SPANNING THE MISSOURI

"Is it possible that the fable of Aladdin and his lamp is no longer a fable but a fact? It must be so," declared the toastmaster. "The bridge is there, an arch of steel spanning the mighty Missouri — how was it done? — it seems like a miracle." On this frigid January evening in 1896, A. W. Erwin's happy listeners were inclined to agree with him. Sioux City's new Pacific Short Line Bridge, which had opened for traffic a few hours earlier, seemed less the work of men than the gift of a genie. Begun in 1889, the bridge's construction had proved to be a study in frustration, and after six years of false starts, law suits, and business failures, many Sioux Citians had pinned their hopes for its completion on the supernatural.

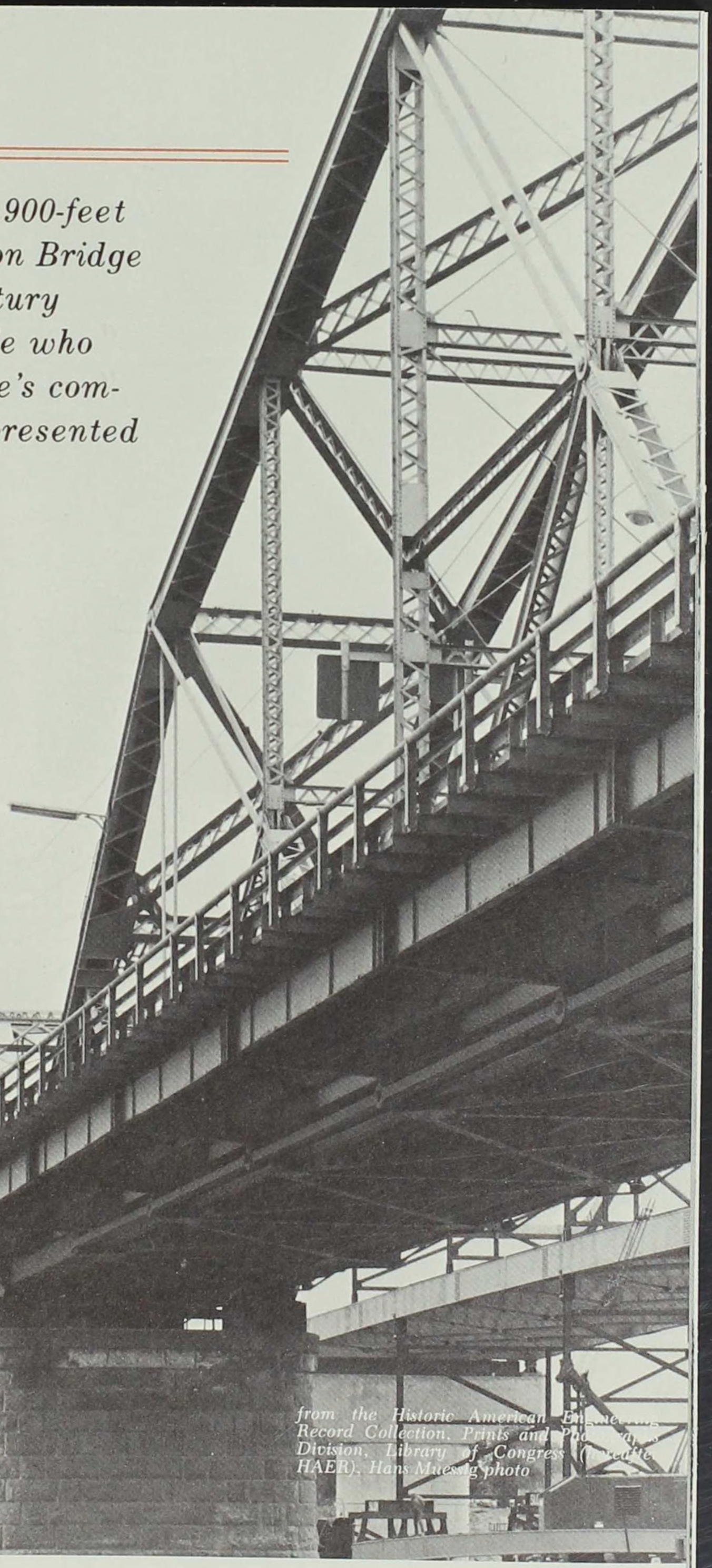
The completed bridge was a peerless engineering triumph. The second of two spans built to carry railroad traffic across the Missouri River at Sioux City, the Pacific Short Line Bridge rested originally on the rather fragile financial schemes of one Donald McLean, a railroad adventurer with an uncanny ability to "get capital." Although his capital eventually proved to exist mostly on paper, McLean wooed local businessmen with a package deal that would not only open the territory of northern Nebraska to commercial development by Sioux City firms, but also provide them with a direct rail line to Salt Lake City and the Pacific Coast. To John Peirce and other investors, still smarting over the routing of the transcontinental railroad through rival Council Bluffs back in 1868, the possibilities afforded by McLean's scheme outweighed any concerns they may have had about his reputation.

Progress on the bridge was rapid at first. Soundings and engineering surveys began in the fall of 1889, soon after the incorporation of the Pacific Short Line Company. At the same time, the PSL erected a temporary railroad bridge to carry construction materials across to the Nebraska side. By the summer of 1890, contracts were awarded to Sooysmith and Company and the Phoenix Bridge Company to execute designs by James A. L. Waddell, Phoenix's western agent. Plans called for a low bridge featuring draw spans at either end, with approaches at First Street in Sioux City and in South Sioux City, Nebraska. It would be a "combination bridge," meaning simply that it would bear horse and pedestrian as well as railroad and streetcar traffic, all on one level (see the drawing on page 17).

Although speed was to have been a hallmark of the project, in the fall of 1890 — with the first pier caisson ready to be sunk — the delays began. In November the Sioux City *Journal* reported that McLean was in financial trouble; in December he was broke. Construction ceased. Following months of negotiations arranged by Sioux City's A. S. Garretson, the builders resumed work in May 1891, but by August the reorganized company was in trouble again. With George Wickersham, Garretson this time bought the company outright — for $2 million — but was unable to send the builders back to work until December 1892. Their rapid progress through the winter months suddenly halted in April 1893 when floodwaters destroyed a tramway connecting two bridge piers. Financial calamity followed natural disaster within days; on April 28 Garretson announced that his company had succumbed to the national business panic triggered by agricultural depression, mone-

With two swing spans and a 1,900-feet reach, Sioux City's Combination Bridge is a triumph of nineteenth-century engineering skill. To the people who paid for it, however, the bridge's completion in 1896 more likely represented a triumph of civic endurance.

by
Martha Bowers
and
Hans Muessig



from the Historic American Engineering Record Collection, Prints and Photographs Division, Library of Congress (hereafter HAER), Hans Muessig photo

HAER (from the files of the Sioux City Journal)

James A. L. Waddell, chief engineer and designer of the Pacific Short Line Bridge, was born in Port Hope, Ontario in 1854. Graduating from Rensselaer Polytechnic Institute in 1875, Waddell worked as a civil engineer and professor of engineering, both in the United States and in Japan. In 1887, he established an engineering practice in Kansas City, doubling as western agent for the Phoenix Bridge Company of Pennsylvania. Many years later he moved to New York City, where he died in 1938.

