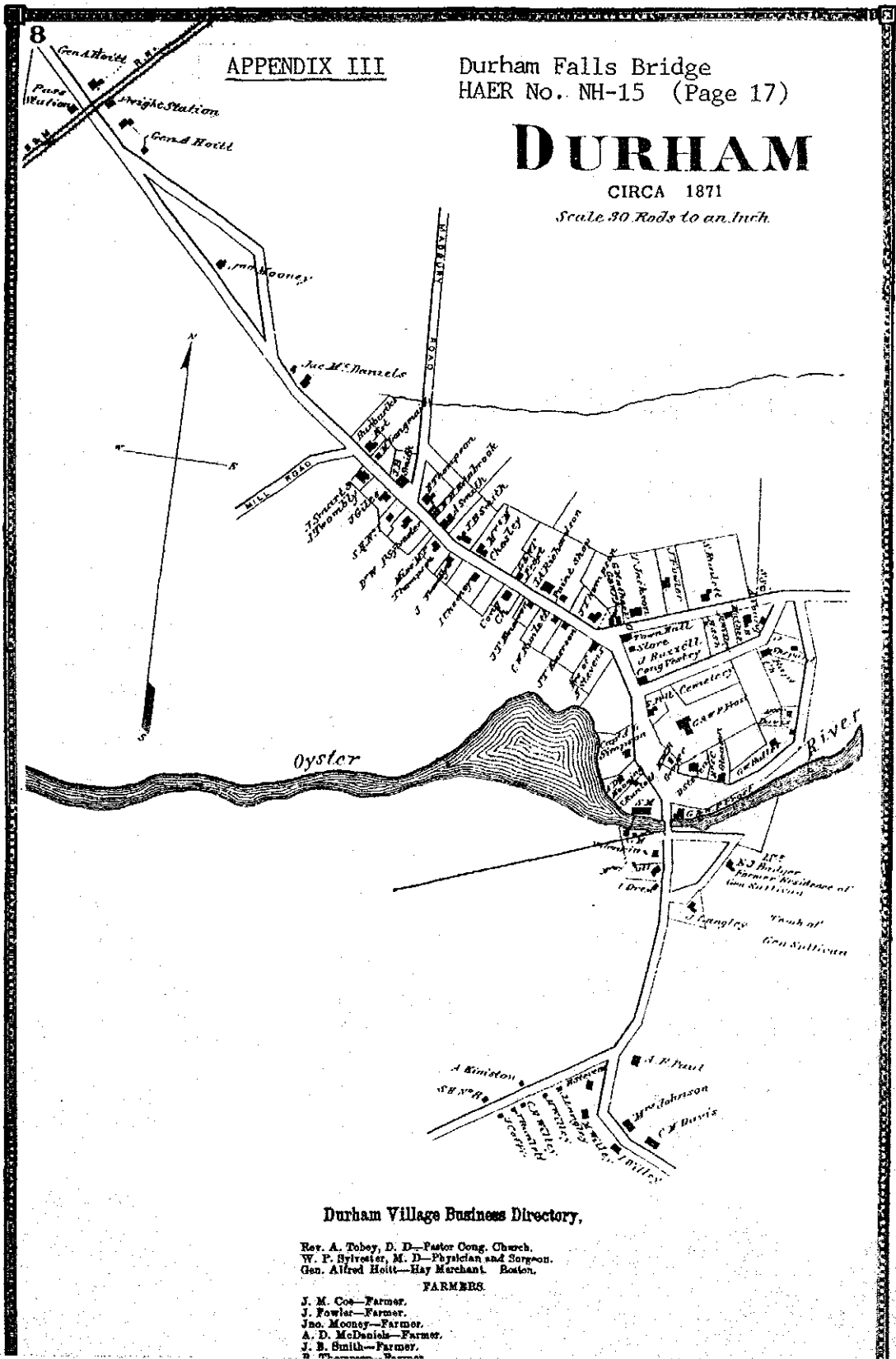
APPENDIX II

Durham Falls Bridge
HAER No. NH-15 (Page 16)



Source: "Atlas of Strafford County, New Hampshire", from actual surveys, drawn and published by Sanford and Everts. Philadelphia: 1871.

G R E A T B A Y



Source: "Atlas of Strafford County, New Hampshire", from actual surveys drawn and published by Sanford and Everts. Philadelphia: 1871.

