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CHICAGO RIVER BASCULE BRIDGES
I&M Canal National Heritage Corridor
Spanning the Chicago River
Chicago
Cook County
Illinois

HAER No. IL-111

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

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HISTORIC AMERICAN ENGINEERING RECORD

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NOTE: Photographs taken by Jet Lowe, HAER photographer, 1987

IL-111-1 GENERAL VIEW OF MOVEABLE BRIDGES ALONG NORTH BRANCH OF THE CHICAGO RIVER, LOOKING NORTHWEST FROM THE SEARS TOWER

IL-111-2 GENERAL VIEW OF MOVEABLE BRIDGES CROSSING THE SOUTH BRANCH OF THE CHICAGO RIVER, LOOKING SOUTH FROM THE SEARS TOWER

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HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO RIVER BASCULE BRIDGES
I&M Canal National Heritage Corridor

HAER No. IL-111

Location:	I & M Canal National Heritage Corridor Various bridges across the Chicago River and its South and North Branches Chicago, Cook County, Illinois
Date of Construction:	1900-1940
Designer:	Chicago Bridge Division, Board of Consulting Engineers
Present Owner:	City of Chicago
Present Use:	Vehicular Bridges
Significance:	The development of the Chicago trunnion bascule bridge occurred during the first three decades of the twentieth century. Despite the controversy over patent infringement -- Joseph E. Strauss charged the City of Chicago engineers with infringing on his patented Strauss-Trunion bascule bridge -- the Chicago bascule received great acclaim within the civil engineering profession.
Project Information:	The Illinois and Michigan Canal was designated a National Heritage Corridor in 1984. The following year HABS/HAER embarked on an extensive inventory and documentation project of the 100 mile-long corridor. Field work for this project was concluded in 1988. Final editing of the documentation was completed in 1992.
Historians:	Frances Alexander, Charles Scott, and John Nicolay, 1986.
Editor:	Gray Fitzsimons, 1993.

By the turn of the century the need to improve the crossings of the Chicago River and its branches prompted Chicago to become, as one engineer observed, "[the] central field thus far for the development of the bascule type of movable bridges." In 1899, the Chicago Bridge Division organized a Board of Consulting Engineers to examine alternatives to the numerous existing center pier swing spans. The board, composed of F. L. Cooley, Ralph Modjeski, and Byron B. Carter, determined that the most suitable bridge design for the Chicago River was the trunnion bascule, a bridge which pivots vertically on a fixed horizontal axle (trunnion) rather than a roller (track) such as the Scherzer rolling lift bridge. One of the major advantages of the trunnion bascule bridge was the location of its counterweights which were contained within a pit inside the abutments; thus, the bridge's abutments were easily adapted to any site. Also, the trunnion bascule featured a short counterweight arm contained within the pit and had a minimum number of moving parts. This offered an advance in speed and efficiency over the horizontal swing and vertical rolling lift bridges. One further innovation occurred in 1908, when Alexander von Babo, a city engineer in charge of bridge design, patented an internal rack which increased the lift of the bascule bridge to eighty degrees without having the truss members interfere with the lift.

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ADDENDUM TO:
CHICAGO RIVER BASCULE BRIDGES
Illinois & Michigan Canal National Heritage Corridor
Chicago Bridges Recording Project
Spanning the Chicago River and its N. and S. Branches
Chicago
Cook County
Illinois

HAER No. IL-111

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
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Washington, DC 20240

Photographs IL-111-1 and IL-111-2 were previously transmitted to the Library of Congress.

Jet Lowe, photographer, summer 1999.

IL-111-3 SOUTH BRANCH LOOKING NNE TOWARD LOOP. PRR BRIDGE # 458 IN FOREGROUND.

IL-111-4 SOUTH BRANCH LOOKING NW. HARRISON STREET BRIDGE IN FOREGROUND, THEN CONGRESS.

IL-111-5 SOUTH LOOKING NORTH TOWARDS LOOP. HARRISON STREET BRIDGE IN FOREGROUND THEN CONGRESS.

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IL-111-12 MAIN BRANCH LOOKING DUE EAST TOWARD LAKE. FRANKLIN-ORLEANS STREET BRIDGE IN FOREGROUND.

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IL-111-23 SIMILAR TO IL-111-22, LOOKING WSW.

IL-111-24 SIMILAR TO IL-111-23, CLOSER IN, OUTER DRIVE BRIDGE IN FOREGROUND.

IL-111-25 MAIN BRANCH LOOKING WEST, COLUMBUS DRIVE, MICHIGAN AVE IN FOREGROUND.

IL-111-26 NORTH BRANCH LOOKING NE TOWARD LAKE.

IL-111-27 NORTH BRANCH LOOKING NE TOWARD LAKE. CHICAGO AVE BRIDGE AT LEFT KINZI STREET AT RIGHT.

IL-111-28 NORTH BRANCH LOOKING NW GRAND STREET BOTTOM, OHIO-ONTARIO CONNECTOR BRIDGE TOP.

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HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO RIVER BASCULE BRIDGES
DEVELOPMENT OF MOVABLE-BRIDGE TECHNOLOGY IN CHICAGO, 1890-1910

HAER No. IL-111

This report is an addendum to a 3 page report previously transmitted to the Library of Congress in 1995.

Location:	Spanning the Chicago River and its North and South Branches.
Date of Construction:	1865-1890
Designer:	City of Chicago
Builder:	Department of Public Works
Present Owner:	City of Chicago
Present Use:	Highway Bridges
Significance:	Between 1865 and 1890, the City of Chicago built 55 movable highway bridges over waterways within municipal limits. All were center-pier swing spans. Despite its ubiquity, the swing span was not universally admired. Its critics pointed to the fact that the center-pier design was becoming a navigational hazard for the ever-larger vessels of the late nineteenth century.
Historian:	Jeffrey A. Hess, Historian
Project Description:	The Chicago Bridges Recording Project was sponsored During the summer of 1999 by HABS/HAER under the General direction of E. Blaine Cliver, Chief; the City of Chicago, Richard M. Daley, Mayor; the Chicago Department of Transportation, Thomas R. Walker, Commissioner, and S.L. Kaderbek, Chief Engineer, Bureau of Bridges and Transit. The field work, measured

drawings, historical reports, and photographs were prepared under the direction of Eric N. DeLony, Chief of HAER.

Between 1865 and 1890, the City of Chicago built 55 movable highway bridges over waterways within municipal limits. All were center-pier swing spans, the most popular type of movable bridge in the United States at the time.[1] Despite its ubiquity, the swing span was not universally admired. Its critics pointed to the fact that the center-pier design was becoming a navigational hazard for the ever-larger vessels of the late nineteenth century. They also noted that the swing span's requirement of a clear turning radius often prohibited the development of docking facilities adjacent to the bridge site. These shortcomings were especially onerous along highly industrialized urban waterways such as the Chicago River, where shipping channels tended to be narrow, highway crossings numerous, and real estate prices high.[2]

No matter how vociferously shipping and real estate interests might decry the center-pier swing span, there was no effective means of regulating movable-bridge design until the early 1890s, when Congress authorized the War Department to approve plans for all new bridges over navigable waterways and to seek the alteration of any existing bridge that interfered with navigation.[3] In 1892, the U.S. Army Corps of Engineers demonstrated both provisions of the law on the South Branch of the Chicago River, by ordering the removal of a recently completed swing span at Canal Street and by prohibiting the construction of a new swing span at South Halsted Street. As Chicago's Commissioner of Public Works observed in his annual report for 1892, "This Department found it necessary to look about and devise some plan that would meet

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[1] See City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Bridge History and Data," 1943, rev. 1950, Drawing Nos. 16188-16192, in CDT Plan Archives. The statistic does not include projects that relocated an old span to a new site. One bridge was built over the Calumet River; the remainder were crossings of the Chicago River system, a dock-lined, 15-mile navigable network that consisted, primarily, of a north branch, a south branch, and a main river channel. Just north of the city's downtown business district, the two branches converged, like the legs of a "Y," to form the main river, which then flowed eastward, about one mile, into Lake Michigan. During the nineteenth century, the Chicago River system served as an inner harbor for Chicago's extensive Great Lakes trade, especially for such commodities as grain and lumber. Although Chicago's railroad business eclipsed its waterborne commerce in the second half of the nineteenth century, the Chicago River remained of considerable commercial significance. As the U.S. Army Corps of Engineers noted in 1893: "Chicago River is the most important navigable stream of its length on the globe. In the number of arrivals and departures of vessels annually it leads all harbors of the United States; in tonnage it is second only to New York"; *Annual Report of the Chief of Engineers, United Sates Army . . . 1893* (Washington: Government Printing Office, 1893), pt. 4, Appendix LL, 2798. For an excellent discussion of the river's place in the city's commercial growth, see William Cronon, *Nature's Metropolis* (New York: W.W. Norton and Company), 1991.

[2] Jeffrey A. Hess and Robert M. Frame III, *Historic Highway Bridges in Wisconsin. Volume 3. Movable Bridges.* (Madison, WI: Wisconsin Department of Transportation, 1996), pt. 1, 10.

[3] W. M. Black, "Bridges Over Navigable Waters of the United States," *Engineering News* 29 (13 April 1893):341-342.

these objections."[4] The result was a decade-long search by Chicago city engineers for a reliable, cost-effective, movable bridge that did not obstruct the shipping channel.

During the next three years, the city built three different types of movable bridges over the South Branch of the Chicago River: a double-leaf, folding-lift bridge at Canal Street (1893); a vertical-lift bridge at South Halsted Street (1894); and a double-leaf, rolling-lift bridge at West Van Buren Street (1895). Each embodied a newly patented design that operated on a different principle. The folding-lift bridge employed a counterweighted, segmented leaf, hinged at the rear and at the middle. When the operating machinery was set in motion, the leaf folded up like a jackknife, the rear segment pivoting upward and the front segment dropping downward. The vertical-lift bridge mimicked the action of a double hung-window, using tower-supported pulleys and cables to lift and lower a counterweighted horizontal span. The rolling-lift bridge, as its name implied, was subject to two types of movement. At the same time that the leaf rose vertically from the water, it also moved horizontally toward the shore. Resting on tracked, curved supports known as "segmental girders," the leaf rolled backwards and forwards like a rocking chair, thereby raising and lowering its front end. The folding-lift patent was controlled Shailer and Schniglau, a Chicago contracting firm; the vertical-lift patent, by engineer J.A.L. Waddell of Kansas City, Missouri; and the rolling-lift patent, by the Scherzer Rolling Lift Bridge Company of Chicago.[5]

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[4] *Mayor's Annual Message and Seventeenth Annual Report of the Department of Public Works . . . Fiscal Year Ending Dec. 31st 1892* (n.p., n.d.), 10, 57-58.

[5] Anticipating the federal government's objections to the swing span, the city had begun searching for an alternative design before the Corps of Engineers' official prohibition. In 1890, the Department of Public Works contracted with Shailer and Schniglau to build a folding-lift bridge over the North Branch Canal at Weed Street. Completed in 1891, this structure was plagued by mechanical problems. The 1892 Canal Street Bridge was supposed to be an improved version, but it, too, failed to give satisfaction. Its mechanical system was completely rebuilt in 1897. The Weed Street Bridge was so poorly designed that it was permanently closed in 1899. Although the folding-lift patent was controlled by Shailer and Schniglau, the inventor and original patent holder was William Harmon of Chicago. See *DPW Annual Report, 1890*, 160, 162, 165; "A Folding-Floor Drawbridge," *Engineering News* 25 (23 May 1891): 486-487; *DPW Annual Report, 1897*, 124; City Council, Proceedings, 18 September 1899, 1060; William Harmon, U.S. Patent No. 383,880, 5 June 1888. From the very beginning, the Department of Public Works had misgivings about Waddell's vertical-lift bridge. As one municipal engineer commented during the bridge's construction, "The whole work is an expensive experiment." Largely because of the South Halsted Street Bridge's reputation for "heavy first cost and maintenance, and expensive operation," it took Waddell over a decade to secure his next vertical-lift commission. In Chicago itself, a second vertical-lift highway bridge was not constructed until 1938, at Torrence Avenue over the Calumet River. See City Council, Proceedings, 29 May 1893, 334; J.A.L. Waddell, "The Halsted Street Lift-Bridge," *American Society of Civil Engineers Transactions*, Paper No. 742 (1895):1-16; C.C. Schneider, "Movable Bridges," *American Society of Civil Engineers Transactions*, Paper 1071 (1908):268-269; Hess and Frame, 13-15; Waddell, U.S. Patent No. 506,571, 10 October 1893. The rolling-lift bridge at West Van Buren Street was constructed simultaneously with an adjacent Scherzer bridge commissioned by the West Side Metropolitan Elevated Railroad Company. The design was the creation of William Scherzer, a Chicago-based, Swiss-trained engineer who was familiar with French attempts to develop a wheel-mounted bascule

As might be expected with new inventions, all three bridges experienced mechanical difficulties during their first years of operation, but the rolling-lift design seemed to be the most promising of the lot. Incorporating the fewest movable parts, it appeared to be the simplest to build and the cheapest to maintain. In 1895, the Chicago Department of Public Works contracted for the construction of a second rolling-lift bridge, which was completed over the North Branch of the Chicago River at North Halsted Street in 1897. It soon became apparent, however, that there were structural as well as mechanical problems with the new rolling-lift design. In 1898, City Engineer John E. Ericson observed that the concrete foundations of the new North Halsted Street Bridge needed to be strengthened. A year later, he reported that the bridge's substructure was literally "falling to pieces."[6] The problem was that the rolling-lift design was best suited for sites with easily accessible bedrock to support bridge foundations, a geological condition that did not exist along the Chicago River. As a Chicago municipal staff engineer explained:

> These [rolling-lift] bridges, although marked improvements over the folding and [vertical] lift bridges, have some objections. The main objection lies in the fact that this type of bridge requires a most solid foundation, as the whole load in opening and closing travels horizontally over a space of from twenty to thirty feet on the substructure. The points of application of this load during operation of the bridge change continuously, and, in connection with the wind pressure, have a very severe action on the foundation, which, if not built of extraordinarily large dimensions, and consequently at great expense, or on solid rock, shows a wagging motion, as the Halsted street bridge over the North branch of the river sufficiently proves.[7]

Disenchanted with the patented designs available on the market, City Engineer Ericson in 1898 recommended that "the city take up the question of investigating movable bridges for the purpose

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earlier in the century. Scherzer filed a patent application for his invention, but died a few months before its approval in 1893. The patent became the property of his brother Albert, who organized the Scherzer Rolling Lift Bridge Company to sell rights to the design. See "Van Buren Street Rolling Lift Bridge," *Engineering Record* 31 (16 February, 2 March 1895):204-206, 242-243; "The Van Buren Street Rolling Lift Bridge, Chicago," *Engineering News* 32 (21 February 1895):114-115; Hess and Frame, 21-22; William Scherzer, U.S. Patent No. 511,713, 26 December 1893. For general overviews of the city's movable-bridge projects during the 1890s, see *DPW Annual Report, 1900*, 87-88; Becker, 266-270.