Waddell is considered one of America's foremost bridge engineers in the era of long-span structures. The Pacific Short Line Bridge, with its two swing spans, was among his earliest designs. He is particularly known for the development of the modern vertical-lift bridge, his first being the Halstead Street Bridge in Chicago (1895). He also served as consulting engineer for Chicago's elevated railway (1896), which today defines that city's central business district — the Loop. Waddell's later work includes the Newark Bay Bridge (1926), the 3,720-foot cantilever bridge at Cairo, Illinois (1929), and the Anthony Wayne High Level Bridge at Toledo, Ohio (1931).

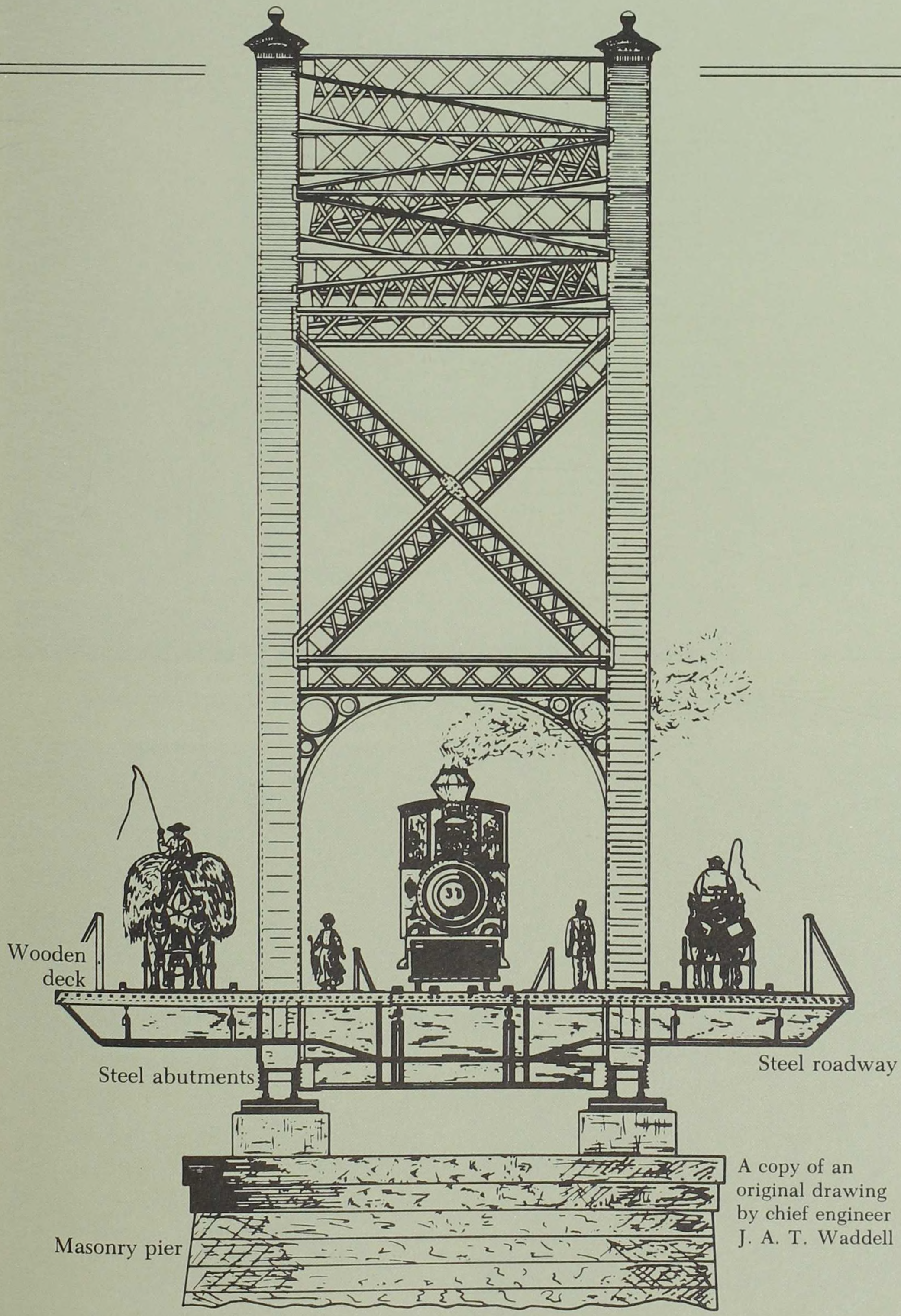
Waddell wrote extensively about the mechanics and economics of bridge-building. Among his publications are *Designing Ordinary Highway Bridges* (1884) and *Bridge Engineering* (1916).

tary problems, and overspeculation.

His faith in the bridge unshaken, Garretson attempted still another reorganization two months later. This effort, aided by his creditors, was named the Combination Bridge Company. With a 2 percent tax approved by Sioux City voters (amounting to about $300,000) and a 10 percent assessment of the company's $4 million in stock, the bridge building resumed in June 1895. Revised contracts with Sooysmith and the Phoenix Bridge Company required four days to negotiate because the new company wanted the bridge finished as quickly as possible. Indeed, reported Chief Engineer Waddell, he had agreed "to do a piece of work unprecedented in the history of civil engineering" — in just eight months!

