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BRIDGES OF
METROPOLITAN
CLEVELAND

PAST AND PRESENT

by
Sara Ruth Watson, Ph. D.
and
John R. Wolfs, P.E.

LIST OF PATRONS

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BRIDGES OF
METROPOLITAN
CLEVELAND

PAST AND PRESENT

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A black and white photograph of a bridge under construction over a river. The bridge's steel framework is visible, including a large arch structure. In the background, a city skyline is visible, featuring a prominent tower. The water in the river is calm, reflecting the bridge and the city.

BRIDGES OF METROPOLITAN CLEVELAND

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Dedicated to
Wilbur Jay Watson, C.E., D. Eng.

FOREWORD

The two co-authors of this book must have spent endless hours in exhaustive research in the preparation of this manuscript. Here included is a compilation of a wealth of information, both technical and general as well as anecdotal, on the most important bridges in Cuyahoga County. This book should hold interest of all civil engineers in Ohio as well as lay persons who have a particular bent for history.

Over half a century has passed since the publication of the only other book on bridges in the county. Consequently this book not only updates the former book, but also presents much greater detail concerning all important Cuyahoga County bridges.

This book has been written by two native Clevelanders, one eastsider and one westsider, who are enthusiasts of engineering-history and are proud of their city. John R. Wolfs, a graduate of both Case Institute of Technology and Western Reserve University, was formerly City Engineer of Cleveland and Chief Engineer of the Cleveland Cuyahoga County Port Authority. Sara Ruth Wilson is a writer, teacher and lecturer. A graduate of Western Reserve University where she took a Ph.D in English Literature. Dr. Watson, now retired, taught for thirty years at Fenn College and Cleveland State University. Not only did she teach courses in English, she also taught a course in the History of Civil Engineering. This pioneer course initiated in 1940, was almost unique; only Purdue University offered a similar course. The American Society of Civil Engineers awarded her the Society's prestigious History and Heritage Award for her life-time interest in Civil Engineering History.

It is only proper that the book should be dedicated to Dr. Wilbur J. Watson, designer of a number of the county's most important bridges and father of co-author Dr. Sara Ruth Watson. A glance at Appendix B, "Bibliography", will show that Dr. Wilbur J. Watson, (1871-1939), through books and articles, has kept alive for posterity the record of his accomplishments.

History buffs will undoubtedly find considerable interest in the anecdotes concerning the manner in which the bridges across the Cuyahoga River accelerated the growth and development of the City of Cleveland during the early and mid 1800's. The treatment later given the four great bridges across the Cuyahoga River is fully detailed and of particular interest.

The co-authors have successfully stressed the fact that the Cuyahoga River is fully replete with all the principal types of bridge structures. Many residents of the county are not cognizant of the fact that many tourists to Cleveland take the boat ride up the Cuyahoga River principally to see the bridges in the county. The co-authors have also rightly given credit to the eminent civil engineers who were responsible throughout all history in the design of the county's bridges.

Inasmuch as both co-authors have been long-time friends of mine I deem it a genuine privilege to prepare this *Foreword*, Dr. Sara Ruth Watson was my associate at Fenn College for many years and John Wolfs, was a former student of mine at Case Institute of Technology, and currently we serve together on the National Committee on the History and Heritage of American Civil Engineering of the American Society of Civil Engineers.

Cleveland, Ohio
1980

G. Brooks Earnest

PREFACE

The authors hope that this, the only in-depth study of the bridges in the area, will fill a gap in the history of Cleveland and will serve as a base for future studies. The only other book written on the subject (now out of print) entitled *Bridges of Cleveland and Cuyahoga County*, was prepared to commemorate the opening of the Detroit-Superior Viaduct in 1918.

The fact that the authors of the present work view it as a collection of all sorts of information concerning the significant bridges and bridge-engineering in the Cleveland area accounts for some stylistic inconsistencies. Descriptions are sometimes technical and detailed, sometimes sociological and historical, and sometimes humorous, chatty, even legendary. In short, there is something for everyone—for the engineer, for the local historian, for the sociologist, and, last but not least, we hope, for the general reader who has a bit of curiosity.

This has been a labor of love, not only for the authors but for those who assist them. It had had special meaning for the co-authors Sara Ruth Watson, and for her helper sister, Emily, because for them it is a tribute to their father, the late Wilbur J. Watson, eminent bridge-engineer, to whom this volume is dedicated. We thank Dr. Clarence H.C. James, former chairman of the Department of Civil Engineering and Engineering Mechanics of the Cleveland State University, who, with two of his student assistants, John Sullivan and Thomas Palko, did an *Inventory of Noteworthy Engineering and Industrial Works in Cuyahoga County, Ohio* for the Historic American Engineering Record of the National Park Service. We also thank Mr. Ralph Robison, Principal Engineer for Howard, Needles, Tammen and Bergendoff, who helped compile the report of the Inner Belt Freeway Viaduct, and the late Ralph E. Scott, of the Osborn Engineering Company, who graciously aided the authors in obtaining information about various structures designed by this, the oldest extant engineering firm in Cleveland. We are especially grateful to Professor Frank J. Gallo of Cleveland State University; he has devoted much of his valuable time, energy and thought to seeing that this project saw the light of day. And we thank the CSU Womens Association for its generous gift which furnished the financial impetus which led to the fulfillment of this project. Last but not least, we thank Emily Watson and Mrs. John (Marjorie) Wolfs for their clerical assistance and helpful criticisms.

Cleveland, Ohio
1981

Sara Ruth Watson
John R. Wolfs

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Figure I. Original Lake Shore & Michigan Southern Railroad and Cleveland, Columbus, Cincinnati Railroad Bridges built about 1850 and still standing near Berea, Ohio.



Figure II. The Main Avenue Bridge shortly after its opening in 1939 with the first installation of Sodium Vapor lighting in the United States.

Chapter 1

INTRODUCTION: THE EARLY BRIDGES

Cleveland has been called the city of bridges. While there is no single spectacular bridge to catch the attention of the citizen, Cleveland offers a unique mixture of bridges. Within a single view, it is often difficult to limit one's vision to only a single span. The panorama of Cleveland's Cuyahoga Valley shows bridges of all sizes, styles, functions and types. To narrate the history of these bridges is the purpose of this book, dedicated to the engineers of the past and present.

Bridge building in Cleveland and its surrounding suburbs is in some ways typical of that of any metropolis located on a major waterway. Almost all important urban centers developed adjacent to water. London, Paris, Rio de Janeiro, Moscow, New York, Chicago, Pittsburgh, Detroit, San Francisco are typical. But in other ways Cleveland is atypical. First, because Cleveland has long been a port on the Great Lakes, now served in addition by the St. Lawrence Seaway. Second, because the Cuyahoga River literally cuts the city in two, and was the dividing line between treaty land and Indian Territory. Third, because Cleveland is a steel manufacturing center, and the Flats area has a utilitarian use, and finally, because the pattern for bridge design seems to have been formed early in the nineteenth century. The city has remained conservative in its architectural style because of its Yankee roots. Every town, village and city has its own peculiar environment -- one that is unique, for it has been formed by the topography, by the life -- functions of its businesses and industries, and most important of all, by its inhabitants who through the generations have molded a cultural environment. There is an intangible "climate" that permeates a given community. Here then is our thesis: we are chronicling a history of bridges, but with special attention to the influence of our environment upon them. By discovering this influence as it has operated in the past, we can design and build with better understanding for the future.

The First Bridges: 1800 to 1900

The Geological history of the Cuyahoga Valley is one of the factors which concern the engineer. In the glacial period, the ice -- mass, as it moved southward, carried with it vast forests, rocks, sand, gravel, soil -- and left the debris as the ice -- mass thawed. The granite boulders, not uncommon on the surface of the sandstone region of Northern Ohio, had come from Canada. After the glacier had plastered these deposits over the land, nature created a new drainage system. In the course of time, a hundred centuries or more, the valleys of the Cuyahoga, the lesser streams, and the ravines of the locality were cut by the force of running water. The lower part of the Cuyahoga River now flows to the lake along a deep, preglacial valley, far above its ancient bed.

The first white settlers were confined to the eastern bank of the Cuyahoga River. The west side was still Indian Territory and remained so until 1805 when the State of Connecticut resolved the problem, by finally allowing the "Firelands" of Erie and Huron Counties to be opened to settlement by the descendants of the Revolutionary War victims.