[6] *DPW Annual Report, 1894*, 23-24; *DPW Annual Report, 1895, 50; DPW Annual Report, 1896*, 104, 110; City Council, Proceedings, 12 September, 1898, 587; 18 September 1899, 1060.

[7] *DPW Annual Report, 1900*, 88.

of designing their own bridges."[8] At the time, the city's finances were in an extremely embarrassed condition. Because of state-mandated restrictions on municipal taxing and bonding powers, the city lacked funds to pay for even basic bridge maintenance, let alone elaborate new design studies.[9] Ericson, therefore, decided on a simple paper investigation by in-house staff. His goal was "a critical analysis of the literature on movable bridges built in the United States and Europe, with the view of selecting a type of bridge suitable to the requirements of the Chicago river and its branches." By 1899, Ericson and his colleagues had decided that the most appropriate model for Chicago was the 1894 Tower Bridge of London, England.

Like the folding-lift and rolling-lift bridges built in Chicago, the Tower Bridge belonged to a class of engineering structures known as "bascules," after the French word for "seesaw." Unlike a swing bridge, which horizontally rotated around a vertical axis, a bascule vertically rotated around a horizontal axis. Some bascules, as in the case of the medieval castle drawbridge, rotated around a stationary horizontal axis; others, such as the Scherzer rolling-lift bridge, had a moving axis. The Tower Bridge was of the stationary type; its horizontal axis was defined by a steel pivot, or trunnion, and it was according called a fixed-trunnion bascule. Its design incorporated two movable sections, or leaves, each counterweighted at the rear so that the leaf's center of gravity was at the trunnion. Located below deck level in the abutments, steam-powered machinery operated the draw by means of a pinion engaging a curved rack mounted at the rear end of the leaf. As the front end of the leaf tilted upward, the counterweighted rear end descended into a masonry pit built into the abutment. When the motive power was reversed, the leaf pivoted into closed position.[10]

The counterbalanced-lever principal of the Tower Bridge was appealing to Ericson for three main reasons. First, it relied on relatively simple operating machinery that was fairly easy to manufacture and install. Second, it was patent-free, so that its use entailed no royalty payments. Third, it dictated a bridge with a fixed center of gravity, so that the action of the movable leaves would not alter the distribution of stresses on the bridge's substructure. With his technological quest at an end, Ericson supervised the preparation of "three complete designs, differing in appearance, method of mounting, etc., but all involving the main feature, that of revolving on a fixed trunnion."[11] Except for minor departures, such as the substitution of electric

[8] "Testimony of John Ericson," *The Scherzer Rolling Lift Bridge Company vs. City of Chicago and Great Lakes Dock Company*, U..S. Court of Appeals, Seventh Circuit, Records and Briefs, October 1924, Case No. 3606, in Record Group 276, National Archives, Chicago.

[9] *DPW Annual Report, 1899*, 68; *DPW Annual Report, 1901*, 5-10.

[10] "Testimony of Thomas G. Pihlfeldt," *Scherzer vs. Chicago*, 93. Pihlfeldt identified the Tower Bridge as the model in Dan Fogle, "Modest Man is Pihlfeldt," *Chicago Daily New*, 15 October 1936, 21. For a description of the Tower Bridge, see Ottis Ellis Hovey, *Movable Bridges* (New York: John Wiley and Sons, 1926), vol 1, 83-88.

[11] *DPW Annual Report, 1900*, 88.

power for steam power, these designs incorporated the basic features of the Tower Bridge. Ericson submitted his drawings to an outside panel of mechanical and civil engineers, who approved the basic fixed-trunnion concept but suggested certain improvements regarding the substructure, flooring system, and operating equipment.

Beginning with the municipal appropriation ordinance of 1900, the City Council cobbled together sufficient funds to allow Ericson to replace five severely deteriorated swing spans with new fixed-trunnion, double-leaf bascules based on in-house designs. The new structures were completed at Clybourn Place (later renamed Cortland Street) over the North Branch of the Chicago River (1902); at Division Street over the North Branch Canal[12] (1903); at Ninety-Fifth Street over the Calumet River (1903); at Division Street over the North Branch (1904); and at North Western Avenue over the North Branch (1904). In terms of general appearance, these bridges established the basic profile of the early "ChicagoType Bascule," as the genre came to be known in the engineering literature.[13] The movable leaves were supported by three evenly spaced, riveted, steel trusses displaying a distinctive, overhead-braced, humpbacked configuration at the shore portals. The bulbous outline of the rear members was dictated by the curvature of the externally mounted operating racks, the only part of the lift machinery visible above roadway level. Apart from the occasional use of decorative portal plates, the city engineers made little attempt to improve the bridges' appearance through architectural detailing.[14]

Although Ericson had rejected the Scherzer rolling-lift design, the Department of Public Works was not the only builder of movable highway bridges in Chicago. In 1889, the state legislature had chartered an independent government agency, the Sanitary District of Chicago, and had given it wide powers over the Chicago River.[15] The Sanitary District's primary responsibility was to reduce the pollution of the waterway, which had long been used for disposing sewage and refuse. As dictated by the region's natural hydraulic patterns, the Chicago River system sluggishly drained into Lake Michigan, just north of the downtown commercial neighborhood. The Sanitary District intended to alter this state of affairs by constructing a canal

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[12] The North Branch Canal was a mile-long navigable waterway that bypassed a bend in the North Branch of the river, located just to the west. The canal was completed in the 1850s to provide additional commercial docking space. See Perry R. Duis and Glen E. Holt, "Chicago's Only Island," *Chicago History* (February 1979):170.

[13] See, for example, C.B. McCullough and Phil A. Franklin, "Bascule Bridges," *Movable and Long-Span Steel Bridges*, ed. George A. Hool and W.S. Kinne (New York: McGraw-Hill Book Company, 1923), vol. 1, 20.

[14] City Council, Proceedings, 4 April 1900, 2817; *DPW Annual Report, 1901*, 5-10; *DPW Annual Report, 1904*, 16-17.

[15] "History of the Sanitary District of Chicago and the Drainage Problem, with the Law Relating to the Same," in *DPW Annual Report, 1889*, 67-93.

to drain the waterway away from the city, southward into the Desplaines River, a tributary of the Illinois River, which, in turn, emptied into the Mississippi River. Upon the canal's completion, the Chicago River would become an outlet of Lake Michigan, which, instead of receiving the city's pollution, would help flush it, in somewhat diluted form, into the Mississippi.[16] To accommodate the Chicago River's increased flow, the Sanitary District also intended to widen the waterway at several points, which required the replacement of several municipal highway bridges. In 1898, while the drainage canal was still under construction, the Sanitary District embarked on the reconstruction of the Taylor Street Bridge over the South Branch of the Chicago River, with the understanding that the city would maintain and operate the structure after its completion. Following the example set by the Department of Public Works in the construction of the West Van Buren and North Halsted street bridges, the Sanitary District selected the Scherzer rolling-lift design for its project.[17] A year later, in 1899, the agency decided that its engineering program also required the replacement of the six-year-old, folding-lift bridge at Canal Street. By this time, however, Ericson had deep misgivings about the way the Scherzer Company designed its bridges, and he secured the Sanitary District's consent to consult on design selection. Since the Scherzer rolling-lift bridge still seemed to be the most efficient and economical alternative to the center-pier swing span, the Scherzer company secured the Canal Street contract as well, but Ericson attempted to force the company to strengthen its foundation design. The outcome apparently was to no one's satisfaction. The Sanitary District and the Scherzer Company resented Ericson's meddling, and Ericson developed a firm dislike for the Scherzer Company's business practices.[18]

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[16] On the construction of the new canal and related features, see Mary Yeater Rathbun, *Architectural and Engineering Resources of the Illinois Waterway between 130th Street in Chicago and La Grange, Illinois* (Carbondale, IL: American Resources Group, Ltd for U.S. Army Corps of Engineers, Rock Island District, Rock Island, IL, 1996), 46-60.

[17] Board of Trustees of the Sanitary District of Chicago, *Proceedings, 1898,* 23 November 1898, 5275-5276; *Proceedings, 1900,* 3 December 1900, 6882. Henceforth, these board minutes will be cited as *SDC Proceedings*, with appropriate date and page.

[18] *SDC Proceedings*, 30 August 1899, 6016; 21 February 1900, 6307-6308; 24 October 1900; 3 December 1900, 6882. Ericson and the Sanitary District initially considered using another rolling-lift design invented and patented by Milwaukee engineer Max G. Schinke. In the Schinke bascule, a counterbalanced leaf was supported by a pivoted swinging arm at the front end while attached to rollers set in a curved stationary track at the rear end. The bridge was set in motion by a simple strut connected to a power source. When the strut pulled back on the span, the front end of the leaf arced upwards, while the rear end rolled downwards along the curved track. Because of the track's shape, the leaf's center of gravity retreated and advanced in a horizontal line, thereby maintaining a counterbalanced system. Between 1895 and 1897, the City of Milwaukee built two Schinke bascules. Although the bridges appear to have functioned fairly well, their curved tracks were expensive to fabricate and difficult to install. Chicago never built a Schinke rolling- lift bridge, and Milwaukee itself abandoned the design after adopting, in 1900, fixed-trunnion bascule bridges that were similar in several respects to the design developed by Ericson. The

If Chicago municipal finances had been in a healthier condition at the turn of the century, Ericson might have had greater leverage with the Scherzer Company. But the city could not afford to take over the construction of the Sanitary District's highway bridges. Indeed, the city could not afford even to replace some of its own most hazardous crossings. In the spring of 1900, Chicago Mayor Harrison H. Carter appealed to the better-funded Sanitary District to assist the city in replacing its deteriorating and obstructive swing spans. As the mayor pointed out, the Sanitary District was responsible for maintaining the flowage rate of the Chicago River at certain legislatively set limits in order to keep the waterway free from sewage build up. Since the center-pier swing spans impeded the river's flow, the Sanitary District, so the mayor reasoned, had an obligation to replace the structures. Although this argument might not have stood up in a court of law, the Sanitary District had its own legal reasons for acceding to the mayor's wishes. A few months earlier, the district's drainage canal had gone into service, with an unexpected consequence. Not only did the canal reverse and increase the flow of the Chicago River, but it also made navigation on the waterway more difficult, especially in the vicinity of center-pier bridges. Fearful that it might be held liable for shipping accidents associated with the more swiftly flowing waterway, the Sanitary District agreed to begin the replacement of certain center-pier bridges. For its part, the city agreed to eventually repay a portion of the construction costs and to assume responsibility for maintaining and operating the new spans. Unlike the Canal Street Bridge project, however, the Department of Public Works was to have no say in the bridge-selection process. Instead, the Sanitary District was to be completely in charge of design and construction, subject only to the federally mandated review of bridge plans by the Corps of Engineers.[19] Under this arrangement, the Sanitary District built a total of eight movable highway bridges. Seven were Scherzer rolling lifts.[20] The eighth was based on an untried bascule design that had been developed by John W. Page, formerly a staff engineer with the

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Milwaukee bascule differed from the Chicago type primarily in its use of plate girders, instead of trusses, for the leaves and in its location of the operating racks, which were mounted on the bottom of the plate girders, just behind the trunnions. See Hess and Frame, 26-29, 36-50; Max G. Schinke, U.S. Patent No. 517,808, 3 April 1894; No. 551,004, 10 December 1895; "Sixteenth Street Bascule Bridge, Milwaukee," *Engineering Record* 31 (9 March 1895):256-257; M.G. Schinke, "The New Huron Street Lift Bridge, Milwaukee, Wis.," *Engineering News* 37 (22 April 1897):253-255.