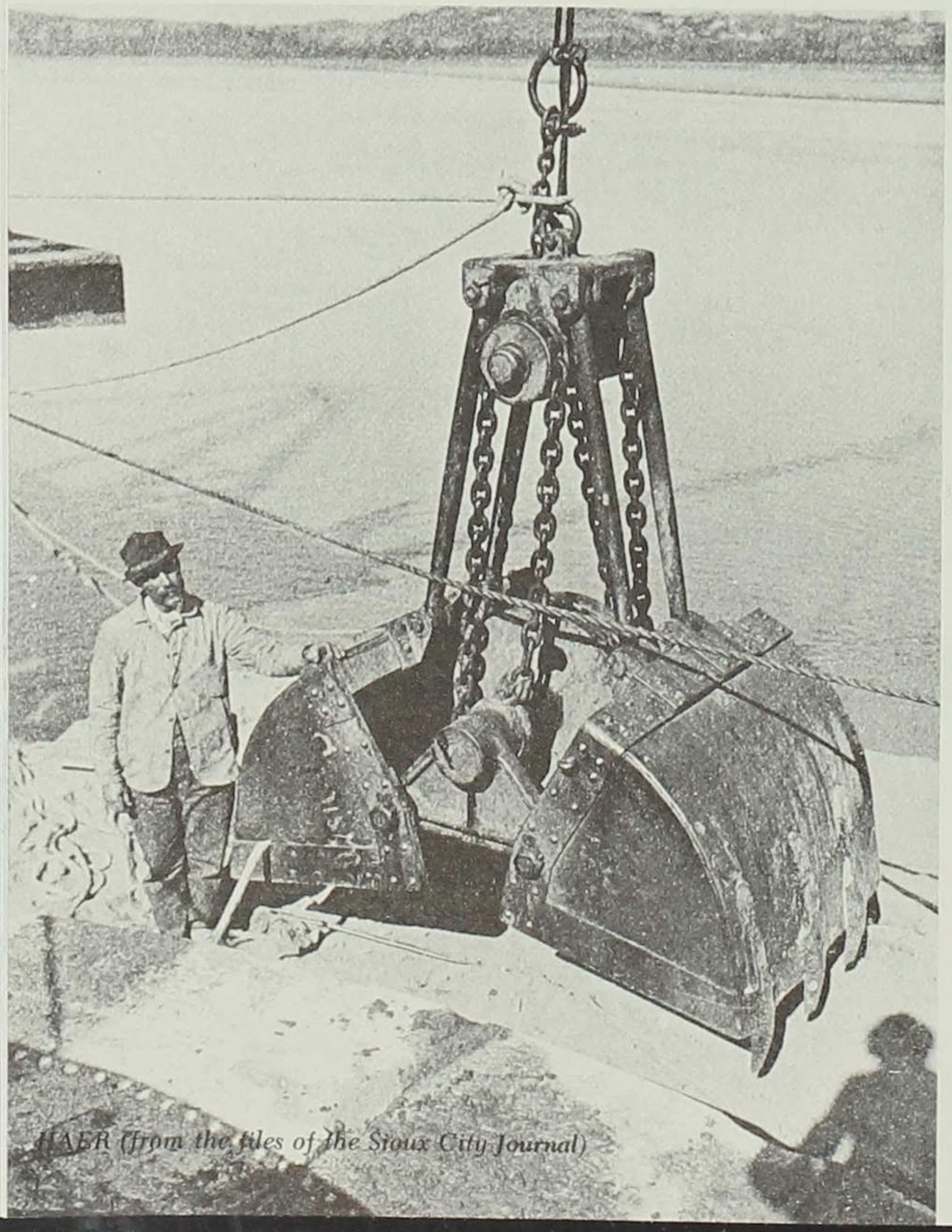
Note on Sources

This article is based on a report by Dennett, Muessig and Associates, Ltd. for the Iowa Department of Transportation. The report and accompanying photographs and drawings are now included in the Historic American Engineering Record collections of the Library of Congress in Washington, D.C.



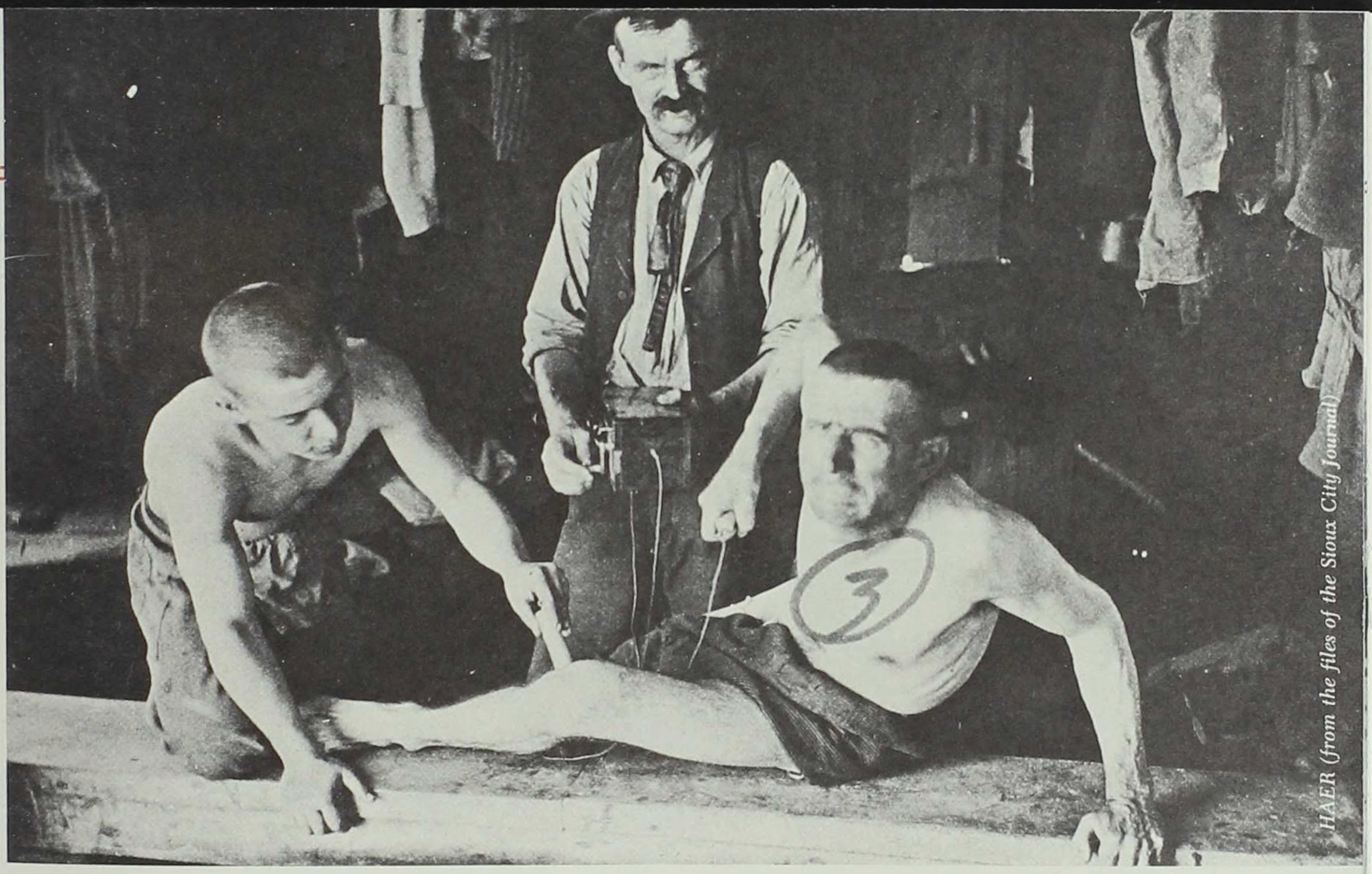
A copy of an original drawing by chief engineer J. A. T. Waddell

HAER (from the files of the Sioux City Journal)



HAER (from the files of the Sioux City Journal)

The task of building the Combination Bridge required both engineering skill and physical courage, as workers had to handle heavy machinery above and below the water line. At left is a dredging bucket used in preliminary excavations. Later, steel caissons are towed into position on the river (above). Working in the caissons was probably the most dangerous phase of the bridgebuilding. Teams of "sandhogs" — enclosed within a pressurized chamber eight feet high — removed gravel, sand, and mud under the caisson, clearing its path to bedrock below. A system of pipes carried the muck out of the chamber and into the water.