Moses Cleaveland and his forty-nine followers entered Ohio on 4 July 1796. They were surveyors enlisted by the Connecticut Land Company to survey an area in Western Reserve called the New Connecticut. When they reached the mouth of the Cuyahoga in mid -- September 1796, they advanced a little way up its channel and "...attempted to land, but in their efforts to do so they ran their boat into the marshy growth of wild vegetation which skirted the easterly bank of the river and stranded here..."¹ The place where they landed was the end of an old Indian trail at the foot of what is now St. Clair Avenue, on the east bank near the present Detroit-Superior Bridge. In about a month the town site had been surveyed, its street plan laid out, and a couple of cabins built. Thereafter, Moses Cleaveland seemed to have had little interest in this venture, for he never returned. In 1796 he wrote, "While I was in *New Connecticut* I laid out a town on the banks of Lake Erie, which was called by my name, and I believe the child is now born that may live to see that place as large as *Old Windham*"; (which was his hometown). He might have borrowed this opinion from Benjamin Franklin, who "from his studies of conditions, pointed out the site of the future Cleveland as the place at which an important city was to arise."²

Moses Cleaveland's party had two married couples. One Elijah and Anna Gun (sometimes spelled Gunn) took charge of the supply station at Conneaut. The other, Job and Tabitha Stiles, became the first husband and wife to live in Cleveland. In the following year, 1797, Elijah Gun came to

Cleveland and for years operated a ferry across the river at the foot of Superior Street, the only easy way to reach the West Side. The town had a hard time growing up, for Cleveland had the reputation of being malaria -- infested. New arrivals preferred the high land near the village of Newburgh or the settlement of Doan's Corners. Another reason was that the Connecticut Land Company doled out the balance of the land within its purchase by lot to the stockholders, each competing with the other to sell their land. For example, Eli and Strong were founders of cities now known as Elyria and Strongsville that offered good farm land of clay soils, in contrast with the sandy soils of Cleveland.

The West Side was accessible only by ferry. A settlement called Brooklyn (later Ohio City) was allotted by Samuel P. Lord as part of his purchase and, and his brother-in-law, Josiah Barber. West Side land speculations began in 1831, when the Buffalo Company bought a large tract of land, laid out streets and put in improvements. The most important venture of the Buffalo Company was a ship canal from the Cuyahoga River to the Old River bed, enabling boats to enter a protected harbor on the West Side. Lord and Barber, who became mayors of Ohio City, founded the Cuyahoga Steam Furnace Company, and early manufacturer of steam engines for lake vessels.

Henry S.W. Wood states that the "...crossings of the Cuyahoga River in the earlier days were made over bridges of crude construction ...a stringer bridge spanning the river, with a rope to steady the person making the passage..."³

One of the first bridges across the river was at Center Street, the old ferry landing. This was a floating bridge made of large whitewood logs chained together. When a ship wanted to pass, a section of the bridge was floated to one side and, after the vessel had passed, was drawn back into place by ropes. One spring this bridge was carried out into the lake by a flood. The structure was replaced by a pontoon bridge made of flat boats chained together. But another flood carried this one away also. It was succeeded by a wooden structure which in due time suffered the same fate.

Elroy Mckindree Avery, in his article, "The Early Bridges of Cleveland", believed that the earliest mention of a fixed bridge was one found among old papers and documents belonging to Wileman White, who came from Berkshire County in Massachusetts to Cleveland in 1815 and died here in 1841. The document, dated "Cleveland, November 16th, 1821", is given in full in Avery's article. Thirteen subscribers promised to pay "a certain sum applied to their signatures for the purpose of erecting a free bridge across the Cuyahoga River, at the line between the lands of

Leonard Case and Noble A. Merwin."⁴ None of the subscribers contributed money; eight promised wheat, four promised work, and one did not specify. Judge Henry C. White, who found the letter among his father's papers, now in the Western Reserve Historical Society, believed his father to have been the builder of the bridge. Nothing more is known about it.

In 1832 the opening of the Ohio Canal from Cleveland to the Lake to Portsmouth, Ohio, -- seven years after it had been started -- brought increased traffic and sudden growth to the young village. In 1832 the population of Cleveland was 1500; but it grew rapidly in the five years following the opening of the canal. This is evident from an early map published by N. Currier (later Currier and Ives) showing the "Port Statistics." This growth can be attributed to the Erie Canal through the state of New York as well as the Welland Canal around Niagara Falls. The Ohio Canal carried the farmers products to Cleveland. The Erie Canal continued the haul to New York City.

In the following year, James S. Clark and Associates laid out, as the main thoroughfare, Columbus Street to the river, through what was then called Cleveland Center. Streets radiating like spokes of a wheel were named after foreign countries -- Russia, British, China, German, French. Many of these street names still survive. Each had a little alley behind the street, and all converged on Columbus road at the proposed river -- landing called "Gravity Place". Even Leonard and Case Streets are side by side along the river in honor of Leonard Case, Jr. Several years later, the group allotted what these entrepreneurs called Willeyville, in honor of the first mayor of Cleveland, and through this section, laid out an extension of Columbus Street as far as West 25th Street -- the "Wooster and Medina Turnpike." Having graded the new street to the river, they spent \$15,000 in 1835 to erect a bridge connecting the two sections of the Columbus Street properties. This bridge, the first important structure across the Cuyahoga, formed the final link in a short route to Cleveland from the south and west, practically sidestepping Ohio City. A description of it, stated in the first city directory printed in 1837, reads as follows:

The bridge was supported by a stone abutment on either shore and piers of solid masonry erected in the center of the river. Between the piers, there is a draw sufficient to allow a vessel of forty-nine feet beam to pass through. The length is two hundred feet, the breadth, including the sidewalks, thirty -- three feet, and the height of the piers, above the surface of the water, may be estimated at twenty-four feet. The whole which, with the exception of the draw, is roofed and enclosed, presents an imposing appearance and reflects much credit on the architect, Mr. Nathan Hunt..⁵

We also have a contemporary picture of the Columbus Road Bridge [Figure III]. In 1835 it was the most remarkable structure in Ohio. Visitors

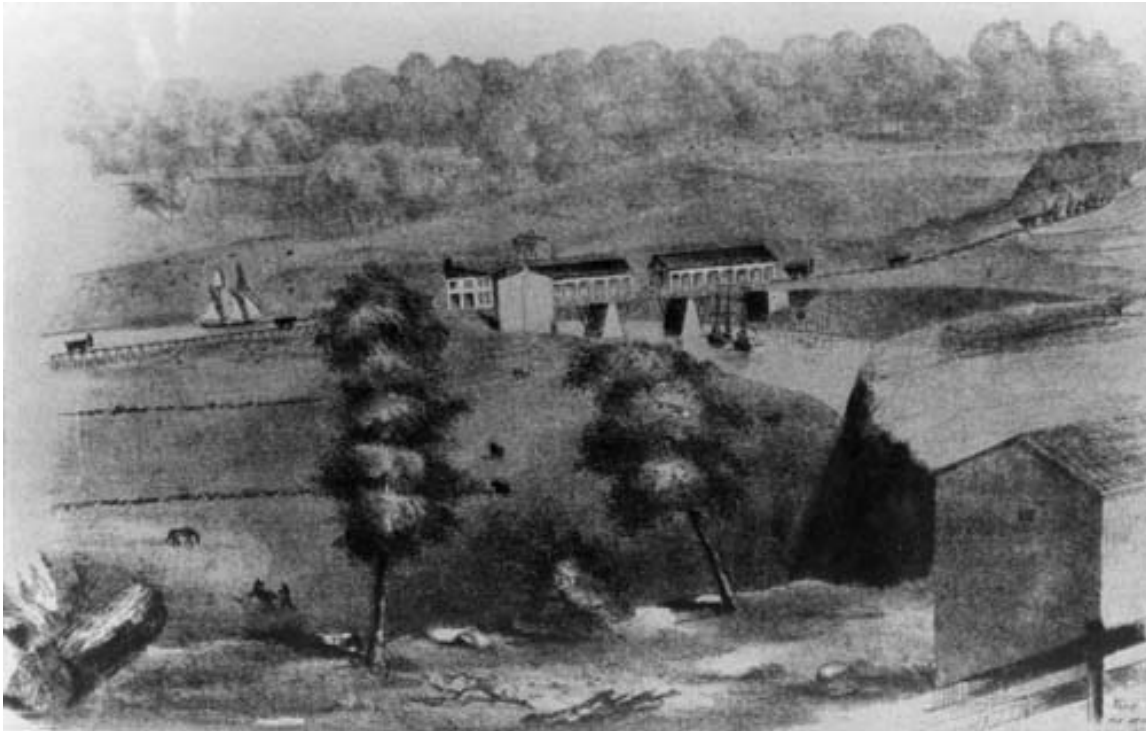


Figure III. Old Columbus Road Bridge, controversial site of Cleveland's infamous Bridge War in 1837.

from all over the state came to view it and gasped at the work which had cost the enormous sum of \$15,000 to build.

In 1836, first the City of Ohio and then the Village of Cleveland were incorporated, and the rivalry between them grew tense. The merchants of Ohio City were entirely willing to have the Columbus Street Bridge, but they also wanted one at Center Street, and so there came into being the famous slogan "two bridges or none." What resulted was the Bridge War, celebrated in the annals of Cleveland. In 1837 the Cleveland City Council directed the removal of its half of the old floating bridge at Center Street. This was an attempt by Cleveland to divert all through traffic to the Columbus Street Bridge, thereby by-passing Ohio City. The mandate of the council was carried out at night, and, when the people of Ohio City realized what had happened, they were enraged. At an indignation meeting they declared the Columbus Street Bridge a public nuisance.