[19] *SDC Proceedings*, 11 April, 16 May 1900, 6410-6411, 6556 ; City Council, Proceedings, 16 July 1900, 6718-6719. For the Sanitary District's concern over its potential legal liabilities, see *SDC Proceedings*, 21 March, 4, 11 April, 11 July, 1900, 6355-6356, 6386-6387, 6394-6395, 6411, 6642-6643.

[20] The Scherzer bridges were built over the main river at State Street (1903) and Dearborn Street (1905); and over the South Branch at Throop Street (1903), Loomis Street (1904), Harrison Street (1905), Eighteenth Street (1905), and Cermak Road (1906).

Sanitary District.[21]

In 1904, the City Council of Chicago finally gained the legal authority to increase the level of municipal indebtedness and to float a bond issue for public improvements. The Department of Public Works immediately began planning for the construction of several movable bridges.[22] The design of these projects was to be the responsibility of Thomas G. Pihlfeldt, a Norwegian-born, German-trained engineer who, after entering the municipal bridge division in 1894, had become "Structural Iron Designer in Charge" in 1901. Pihlfeldt's "Assistant Designer" was Alexander von Babo. Like Pihlfeldt himself, von Babo had helped Ericson develop the city's fixed-trunnion bascule design.[23] By December 1904, Pihlfeldt and

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[21] *SDC Proceedings*, 20 June 1900, 6648-6649; "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 43 (27 April 1901):3392-394; "Page Bascule over the [West Fork of the South Branch of] the Chicago River at [South] Ashland Ave.," *Engineering News* 45 (25 April 1901):311-312; J. B. Strauss, "The Bascule Bridge in Chicago," *A Half Century of Chicago Building*, ed. John H. Jones and Fred A. Britten (Chicago, 1910), 92. Page's goal was to eliminate the deep counterweight pits required by the city's fixed-trunnion bascule, as well as certain versions of the Scherzer rolling-lift design. These pits were expensive to build, and they frequently leaked. The original Page design for South Ashland Avenue was a counterweighted, double-leaf structure pivoting on fixed trunnions in the lower chords of the bascule trusses. The counterweight was split into two basic components: (1) overhead cast-iron blocks rigidly suspended from the top chord of the bascule trusses, and (2) movable steel struts pivoted at one end to the fixed approach section and at the other end to heavy, steel, transverse girders supported by rollers resting on the tops chords of the bascule trusses. The transverse girders carried an electric-powered drive chain containing pinions that meshed with curved racks mounted on the top chords of the bascule trusses. During the bridge's opening cycle, the pinion-and-rack arrangement caused the transverse girders to roll slightly forward and the bascule trusses to pivot open on their trunnions. The curvature of the racks was calculated to compensate for the movement of the transverse girders, so that the bridge's center of gravity at all times remained at the fixed trunnions. Shortly after the Sanitary District accepted this bascule design, Page developed a simplified deck-truss version that completely eliminated the rolling segment of the counterweight. In this version, as completed at South Ashland Avenue in 1902, the bridge's approach spans functioned as counterweights pivoting in the abutments. The river ends of the spans rested on rollers that engaged curved tracks in the tail ends of the bascule deck trusses. As in the original design, the tracks' curvature maintained the center of gravity at the trunnions. See "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 48 (10 October 1903):434-436. Upon assuming custody of the South Ashland Bridge, the Department of Public Works found defects in the counterweight design that necessitated expense repairs; the bridge was eventually replaced in the mid 1930s. Neither the city nor the Sanitary District built another Page bascule. The Chicago and Alton Railroad, however, erected a Page bascule for its own use in 1906, over the South Fork of the South Branch of the Chicago River near Archer Avenue.

[22] *DPW Annual Report, 1904*, 16-17.

[23] *DPW Annual Report, 1901*, 101; "The Chicago Type Bascule Bridge," *Engineering Record* 42 (21 July 1900):50. There is little biographical information available on von Babo. He remained a bridge engineer with the city until 1915. On Pihlfeldt, see "Pihlfeldt Dies at 82; Designed 50 Bridges for City in 51 Years," *Chicago Daily News*, 23 January 1941, 14; Kenneth Bjork, *Saga in Steel and Concrete* (Northfield, MN: Norwegian-American Historical Association, 1947), 121-126.

von Babo had prepared a set of plans for the first of the bond-funded bridges, which would serve as a replacement for the severely deteriorated, center-pier, swing span built in 1877 over the North Branch of the Chicago River at North Avenue. The bridge's fixed-trunnion, double-leaf, bascule superstructure closely copied the engineering of the 1904 West Division Street Bridge, while its substructure and operating machinery followed the layout of the 1904 North Western Avenue Bridge.[24]

Although the city engineers seem to have had every intention of using their own design, the Commissioner of Public Works, F.W. Blocki, motivated apparently by legal reasons, informed the Scherzer Company that "the City of Chicago has no objection to advertising for proposals for the building of a bascule bridge of the Scherzer type at North [A]venue; provided plans for such proposals are made to conform in every respect with all the requirements of the city's specifications for such a bridge."[25] In February 1905, Ericson sent the Scherzer Company the North Avenue Bridge specifications, which contained provisions concerning substructure and counterweight design that would have required the company to alter its standard treatment of these features. John W. Page, the inventor of the bascule type built by the Sanitary District at South Ashland Avenue in 1902, also received the city's specifications, and he duly submitted a design. In March 1905, the city ruled that Page's design was not in compliance and therefore should not be considered by potential bidders on the North Avenue Bridge project.[26] The Scherzer Company took a different tack. Instead of presenting a preliminary design for city approval, it waited until the bidding deadline and then submitted two proposals, both of which ignored the objectionable provisions in the city's specifications. One proposal, in the amount of $160,000, offered "an artistic deck Scherzer Rolling Lift Bridge with arched outline (similar to the Scherzer... Bridge [built for the Sanitary District in 1905] across the Chicago River at State Street)." The other, in the amount of $150,000, was for "a through Scherzer rolling lift bridge (similar in outline to the 'Ericson Trunnion Bridge' of which plans prepared by the city are on

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[24] City of Chicago, Bureau of Engineering, Plans for North Avenue Bridge over the North Branch Chicago River, 1904, Drawing Nos. 6690-6710, in CDT Plan Archives. In 1899, Ericson had described the North Avenue Bridge as " likely to be closed any time" in view of the fact that "the wooden member is rapidly rotting away, iron work badly rusted and center pier shaky and rotten"; see City Council, Proceedings, 18 September 1899, 1060. On the West Division Street Bridge and North Western Avenue Bridge, see "The Division Street Bascule Bridge, Chicago," *Engineering Record* 42 (20 August 1904):215-217; "Trunnion Bascule Bridge at Northwestern [sic] Ave., Chicago," 64-65.

[25] F.W. Blocki to Frank Montgomery and Co., 22 December 1904, in "Bill for Injunction, Exhibit A, filed 31 March 1905, *Albert H. Scherzer v. City of Chicago et. al*, Case File No. 243,514, Superior Court, Cook County, Illinois, in Clerk of the Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, IL. Frank M. Montgomery and Company served as Scherzer's engineering and construction company in Chicago.

[26] The Scherzer Company was notified of Page's disqualification in a letter from Ericson dated 18 March 1905; see"Bill for Injunction," Exhibit B, *Scherzer v. City of Chicago*.

file)."[27] When the Department of Public Works opened the North Avenue Bridge bids on 31 March 1905, it rejected both Scherzer proposals for noncompliance. Contracts totaling $193,352 were then awarded to low-bidding firms that had adopted the city's fixed-trunnion bascule design. The Scherzer Company, filing on behalf of itself and the taxpayers of Chicago, immediately obtained an injunction from the Superior Court of Cook County to stop the letting of the contracts, on the grounds that the Department of Public Works had "maliciously, fraudulently, and unlawfully" prohibited the company from providing Chicago with "a superior type of bridge . . . at a great saving in cost."[28]

In July 1905, the city administration took steps that seem to have been at least partly aimed at placating the Scherzer Company. A newly installed commissioner of public works removed the bridge division from Ericson's bailiwick and transformed it into a separate administrative entity under Pihlfeldt's supervision. Henceforth, Pihlfeldt was to be "more or less independent of the City Engineer [i.e., Ericson,]" who would exercise "only a general supervision over the [bridge] work."[29] The Scherzer Company also received what it thought were assurances that the city would amend its bridge specifications to permit competitive bidding on the Scherzer rolling-lift design. In August, the company dropped its suit against the city, and the court dissolved the injunction prohibiting the letting of contracts for the North Avenue Bridge, which was completed two years later.[30]

In the fall of 1905, the Department of Public Works began planning its next movable-

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[27] Frank M. Montgomery and Co. to F.W. Blocki, 31 March 1905, in "Supplemental Bill," Exhibit C, filed 11 April 1905, *Scherzer v. City of Chicago*. The Scherzer Company appears to have hoped that its "artistic" bascule design would rally public support in its favor. In 1900, the newly established Municipal Art League of Chicago, which counted among its members such influential architects as Louis Sullivan and Martin Roche, had tried to persuade the Sanitary District to improve the aesthetic quality of the bascules it was building for the city. The league particularly wanted a "monumental" treatment for the prominently sited State Street Bridge. The Sanitary District was initially receptive to the league's design suggestions, but it failed to act on them. In 1903, the league abandoned its efforts, noting that it had failed "to have any influence in the design of the new bridges across the Chicago River." Its president, Franklin MacVeah, declared, "A Chicago bridge is a depressing sight . . . It is a marvel that suicides from these bridges are so infrequent." Although Scherzer's design for the State Street Bridge failed to meet the league's aesthetic standards, its arched treatment of the structure was the first attempt in Chicago to beautify a movable bridge. See Municipal Art League of Chicago, *Year Book, Twentieth Century, Year One* (n.p., 1901), 5-6; *Year Book, Twentieth Century, Year Three* (n.p., 1903), 13; *Year Book, Twentieth Century, Year Four* (n.p., 1904), 10.

[28] Scherzer, "Supplemental Bill," 3; Scherzer, "Bill for Injunction," 7.

[29] On the reorganization, see *DPW Annual Report, 1905*, 149; William L. O'Connell and Thomas G. Pihlfeldt, "Joint and Several Answer of the Defendants," 11 February 1907, in *Albert H. Scherzer v. City of Chicago et. al*, Circuit Court of Cook County, Illinois, Case File No. 277,091, in Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, Illinois; *DPW Annual Report, 1907*, 24.

[30] *DPW Annual Report, 1906*, 284; *DPW Annual Report, 1907*, 9.

bridge project, scheduled for the North Branch of the Chicago River at Indiana Street. By this time, still another independent movable-bridge designer was seeking to break into the Chicago market. Chicago engineer Joseph B. Strauss had spent several years developing a fixed-trunnion bascule with a movable rear counterweight suspended in a pivoted parallelogram framework. As the leaf rotated up and down on its fixed trunnion, the parallelogram linkage swung the counterweight through a series of parallel positions, at all times concentrating the weight on the very end of the leaf. Because the parallelogram linkage maximized the leverage of the counterbalancing system, Strauss' design made it possible to shorten the rear of the leaf, thereby saving on both material and space. With his first bascule under construction in Cleveland, Ohio, in 1905, Strauss, like the Scherzer Company, clamored for contracts in his home city.[31] In December 1905, the Department of Public Works informed both Strauss and Scherzer that it would consider their designs for the Indiana Street crossing.[32]

The key issue, however, was whether Pihlfeldt would prepare specifications that, in fact, gave outside designers a competitive chance to have their proposals accepted. As it turned out, the Indiana Street bridge would not provide a test case, for the city postponed the project. But plans did go forward to replace a 30-year-old swing span at North Halsted Street over the North Branch Canal. In July 1906, the Scherzer Company requested and received the city's specifications for this project. Although the company still found a few provisions to be objectionable, it decided that the specifications as a whole were acceptable and began preparing a proposal for the new bridge. In November, however, Pihlfeldt circulated a new set of specifications based on the city's fixed-trunnion bascule built at North Western Avenue in 1904. These specifications were as difficult for the Scherzer Company to adopt as those previously issued for the North Avenue Bridge, which was, itself, partly modeled on the North Western Avenue bascule. Once again the Scherzer Company submitted a full design-and-construction proposal that ignored the issues in contention, and once again the Department of Public Works discarded its entry. In late December, Pihlfeldt awarded the North Halsted Street construction contracts to bidders who had based their submittals on the city's fixed-trunnion bascule design.

[31] Strauss eventually received patents for a number of bascule designs employing the parallelogram linkage; he assigned these to the Strauss Bascule Bridge Company, founded in 1902. See "Bascule Bridges," *Engineer* 115 (28 March 1913):340-343; Paul T. Gilbert, *Chicago and Its Makers* (Chicago: Felix Mendelsohn, 1929), 875. Strauss' first two projects are described in "The Strauss Trunnion Bascule Bridge Near Rahway, N.J.," *Engineering Record* 55 (13 April 1907):465-467.