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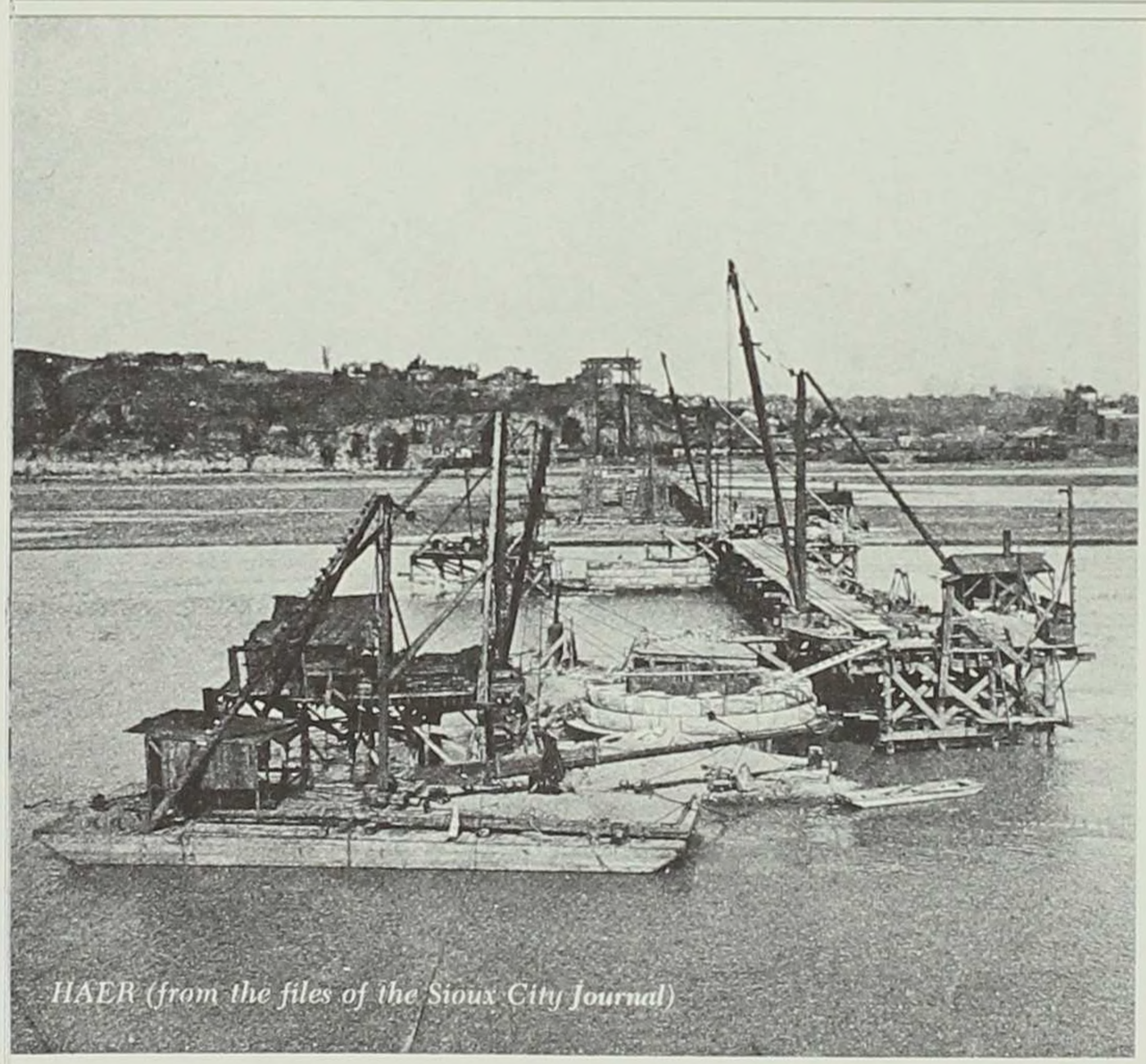
A continuing problem in the underwater work was decompression sickness — commonly known as "the bends" — caused by a too-rapid reduction in air pressure as sandhogs ascended from the depths. Treatment with oxygen — and a good hot meal — restored vigor to men stricken with the bends. (Markings on original photographs.)

HAER (from the files of the Sioux City Journal)



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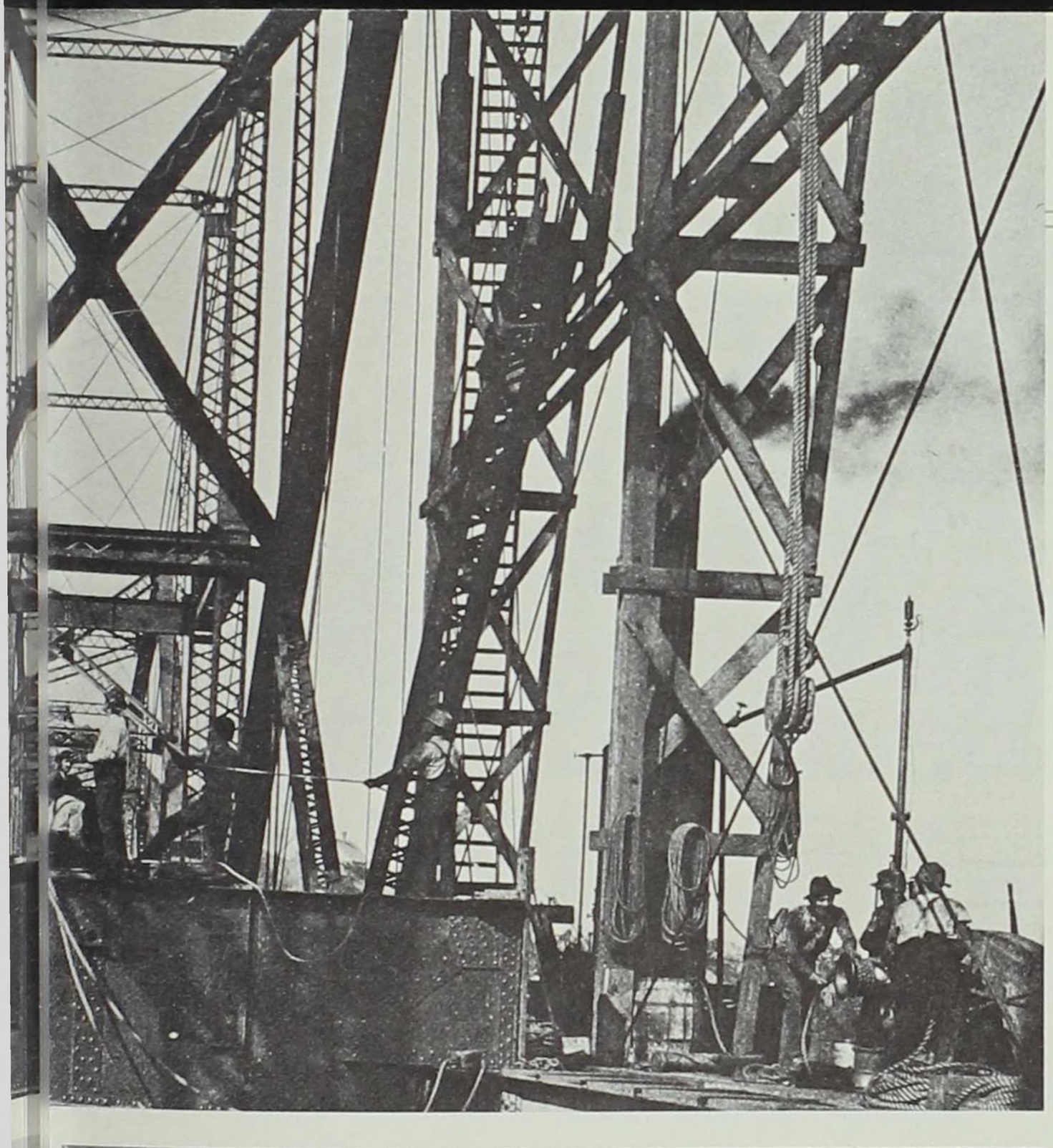
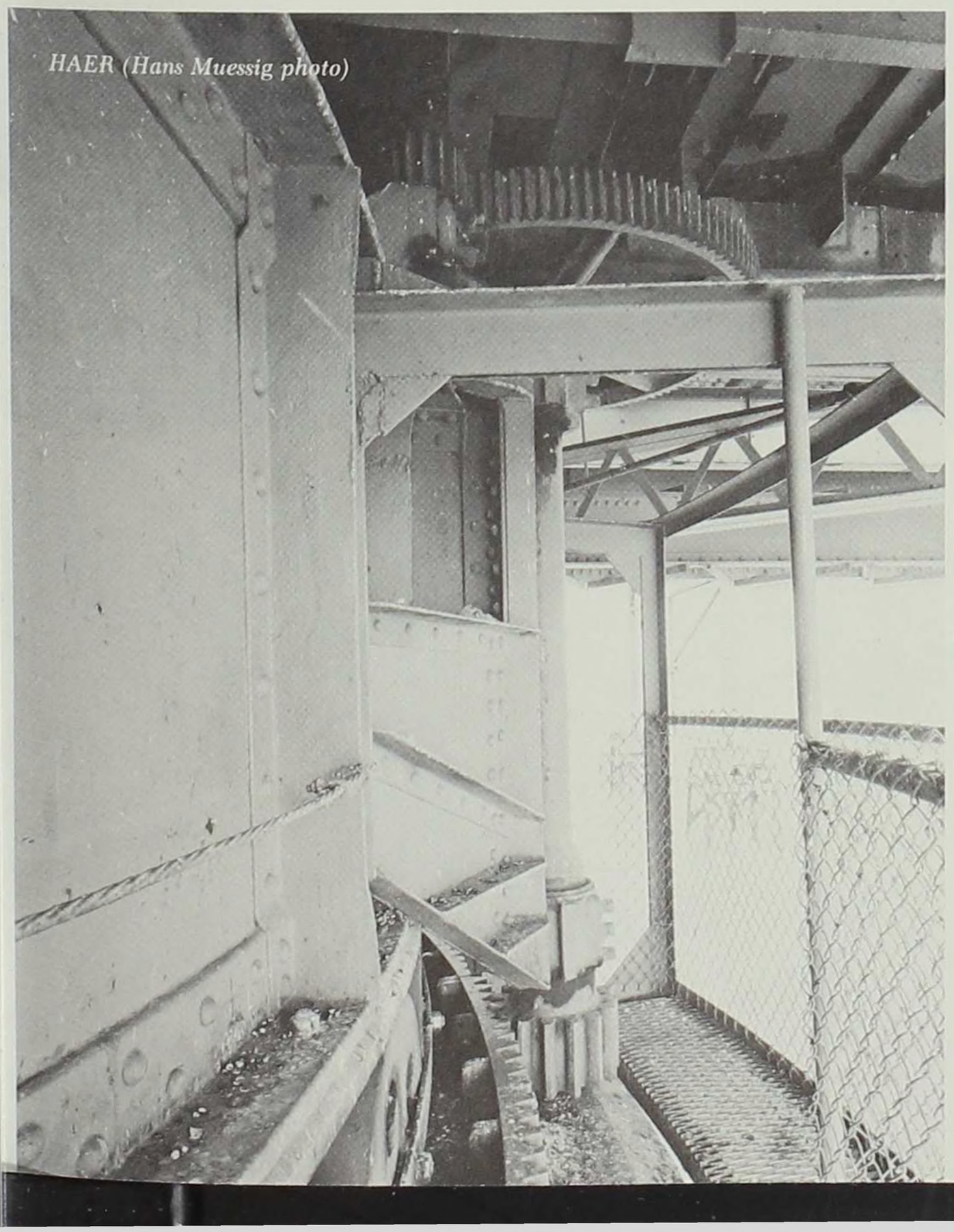