Their Marshall directed a posse of deputies, who damaged the bridge by a charge of powder under the Ohio City end, damaging it only slightly. Then the marshal with his deputies marched to the Cleveland side of the bridge, dug up a deep trench at the approaches, and damaged that end, thus

rendering the bridge useless. Ohio City held a council of war and staged an all-out attack upon the bridge. Nearly a thousand men, armed with clubs, rocks, and rifles marched to the bridge, accompanied by a chaplain and a lawyer.

But Cleveland had learned about the attack from scouts. The Ohio City posse found itself confronted by a company of militia with muskets. Even an ancient cannon had been rolled down to the river's edge. At this point John W. Willey, first mayor Cleveland, stepped forward, but before he could utter more than a few words, he was greeted by a volley of rocks, and the fight started.

At either end of the bridge was an apron that could be raised or lowered, and the one at the Ohio City side was let down to provide a shelter for the anti-bridge forces. The men went at their destructive task, ripping up planks and throwing them into the river. One Ohio City man named Deacon House picked his way through the Cleveland lines and spiked the cannon with an old file. He became quite the hero of the Battle of the Bridge.

Some men were injured but none killed. Finally the fray was stopped by the Cleveland marshal, who also was sheriff of the county. He took possession of the bridge, obtained a court order against further interference, and posted guards at either end to maintain free movement of traffic. This Battle of the Bridge produced a poet -- laureate in D. W. Cross, who wrote a mock -- epic poem, in heroic couplets, entitled "The Battle of the Bridge," which was published in the *Magazine of Western History*. Its model was Alexander Pope's *Rape of the Lock*. We have space here to quote but a few of the stanzas:

*On hills, like Rome, two cities might be seen,
(Meand' ring Cuyahoga flowed between);*

*Whose rival spires in rivalry arose,
The pride of friends, the envy of their foes.*

*Each rival ruler of each rival town
On his would smile, but on the other frown.*

*Each sought for greatness, in his rival's fall,
Regardless that the world was made for all.*

*Envy and hatred waxed to frenzied height!
Naught could appease but fierce and bloody fight.*

*The culmination came!
A peanut stand Erected by a "combination" band*

*Of desperate men of capital, who swore
No trade should be diverted from their shore.*

*They claimed that Clark and Willey, reckless, sought
To build a bridge. The right of way was bought*

*Already! and they then designed to build Columbus Street and
bridge! This rumor filled*

*Their souls with madness, and their eyes with tears! To think
that peanut stand, the toil of years*

*Should for the want of patronage decay
And trade and barter turn some other way*

*They all agreed this could not be allowed.
And boisterous bellowing agitate the crowd!.⁶*

The result of the bridge war was that the West Siders gained their point, and two bridges were provided. The Center Street Bridge was completed after much discussion and the Columbus Street Bridge was equipped with a movable center span.

The Columbus Street Bridge of 1835 marked the beginning of the first period of bridge building over the Cuyahoga River -- bridges of wood with masonry piers, designed for wagon traffic. As late as 1835 there were still three of these: the Columbus Street Bridge, one at Seneca (West Third) Street, and one at Division Street (Center Street). There was agitation for a new at Columbus Street, but because the two towns could not agree on a plan, the county re-built the span. In 1854 Cleveland annexed Ohio City. And immediately after annexation, Cleveland built the Main Street Bridge, rebuilt the Center Street Bridge, and constructed the Seneca Street Bridge. In 1870, a third Columbus Street Bridge was erected -- an iron truss bridge which was replaced in 1895 by number four in the series.

The Seneca Street Bridge, one of the earliest, was a wooden structure that collapsed in 1857 under a load of cattle. A new timber structure, with a draw operated by hand, replaced it. In 1888 the third bridge at this site, this time an iron one with a pivot span of 180 feet and one fixed span of 105 feet, was built. The fourth one was a Scherzer roller lift bridge, the first one of its kind in the city. This bridge, designed by a Chicago firm, was opened to traffic on 25 June, 1903. It had a roadway about twenty-three feet wide, with two six-foot sidewalks.

The history of the Center Street Bridge is similar. This was the original crossing of floating logs that were drawn aside for ships. In 1853 a wooden draw span was built, but it had to be replace five or six times until 1900, when a steel bridge was erected. This bridge is the only remaining swing bridge in the Cleveland area. Although the deck has been replaced

with an open mesh at one end and concrete at the other to counterbalance the unequal lengths of the spans, it continues to serve heavy truck traffic that sets the light bracing to dancing under impact. Because of the obstructing pier in the middle of the waterway, this type of bridge is no longer being built.

And so the need for bridges kept pace with the growth of population and commerce. Particularly significant was the peace-making role that the bridges across the Cuyahoga River played in attempting to join together the two communities for better or worse; after river navigation had been improved by eliminating the sand bar and opening a new outlet, moveable bridges were necessary to accommodate shipping. The channel width dictated the type of bridges to be built.

Perhaps even more important than the local roads to the growth of the young city was the construction of the railroads beginning in the 1850's. The iron horse demanded more bridges to cross the valleys and the rivers of northeast Ohio to link Cleveland with the rest of the nation. Some of the railroad bridges will be discussed later.

Chapter 2

THE FOUR GREAT VIADUCTS

Four major high-level bridges with fixed spans now cross the lower Cuyahoga River in the heart of the city. As they transport stone and iron ore to the upriver mills, lake vessels (even with masts of 98 feet) affect only the low-level bridges.

The oldest high-level bridge in daily use is the Detroit-Superior Bridge, opened in 1918. It-together with the Lorain-Carnegie Bridge (1932), the Main Avenue Bridge (1939), and the Inner Belt Bridge (1959)-carries the heavy traffic of the major arterials from the downtown section of Cleveland to the West Side.

The Old Superior Bridge

But what about the seven, semi-circular stone arches standing west of the river? The approach is at West 25th Street and Detroit Avenue, but the arches end abruptly with a barricade at the river. These arches are all that remain of the original Superior Viaduct, predecessor of the Detroit-Superior Bridge. As a bridge, the old structure had a short but useful life of some 43 years-from the opening day, 28 December 1878, to the day of its successor opened in 1918.

Let us digress and discuss this original Superior Bridge, which was to be the catalyst, joining the East and West Sides.

Even before the Civil War the need for a high-level bridge to facilitate traffic to and fro across the river was recognized. In fact, Oliver P. Baldwin, editor of the *Cleveland Daily Advertiser*, advocated the erection of just such a bridge as early as 1835, In his editorial he wrote:

On visiting Cleveland and Brooklyn a few days since, and surveying the disadvantages which exist in communication between those two cites, I was naturally led to reflect what great plan could be adopted which the prospects of the place and the condition of the country would warrant to remove all those difficulties...

That some communication between these two rival cities of tenfold greater magnitude and convenience than any or all that had been enjoyed, is absolutely necessary, needs no proof.

The following project is therefore laid before your readers and the whole community. It is to be built by a company chartered for the purpose, or by the State, a grand and stupendous bridge from the top of the hill in Cleveland to the top of the hill in Ohio City, from suitable points in each place, and that it be built of stone with a sufficient number of arches of the best mason work, supported by stone piers laid deep and strong, either solid or arched widthways, and that this bridge be 120 feet wide, all of the best stone work, and level on the top for the above railroads, and a common road with side-walks and iron railings, and that walls of brick or stone be carried up on each side of the bridge with a center or partition wall in the middle, and other partitions walls the other way as necessary. And that floors be placed in all these apartments as many stores as the whole height of the bridge would allow, and that rooms on each side, sixty feet deep, and such width as would be convenient, would form the best, most convenient and permanent stores and warehouses that could be conceived of...

The upper stories might be occupied as shops, offices, or even boarding houses, and every apartment accessible by flights of stairs as well as from the top of the bridge as from the ground. This bridge would be high enough to allow any masts or rigging of any vessel that sails the lake to go under, so that it would not impede the navigation of the river, and that these stores, warehouses, rooms and tenements, would rent for a sum sufficient, with what two railroad companies can well afford to pay, to refund the whole expense of the work in ten years from its completion...⁷

It took thirty-five years for such a vision to take shape. In 1870 there were several low-level bridge crossings, all with movable spans to permit the flow of traffic: Main Street, Center Street, Columbus Street, and Seneca Street (West Third). The population of Cleveland was about one hundred thousand, and the city was rapidly growing in industries as well as in population. In April 1870, East Siders were invited to attend a lecture by J.F. Holloway at the East Side High School building, which stood at Euclid Avenue and East Ninth Street. Holloway presented a plan for a high bridge, including an estimated cost and survey figures of traffic crossing the Cuyahoga River at different points.