[32] As Strauss reported, "The City of Chicago is now adopting this policy [of throwing open the design of movable bridges to public competition] and has invited various specialists in this class of work to place their designs on file for the proposed new Indiana Street bridge. On these plans the city will then receive bids and award the contract to the lowest bidder"; Strauss to R.R. McCormick, President Sanitary District, 11 December 1905, in *SDC Proceedings*, 20 December 1905. Strauss was writing to the Sanitary District to encourage its board to adopt the city's policy and consider movable-bridge designs other than those of the Scherzer Company, which had pretty much monopolized the Sanitary District's business in this area.

The awards totaled $257,458, approximately $50,000 more than the Scherzer Company's proposal for the bridge. The Scherzer Company immediately filed another lawsuit against the city, naming Pihlfeldt and Commissioner of Public Works William L. O'Connell as defendants.[33] Seeking both an injunction to halt the North Halsted Street Bridge project and compensatory damages for being excluded from the bidding, the Scherzer Company laid three major allegations before the Circuit Court of Cook County, Illinois. First, after noting that over 100 Scherzer rolling-lift bascules had been built in various parts of the world, including Chicago, the company averred that "these bridges have every advantage in permanency, structural strength, convenience and economy over any other bascule bridge." Second, the Scherzer Company asserted that Chicago City Engineer John Ericson was associated with a private engineering firm promoting the construction of "Ericson-trunnion bridges" and that every bridge of this design built by the city was simply so much advertizing for Ericson's business. Third, it contended that the city's chief bridge designer, Pihlfeldt, was "influenced or controlled in his actions with regard to the selection of bridges by the said John Ericson, and that the said Pihlfeldt is endeavoring to have the City of Chicago construct Ericson-trunnion bridges for the purpose of assisting said John Ericson in his private business even if the City of Chicago and the taxpayers thereof are required to pay from $50,000 to $100,000 more for each Ericson-trunnion bridge than they would be obliged to pay for a better bridge of the Scherzer design."[34]

The Scherzer Company's allegations concerning Ericson had the muck-raking quality of an expose, but the Chicago City Engineer had made no secret of the fact that he was involved in a private consulting practice that was trying to market a variant of the city's fixed-trunnion bascule design. Indeed, at the time of the North Halsted Street litigation, Ericson was negotiating a contract for a bascule bridge in Michigan City, Indiana.[35] In the early twentieth century, private ventures by government employees were generally accepted, as long as they did not interfere with the proper discharge of official responsibilities.[36] The Department of Public

[33] Both the city and the Scherzer Company were in general agreement about the events leading up to the lawsuit, as described above; see Albert H. Scherzer, "Amended and Supplemental Bill of Complaint," 9 February 1907; William L. O'Connell and Thomas G. Pihlfeldt, "The Joint and Several Answer of the Defendants," 11 February 1907, in *Scherzer v. City of Chicago,* Circuit Court of Cook County, Case File No. 277,091.

[34] Scherzer, "Amended and Supplemental Bill of Complaint," 12-14.

[35] This bridge was completed in 1908; see "Lift Bridges," *Proceedings of the Engineers' Society Western Pennsylvania* 25 (February 1909):28.

[36] Legal disputes concerning this practice usually centered on the ownership of patentable inventions developed by an employee as part of his government duties. In 1883, Congress had enacted legislation authorizing federal employees to patent and market inventions developed during the course of their work, with the proviso that the government retained the right to use the invention free of charge. Government agencies, however, did not always honor the law. See Jeffrey A. Hess, "Inventions and Patents for the Public Good: The Needle-Valve Program of the Bureau of Reclamation," *IA: The Journal of the Society for Industrial Archeology* 22 (No. 1,

Works, therefore, did not spend a great deal of time answering the Scherzer's Company charge. In their court deposition, O'Connell and Pihlfeldt merely stated that Ericson's private dealings had no bearing on the department's selection of the city's fixed-trunnion design for the North Halsted Street Bridge. Instead, they based their defense on the argument that the city's design was technologically superior and more economical that the Scherzer Company rolling-lift design.[37] By way of emphasis, the Department of Public Works took the unprecedented step of turning the bridge division's annual report for 1906 into an illustrated catalog of maintenance problems experienced by the city while operating its Scherzer bridges. Authored by Pihlfeldt's chief assistant, von Babo, this critique bypassed the city's customary complaint concerning the substructure weakness of the Scherzer design and concentrated on another structural problem that appeared to be even more damning.[38] The defining feature of a Scherzer bridge was that the bascule superstructure rolled backwards and forwards on curved steel girders supported by horizontal steel tracks. According to von Babo, this rolling action created such enormous contact pressures that both the "[curved] segment and track-girders of these bridges deteriorate amazingly fast." As an example, von Babo presented photographs of severe track deformation in the rolling-lift bridge at Taylor Street, built by the Sanitary District in 1900 and since maintained by the city. To indicate that such deterioration was not simply the result of the city's poor maintenance practices or faulty operating procedures, he also included photographs of the same condition in a Chicago railroad bridge designed by the Scherzer Company. The photographs, von Babo asserted, "show plainly that the above remarks are not theoretical quibbles, but are based on actual facts." Although von Babo did concede that the Scherzer Company's bridges were initially cheaper than those built according to the city's design, he argued that these savings were made at the expense of quality:

> Savings made and claimed for rolling lift bridge designers have nothing to do with the system or type of bridges, but are the result of the efforts on the part of the owners of the patents to keep the original cost down to a minimum. Just as any other public improvement, for instance a schoolhouse, may be constructed in a more or less substantial and lasting manner, so it is with bridges. If one structure costs less to build than another, it does not necessarily follow that it is also the cheaper and better of the two in the long run for the taxpayers.

Von Babo's criticisms appear to have struck home, for the Scherzer Company did not choose to continue the debate in court. In February 1907, the company quietly withdrew its complaint, and the city proceeded with the construction of the North Halsted Street Bridge,

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1996):48-49, note 49.

[37] O'Connell and Pihlfeldt, "Joint and Several Answers."

[38] *DPW Annual Report, 1906*, 269-284.

which was completed without further incident in November 1908.[39] The Scherzer Company did not again use the courts to interfere with a municipal bridge letting, but it did continue to submit noncomplying proposals and to criticize the Department of Public Works for rejecting them.[40] The company apparently hoped that its tactics would mobilize Chicago taxpayers to support its cheaper bridges, but public attention focused instead upon the royalties received by the company for permitting the use of its patented designs. In Chicago, these fees were about $18,000 per bridge. The issue first surfaced during the 1905 North Avenue Bridge dispute, when the local press reported that the "Sanitary District always has stuck to the Scherzer bridge and paid the company a heavy royalty for using them." Shortly afterwards, the district's own chief engineer, Isham Randolph, expressed the opinion that "the royalties asked by that company [i.e., Scherzer], are excessive." In the spring of 1906, after an audit by independent accountants raised questions about the Sanitary District's bridge-building "extravagance," the agency initiated an in-house financial investigation, resulting two years later in its abandonment of patent-bridge designs. As the district's president, Robert R. McCormick, announced in 1908, "Because of controversies and scandals growing out of the use of patented bridges in the past, I am firmly of the opinion that in the future these bridges should be designed by the [district's] bridge department whenever possible." The Scherzer Company, therefore, lost its last remaining customer in Chicago.[41]

Strauss fared slightly better than the Scherzer Company in dealing with the Chicago Department of Public Works. Surviving city records do not indicate whether or not Strauss submitted a proposal for the North Halsted Street Bridge, but in 1907 he was enlisted by Pihlfeldt

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[39] Contact-pressure deformation remained a serious problem for the Scherzer Company for more than 20 years; see "Track Castings for Rolling-Lift Bridges," *Engineering News-Record* 97 (25 November 1926):878-879. Strauss made good use of the city's critique of the Scherzer Company, routinely sending it out to prospective movable-bridge clients who might be considering a rolling-lift design. He also compiled his own list of Scherzer bridge "failures," which generally involved substructure movement or rolling-track difficulties; see, for example, the Strauss Bascule Bridge Company, publicity packet, c. 1921, in Proposals File, Department of Public Works, City of Green Bay, Wisconsin. Despite the various flaws in the rolling-lift design, the Scherzer Company built over 200 bridges by 1915; *Scherzer Rolling Lift Bridges. Their Inception, Development and Use* (Chicago: Scherzer Rolling Lift Bridge Company, c. 1915).

[40] See, for example, "Bridge Engineer Is Assailed," *Chicago Record Herald*, 17 April 1908, 4; "New [Polk Street] Bridge Contract Is Delayed by Bids," *Chicago Record Herald*, 16 April 1908. The Scherzer Company did sue the city again over an alleged patent infringement involving the construction of the Lake Street Bridge, a city-designed, fixed-trunnion bascule completed over the Chicago River in 1920. The company lost the case; see *The Scherzer Rolling Lift Bridge Company vs. City of Chicago and Great Lakes Dock Company*, U..S. Court of Appeals, Seventh Circuit, Records and Briefs, October 1924, Case No. 3606, in Record Group 276, National Archives, Chicago.

[41] "Finds Flaws in Bridges," *Chicago Tribune*, 15 August 1905, pt. 1, 8; Isham Randolph to Robert R. McCormick, 13 December 1905, in *SDC Proceedings*, 20 December 1905, 11089; "Canal Inquiry Is Begun," *Chicago Tribune*, 11 May 1906, 3; *SDC Proceedings*, 23 December 1908, 1409.

to prepare a version of his patented bascule design for the Polk Street crossing of the South Branch of the Chicago River. Originally Pihlfeldt had hoped to use the city's fixed-trunnion bascule at this location as well, but to do so he would have had to deprive the Chicago Great Western Railway of existing trackage in order to make room for the bridge's east approach. The railroad company threatened suit, claiming that the city had a feasible alternative in the Strauss bascule design, which required less space and therefore could be constructed without any track relocation. Upon the advice of the city attorney, Pihlfeldt decided to use a Strauss-patent design for the site. Completed in 1910, the Polk Street Bridge project rewarded Strauss with $14,000 in royalties, as well as additional engineering fees. Although this royalty payment was less than the Scherzer company's customary fee, it still attracted a good deal of public censure. No other Strauss-patent highway bridges were built by the city.[42] Chicago railroad companies, however, would later number among Strauss' most important customers.[43]

The 1908 North Halsted Street Bridge was the eighth bascule to be built according to the city's fixed-trunnion design.[44] In a sense, its completion marked the end of an era. Although the city still had several center-pier swing spans to replace, the next wave of construction would await the passage of another bond issue in 1911. These later bridges incorporated a number of technological refinements that distinguished them from those built prior to 1910. They tended to have two bascule pony trusses instead of the three trusses with partial overhead bracing that characterized the city's original design. They also incorporated a new type of rack for operating

[42] "High Bridge Royalty Is Demanded of City," *Chicago Record Herald*, 28 December 1907, 1; " Defends Bridge Bonus," *Chicago Record Herald*, 30 December 1907, 5. In March 1913, Strauss sued the city for patent infringement, claiming that a trunnion-support technique used by the city in the recently completed Washington Street Bridge violated the company's proprietary technology. Strauss won his case in federal district court in 1918, and the verdict was upheld at the appellate level two years later. By that time, the city had built ten fixed-trunnion bascules with the offending trunnion-support system. In his promotional literature, Strauss listed these structures as "Strauss Movable Bridge Designs," but none of the ten bridges incorporated a pivoting counterweight in a parallelogram framework, which was the hallmark of the Strauss bascule bridge. See "Chicago Settles with Strauss for Infringing Bridge Patent," *Engineering New-Record* 85) 9 December 1920):1158-1159; *City of Chicago vs. Strauss Bascule Bridge Company*, U.S. Court of Appeals, Seventh Circuit, Records and Briefs, Case No.2677, October 1924, Record Group 276, National Archives, Chicago Illinois; Strauss Bascule Bridge Company, Publicity Packet, c. 1921.

[43] See, for example, W.T. Christine, "Bascule Bridge, Largest of Its Type, Built over the Chicago River," *Engineering World* (1 January 1920):11-14; "Chicago Bascule Bridge Erected over Railroad Tracks," *Engineering News-Record* (11 October 1928):546-550.

[44] The seven previous bascules were built as follows: Clybourn Place (North Branch), 1902; Ninety-Fifth Street (Calumet River), 1903; East Division Street (North Branch Canal), 1903; West Division Street (North Branch), 1904; North Western Avenue (North Branch), 1904; Archer Avenue (South Branch), 1906; and North Avenue (North Branch). All of the bridges were double-leaf structures, except for the Archer Avenue bascule, which contained a single leaf. In 1909, the city replicated the Archer Avenue design at Kinzie Street, over the North Branch of the River.

the movable leaf, as well as a new system for supporting the trunnions. And perhaps most notably, they showed a concern for aesthetic detailing that was completely lacking in the North Halsted Street Bridge and its predecessors.[45] These later bridge would help place Chicago in the forefront of the City Beautiful Movement.