HAER (Hans Muessig photo)



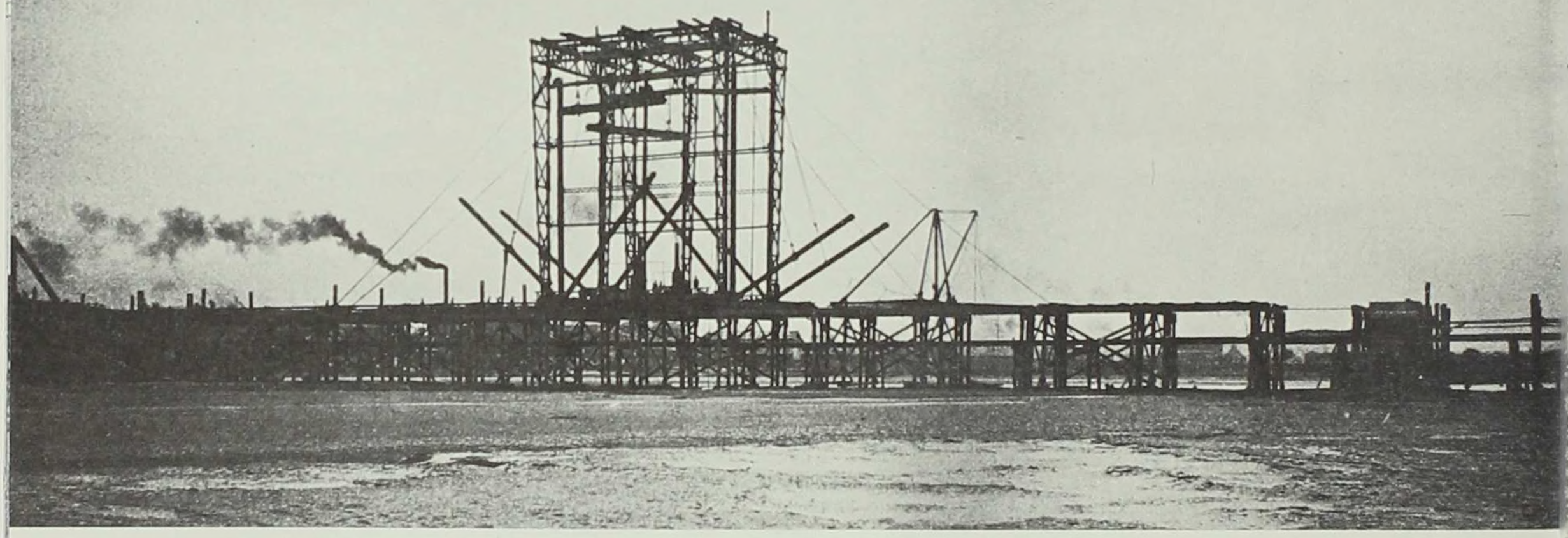
Once the caisson reached bedrock, it was filled with concrete, forming the pier's foundation. Sandhogs then paved the pier (lower left), and prepared it for structural steel.

Two of the bridge's six piers required power stations for the swing spans, pictured under construction (upper left). Soon afterward, construction progress accelerated as crews worked around the clock on the steel superstructure (upper right). Illuminated by huge arc lights, laborers carried structural pieces out onto the bridge during the night in preparation for the next day's work.