A year later the city Fathers decided that, without some supporting state legislation, the city was powerless to undertake the project. R.B. Dennis, a member of the Ohio House of Representatives, introduced a bill authorizing building the bridge. The bill passed the House but failed in the Senate.

The opponents of the bridge found an ally in the *Cleveland Herald*, whereas the advocates had the support of the *Leader*. The *Herald* declared the project impossible, warning that it would saddle Clevelanders with a debt of two million dollars. The reply to this in the *Leader* read: "The old lady shakes her withered finger solemnly protesting against building the waterworks, the railroad, and the swing bridges. During the same year, an editorial appeared in the *Ashtabula Sentinel*, which left no doubt as to what the newspaper thought of the whole idea."⁸

Our exchanges are discussing a scheme that has been proposed by some hair(air) brained mechanic of building a bridge across the valley of the Cuyahoga upon a level nearly level. The poor fellow who proposed it talks as if it were really a sane project, the *Leader* supports it as if it

were possible, and the *Herald* opposes it-as it anybody outside of a madhouse intended to build and use such a bridge. Why not start a bridge. Why not start a question of tunneling the lake to Canada?."9

On 18 April 1871, a resolution was introduced in the City Council providing for the formulation of a committee to determine the best site for a bridge and to formulate plans for improving communication between the residents of the West Side and the East. After long discussion the Council adopted the resolution on 8 May 1871. Also, the U.S. Corps of Engineers agreed to such a bridge with a swing-span for navigation purposes. During the summer of 1871 surveys were made to determine the route of the bridge. One plan was to connect Ohio Street (now Central Avenue) on the east with Lorain Street on the West. At a meeting of City Council on 18 April 1871, a petition was presented which asked that the necessary "surveys, plans and estimates be made for a high-level bridge" having a double-track carriage-way and providing for streetcar tracks and sidewalks. This petition was signed by F.W. Pelton, and sixty-seven others. One of Cleveland's notable citizens and an advocate of the bridge in City Council was John Huntington, who introduced the resolution of construction of the viaduct and who was later a member of the committee that supervised construction.

It is to be noted that the least preferred of these suggested routes was the one that years later was adopted for the Lorain-Carnegie Bridge, a structure that has never carried its predicted traffic volume, nor has its lower level, designed for streetcars, ever been used except for utility ducts.

At a public meeting held on the West Side on 22 April 1871, it was argued that the number of people crossing the viaduct each day would be 15,240 and the number of teams of horses 4,671. Consequently, a two-cent toll would be exacted from pedestrians, streetcars, and vehicles which would ultimately pay the cost of construction and would create a sinking fund, so that the bridge would cost the city nothing. At this same meeting a resolution passed approving the bill introduced in the Legislature by Mr. Dennis, and its immediate passage was urged. In January f 1872 the legislature passed this bill, thus granting permission to build the viaduct. This action was bitterly assailed by the *Cleveland Herald*.

On 30 January 1872, a resolution was introduced in City Council proposing that railroad tracks be laid to the site of the bridge to facilitate movement of materials. This action necessitated a change in the bill, so that a new one had to be written and approved. A bill was also introduced to vacate a part of the Ohio Canal in the designated area. Both of these measures were strenuously opposed by East Siders. But Judge Coffinberry argued in favor of the bridge, by pointing out that the city was growing

rapidly and that the existing bridges would soon be wholly inadequate. He recalled the time when the Lighthouse Bridge (Main Street) was built only after long litigation and after predictions of bankruptcy, of ruinous conditions, and of dangers to navigation.

On 27 April 1872, a new bill authorizing Cleveland to occupy a part of the Ohio Canal site was adopted. The question whether tolls should be collected on the new bridge was left open in the bill; permission was given to let the voters decide.

Meanwhile two new routes had been surveyed: one from the intersection of Superior Avenue and Water Street (West 9th Street) to the intersection of Pearl (West 25th Street) and Franklin; the other from the intersection of Superior and Union Lane (West 10th Street) to the intersection of Pearl and Detroit. The second route was the one recommended to Council and finally approved.

In April of 1872 the proposal for the new bridge was submitted to the vote of the people. The result was 7,548 in favor of the bridge and 2,623 against. The first estimated cost was fixed at \$759,328.78.

A protest against construction was filed on 18 January 1873—a protest signed by Charles A. Otis, H. Garrettson, W. P. Southworth, Fayette Brown, D.P. Eeles, Samuel Williamson and 252 more. These were influential men in the city. They claimed that the cost was excessive and that a bridge could be built for much less. A similar complaint was filed on 11 February. Although these petitions were referred to the Board of Improvements, they had no effect.

On 19 August, an ordinance authorizing the issue of bonds to the amount of \$117,893 for acquiring land came before the Council was defeated by a vote of eleven to twelve. The next morning the Leader declared, "Thus the ordinance was consigned to its fate and the viaduct killed."¹⁰

However, public agitation was aroused. Citizens on the West Side held an indignation meeting, the result of which was a petition sent to the Council to reconsider, signed by four thousand voters. Despite constant opposition, land was finally purchased; and on 7 October 1873, E.W. Ensign was awarded a contract for the masonry construction, his bid of \$512,720 being the lowest. Mr. Ensign was a Berea, Ohio quarry owner and contractor; among other large contracts of his was the construction of the Lake Shore R.R. in 1871-2; the culverts of which are built of Berea sandstone which was famous at this time. Sherman and Flager constructed the masonry piers.

Even after the work had begun and \$500,000 expended, resolutions were submitted to the Council demanding that the project be abandoned. From 1870 to its completion in 1878, agitation for and against the bridge continued. Strong opposition came from the East Side, whose residents would claimed that taxes would be excessive. West Siders protested that the bridge would deflect trade to the East Side. Injunctions and objections created frequent changes in plans. Initial plans had called for a roadway 50 feet wide, but in 16 March 1875, a change was made to adopt a 64-foot roadway. One argument advanced for the widening was that business houses could be built on each side of the stone arches. The total cost with these changes was approximately \$2,200,000, the cost of the bridge structure being \$1,600,000. To meet the increased cost resulting from the change of plans, the question of voting additional bonds was submitted to the voters on 4 May 1876. That the viaduct now had firm friends was indicate by the fact that 6,863 voted in favor of the bond issue, while only 3,181 opposed it.

On 21 December 1875, the City Council asked the Legislature to authorize the collection of tolls not to exceed three cents for a single team and five cents for a double team each way. This money was to defray the expense presented, asking the legislature to permit toll to be collected "from each passenger and vehicle passing over the bridge, as it may be deemed necessary."¹¹

At a council meeting held on 18 April 1876, Horatio C. Ford introduced the following resolution:

That as a measure of equalization and the relief from immediate burdensome taxation, it is the judgment of the council that for the first twenty years after the completion of the Superior Street Viaduct, a toll shall be required from all traffic passing over the structure..¹²

Then on 5 December 1876, N.A. Gilbert introduced a resolution calling the attention to the council to the action of the legislature authorizing the city to collect tolls. But in spite of various reminders and ordinances, and in spite of its reassurances to persuade voters that taxes would not be raised, at no time was toll of any kind taken for using the viaduct.

Work on the bridge began in March of 1875, with the driving of the piles. When borings were taken, it was discovered that timber piles had to be driven to refusal (that is, 20 feet deep) into clay substratum, and it took a great many piles, because they had to be placed under the whole width, which was 80 feet. If all the piles had been laid end to end, they would have extended for forty miles; upon the piles timber and concrete grillages were erected, which bore, in turn, the masonry work of the piers.

On 20 May 1875, the first blocks for the semi-circular masonry arches were laid. Starting from the western approach there were eight masonry arches of 83-foot span and two arches of 97 1/2 foot span, with retaining walls. This masonry work was 1,382 feet in length and 72 feet in height above the pile foundations. More than two million cubic feet of sandstone was quarried, cut and shipped from Berea, Ohio.

Then came a pivot swing-span, 332 feet long. The eastern approach consisted of a continuous plate-girder bridge of three 162-foot spans, followed by two 145-foot spans, and one 160-foot span. Total length of the viaduct was 3,211 feet, and it rose 86 feet above the river. The wide sidewalks and double tracks of streetcars encouraged use by pedestrians and passengers alike. Claflin and Sheldon constructed the iron spans and the swing span. Lauderback and Company built the iron railing.