Between 1890 and 1910, Chicago was the world's center for the development of movable-bridge technology. During this 20-year period, no other city experimented with as many different types. Among patent bridges, the Harmon folding-lift bascule, the Waddell vertical-lift bridge, the Scherzer rolling-lift bascule, and the Page bascule all made their debut as highway crossings of the Chicago River, which also provided a site for one of the earliest Strauss bascules.[46] Chicago, however, is most closely identified with the unpatented fixed-trunnion design that bears its name, the Chicago Type Bascule. Developed by city staff engineers and defended by the city in court, the Chicago Type Bascule strongly encouraged the use of fixed-trunnion technology throughout the United States. Some cities, such as Seattle, adopted the Chicago Type Bascule with little modification; others, such as Milwaukee, used it as a point of departure for developing their own type of fixed-trunnion bascule.[47] Despite the design's geographic dispersion, no other city would build as many Chicago Type Bascules as Chicago itself. By 1960, the Chicago Department of Public Works had over 50 such bridges in operation, all clearly the progeny of the fixed-trunnion design presented to the public by City Engineer Ericson in 1900.

[45] Becker, 279-283.

[46] The only major patented type that did not appear on Chicago highways during this period was a bascule design developed by American engineer Theodore Rall. Rights to this design were held by a Chicago firm, the Strobel Steel Construction Company, which built several Rall bascules during the first decade of the twentieth century. Like the Page bascule, the Rall bascule combined elements of rolling-lift and trunnion technology. See "Lift Bridges," *Proceedings Engineers' Society of Western Pennsylvania*, 32.

[47] See "Three Double-Leaf Bascule Bridges at Seattle, Wash.," *Engineering News-Record* 84 (8 April 1920):718-722; Hess and Frame, 33-45.

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FRANKLIN-ORLEANS STREET BRIDGE IN FOREGROUND.

IL-111-16 MAIN BRANCH LOOKING SE, WELLS STREET BRIDGE AT BOTTOM FRAME.

IL-111-17 SOUTH BRANCH LOOKING DUE SOUTH FROM JUNCTION.

IL-111-18 SOUTH BRANCH LOOKING SSE FROM JUNCTION.

IL-111-19 SOUTH BRANCH LOOKING SOUTH FROM JUNCTION.

IL-111-20 SOUTH BRANCH LOOKING DUE EAST TOWARD LOOP , WASHINGTON BOULEVARD, MADISON STREET, MONROE STREET FROM L TO R.

IL-111-21 SOUTH BRANCH LOOKING SSE FROM BOTTOM TO TOP, MADISON STREET, MONROE STREET, ADAMS STREET, JACKSON BOULEVARD.

IL-111-22 MAIN BRANCH LOOKING WEST FROM LAKE. CHICAGO RIVER ENTRANCE LOCKS, OUTER DRIVE BRIDGE IN FOREGROUND.

IL-111-23 SIMILAR TO IL-111-22, LOOKING WSW.

IL-111-24 SIMILAR TO IL-111-23, CLOSER IN, OUTER DRIVE BRIDGE IN FOREGROUND.

IL-111-25 MAIN BRANCH LOOKING WEST, COLUMBUS DRIVE, MICHIGAN AVE IN FOREGROUND.

IL-111-26 NORTH BRANCH LOOKING NE TOWARD LAKE.

IL-111-27 NORTH BRANCH LOOKING NE TOWARD LAKE. CHICAGO AVE BRIDGE AT LEFT KINZI STREET AT RIGHT.

IL-111-28 NORTH BRANCH LOOKING NW GRAND STREET BOTTOM, OHIO-ONTARIO CONNECTOR BRIDGE TOP.

HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO RIVER BASCULE BRIDGES
DEVELOPMENT OF MOVABLE-BRIDGE TECHNOLOGY IN CHICAGO, 1890-1910

HAER No. IL-111

This report is an addendum to a 3 page report previously transmitted to the Library of Congress in 1995.

Location:	Spanning the Chicago River and its North and South Branches.
Date of Construction:	1865-1890
Designer:	City of Chicago
Builder:	Department of Public Works
Present Owner:	City of Chicago
Present Use:	Highway Bridges
Significance:	Between 1865 and 1890, the City of Chicago built 55 movable highway bridges over waterways within municipal limits. All were center-pier swing spans. Despite its ubiquity, the swing span was not universally admired. Its critics pointed to the fact that the center-pier design was becoming a navigational hazard for the ever-larger vessels of the late nineteenth century.
Historian:	Jeffrey A. Hess, Historian
Project Description:	The Chicago Bridges Recording Project was sponsored During the summer of 1999 by HABS/HAER under the General direction of E. Blaine Cliver, Chief; the City of Chicago, Richard M. Daley, Mayor; the Chicago Department of Transportation, Thomas R. Walker, Commissioner, and S.L. Kaderbek, Chief Engineer, Bureau of Bridges and Transit. The field work, measured

drawings, historical reports, and photographs were prepared under the direction of Eric N. DeLony, Chief of HAER.

Between 1865 and 1890, the City of Chicago built 55 movable highway bridges over waterways within municipal limits. All were center-pier swing spans, the most popular type of movable bridge in the United States at the time.[1] Despite its ubiquity, the swing span was not universally admired. Its critics pointed to the fact that the center-pier design was becoming a navigational hazard for the ever-larger vessels of the late nineteenth century. They also noted that the swing span's requirement of a clear turning radius often prohibited the development of docking facilities adjacent to the bridge site. These shortcomings were especially onerous along highly industrialized urban waterways such as the Chicago River, where shipping channels tended to be narrow, highway crossings numerous, and real estate prices high.[2]

No matter how vociferously shipping and real estate interests might decry the center-pier swing span, there was no effective means of regulating movable-bridge design until the early 1890s, when Congress authorized the War Department to approve plans for all new bridges over navigable waterways and to seek the alteration of any existing bridge that interfered with navigation.[3] In 1892, the U.S. Army Corps of Engineers demonstrated both provisions of the law on the South Branch of the Chicago River, by ordering the removal of a recently completed swing span at Canal Street and by prohibiting the construction of a new swing span at South Halsted Street. As Chicago's Commissioner of Public Works observed in his annual report for 1892, "This Department found it necessary to look about and devise some plan that would meet

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[1] See City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Bridge History and Data," 1943, rev. 1950, Drawing Nos. 16188-16192, in CDT Plan Archives. The statistic does not include projects that relocated an old span to a new site. One bridge was built over the Calumet River; the remainder were crossings of the Chicago River system, a dock-lined, 15-mile navigable network that consisted, primarily, of a north branch, a south branch, and a main river channel. Just north of the city's downtown business district, the two branches converged, like the legs of a "Y," to form the main river, which then flowed eastward, about one mile, into Lake Michigan. During the nineteenth century, the Chicago River system served as an inner harbor for Chicago's extensive Great Lakes trade, especially for such commodities as grain and lumber. Although Chicago's railroad business eclipsed its waterborne commerce in the second half of the nineteenth century, the Chicago River remained of considerable commercial significance. As the U.S. Army Corps of Engineers noted in 1893: "Chicago River is the most important navigable stream of its length on the globe. In the number of arrivals and departures of vessels annually it leads all harbors of the United States; in tonnage it is second only to New York"; *Annual Report of the Chief of Engineers, United Sates Army . . . 1893* (Washington: Government Printing Office, 1893), pt. 4, Appendix LL, 2798. For an excellent discussion of the river's place in the city's commercial growth, see William Cronon, *Nature's Metropolis* (New York: W.W. Norton and Company), 1991.

[2] Jeffrey A. Hess and Robert M. Frame III, *Historic Highway Bridges in Wisconsin. Volume 3. Movable Bridges.* (Madison, WI: Wisconsin Department of Transportation, 1996), pt. 1, 10.

[3] W. M. Black, "Bridges Over Navigable Waters of the United States," *Engineering News* 29 (13 April 1893):341-342.

these objections."[4] The result was a decade-long search by Chicago city engineers for a reliable, cost-effective, movable bridge that did not obstruct the shipping channel.

During the next three years, the city built three different types of movable bridges over the South Branch of the Chicago River: a double-leaf, folding-lift bridge at Canal Street (1893); a vertical-lift bridge at South Halsted Street (1894); and a double-leaf, rolling-lift bridge at West Van Buren Street (1895). Each embodied a newly patented design that operated on a different principle. The folding-lift bridge employed a counterweighted, segmented leaf, hinged at the rear and at the middle. When the operating machinery was set in motion, the leaf folded up like a jackknife, the rear segment pivoting upward and the front segment dropping downward. The vertical-lift bridge mimicked the action of a double hung-window, using tower-supported pulleys and cables to lift and lower a counterweighted horizontal span. The rolling-lift bridge, as its name implied, was subject to two types of movement. At the same time that the leaf rose vertically from the water, it also moved horizontally toward the shore. Resting on tracked, curved supports known as "segmental girders," the leaf rolled backwards and forwards like a rocking chair, thereby raising and lowering its front end. The folding-lift patent was controlled Shailer and Schniglau, a Chicago contracting firm; the vertical-lift patent, by engineer J.A.L. Waddell of Kansas City, Missouri; and the rolling-lift patent, by the Scherzer Rolling Lift Bridge Company of Chicago.[5]

[4] *Mayor's Annual Message and Seventeenth Annual Report of the Department of Public Works . . . Fiscal Year Ending Dec. 31st 1892* (n.p., n.d.), 10, 57-58.

[5] Anticipating the federal government's objections to the swing span, the city had begun searching for an alternative design before the Corps of Engineers' official prohibition. In 1890, the Department of Public Works contracted with Shailer and Schniglau to build a folding-lift bridge over the North Branch Canal at Weed Street. Completed in 1891, this structure was plagued by mechanical problems. The 1892 Canal Street Bridge was supposed to be an improved version, but it, too, failed to give satisfaction. Its mechanical system was completely rebuilt in 1897. The Weed Street Bridge was so poorly designed that it was permanently closed in 1899. Although the folding-lift patent was controlled by Shailer and Schniglau, the inventor and original patent holder was William Harmon of Chicago. See *DPW Annual Report, 1890*, 160, 162, 165; "A Folding-Floor Drawbridge," *Engineering News* 25 (23 May 1891): 486-487; *DPW Annual Report, 1897*, 124; City Council, Proceedings, 18 September 1899, 1060; William Harmon, U.S. Patent No. 383,880, 5 June 1888. From the very beginning, the Department of Public Works had misgivings about Waddell's vertical-lift bridge. As one municipal engineer commented during the bridge's construction, "The whole work is an expensive experiment." Largely because of the South Halsted Street Bridge's reputation for "heavy first cost and maintenance, and expensive operation," it took Waddell over a decade to secure his next vertical-lift commission. In Chicago itself, a second vertical-lift highway bridge was not constructed until 1938, at Torrence Avenue over the Calumet River. See City Council, Proceedings, 29 May 1893, 334; J.A.L. Waddell, "The Halsted Street Lift-Bridge," *American Society of Civil Engineers Transactions*, Paper No. 742 (1895):1-16; C.C. Schneider, "Movable Bridges," *American Society of Civil Engineers Transactions*, Paper 1071 (1908):268-269; Hess and Frame, 13-15; Waddell, U.S. Patent No. 506,571, 10 October 1893. The rolling-lift bridge at West Van Buren Street was constructed simultaneously with an adjacent Scherzer bridge commissioned by the West Side Metropolitan Elevated Railroad Company. The design was the creation of William Scherzer, a Chicago-based, Swiss-trained engineer who was familiar with French attempts to develop a wheel-mounted bascule

As might be expected with new inventions, all three bridges experienced mechanical difficulties during their first years of operation, but the rolling-lift design seemed to be the most promising of the lot. Incorporating the fewest movable parts, it appeared to be the simplest to build and the cheapest to maintain. In 1895, the Chicago Department of Public Works contracted for the construction of a second rolling-lift bridge, which was completed over the North Branch of the Chicago River at North Halsted Street in 1897. It soon became apparent, however, that there were structural as well as mechanical problems with the new rolling-lift design. In 1898, City Engineer John E. Ericson observed that the concrete foundations of the new North Halsted Street Bridge needed to be strengthened. A year later, he reported that the bridge's substructure was literally "falling to pieces."[6] The problem was that the rolling-lift design was best suited for sites with easily accessible bedrock to support bridge foundations, a geological condition that did not exist along the Chicago River. As a Chicago municipal staff engineer explained:

> These [rolling-lift] bridges, although marked improvements over the folding and [vertical] lift bridges, have some objections. The main objection lies in the fact that this type of bridge requires a most solid foundation, as the whole load in opening and closing travels horizontally over a space of from twenty to thirty feet on the substructure. The points of application of this load during operation of the bridge change continuously, and, in connection with the wind pressure, have a very severe action on the foundation, which, if not built of extraordinarily large dimensions, and consequently at great expense, or on solid rock, shows a wagging motion, as the Halsted street bridge over the North branch of the river sufficiently proves.[7]

Disenchanted with the patented designs available on the market, City Engineer Ericson in 1898 recommended that "the city take up the question of investigating movable bridges for the purpose

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earlier in the century. Scherzer filed a patent application for his invention, but died a few months before its approval in 1893. The patent became the property of his brother Albert, who organized the Scherzer Rolling Lift Bridge Company to sell rights to the design. See "Van Buren Street Rolling Lift Bridge," *Engineering Record* 31 (16 February, 2 March 1895):204-206, 242-243; "The Van Buren Street Rolling Lift Bridge, Chicago," *Engineering News* 32 (21 February 1895):114-115; Hess and Frame, 21-22; William Scherzer, U.S. Patent No. 511,713, 26 December 1893. For general overviews of the city's movable-bridge projects during the 1890s, see *DPW Annual Report, 1900,* 87-88; Becker, 266-270.