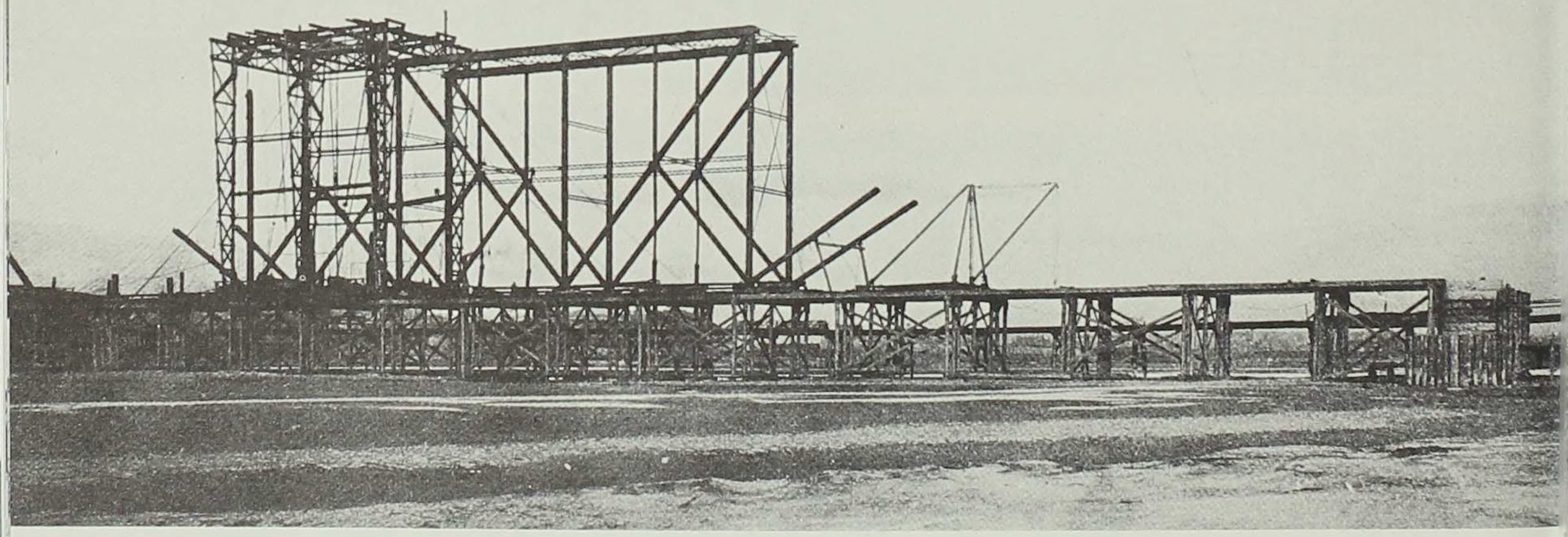
The Iowa draw span rests on steel rollers fitted between cast iron tracks (lower right) turned by a rack and pinion system anchored to the pier. Driven by two capstans — originally operated by four men but later powered by electric engines — the swing spans could be lifted and rotated out of the way of oncoming river traffic.