Mayor P. Payne, in his annual message to the City Council delivered 11 April 1876, reported:

The Superior Street Viaduct, the foundations for which are being laid, has been urged forward with commendable energy, and the quality of the work is above criticism. In March, one year ago, the City Council, on recommendation of the Board of Improvements, determined to widen the structure fourteen feet, both to increase its strength and enlarge its usefulness. This the present administration recognized as a measure of wisdom, as the immense weight of the superstructure, considering the character of the rock beneath it, required great strength to ensure its durability: and there would be no justification for the expenditure of so much money unless when built it afforded abundant facilities for transit across the valley for many years to come. On the original plan it would not accommodate two railroad tracks and two roadways; this width seemed indispensable. To avoid litigation and liability to pay damages for obstructing Superior Street, and to the effect a better crossing of the River, the Board of Improvements in June last recommended that the route of the easterly side of the river be changed by deflecting sufficiently to the south to take it out of Superior Street. The Board also recommended that the easterly terminus be extended to Water Street (West 9th Street), and that the superstructure be raised in the center sixteen feet. The City Council, with but two or three dissenting voices, concurred in these recommendations. The object in raising it which these changes were made indicate their expediency, although attended with considerable expense. The engineer's estimate of extra cost for widening both sides is \$203,000; for raising, \$260,000; total \$463,000.

Mayor Payne was concerned over the increasing cost of the bridge and expressed his concern in guarded words:

A provision in the supplementary viaduct law recently enacted by the general assembly of the State, required the council of cities acting under it, within two years, after its passage, to create a sinking fund for the extinguishment at maturity of all indebtedness incurred by its authority and that of the act to which it is supplementary. This law provides also that the proceeds of the sale or lease of all lands or interest in lands acquired by virtue of the same authority, shall be appropriated to the exclusive use of this fund. On the 25th of October last (1875) the mayor executed on behalf of the city, by authority of the council, a contract with the Valley Railway Company to lease to said company for a term of ninety-nine years, the strip of land known as the canal bed, in which the city's title will be complete as soon as the new lock into the rivers is finished, which will probably be in July next. The consideration to the city, which will be paid on the execution of the

lease, is \$265,000 in first mortgage gold bearing bonds of the company. I therefore recommend that immediately upon the receipt of these securities a sinking fund be established for the exclusive purpose of redeeming the viaduct and canal bonds, and that these and other assets and money's designated in this law be applied to this use. One other suggestion respecting sinking funds. We have levied annually for the past ten years an average of two mills for sinking fund purposes, and we have had an average surplus to the credit of this fund or more than one thousand dollars. This surplus has been constantly invaded, without authority of law, to meet deficits in the funds of other departments, and has thus encouraged extravagance, or has laid in the treasury idle. I recommend that at the earliest possible time it be placed where its earnings will meet some of our increasing obligations. No resource the city has is too small to be husbanded and made available to aid the taxpayers in times like these.."¹³

Mayor Payne's words went for naught and his advice unheeded. While the \$265,000 in gilt-edged certificates were delivered, the 7 1/2 percent annual interest payments were received but once, for the Valley Railroad went bankrupt the next year. The Cleveland and Valley Railroad took over the lease, but made no payments to the city.

In a report upon the bridge, written in 1909 by the City Engineer B.F. Morse, the foundations for the stone work was described. Mr. Morse, a direct descendant of Samuel B. Morse, the inventor of the telegraph, was City Engineer from 1875 to 1884. Had it been possible. Mr. Morse wrote, to have built these piers upon a rock foundation, they would have lasted several hundred years; but that was impossible. When the arches were being completed, all of the abutments and piers settled from two inches to four or five inches. However, after the viaduct was opened, very slight additional settlement occurred.

A few years after completion, the city attempted to open the river channel west of the center pier of the iron drawspan, as had been originally intended, but when pier eight settled several inches, work on the channel opening was stopped. After that, no further settlement took place. In the 1909 report, Mr. Morse wrote that all the arches showed cracks running lengthwise near the centers of the arches, cracks varying from 1/2 to 1/4 inches at the crown of the arches, and diminishing towards the spring line. Caused by the settling of the pile foundation, these cracks did not affect the safety of the viaduct, declared Mr. Morse. Every so often, some latter-day dooms-dayer finds these old cracks and expresses the same concern all over again.

The fixed spans east of the river and the draw (except the 145-foot continuous plate girders) were of the type then called the Linville double-intersection type of truss. J.F. Linville, a distinguished American engineer, was Chief Engineer of the Pennsylvania Railroad. His wrought-iron truss was a trapezoidal one, with double intersecting diagonals-that is, the

diagonals were a forty-five degree angle; but the panels were on half as long as they were deep.

All parts were proportioned to carry a live load of one hundred pounds per square foot of roadway, or 6,400 pounds per linear foot bridge, with a safety factor of five (then considered abundantly strong for city bridges).

The drawspan, with a pivot in the middle, has a total length of 322 feet, each arm being 166 feet in length from the center. Contraction during cold weather left an opening at the ends of the draw of from 2 to 3 inches; and, of course, in warm weather expansion closed the space. The rapid movement of streetcars on and off the span, the often bad condition of the rails and frogs and of the wedges under the ends of the draw—all caused extraordinary strain on the span and led to delays in opening and closing. The span was, however, constructed with extra weight because there could be no protective piling under the ends when the span was open. In 1909 the span was opened on an average of 3,600 times a year, or 300 times a month. When in good working order, it took four to six minutes to open or close.

When finally completed, the viaduct cost \$1,574,921.32, exclusive of right-of-way, which cost in excess of \$600,000. In its day it was acclaimed an architectural wonder. On 27 December 1878, it was opened to traffic. The booming of cannons awakened the citizenry at dawn. The bridge was decorated with thousands of flags. In mid-morning the two promoters of the structure, Henry Wood and Beldon Seymour, standing at opposite ends of the viaduct, began a slow march toward the middle of the bridge, where they met and shook hands. Then a federal salute was fired, bands played, crowds shouted. A big parade, which took 20 minutes to pass a given point, formed. In it were the Cleveland Grays, the Light Artillery, the Fire Department, the Hibernian Guards. In the line were Governor R.M. Bishop of Ohio, Governor M. Mathews of Virginia, and mayors galore.

The celebration continued throughout the afternoon in the old Tabernacle at the corner of Ontario and St. Clair Streets, where the Mayor, William Gray Rose, the two governors and others gave speeches. William McKinley was invited to attend, but did not.

The banquet at the Weddell House that evening was the most elegant social event yet seen in Cleveland. There were ten courses, with food and liquor piled high on tables. On the menu were boned jellied turkey, gelatin of chicken, larded quail, larded prairie chicken, saddle of venison, partridge, lobster, egg kiss pyramids, Geneva cake, orange mangle, sliced oranges in cherry wine, slice pineapple in champagne, Bavarian cream, chantilla cream, etc. There were fifteen speakers and many toasts.

And the Hon, R.C. Parsons philosophized in the customary rhetorical vein:

Who and where are the men who erected the magnificent ruins on the banks of the Nile, whose colossal monuments of engineering skill and power lie scattered along its shores? Where are the men who built the aqueducts of Rome?...as it has been with other nations, so it is likely to be with us. The time may come when in some far-off century the orator or the poet of a yet unborn race will point to the remains of the splendid works of engineering skill scattered all over the American continent, and among them the Cleveland viaduct whose successful completion we this day commemorate, as marks of high civilization and intelligent skill of a simple remembered people..¹⁴

However, the disadvantage of the central drawspan to allow for passage of high masts and funnels caused continuous irritation and finally led to the replacement of the bridge. Condemned in 1920, its demise took place in 1922, when a crowd of people witnessed the demolition of the river span, destroyed by 150 pounds of dynamite. Recently one of the local newspapers consigned the remaining stone arches to the wreckers ball with the words, "a bridge to nowhere awaiting its doom." These are words that are typical to the unimaginative.

Today, "Ohio City" is being restored by owners of buildings and residences in the Franklin Circle area. Bridge and Jay Avenues are beginning to recapture the charm of the gay nineties and earlier. And, although the old "Angle" district and the high-rise structures along West 25th are not available as renting units except to the poor and elderly, why not provide for more apartments with a view of the river? What would be more appropriate than a pair of high-rise structures on both sides of the Superior Viaduct, straddling Elm and Riverfront Streets, that would have made-to-order private road and courtyard with a view that is unsurpassed? [Figure IV.]



Figure IV. Stone arches of the old Detroit Viaduct, still standing over the Cuyahoga River.

The legal and economical problems of most civic projects are serious stumbling blocks, but women are persistent. The Viaduct View Inc., headed by Isabel Tener, includes two service club-Soroptimst International of Cleveland and Altrusa International of Cleveland. Mrs. Tener was not the first to formulate plans for the use of the old arches but she was the first to do something tangible. The aim of the Viaduct View is to restore, maintain and beautify the old viaduct. Already \$93,000 of the projected \$2509,000 has been raised. With the backing of many of Cleveland's prestigious groups, the project stands a good chance of being realized.

Somebody always is suspect of an old bridge put to new use; modern stress analysis do not know how to figure the loads in a stone arch. The design loads used one hundred years ago are different from those used at present. But as people plaza (perhaps with shops) and a service road, the old bridge needs only a new railing, some cleanup work and drainage to start on a second century of service.