[6] *DPW Annual Report, 1894,* 23-24; *DPW Annual Report, 1895, 50; DPW Annual Report, 1896,* 104, 110; City Council, Proceedings, 12 September, 1898, 587; 18 September 1899, 1060.

[7] *DPW Annual Report, 1900,* 88.

of designing their own bridges."[8] At the time, the city's finances were in an extremely embarrassed condition. Because of state-mandated restrictions on municipal taxing and bonding powers, the city lacked funds to pay for even basic bridge maintenance, let alone elaborate new design studies.[9] Ericson, therefore, decided on a simple paper investigation by in-house staff. His goal was "a critical analysis of the literature on movable bridges built in the United States and Europe, with the view of selecting a type of bridge suitable to the requirements of the Chicago river and its branches." By 1899, Ericson and his colleagues had decided that the most appropriate model for Chicago was the 1894 Tower Bridge of London, England.

Like the folding-lift and rolling-lift bridges built in Chicago, the Tower Bridge belonged to a class of engineering structures known as "bascules," after the French word for "seesaw." Unlike a swing bridge, which horizontally rotated around a vertical axis, a bascule vertically rotated around a horizontal axis. Some bascules, as in the case of the medieval castle drawbridge, rotated around a stationary horizontal axis; others, such as the Scherzer rolling-lift bridge, had a moving axis. The Tower Bridge was of the stationary type; its horizontal axis was defined by a steel pivot, or trunnion, and it was according called a fixed-trunnion bascule. Its design incorporated two movable sections, or leaves, each counterweighted at the rear so that the leaf's center of gravity was at the trunnion. Located below deck level in the abutments, steam-powered machinery operated the draw by means of a pinion engaging a curved rack mounted at the rear end of the leaf. As the front end of the leaf tilted upward, the counterweighted rear end descended into a masonry pit built into the abutment. When the motive power was reversed, the leaf pivoted into closed position.[10]

The counterbalanced-lever principal of the Tower Bridge was appealing to Ericson for three main reasons. First, it relied on relatively simple operating machinery that was fairly easy to manufacture and install. Second, it was patent-free, so that its use entailed no royalty payments. Third, it dictated a bridge with a fixed center of gravity, so that the action of the movable leaves would not alter the distribution of stresses on the bridge's substructure. With his technological quest at an end, Ericson supervised the preparation of "three complete designs, differing in appearance, method of mounting, etc., but all involving the main feature, that of revolving on a fixed trunnion."[11] Except for minor departures, such as the substitution of electric

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[8] "Testimony of John Ericson," *The Scherzer Rolling Lift Bridge Company vs. City of Chicago and Great Lakes Dock Company*, U..S. Court of Appeals, Seventh Circuit, Records and Briefs, October 1924, Case No. 3606, in Record Group 276, National Archives, Chicago.

[9] *DPW Annual Report, 1899*, 68; *DPW Annual Report, 1901*, 5-10.

[10] "Testimony of Thomas G. Pihlfeldt," *Scherzer vs. Chicago*, 93. Pihlfeldt identified the Tower Bridge as the model in Dan Fogle, "Modest Man is Pihlfeldt," *Chicago Daily New*, 15 October 1936, 21. For a description of the Tower Bridge, see Ottis Ellis Hovey, *Movable Bridges* (New York: John Wiley and Sons, 1926), vol 1, 83-88.

[11] *DPW Annual Report, 1900*, 88.

power for steam power, these designs incorporated the basic features of the Tower Bridge. Ericson submitted his drawings to an outside panel of mechanical and civil engineers, who approved the basic fixed-trunnion concept but suggested certain improvements regarding the substructure, flooring system, and operating equipment.

Beginning with the municipal appropriation ordinance of 1900, the City Council cobbled together sufficient funds to allow Ericson to replace five severely deteriorated swing spans with new fixed-trunnion, double-leaf bascules based on in-house designs. The new structures were completed at Clybourn Place (later renamed Cortland Street) over the North Branch of the Chicago River (1902); at Division Street over the North Branch Canal[12] (1903); at Ninety-Fifth Street over the Calumet River (1903); at Division Street over the North Branch (1904); and at North Western Avenue over the North Branch (1904). In terms of general appearance, these bridges established the basic profile of the early "ChicagoType Bascule," as the genre came to be known in the engineering literature.[13] The movable leaves were supported by three evenly spaced, riveted, steel trusses displaying a distinctive, overhead-braced, humpbacked configuration at the shore portals. The bulbous outline of the rear members was dictated by the curvature of the externally mounted operating racks, the only part of the lift machinery visible above roadway level. Apart from the occasional use of decorative portal plates, the city engineers made little attempt to improve the bridges' appearance through architectural detailing.[14]

Although Ericson had rejected the Scherzer rolling-lift design, the Department of Public Works was not the only builder of movable highway bridges in Chicago. In 1889, the state legislature had chartered an independent government agency, the Sanitary District of Chicago, and had given it wide powers over the Chicago River.[15] The Sanitary District's primary responsibility was to reduce the pollution of the waterway, which had long been used for disposing sewage and refuse. As dictated by the region's natural hydraulic patterns, the Chicago River system sluggishly drained into Lake Michigan, just north of the downtown commercial neighborhood. The Sanitary District intended to alter this state of affairs by constructing a canal

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[12] The North Branch Canal was a mile-long navigable waterway that bypassed a bend in the North Branch of the river, located just to the west. The canal was completed in the 1850s to provide additional commercial docking space. See Perry R. Duis and Glen E. Holt, "Chicago's Only Island," *Chicago History* (February 1979):170.

[13] See, for example, C.B. McCullough and Phil A. Franklin, "Bascule Bridges," *Movable and Long-Span Steel Bridges*, ed. George A. Hool and W.S. Kinne (New York: McGraw-Hill Book Company, 1923), vol. I, 20.

[14] City Council, Proceedings, 4 April 1900, 2817; *DPW Annual Report, 1901*, 5-10; *DPW Annual Report, 1904*, 16-17.

[15] "History of the Sanitary District of Chicago and the Drainage Problem, with the Law Relating to the Same," in *DPW Annual Report, 1889*, 67-93.

to drain the waterway away from the city, southward into the Desplaines River, a tributary of the Illinois River, which, in turn, emptied into the Mississippi River. Upon the canal's completion, the Chicago River would become an outlet of Lake Michigan, which, instead of receiving the city's pollution, would help flush it, in somewhat diluted form, into the Mississippi.[16] To accommodate the Chicago River's increased flow, the Sanitary District also intended to widen the waterway at several points, which required the replacement of several municipal highway bridges. In 1898, while the drainage canal was still under construction, the Sanitary District embarked on the reconstruction of the Taylor Street Bridge over the South Branch of the Chicago River, with the understanding that the city would maintain and operate the structure after its completion. Following the example set by the Department of Public Works in the construction of the West Van Buren and North Halsted street bridges, the Sanitary District selected the Scherzer rolling-lift design for its project.[17] A year later, in 1899, the agency decided that its engineering program also required the replacement of the six-year-old, folding-lift bridge at Canal Street. By this time, however, Ericson had deep misgivings about the way the Scherzer Company designed its bridges, and he secured the Sanitary District's consent to consult on design selection. Since the Scherzer rolling-lift bridge still seemed to be the most efficient and economical alternative to the center-pier swing span, the Scherzer company secured the Canal Street contract as well, but Ericson attempted to force the company to strengthen its foundation design. The outcome apparently was to no one's satisfaction. The Sanitary District and the Scherzer Company resented Ericson's meddling, and Ericson developed a firm dislike for the Scherzer Company's business practices.[18]

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[16] On the construction of the new canal and related features, see Mary Yeater Rathbun, *Architectural and Engineering Resources of the Illinois Waterway between 130th Street in Chicago and La Grange, Illinois* (Carbondale, IL: American Resources Group, Ltd for U.S. Army Corps of Engineers, Rock Island District, Rock Island, IL, 1996), 46-60.

[17] Board of Trustees of the Sanitary District of Chicago, *Proceedings, 1898,* 23 November 1898, 5275-5276; *Proceedings, 1900,* 3 December 1900, 6882. Henceforth, these board minutes will be cited as *SDC Proceedings*, with appropriate date and page.

[18] *SDC Proceedings*, 30 August 1899, 6016; 21 February 1900, 6307-6308; 24 October 1900; 3 December 1900, 6882. Ericson and the Sanitary District initially considered using another rolling-lift design invented and patented by Milwaukee engineer Max G. Schinke. In the Schinke bascule, a counterbalanced leaf was supported by a pivoted swinging arm at the front end while attached to rollers set in a curved stationary track at the rear end. The bridge was set in motion by a simple strut connected to a power source. When the strut pulled back on the span, the front end of the leaf arced upwards, while the rear end rolled downwards along the curved track. Because of the track's shape, the leaf's center of gravity retreated and advanced in a horizontal line, thereby maintaining a counterbalanced system. Between 1895 and 1897, the City of Milwaukee built two Schinke bascules. Although the bridges appear to have functioned fairly well, their curved tracks were expensive to fabricate and difficult to install. Chicago never built a Schinke rolling- lift bridge, and Milwaukee itself abandoned the design after adopting, in 1900, fixed-trunnion bascule bridges that were similar in several respects to the design developed by Ericson. The

If Chicago municipal finances had been in a healthier condition at the turn of the century, Ericson might have had greater leverage with the Scherzer Company. But the city could not afford to take over the construction of the Sanitary District's highway bridges. Indeed, the city could not afford even to replace some of its own most hazardous crossings. In the spring of 1900, Chicago Mayor Harrison H. Carter appealed to the better-funded Sanitary District to assist the city in replacing its deteriorating and obstructive swing spans. As the mayor pointed out, the Sanitary District was responsible for maintaining the flowage rate of the Chicago River at certain legislatively set limits in order to keep the waterway free from sewage build up. Since the center-pier swing spans impeded the river's flow, the Sanitary District, so the mayor reasoned, had an obligation to replace the structures. Although this argument might not have stood up in a court of law, the Sanitary District had its own legal reasons for acceding to the mayor's wishes. A few months earlier, the district's drainage canal had gone into service, with an unexpected consequence. Not only did the canal reverse and increase the flow of the Chicago River, but it also made navigation on the waterway more difficult, especially in the vicinity of center-pier bridges. Fearful that it might be held liable for shipping accidents associated with the more swiftly flowing waterway, the Sanitary District agreed to begin the replacement of certain center-pier bridges. For its part, the city agreed to eventually repay a portion of the construction costs and to assume responsibility for maintaining and operating the new spans. Unlike the Canal Street Bridge project, however, the Department of Public Works was to have no say in the bridge-selection process. Instead, the Sanitary District was to be completely in charge of design and construction, subject only to the federally mandated review of bridge plans by the Corps of Engineers.[19] Under this arrangement, the Sanitary District built a total of eight movable highway bridges. Seven were Scherzer rolling lifts.[20] The eighth was based on an untried bascule design that had been developed by John W. Page, formerly a staff engineer with the

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Milwaukee bascule differed from the Chicago type primarily in its use of plate girders, instead of trusses, for the leaves and in its location of the operating racks, which were mounted on the bottom of the plate girders, just behind the trunnions. See Hess and Frame, 26-29, 36-50; Max G. Schinke, U.S. Patent No. 517,808, 3 April 1894; No. 551,004, 10 December 1895; "Sixteenth Street Bascule Bridge, Milwaukee," *Engineering Record* 31 (9 March 1895):256-257; M.G. Schinke, "The New Huron Street Lift Bridge, Milwaukee, Wis.," *Engineering News* 37 (22 April 1897):253-255.

[19] *SDC Proceedings*, 11 April, 16 May 1900, 6410-6411, 6556 ; City Council, Proceedings, 16 July 1900, 6718-6719. For the Sanitary District's concern over its potential legal liabilities, see *SDC Proceedings*, 21 March, 4, 11 April, 11 July, 1900, 6355-6356, 6386-6387, 6394-6395, 6411, 6642-6643.

[20] The Scherzer bridges were built over the main river at State Street (1903) and Dearborn Street (1905); and over the South Branch at Throop Street (1903), Loomis Street (1904), Harrison Street (1905), Eighteenth Street (1905), and Cermak Road (1906).