The First Fixed Span, October 5-13, 1895

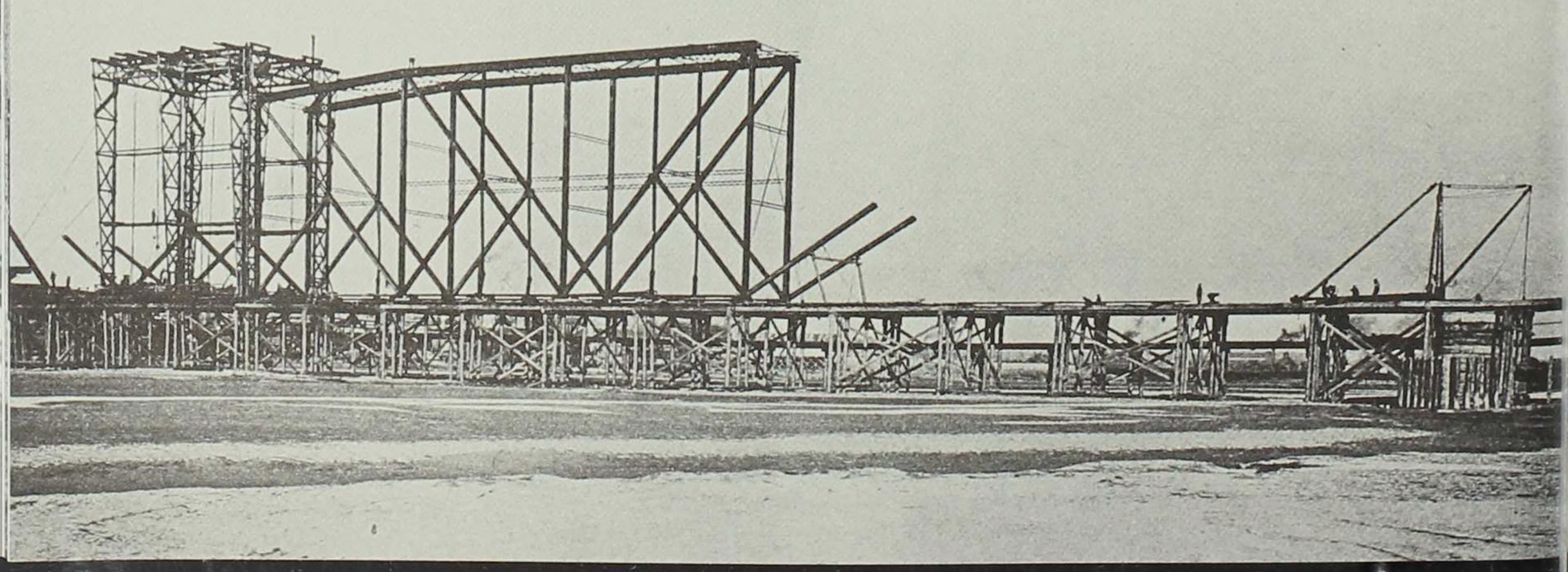
October 5, 1895



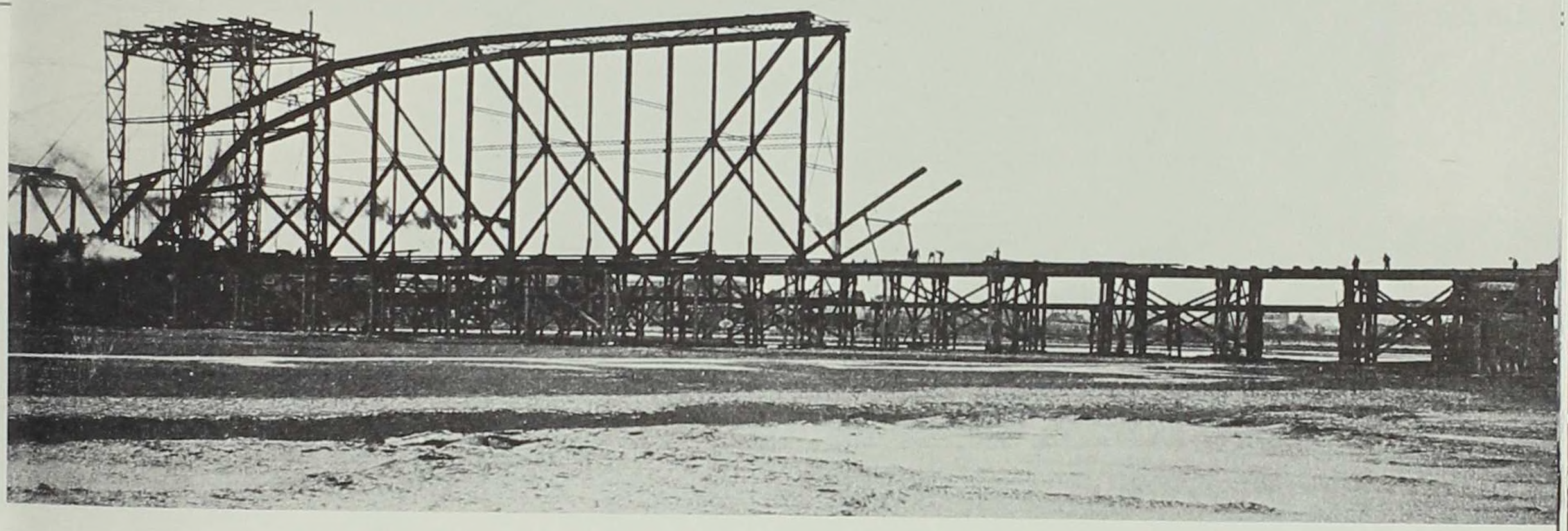
October 7, 1895



October 8, 1895



October 9, 1895



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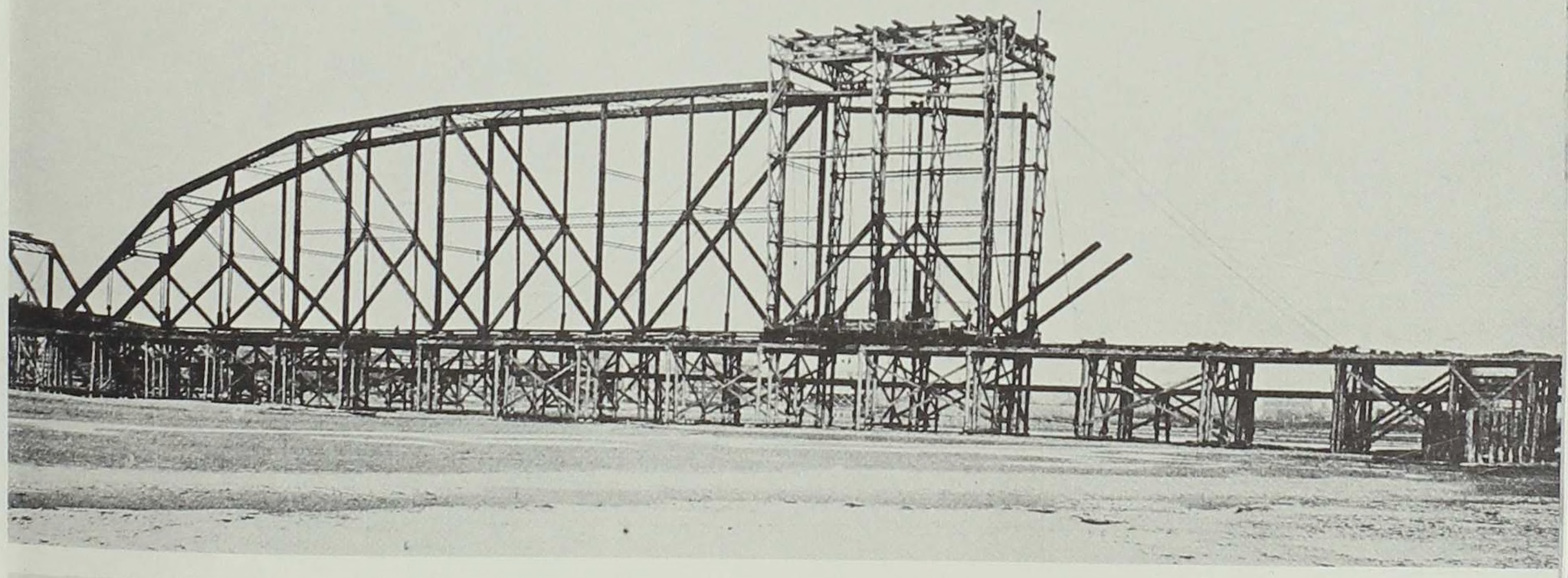

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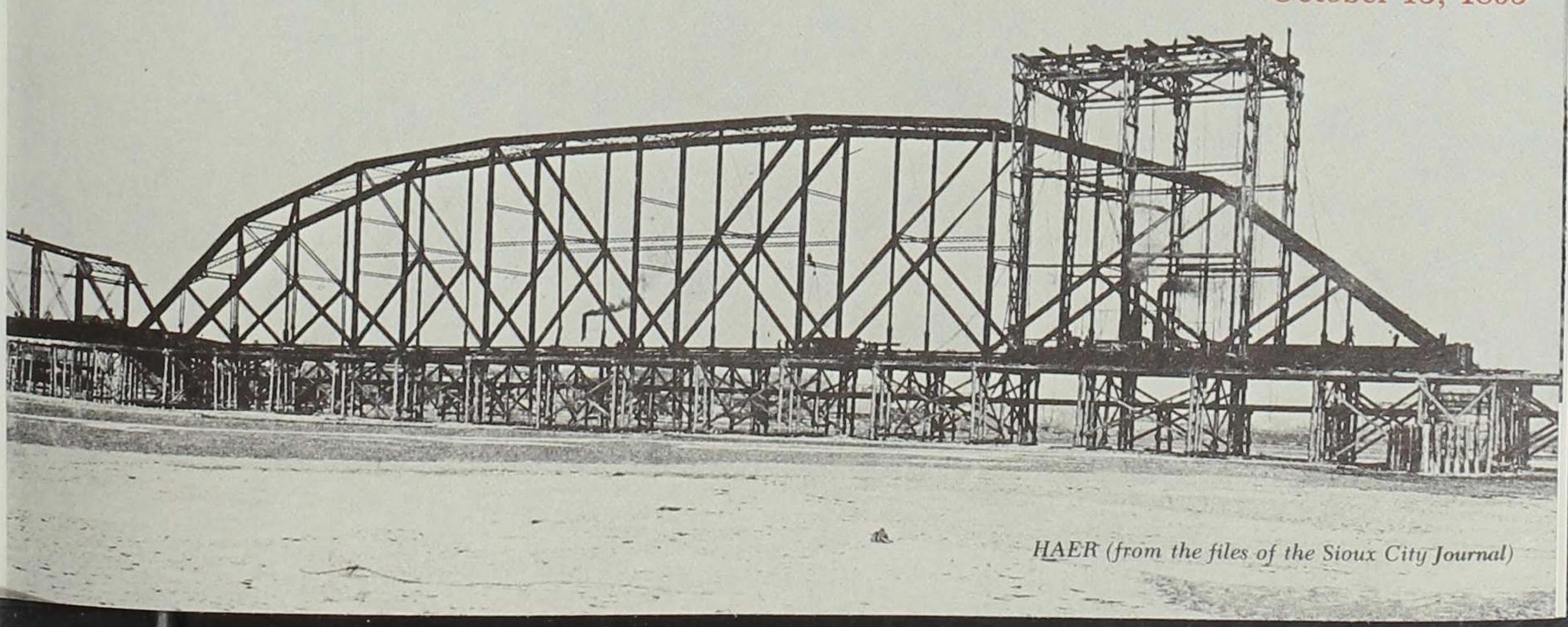