The Detroit-Superior High Level Bridge (1918)

Only a few years after the opening of the "Old" Superior Viaduct, people began to clamor for a true "high level" bridge, for, as traffic increased, the delay caused by the opening and closing of the drawspan proved to be a source of irritation. At the time of construction there had been some talk of raising the level of the structure in order to dispense with the drawspan, but most people seemed to have agreed with the city councilman who remarked, "What would be the use? You might better go down a hill on terra firma as up a hill on a bridge in the air." ¹⁵

On 15 February 1909, R.F. Morse, the City Engineer, made a plea for incorporating the stone arches of the old viaduct; if a high level bridge is to be built, why not use as much of the old structure and right-of-way as possible? It would be a pity to take down those grand old stone arches that with a good foundation would last hundreds of years." ¹⁶

Although we can sympathize with him, when even today we admire the strength of the remains of these still beautiful arches, his plea was in vain. The good citizens of Cleveland wanted a new and spectacular bridge-one as great as any in the world. Compared to the opposition that dogged the erection of the old bridge, this new bridge was relatively easily achieved. As Stanley L. McMichael wrote, in 1918:

*The new Detroit-Superior High-Level Viaduct...stands as a splendid monument to the enterprise and aggressive action to the citizens of Cuyahoga County. Nowhere in America does there exist at the present day any bridge or viaduct that can rival in artistic design, usefulness, and permanency of construction this massive span which binds together the two most populous sections of the metropolis of the middle west.*¹⁷

The general route chosen, one that has been used for a century and a quarter, crosses the river near the present low-level Center Street span, where the first floating bridge had been built.

After considerable discussion and many meetings with representatives of the U.S. Corps of Engineers, of the shipping interests, and of the city and County, it was at length agreed that a vertical clearance of 93 feet was sufficient for the new bridge.

The bridge was funded by the Cuyahoga County Commissioners, since both Superior and Detroit Avenues are county thoroughfares. However, the City of Cleveland cooperated, by paying for the removal of underground pipe and wire obstructions, and by re-routing street-car lines. Actual cost, including the land purchased for right-of-way, was \$5,407,000 (about twice the cost of the old bridge): \$1,687,200 for land and \$3,719,800 for the superstructure.

The bridge is 3,112 feet long and originally had a pavement width of 75 feet. (It has, however, been widened recently). There are twelve concrete arches, varying in size from 58 feet to 174 feet, and an overhead steel-arch span, which crosses the river on a skew with a minimum clearance for lake vessels of 96 feet. The steel span is 591 feet and the maximum height, at the crown, is 196 feet [Figure V].

A lower deck provided for six streetcar tracks. Original plans did not include the construction of subway entrances, but after work had begun, it was determined that subways would greatly aid in eliminating traffic congestion at the approaches. Provision was made to construct a four-track



Figure V. Detroit-Superior Bridge under construction, about 1918.

subway, entering the lower level at West 6th Street, and two double-track sub-track subways at the western end, one rising to the surface on West 25th Street near Church Avenue and the other emerging on Detroit Avenue near West 29th Street. The ramp portions have since been filled in after streetcars were eliminated from city streets.

The foundations were carefully laid, perhaps because memory of foundation troubles of the old bridge still lingered. The foundations of the new bridge rest partly on clay and partly on concrete piles. The west abutments and piers 5 to 11 inclusive, rest on precast reinforced concrete piles varying in length from 25 to 50 feet. They were required under tests to carry a load of 60 tons for seven days, with a maximum allowed settlement of 1/4 of an inch. The use of precast reinforced concrete piles were relatively new type of foundation. Piers 1 and 2 were carried down 35 to 40 feet into a natural substratum of clay, bringing the footings of the piers 60 to 65 below the surface grade of the ground. They are of the caisson type, built in cribs, of reinforced concrete.

The superstructure east of the river was erected with the aid of a double cableway having a span between towers of 1200 feet. The steel head tower was 180 feet high and the main cables 2 1/2 inches in diameter. The cableway had an ordinary carrying capacity of 8 tons, but it handled 12 1/2 tons in emergencies. A complete saw-mill plant and framing yard were maintained to build forms, and material was carried by the cableways.

The twelve concrete arches are, with the exception of the first one at the east end, of the same general type. They consist of four ribs, each

reinforced at points where possible tension may occur. The arch spanning the tracks of the Big For and Erie Railways had to be different because the required clearance did not permit the use of arch centering. Accordingly, three-hinged steel arches of a greater rise, the lower deck being carried through, were used to support the weight of the concrete while it was poured around the steel arches.

The outstanding feature of the bridge is the steel trussed arch. It is a three-hinged 591-foot arch, designed to carry a load of 10,000 pounds per linear foot of bridge, plus impact varying for different positions. The span trusses are of nickel steel; other parts are of carbon steel. The arch has a rise of 144 feet, a depth at the crown of 20 feet, and at the end of the hangars of 91 feet.

The arch was erected by cantilever method, anchored with back stays to the main concrete piers. The construction of each arm started from 90-foot steel towers which, erected just back of the abutment piers, sustained the traveler and its two stiff-legged derricks.

The engineers had computed that, when the trusses were finally placed and before being lowered to take bearing on the center pin, the bearing faces would be about twenty inches apart. When the last section in the trusses had been placed, the two halves lined up within one-eighth of an inch, a difference easily adjusted by means of a cable. The halves were within twenty inches of bearing when lowering operations began. Final adjustment varied only two inches from the computations. On the morning of 8 October 1918, nearly a foot of sky showed between the arms, During the afternoon the toggle screws which supported the two halves were released and the bridge-ends settled together. "She fits like paper on the wall", shouted the steel boss and hurried to his office for a box of cigars. The structural iron worker cheered and went to a nearby saloon to drink a toast to the foreman; steamboats and factories in the Flats blew their whistles. But this was the only celebration; no formal ceremonies were held, for 1918 was a war year, with little incentive for merrymaking.

The total weight of steel in the central span is 8,500,000 pounds. There were 195,000 pounds of rivets used in the field joints, and 45,000 pounds of paint was required to cover the arch.



Figure VI. A Section of the Detroit-Superior Bridge put into place by cables and cranes.

Following the completion of the reinforced concrete arches of the approaches and of the main central arch, earth fills were made between walls at each end of the bridge; decks were waterproofed and pavements laid [Figure VI].

In 1918 the bridge was the largest double-deck, reinforced concrete structure in the world. Although the structure no doubt appeared more light and diaphanous than it does to us today, it is still a handsome bridge. One of the officials suggested that it be called the "rainbow bridge", and, although the title never caught on, it does reflect the point-of-view of the people of Cleveland toward the new wonder. We may find the concrete arches a bit too massive; however, they were remarkable in their day because they do not in any way suggest stonework—they speak the new language of reinforced concrete with relatively thin ribs and open spandrel design. The through steel arch of the central span gives the whole structure a dramatic focal point, and the slaying of the chords at the spring line creates a spacious and stable effect. A famous bridge engineer of the early twentieth century, Henry Grattan Tyrrell, greatly admired this bridge, and, in an article he wrote in 1918 on Cleveland bridges, he compared it favorably with the Pia Maria Bridge over the Douro At Oporto, Spain, and with the Garabit Viaduct in France (both of which had been built by Gustave Eiffel)..¹⁸

The county engineers responsible for the project were A.B. Lea, Frank R. Lander, and the Chief County Engineer, W.A. Stinchcomb. Their assistants were A.M. Felgate and A.W. Zesiger. City Engineer Robert Hoffman had charge of the removal of pipe and wire obstructions, and of the supervision of local traffic. A number of contractors were involved: The O'Rourke Engineering Company of New York built the two main river piers; the Great Lakes Dredge and Dock Company placed the foundations for the piers of the concrete arches; the Hunkin-Conkey Construction Company had the main contract for the concrete superstructure; the King Bridge Company built the great steel central span; Bates and Rogers of Chicago were in charge of the subway approaches; the Trinidad Paving Company laid the pavements; the Ohio Cut Stone Company furnished the limestone balustrades.¹⁹

The Detroit-Superior High-level Bridge has just undergone extensive repairs and remodeling. Albert S. Porter, County Engineer (at the time of this writing), employed Howard, Needles, Tammen and Bergendoff to investigate the structure and report on its state. Because of age and corrosion caused by air pollution, the bridge had deteriorated to the point where structural adequacy of some of its members was questionable. In addition to the aging process there were two basic causes for deterioration: (1) certain instances of faulty initial construction, and (2) failure of the drainage system to function properly, which resulted in extensive salt damage.

Two types of steel had been used in the original construction. The main truss members and hangars are of corrosion-resisting nickel steel; the floor system and bracing members are of ordinary carbon steel. The nickel steel floor systems showed signs of corrosion. The consultants designed means to improve and widen the bridge.