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Index to Photographs

Durham Falls Bridge

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Spanning Oyster River on State Route 108,
0.2 miles southeast of the intersection
with Main Street

Durham
Strafford County
New Hampshire

NOTE: Photographs were taken Bruce Alexander, photographer, Preservation
Company, December 1988

- NH-15-1 VIEW OF BRIDGE, SPANNING OYSTER RIVER, LOOKING NORTHWEST
- NH-15-2 VIEW OF EAST ELEVATION, LOOKING WEST, THROUGH TO DAM
- NH-15-3 VIEW OF RETAINING WALLS, EAST ELEVATION, LOOKING SOUTHWEST
- NH-15-4 VIEW OF RETAINING WALLS AND ABUTMENTS, SHOWING RIVER COURSE AT
LOW TIDE, LOOKING WEST
- NH-15-5 THROUGH VIEW OF NORTH AND SOUTH ABUTMENTS, SHOWING RAILING
DETAIL, UNDER DECK AND I-BEAMS, LOOKING WEST
- NH-15-6 VIEW OF SOUTH AND NORTH ABUTMENTS, LOOKING SOUTH
- NH-15-7 VIEW OF NORTH ABUTMENT, LOOKING NORTHWEST
- NH-15-8 VIEW OF NORTH FACE OF SOUTH ABUTMENT, SHOWING JACK ARCHES AND
I-BEAM, LOOKING SOUTHEAST
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The following are historic photographs, courtesy of the Durham Historical Society:

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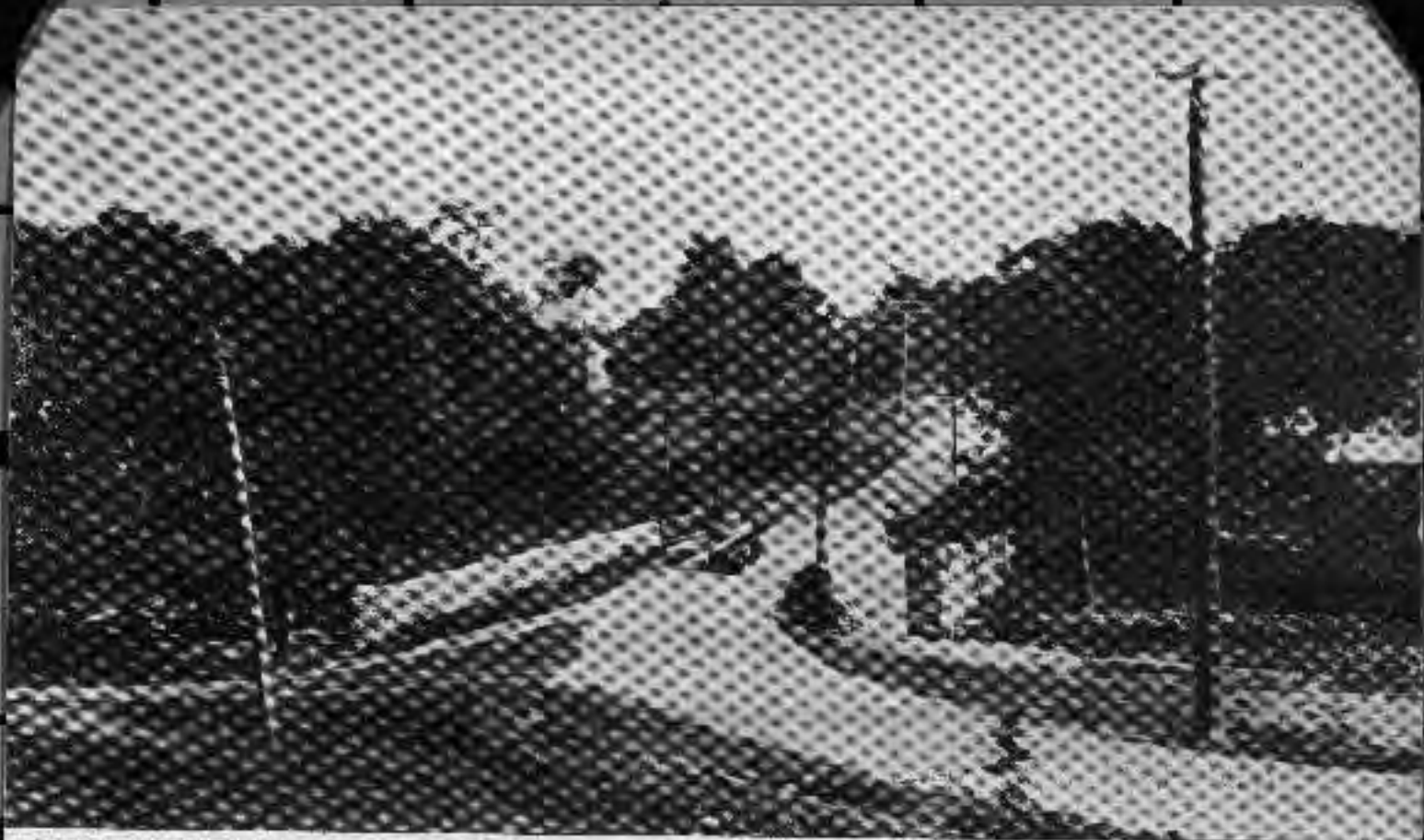
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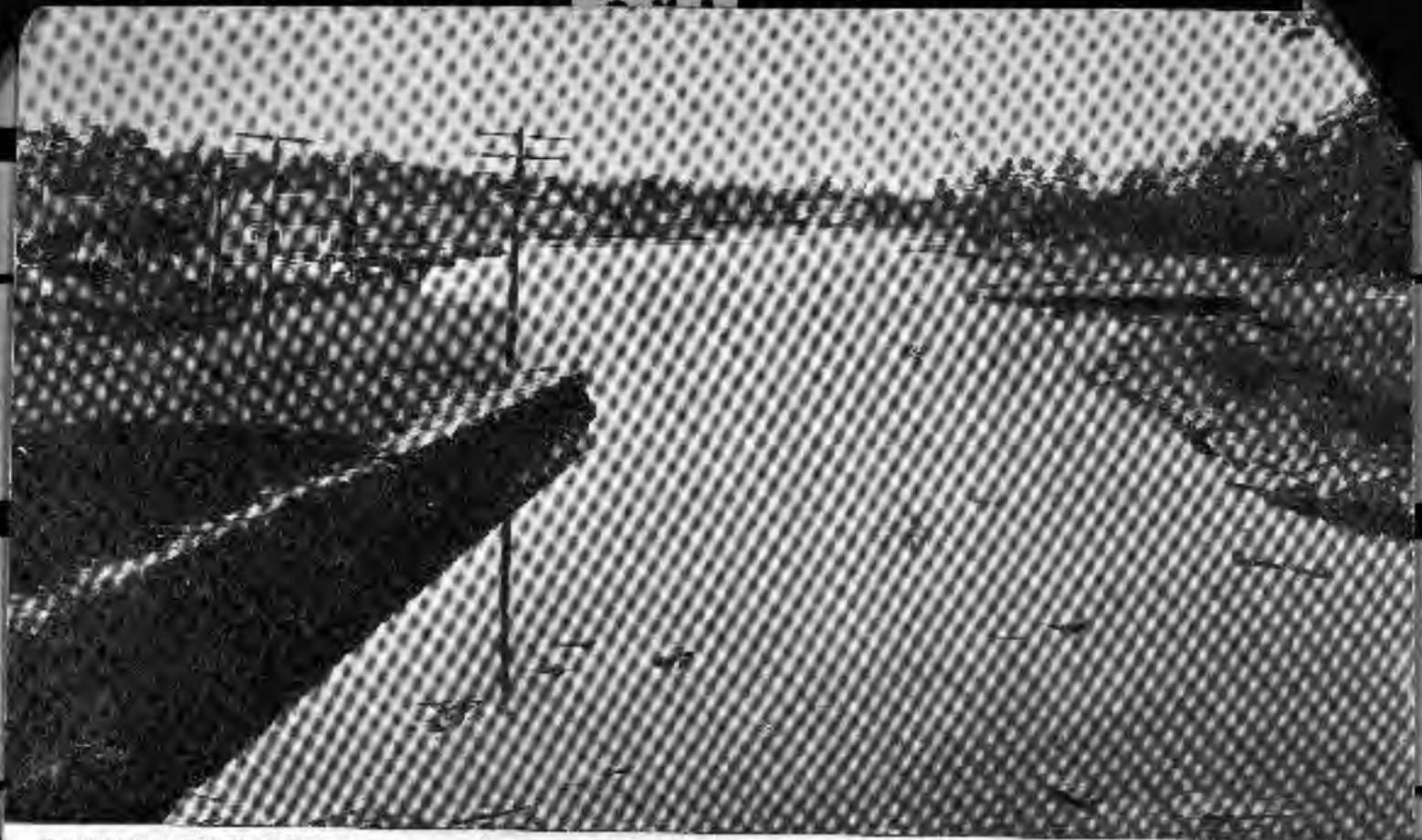
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