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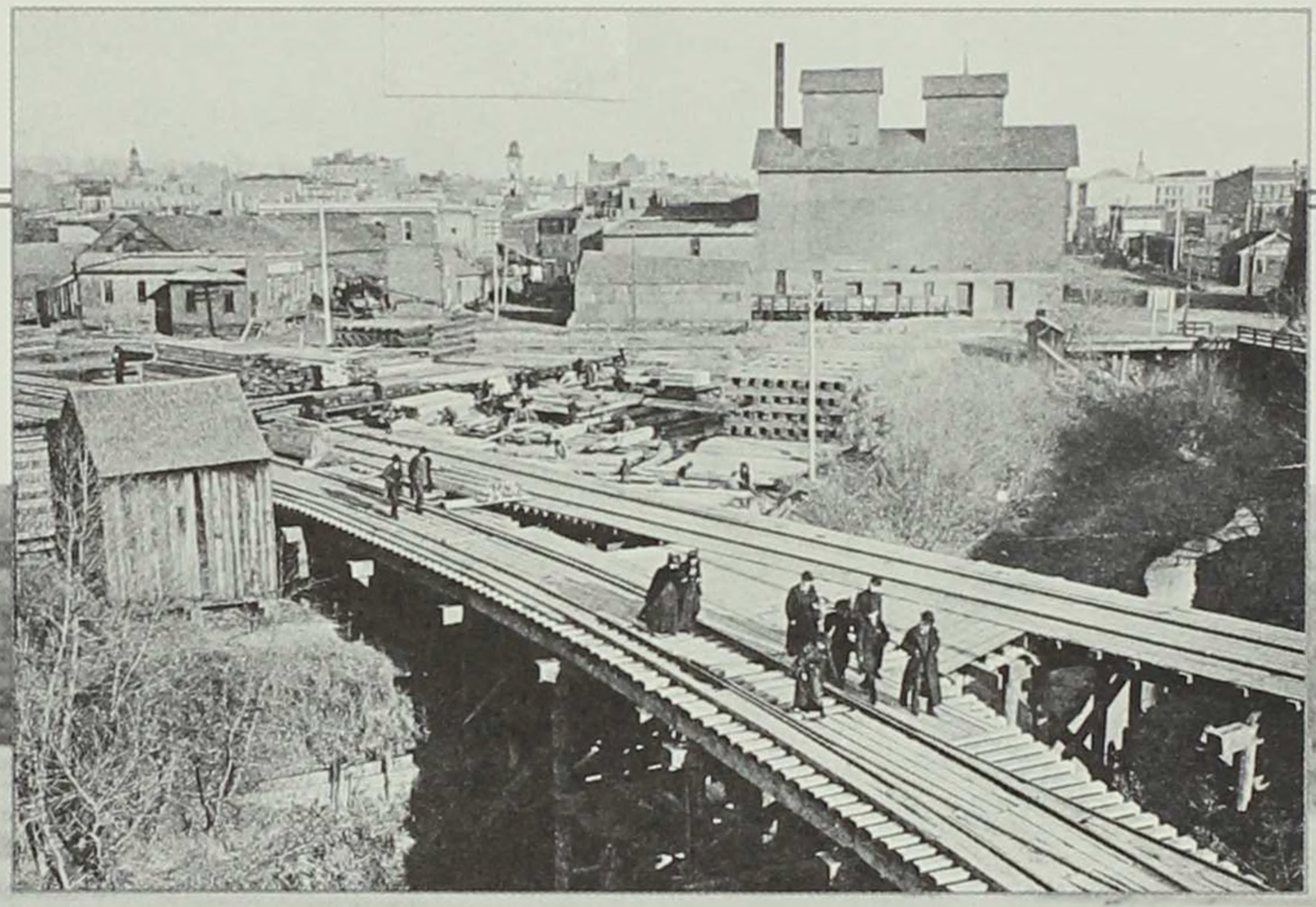
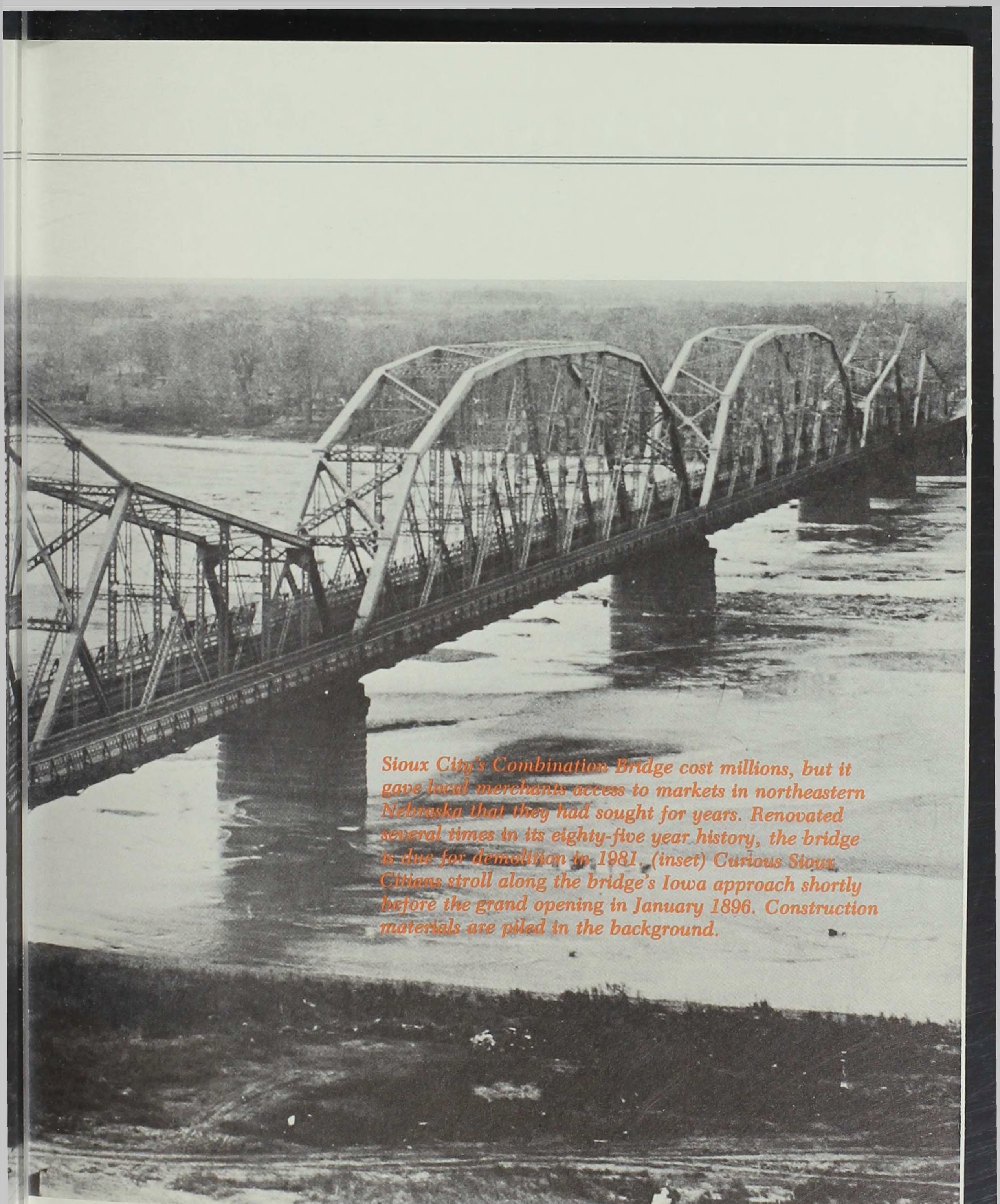


HAER (from the files of the Sioux City Public Museum)



Sioux City's Combination Bridge cost millions, but it gave local merchants access to markets in northeastern Nebraska that they had sought for years. Renovated several times in its eighty-five year history, the bridge is due for demolition in 1981. (inset) Curious Sioux Citians stroll along the bridge's Iowa approach shortly before the grand opening in January 1896. Construction materials are piled in the background.