During 1967 and 1968, the deck was repaired and was made into a six-lane roadway, to accommodate increased traffic loads, by cantilevering the extra lanes outside the center span.²⁰

The Lorain-Carnegie Bridge (1932)

South of the Detroit-Superior High-Level Viaduct stands the second major bridge across the Cuyahoga Valley—the Lorain-Carnegie. Completed in November of 1932, it was declared by the American Institute of Steel Construction to be one of the most beautiful bridges built in that year.

As early as 1916 (that is, before the Detroit-Superior High-Level Bridge was finished) agitation grew for a third viaduct to cross the valley. Bond issues were passed, but World War I shelved all such plans.

Then during the twenties the Van Sweringens, in the fullness of their power, had built the terminal complex at the foot of Huron Road and also their Shaker Square development with the Rapid Transit. These terminals suggested that Carnegie Avenue could become a major thoroughfare, with traffic moving from the Heights to Public Square. Likewise, from the West Side, Lorain Avenue would carry heavy traffic to downtown Cleveland. In 1924 a City Planning Commission report recommended that the bridge be built immediately.

In 1927 a Citizens Committee of fifteen was appointed to make recommendations to the County Commissioners regarding the construction of the Lorain-Carnegie Bridge. The recommendations this group made were twofold -- one set applying to the bridge proper and another applying to the approaches. The fact that many of these latter recommendations were never carried out is perhaps one reason why the bridge has failed to serve the city as extensively as had been predicted. Since the construction of the Inner Belt Bridge (I-90) and the Main Avenue Bridge, through traffic has completely neglected this bridge, and pedestrian traffic is non-existent.

In 1927 *The Clevelander* published an article concerning the November election, in which the voters had approved two bridge bonds (one for the structure and one for the land). At that time the Chamber of Commerce specified that pier placement should not interfere with any future river straightening; and the City Plan Committee was concerned with traffic and transportation distribution. The writer of the article in *The Clevelander* had some interesting ideas:

But while these are in process of reconciliation the committee on city plan is to take just as firm a stand on the entirely indisputable economic fact that an ugly Lorain-Central Bridge would be a distinct economical handicap to the Cuyahoga Valley. Steel and concrete, as materials which can achieve beauty in building, have certainly demonstrated themselves to Clevelanders in the Telephone Building and in the Union Terminal Tower. That steel alone can be arched into bridges of beauty has been proven in the United States and in Europe. Wilbur J. Watson, internationally known bridge engineer and chairman of the City Plan Committee's subcommittee on bridges, in his recent volume, "Bridge Architecture", cited many such instances.

The first question in the taxpayer is supposed to ask is whether it is good business to spend his money to obtain -- not only the certainty that the bridge won't fall down and will carry loads, but also noble proportions and details in such a strictly utilitarian structure. According to most of the cities in the United States which have built such structures in recent years, the answer is undoubtedly -- yes. Pleasing lines do not need to be expensive.

It is not a question of cost, so much as of skill, on the part of the designer to design to this goal. It is becoming usual to have important bridges designed by engineers in collaboration with an architectural firm...as a structure that satisfies esthetic taste pays not only in increased values of surrounding property, but in the civic imponderables -civic pride and civic pleasure."²¹

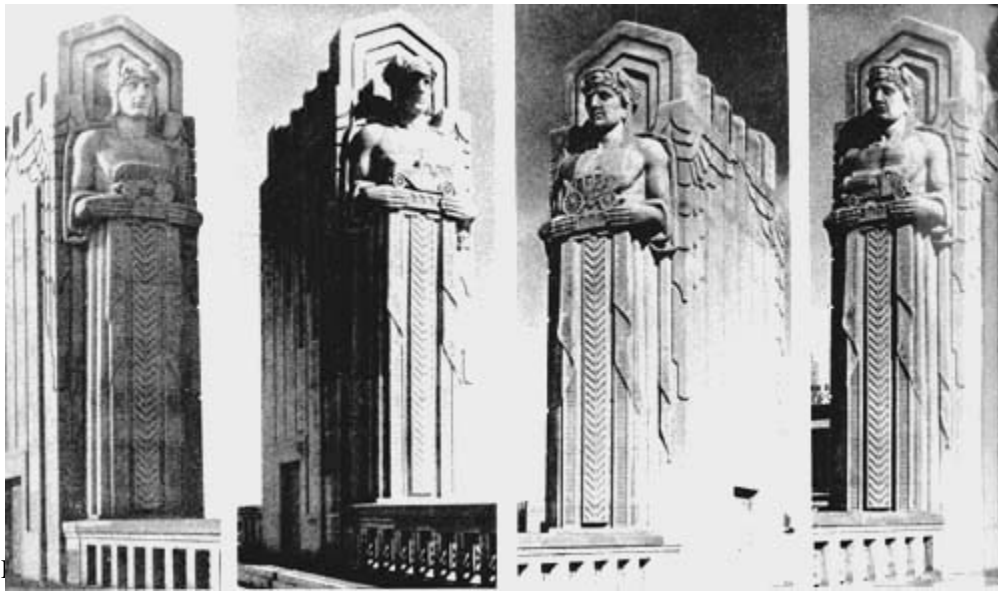
To make a justification for a steel bridge as late as 1927 seems strange to us, but Clevelanders were conservative; they associated beauty with stone or concrete arches, and probably the public had to be educated.

In 1930 work began. The bed of the Cuyahoga Valley is composed of glacial deposits of silt, sand, and clay overlying the native shale to a depth of approximately 150 feet. The characteristics of this overburden vary greatly but in general cannot be relied upon to carry heavy loads. Therefore, all of the piers are founded upon piling, concrete piles being used under all piers except those at the crossing of the river, which are founded upon timber piling. The footings for the river piers were carried down to an average depth of 38 feet below the river level.

The superstructure consists of fourteen cantilever-truss spans, varying in length from the largest, 299 feet -- which is over the river -- to 132 feet at the ends. Total length is 5,865 feet; and its elevation of 93 feet is that demanded by the Corps of Engineers for shipping clearance. It was not generally known that there are two decks; the upper one has a 60-foot roadway and two 7-foot walks; the lower deck, which has never been used, was designed to accommodate two rapid transit tracks and two 18-foot trucking roadways.

The bottom chord of the trusses was curved for esthetic reasons. It was found that the increased cost of curving these chords was slight and was fully warranted by the better appearance, since the side elevation of this bridge is seen from the other viaducts and from many of the principal office buildings overlooking the valley. For similar reasons a concrete fascia was carried from the tops of the concrete piers to the underside of the coping; and the parapets, too, add greatly to the bridge's beauty, for the top and bottom rails and the posts are of Berea sandstone with inset panels of cast pierced aluminum.²² Albert Porter insisted that the high-strength superstructure was necessary because of the extra weight added by the sandstone. The ornamental railings and sidewalks that contribute greatly to the massive appearance of the structure are expensive to maintain and will probably be removed when the bridge is rehabilitated.

But the most obvious architectural treatment is the presence of four colossal pylons, on each of which are two sculptured stylized figures that symbolize progress in transportation. These were designed by Frank Walker of the architectural firm of Walker and Weeks, and executed by Henry Hering, New York sculptor, who also designed the statues, symbolizing



in 1932.

Security and Integrity, in front of the Federal Reserve Bank Building. The huge figures on the pylons hold in their hands a hay rake, a covered wagon, a stage coach, a passenger automobile, and four types of trucks. A sandblasting would reveal the designer's original concept [Figure VII].

Silicon steel was used for the main members of the trusses, and haydite concrete for the 8-inch deck slab. The 3-inch wearing surface of asphalt was laid directly upon the roadway slab. About 71,000 yards of concrete were used and 13,000 tons of structural steel. Total cost, excluding that of real estate and property damage, was about four million dollars.

The bridge was built by the Cuyahoga County engineers under the direction of Fred R. Williams County Engineer, and A.M. Felgate, County Bridge Engineer. The design was by Wilbur J. Watson, Consulting Engineer, with F.R. Walker, architect -- two eminent names in Cleveland.

The completion of this bridge was marked by fitting festivities. On the evening of 9 November 1932, several thousand persons, according to the newspapers, "braved wintry winds to attend the formal opening, at the west approach." Besides the formal ceremony, festivities included a masquerade, dancing, and the distribution of more than one hundred prizes donated by the owners of stands in the West Side Market. County Engineer, John O. McWilliams, and a candidate for municipal judge, made a brief appearance and delivered a short address. Speaking of the west approach he said:

This improvement was partly due to the efforts of the county engineer's office...and I hope someday the same sort of improvements can be carried further over Lorain Avenue.

Some of the stores were set back from the property line, but the street was never widened.

Although he did not win a prize for the most original costume, the most uncomfortable masked person was an unidentified young man attired (or rather more unattired) as a cannibal. According to the news reporter, this young man's knees could be seen knocking together by those in the farthest rows from the platform.²³

The eminent minister of Pilgrim Congregational Church, the Reverend Dan F. Bradley, preached a sermon upon the opening of this bridge, using it as a symbol of brotherhood and unity.