Sanitary District.[21]

In 1904, the City Council of Chicago finally gained the legal authority to increase the level of municipal indebtedness and to float a bond issue for public improvements. The Department of Public Works immediately began planning for the construction of several movable bridges.[22] The design of these projects was to be the responsibility of Thomas G. Pihlfeldt, a Norwegian-born, German-trained engineer who, after entering the municipal bridge division in 1894, had become "Structural Iron Designer in Charge" in 1901. Pihlfeldt's "Assistant Designer" was Alexander von Babo. Like Pihlfeldt himself, von Babo had helped Ericson develop the city's fixed-trunnion bascule design.[23] By December 1904, Pihlfeldt and

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[21]*SDC Proceedings*, 20 June 1900, 6648-6649; "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 43 (27 April 1901):3392-394; "Page Bascule over the [West Fork of the South Branch of] the Chicago River at [South] Ashland Ave.," *Engineering News* 45 (25 April 1901):311-312; J. B. Strauss, "The Bascule Bridge in Chicago," *A Half Century of Chicago Building*, ed. John H. Jones and Fred A. Britten (Chicago, 1910), 92. Page's goal was to eliminate the deep counterweight pits required by the city's fixed-trunnion bascule, as well as certain versions of the Scherzer rolling-lift design. These pits were expensive to build, and they frequently leaked. The original Page design for South Ashland Avenue was a counterweighted, double-leaf structure pivoting on fixed trunnions in the lower chords of the bascule trusses. The counterweight was split into two basic components: (1) overhead cast-iron blocks rigidly suspended from the top chord of the bascule trusses, and (2) movable steel struts pivoted at one end to the fixed approach section and at the other end to heavy, steel, transverse girders supported by rollers resting on the tops chords of the bascule trusses. The transverse girders carried an electric-powered drive chain containing pinions that meshed with curved racks mounted on the top chords of the bascule trusses. During the bridge's opening cycle, the pinion-and-rack arrangement caused the transverse girders to roll slightly forward and the bascule trusses to pivot open on their trunnions. The curvature of the racks was calculated to compensate for the movement of the transverse girders, so that the bridge's center of gravity at all times remained at the fixed trunnions. Shortly after the Sanitary District accepted this bascule design, Page developed a simplified deck-truss version that completely eliminated the rolling segment of the counterweight. In this version, as completed at South Ashland Avenue in 1902, the bridge's approach spans functioned as counterweights pivoting in the abutments. The river ends of the spans rested on rollers that engaged curved tracks in the tail ends of the bascule deck trusses. As in the original design, the tracks' curvature maintained the center of gravity at the trunnions. See "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 48 (10 October 1903):434-436. Upon assuming custody of the South Ashland Bridge, the Department of Public Works found defects in the counterweight design that necessitated expense repairs; the bridge was eventually replaced in the mid 1930s. Neither the city nor the Sanitary District built another Page bascule. The Chicago and Alton Railroad, however, erected a Page bascule for its own use in 1906, over the South Fork of the South Branch of the Chicago River near Archer Avenue.

[22] *DPW Annual Report, 1904*, 16-17.

[23] *DPW Annual Report, 1901*, 101; "The Chicago Type Bascule Bridge," *Engineering Record* 42 (21 July 1900):50. There is little biographical information available on von Babo. He remained a bridge engineer with the city until 1915. On Pihlfeldt, see "Pihlfeldt Dies at 82; Designed 50 Bridges for City in 51 Years," *Chicago Daily News*, 23 January 1941, 14; Kenneth Bjork, *Saga in Steel and Concrete* (Northfield, MN: Norwegian-American Historical Association, 1947), 121-126.

von Babo had prepared a set of plans for the first of the bond-funded bridges, which would serve as a replacement for the severely deteriorated, center-pier, swing span built in 1877 over the North Branch of the Chicago River at North Avenue. The bridge's fixed-trunnion, double-leaf, bascule superstructure closely copied the engineering of the 1904 West Division Street Bridge, while its substructure and operating machinery followed the layout of the 1904 North Western Avenue Bridge.[24]

Although the city engineers seem to have had every intention of using their own design, the Commissioner of Public Works, F.W. Blocki, motivated apparently by legal reasons, informed the Scherzer Company that "the City of Chicago has no objection to advertising for proposals for the building of a bascule bridge of the Scherzer type at North [A]venue; provided plans for such proposals are made to conform in every respect with all the requirements of the city's specifications for such a bridge."[25] In February 1905, Ericson sent the Scherzer Company the North Avenue Bridge specifications, which contained provisions concerning substructure and counterweight design that would have required the company to alter its standard treatment of these features. John W. Page, the inventor of the bascule type built by the Sanitary District at South Ashland Avenue in 1902, also received the city's specifications, and he duly submitted a design. In March 1905, the city ruled that Page's design was not in compliance and therefore should not be considered by potential bidders on the North Avenue Bridge project.[26] The Scherzer Company took a different tack. Instead of presenting a preliminary design for city approval, it waited until the bidding deadline and then submitted two proposals, both of which ignored the objectionable provisions in the city's specifications. One proposal, in the amount of $160,000, offered "an artistic deck Scherzer Rolling Lift Bridge with arched outline (similar to the Scherzer. . . Bridge [built for the Sanitary District in 1905] across the Chicago River at State Street)." The other, in the amount of $150,000, was for "a through Scherzer rolling lift bridge (similar in outline to the 'Ericson Trunnion Bridge' of which plans prepared by the city are on

[24] City of Chicago, Bureau of Engineering, Plans for North Avenue Bridge over the North Branch Chicago River, 1904, Drawing Nos. 6690-6710, in CDT Plan Archives. In 1899, Ericson had described the North Avenue Bridge as " likely to be closed any time" in view of the fact that "the wooden member is rapidly rotting away, iron work badly rusted and center pier shaky and rotten"; see City Council, Proceedings, 18 September 1899, 1060. On the West Division Street Bridge and North Western Avenue Bridge, see "The Division Street Bascule Bridge, Chicago," *Engineering Record* 42 (20 August 1904):215-217; "Trunnion Bascule Bridge at Northwestern [sic] Ave., Chicago," 64-65.

[25] F.W. Blocki to Frank Montgomery and Co., 22 December 1904, in "Bill for Injunction, Exhibit A, filed 31 March 1905, *Albert H. Scherzer v. City of Chicago et. al*, Case File No. 243,514, Superior Court, Cook County, Illinois, in Clerk of the Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, IL. Frank M. Montgomery and Company served as Scherzer's engineering and construction company in Chicago.

[26] The Scherzer Company was notified of Page's disqualification in a letter from Ericson dated 18 March 1905; see"Bill for Injunction," Exhibit B, *Scherzer v. City of Chicago*.

file)."[27] When the Department of Public Works opened the North Avenue Bridge bids on 31 March 1905, it rejected both Scherzer proposals for noncompliance. Contracts totaling $193,352 were then awarded to low-bidding firms that had adopted the city's fixed-trunnion bascule design. The Scherzer Company, filing on behalf of itself and the taxpayers of Chicago, immediately obtained an injunction from the Superior Court of Cook County to stop the letting of the contracts, on the grounds that the Department of Public Works had "maliciously, fraudulently, and unlawfully" prohibited the company from providing Chicago with "a superior type of bridge . . . at a great saving in cost."[28]

In July 1905, the city administration took steps that seem to have been at least partly aimed at placating the Scherzer Company. A newly installed commissioner of public works removed the bridge division from Ericson's bailiwick and transformed it into a separate administrative entity under Pihlfeldt's supervision. Henceforth, Pihlfeldt was to be "more or less independent of the City Engineer [i.e., Ericson,]" who would exercise "only a general supervision over the [bridge] work."[29] The Scherzer Company also received what it thought were assurances that the city would amend its bridge specifications to permit competitive bidding on the Scherzer rolling-lift design. In August, the company dropped its suit against the city, and the court dissolved the injunction prohibiting the letting of contracts for the North Avenue Bridge, which was completed two years later.[30]

In the fall of 1905, the Department of Public Works began planning its next movable-

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[27] Frank M. Montgomery and Co. to F.W. Blocki, 31 March 1905, in "Supplemental Bill," Exhibit C, filed 11 April 1905, *Scherzer v. City of Chicago*. The Scherzer Company appears to have hoped that its "artistic" bascule design would rally public support in its favor. In 1900, the newly established Municipal Art League of Chicago, which counted among its members such influential architects as Louis Sullivan and Martin Roche, had tried to persuade the Sanitary District to improve the aesthetic quality of the bascules it was building for the city. The league particularly wanted a "monumental" treatment for the prominently sited State Street Bridge. The Sanitary District was initially receptive to the league's design suggestions, but it failed to act on them. In 1903, the league abandoned its efforts, noting that it had failed "to have any influence in the design of the new bridges across the Chicago River." Its president, Franklin MacVeah, declared, "A Chicago bridge is a depressing sight . . . It is a marvel that suicides from these bridges are so infrequent." Although Scherzer's design for the State Street Bridge failed to meet the league's aesthetic standards, its arched treatment of the structure was the first attempt in Chicago to beautify a movable bridge. See Municipal Art League of Chicago, *Year Book, Twentieth Century, Year One* (n.p., 1901), 5-6; *Year Book, Twentieth Century, Year Three* (n.p., 1903), 13; *Year Book, Twentieth Century, Year Four* (n.p., 1904), 10.

[28] Scherzer, "Supplemental Bill," 3; Scherzer, "Bill for Injunction," 7.

[29] On the reorganization, see *DPW Annual Report, 1905*, 149; William L. O'Connell and Thomas G. Pihlfeldt, "Joint and Several Answer of the Defendants," 11 February 1907, in *Albert H. Scherzer v. City of Chicago et. al*, Circuit Court of Cook County, Illinois, Case File No. 277,091, in Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, Illinois; *DPW Annual Report, 1907*, 24.

[30] *DPW Annual Report, 1906*, 284; *DPW Annual Report, 1907*, 9.

bridge project, scheduled for the North Branch of the Chicago River at Indiana Street. By this time, still another independent movable-bridge designer was seeking to break into the Chicago market. Chicago engineer Joseph B. Strauss had spent several years developing a fixed-trunnion bascule with a movable rear counterweight suspended in a pivoted parallelogram framework. As the leaf rotated up and down on its fixed trunnion, the parallelogram linkage swung the counterweight through a series of parallel positions, at all times concentrating the weight on the very end of the leaf. Because the parallelogram linkage maximized the leverage of the counterbalancing system, Strauss' design made it possible to shorten the rear of the leaf, thereby saving on both material and space. With his first bascule under construction in Cleveland, Ohio, in 1905, Strauss, like the Scherzer Company, clamored for contracts in his home city.[31] In December 1905, the Department of Public Works informed both Strauss and Scherzer that it would consider their designs for the Indiana Street crossing.[32]

The key issue, however, was whether Pihlfeldt would prepare specifications that, in fact, gave outside designers a competitive chance to have their proposals accepted. As it turned out, the Indiana Street bridge would not provide a test case, for the city postponed the project. But plans did go forward to replace a 30-year-old swing span at North Halsted Street over the North Branch Canal. In July 1906, the Scherzer Company requested and received the city's specifications for this project. Although the company still found a few provisions to be objectionable, it decided that the specifications as a whole were acceptable and began preparing a proposal for the new bridge. In November, however, Pihlfeldt circulated a new set of specifications based on the city's fixed-trunnion bascule built at North Western Avenue in 1904. These specifications were as difficult for the Scherzer Company to adopt as those previously issued for the North Avenue Bridge, which was, itself, partly modeled on the North Western Avenue bascule. Once again the Scherzer Company submitted a full design-and-construction proposal that ignored the issues in contention, and once again the Department of Public Works discarded its entry. In late December, Pihlfeldt awarded the North Halsted Street construction contracts to bidders who had based their submittals on the city's fixed-trunnion bascule design.

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[31] Strauss eventually received patents for a number of bascule designs employing the parallelogram linkage; he assigned these to the Strauss Bascule Bridge Company, founded in 1902. See "Bascule Bridges," *Engineer* 115 (28 March 1913):340-343; Paul T. Gilbert, *Chicago and Its Makers* (Chicago: Felix Mendelsohn, 1929), 875. Strauss' first two projects are described in "The Strauss Trunnion Bascule Bridge Near Rahway, N.J.," *Engineering Record* 55 (13 April 1907):465-467.

[32] As Strauss reported, "The City of Chicago is now adopting this policy [of throwing open the design of movable bridges to public competition] and has invited various specialists in this class of work to place their designs on file for the proposed new Indiana Street bridge. On these plans the city will then receive bids and award the contract to the lowest bidder"; Strauss to R.R. McCormick, President Sanitary District, 11 December 1905, in *SDC Proceedings*, 20 December 1905. Strauss was writing to the Sanitary District to encourage its board to adopt the city's policy and consider movable-bridge designs other than those of the Scherzer Company, which had pretty much monopolized the Sanitary District's business in this area.

The awards totaled $257,458, approximately $50,000 more than the Scherzer Company's proposal for the bridge. The Scherzer Company immediately filed another lawsuit against the city, naming Pihlfeldt and Commissioner of Public Works William L. O'Connell as defendants.[33] Seeking both an injunction to halt the North Halsted Street Bridge project and compensatory damages for being excluded from the bidding, the Scherzer Company laid three major allegations before the Circuit Court of Cook County, Illinois. First, after noting that over 100 Scherzer rolling-lift bascules had been built in various parts of the world, including Chicago, the company averred that "these bridges have every advantage in permanency, structural strength, convenience and economy over any other bascule bridge." Second, the Scherzer Company asserted that Chicago City Engineer John Ericson was associated with a private engineering firm promoting the construction of "Ericson-trunnion bridges" and that every bridge of this design built by the city was simply so much advertizing for Ericson's business. Third, it contended that the city's chief bridge designer, Pihlfeldt, was "influenced or controlled in his actions with regard to the selection of bridges by the said John Ericson, and that the said Pihlfeldt is endeavoring to have the City of Chicago construct Ericson-trunnion bridges for the purpose of assisting said John Ericson in his private business even if the City of Chicago and the taxpayers thereof are required to pay from $50,000 to $100,000 more for each Ericson-trunnion bridge than they would be obliged to pay for a better bridge of the Scherzer design."[34]

The Scherzer Company's allegations concerning Ericson had the muck-raking quality of an expose, but the Chicago City Engineer had made no secret of the fact that he was involved in a private consulting practice that was trying to market a variant of the city's fixed-trunnion bascule design. Indeed, at the time of the North Halsted Street litigation, Ericson was negotiating a contract for a bascule bridge in Michigan City, Indiana.[35] In the early twentieth century, private ventures by government employees were generally accepted, as long as they did not interfere with the proper discharge of official responsibilities.[36] The Department of Public

[33] Both the city and the Scherzer Company were in general agreement about the events leading up to the lawsuit, as described above; see Albert H. Scherzer, "Amended and Supplemental Bill of Complaint," 9 February 1907; William L. O'Connell and Thomas G. Pihlfeldt, "The Joint and Several Answer of the Defendants," 11 February 1907, in *Scherzer v. City of Chicago,* Circuit Court of Cook County, Case File No. 277,091.

[34] Scherzer, "Amended and Supplemental Bill of Complaint," 12-14.

[35] This bridge was completed in 1908; see "Lift Bridges," *Proceedings of the Engineers' Society Western Pennsylvania* 25 (February 1909):28.

[36] Legal disputes concerning this practice usually centered on the ownership of patentable inventions developed by an employee as part of his government duties. In 1883, Congress had enacted legislation authorizing federal employees to patent and market inventions developed during the course of their work, with the proviso that the government retained the right to use the invention free of charge. Government agencies, however, did not always honor the law. See Jeffrey A. Hess, "Inventions and Patents for the Public Good: The Needle-Valve Program of the Bureau of Reclamation," *IA: The Journal of the Society for Industrial Archeology* 22 (No. 1,

Works, therefore, did not spend a great deal of time answering the Scherzer's Company charge. In their court deposition, O'Connell and Pihlfeldt merely stated that Ericson's private dealings had no bearing on the department's selection of the city's fixed-trunnion design for the North Halsted Street Bridge. Instead, they based their defense on the argument that the city's design was technologically superior and more economical that the Scherzer Company rolling-lift design.[37] By way of emphasis, the Department of Public Works took the unprecedented step of turning the bridge division's annual report for 1906 into an illustrated catalog of maintenance problems experienced by the city while operating its Scherzer bridges. Authored by Pihlfeldt's chief assistant, von Babo, this critique bypassed the city's customary complaint concerning the substructure weakness of the Scherzer design and concentrated on another structural problem that appeared to be even more damning.[38] The defining feature of a Scherzer bridge was that the bascule superstructure rolled backwards and forwards on curved steel girders supported by horizontal steel tracks. According to von Babo, this rolling action created such enormous contact pressures that both the "[curved] segment and track-girders of these bridges deteriorate amazingly fast." As an example, von Babo presented photographs of severe track deformation in the rolling-lift bridge at Taylor Street, built by the Sanitary District in 1900 and since maintained by the city. To indicate that such deterioration was not simply the result of the city's poor maintenance practices or faulty operating procedures, he also included photographs of the same condition in a Chicago railroad bridge designed by the Scherzer Company. The photographs, von Babo asserted, "show plainly that the above remarks are not theoretical quibbles, but are based on actual facts." Although von Babo did concede that the Scherzer Company's bridges were initially cheaper than those built according to the city's design, he argued that these savings were made at the expense of quality:

Savings made and claimed for rolling lift bridge designers have nothing to do with the system or type of bridges, but are the result of the efforts on the part of the owners of the patents to keep the original cost down to a minimum. Just as any other public improvement, for instance a schoolhouse, may be constructed in a more or less substantial and lasting manner, so it is with bridges. If one structure costs less to build than another, it does not necessarily follow that it is also the cheaper and better of the two in the long run for the taxpayers.

Von Babo's criticisms appear to have struck home, for the Scherzer Company did not choose to continue the debate in court. In February 1907, the company quietly withdrew its complaint, and the city proceeded with the construction of the North Halsted Street Bridge,

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1996):48-49, note 49.

[37] O'Connell and Pihlfeldt, "Joint and Several Answers."

[38] *DPW Annual Report, 1906*, 269-284.

which was completed without further incident in November 1908.[39] The Scherzer Company did not again use the courts to interfere with a municipal bridge letting, but it did continue to submit noncomplying proposals and to criticize the Department of Public Works for rejecting them.[40] The company apparently hoped that its tactics would mobilize Chicago taxpayers to support its cheaper bridges, but public attention focused instead upon the royalties received by the company for permitting the use of its patented designs. In Chicago, these fees were about $18,000 per bridge. The issue first surfaced during the 1905 North Avenue Bridge dispute, when the local press reported that the "Sanitary District always has stuck to the Scherzer bridge and paid the company a heavy royalty for using them." Shortly afterwards, the district's own chief engineer, Isham Randolph, expressed the opinion that "the royalties asked by that company [i.e., Scherzer], are excessive." In the spring of 1906, after an audit by independent accountants raised questions about the Sanitary District's bridge-building "extravagance," the agency initiated an in-house financial investigation, resulting two years later in its abandonment of patent-bridge designs. As the district's president, Robert R. McCormick, announced in 1908, "Because of controversies and scandals growing out of the use of patented bridges in the past, I am firmly of the opinion that in the future these bridges should be designed by the [district's] bridge department whenever possible." The Scherzer Company, therefore, lost its last remaining customer in Chicago.[41]

Strauss fared slightly better than the Scherzer Company in dealing with the Chicago Department of Public Works. Surviving city records do not indicate whether or not Strauss submitted a proposal for the North Halsted Street Bridge, but in 1907 he was enlisted by Pihlfeldt

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[39] Contact-pressure deformation remained a serious problem for the Scherzer Company for more than 20 years; see "Track Castings for Rolling-Lift Bridges," *Engineering News-Record* 97 (25 November 1926):878-879. Strauss made good use of the city's critique of the Scherzer Company, routinely sending it out to prospective movable-bridge clients who might be considering a rolling-lift design. He also compiled his own list of Scherzer bridge "failures," which generally involved substructure movement or rolling-track difficulties; see, for example, the Strauss Bascule Bridge Company, publicity packet, c. 1921, in Proposals File, Department of Public Works, City of Green Bay, Wisconsin. Despite the various flaws in the rolling-lift design, the Scherzer Company built over 200 bridges by 1915; *Scherzer Rolling Lift Bridges. Their Inception, Development and Use* (Chicago: Scherzer Rolling Lift Bridge Company, c. 1915).

[40] See, for example, "Bridge Engineer Is Assailed," *Chicago Record Herald*, 17 April 1908, 4; "New [Polk Street] Bridge Contract Is Delayed by Bids," *Chicago Record Herald*, 16 April 1908. The Scherzer Company did sue the city again over an alleged patent infringement involving the construction of the Lake Street Bridge, a city-designed, fixed-trunnion bascule completed over the Chicago River in 1920. The company lost the case; see *The Scherzer Rolling Lift Bridge Company vs. City of Chicago and Great Lakes Dock Company*, U..S. Court of Appeals, Seventh Circuit, Records and Briefs, October 1924, Case No. 3606, in Record Group 276, National Archives, Chicago.

[41] "Finds Flaws in Bridges," *Chicago Tribune*, 15 August 1905, pt. 1, 8; Isham Randolph to Robert R. McCormick, 13 December 1905, in *SDC Proceedings*, 20 December 1905, 11089; "Canal Inquiry Is Begun," *Chicago Tribune*, 11 May 1906, 3; *SDC Proceedings*, 23 December 1908, 1409.

to prepare a version of his patented bascule design for the Polk Street crossing of the South Branch of the Chicago River. Originally Pihlfeldt had hoped to use the city's fixed-trunnion bascule at this location as well, but to do so he would have had to deprive the Chicago Great Western Railway of existing trackage in order to make room for the bridge's east approach. The railroad company threatened suit, claiming that the city had a feasible alternative in the Strauss bascule design, which required less space and therefore could be constructed without any track relocation. Upon the advice of the city attorney, Pihlfeldt decided to use a Strauss-patent design for the site. Completed in 1910, the Polk Street Bridge project rewarded Strauss with $14,000 in royalties, as well as additional engineering fees. Although this royalty payment was less than the Scherzer company's customary fee, it still attracted a good deal of public censure. No other Strauss-patent highway bridges were built by the city.[42] Chicago railroad companies, however, would later number among Strauss' most important customers.[43]

The 1908 North Halsted Street Bridge was the eighth bascule to be built according to the city's fixed-trunnion design.[44] In a sense, its completion marked the end of an era. Although the city still had several center-pier swing spans to replace, the next wave of construction would await the passage of another bond issue in 1911. These later bridges incorporated a number of technological refinements that distinguished them from those built prior to 1910. They tended to have two bascule pony trusses instead of the three trusses with partial overhead bracing that characterized the city's original design. They also incorporated a new type of rack for operating

[42] "High Bridge Royalty Is Demanded of City," *Chicago Record Herald*, 28 December 1907, 1; " Defends Bridge Bonus," *Chicago Record Herald*, 30 December 1907, 5. In March 1913, Strauss sued the city for patent infringement, claiming that a trunnion-support technique used by the city in the recently completed Washington Street Bridge violated the company's proprietary technology. Strauss won his case in federal district court in 1918, and the verdict was upheld at the appellate level two years later. By that time, the city had built ten fixed-trunnion bascules with the offending trunnion-support system. In his promotional literature, Strauss listed these structures as "Strauss Movable Bridge Designs," but none of the ten bridges incorporated a pivoting counterweight in a parallelogram framework, which was the hallmark of the Strauss bascule bridge. See "Chicago Settles with Strauss for Infringing Bridge Patent," *Engineering New-Record* 85) 9 December 1920):1158-1159; *City of Chicago vs. Strauss Bascule Bridge Company*, U.S. Court of Appeals, Seventh Circuit, Records and Briefs, Case No.2677, October 1924, Record Group 276, National Archives, Chicago Illinois; Strauss Bascule Bridge Company, Publicity Packet, c. 1921.

[43] See, for example, W.T. Christine, "Bascule Bridge, Largest of Its Type, Built over the Chicago River," *Engineering World* (1 January 1920):11-14; "Chicago Bascule Bridge Erected over Railroad Tracks," *Engineering News-Record* (11 October 1928):546-550.

[44] The seven previous bascules were built as follows: Clybourn Place (North Branch), 1902; Ninety-Fifth Street (Calumet River), 1903; East Division Street (North Branch Canal), 1903; West Division Street (North Branch), 1904; North Western Avenue (North Branch), 1904; Archer Avenue (South Branch), 1906; and North Avenue (North Branch). All of the bridges were double-leaf structures, except for the Archer Avenue bascule, which contained a single leaf. In 1909, the city replicated the Archer Avenue design at Kinzie Street, over the North Branch of the River.

the movable leaf, as well as a new system for supporting the trunnions. And perhaps most notably, they showed a concern for aesthetic detailing that was completely lacking in the North Halsted Street Bridge and its predecessors.[45] These later bridge would help place Chicago in the forefront of the City Beautiful Movement.

Between 1890 and 1910, Chicago was the world's center for the development of movable-bridge technology. During this 20-year period, no other city experimented with as many different types. Among patent bridges, the Harmon folding-lift bascule, the Waddell vertical-lift bridge, the Scherzer rolling-lift bascule, and the Page bascule all made their debut as highway crossings of the Chicago River, which also provided a site for one of the earliest Strauss bascules.[46] Chicago, however, is most closely identified with the unpatented fixed-trunnion design that bears its name, the Chicago Type Bascule. Developed by city staff engineers and defended by the city in court, the Chicago Type Bascule strongly encouraged the use of fixed-trunnion technology throughout the United States. Some cities, such as Seattle, adopted the Chicago Type Bascule with little modification; others, such as Milwaukee, used it as a point of departure for developing their own type of fixed-trunnion bascule.[47] Despite the design's geographic dispersion, no other city would build as many Chicago Type Bascules as Chicago itself. By 1960, the Chicago Department of Public Works had over 50 such bridges in operation, all clearly the progeny of the fixed-trunnion design presented to the public by City Engineer Ericson in 1900.

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[45] Becker, 279-283.

[46] The only major patented type that did not appear on Chicago highways during this period was a bascule design developed by American engineer Theodore Rall. Rights to this design were held by a Chicago firm, the Strobel Steel Construction Company, which built several Rall bascules during the first decade of the twentieth century. Like the Page bascule, the Rall bascule combined elements of rolling-lift and trunnion technology. See "Lift Bridges," *Proceedings Engineers' Society of Western Pennsylvania*, 32.

[47] See "Three Double-Leaf Bascule Bridges at Seattle, Wash.," *Engineering News-Record* 84 (8 April 1920):718-722; Hess and Frame, 33-45.

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