The bridge is essential to the highway. Without it the best of roads fails of its purpose. For the river divides men and the bridge brings them together.

Pilgrim Congregational Church at West 14th Street and Starkweather Avenue was the most prominent of the churches on the West Side, having many influential families on its membership rolls. In this same sermon Dr. Bradley spoke of the symbolism of the bridge:

Now, the metropolitan city, after many years of earnest effort by the citizens of the West Side, has erected a noble bridge, the Lorain-Carnegie, best of all of our bridges...

The bridge is a thing of intimate human interest. Its spaciousness is a guarantee of safety for untold precious lives...and the bridge is a symbol of a moral quality without which the edifice would be impossible. The bridge is built with truth, in obedience of physical and chemical laws which are the laws of God, Thieves, murderers, and liars cannot make good bridges. There must be honesty, from the blueprints of the architect to the mixture that goes into the cement hopper.

The bridge is a significant emblem, pointing to the aspiration of a community like ours to attain the best and high achievements for the common welfare. The bridge belongs to every citizen; to the rich man and to the very poor man. It marks the cooperation of us all to reach perfection.

We have a great and increasingly important city, and a people who can build and pay for so great an enterprise are not cheap and inferior people; and you and I who are a part of the great metropolis must live up to all that is great and fine in our community. We must use the bridge to inspire our children to live worthily and nobly as befitting people who have such wonderful advantages.."²⁴

Perhaps the first conclusion to this account of the building of the building of the Lorain-Carnegie Bridge is to put out that the builders of Cleveland were striving to design and create beautiful structures to serve the community and to improve the environment. The bridge is a monument to that effect. It has recently been placed on the National Register of Historic Monuments [Figure VIII].



The bridge was closed on October 1, 1980 for three years, for major repairs and renovation. Chemical and waste discharge from industry in the Flats has caused pollution and erosion of the concrete.

The Main Avenue Viaduct (1939)

The first Main Avenue Bridge was built in 1869, a swing structure, one of the first iron bridges in the city. Cleveland's first three log huts stood only three hundred feet from its site. It was, of course, a "low-level" structure, with a 200-foot swing span that was pivoted on a central pier; width was 31 feet. The *Herald* wrote of this new marvel, "so perfect is the mechanism...a boy of 12 years can swing the mighty mass with ease."²⁵ In 1885 the bridge was rebuilt and operated by steam; but in 1915 the bridge was moved slightly and repaired; and longer approaches were constructed to permit larger vessels to enter. Records of 1943 show that the draw was swinging 9000 times a year. The new high-level Main Avenue Bridge replaced this swing bridge, which was torn down in 1947. Nevertheless, it had had a long and useful life. It was an extremely popular bridge for the Westsider who used Bulkley Boulevard to get downtown, for the Detroit-

Superior Bridge had bottlenecks at both ends because of the streetcar subways.

As early as 1930 plans for a Main Avenue Viaduct were drawn up, and in November of that year a \$6,000,000 bond issue for the bridge was passed by the voters. No doubt the Great Depression postponed further work, But, with the formation of the Public Works Administration, the county commissioners recognized a new source of revenue, so that the bridge was built with the aid of the PWA.

Numerous and complex are the problems that must be solved in the building of a great bridge, even before construction begins. Right-of-Way and land must be purchased, making sure that legal and ethical obligations have been met. The fundamental problem facing the engineers is to gain agreement from all agencies and organizations involved: agreement on the location, type of structure, cost estimates and finances, accessibility of the bridge. As plans for each unit -- the piers, abutments, spans, and so forth -- are formulated, they are submitted to the County Commissioners for approval, to the city council, to the City Planning Commission, and to the County Planning Commission. The State Highway Director investigates all plans as a precaution; district U.S. Army engineer must give his permission; finally, the Public Works Administration must affix its stamp of approval upon every sheet. Literally hundreds of sheets, blueprints, plans, and specifications are required to be so endorsed.

Ground was finally broken on 12 May 1938. The bridge, 2,250 feet long, stretches across a half-mile; the total length is 5,920 feet, but, including approach ramps, it is 8,000 feet. Beginning at the western end of the bridge proper, near West 25th Street, there are five steel spans each 200 feet long. These are followed by two spans of 240 feet each, and a span of 320 feet, which is 150 feet west of West 10th Street. All spans are of the truss-cantilever types. Construction was begun at both ends. Clearance for river traffic is 98 feet, except for the central span, which is 115 feet above the water. The roadway is 82 feet wide. The principal part of the east ramp, across the railroad tracks, consists of a four-span continuous structure supported on three parallel plate girders of unusual depth and length. The supports are skewed so that no two girders are alike. Professor William J. Eney of Lehigh University was engaged to build models for this testing. "²⁶ These girders are 270.8 long, the longest girder-spans built in America up to that time.

The concrete piers of the river span are anchored in hard blue clay, 45 feet below the riverbed, and stand nearly 100 feet back from the river bank, to permit river widening without interfering with the bridge.

As the steelwork of the superstructure was built out from both ends, the moment of the meeting was the most spectacular. An amusing column about this appeared in the *Cleveland News*, written by Howard Beaufait:



Figure IX. Main Avenue Bridge with the old Main Avenue Swing Bridge in the open position.

I joined the rubberneck gang of sidewalk experts supervising construction of the new Main Avenue Bridge...

Trying to appear as nonchalant as possible. I leaned against a building down in the Flats. Next to me stood a man in a leather zipper jacket. His eyes were sad and contemplative, and his eyebrows were arched in such a way the he look perpetually amazed.

"How in the hell are they going to make that thing meet in the middle?" he asked. ...I didn't know, I said, but I understood it was a ticklish job to get that final connecting link into place...

My companion made a clucking noise with his tongue. He said it was a mistake, that they should start on one end and just keep on going until they reached the other end...."²⁷

At any rate, we know that the meeting was achieved; on 25 April 1939, in the presence of a large crowd, a golden rivet was driven home to link the east and west sides [Figure IX].

In a record-breaking time of less than a year and a half, this bridge was completed and opened with a befitting celebration. Total cost of the bridge was \$7,500,000. On 6 October 1939, more than a thousand people attended the dedication; workmen, military organizations, and fraternal bodies participated in a parade. The city, county, and nation were

represented on the speaker's program; and after the ribbon had been cut, there was dancing on the bridge.

In charge of construction was John O. McWilliams, County Engineer. His associates were W.E. Blaser, F.L. Plummer, R.W. Dietrich, and C.M. Haake, Wilbur J. Watson was the consulting engineer. County Commissioners were Joseph F. Gorman, John F. Curry, and James Reynolds.

From its opening, this bridge has carried increasingly heavy traffic, inasmuch as it is, in effect, the bypass around the city for through traffic and links the Lakeland Freeway with Bulkley Boulevard.

Although the bridge is barren of any ornamentation and is functional in design, the American Institute of Steel Construction awarded it an Honorable Mention for its appearance. This is no doubt because of the clean lines and although the bridge was built as a cantilever, the bottom members form a curve that gives the pleasing appearance of an arch.

Only the street lighting was a failure. The public objected to the starkness of the yellow sodium vapor lights used first in Cleveland and promoted by a prominent lighting firm. The effect of temperature on the operation of these bulbs had not been sufficiently studied. This problem solved, the outdoor mercury vapor lights are now widely used, and the very latest ones -- the "warm golden light" flooding the Public Square and Euclid Avenue -- are a direct descendant of those once used on the bridge. The structure was extensively repaired in 1978.

The Old Central Viaduct

The Inner Belt Bridge (Interstate 90) stands approximately where Cleveland's second oldest viaduct -- the Central Viaduct -- once crossed the valleys of Walworth Run and the Cuyahoga River. As it was with the old Detroit-Superior Bridge, the Central Viaduct was debated pro and con for a decade before it was built, for the project met with vigorous opposition. Pressure urging construction of the bridge was brought to bear upon City Council by the South Side as early as March 1879, when Councilman James M. Curtiss introduced a resolution asking that the City Engineer report upon the best location for such a structure. But nothing was done until 1883, at which time the resolution was passed, and the council authorized an expenditure of a million dollars. In December 1885 the ordinance of construction was approved, bids were opened by November of 1886, and in May of 1887 ground was broken.

Its location was chosen to bring traffic from the southwest parts of the city to the downtown area. At its south end was a neighborhood which had long been called University Heights. (The present suburb of University Heights is a latter-day copy). A college had been started but lasted only a year; however, the existing street names in the area are reminders -- such as Professor, Literary and College. The neighborhood was fashionable because it supposedly provided escape from malaria and from the chills and fever which were believed to have been caused by the marshy lowlands of Cleveland.

The contract provided for two bridges. The main structure known as the Central Viaduct, was 2,839 feet in length and extended from genteel Jennings Avenue (West 14th Street) to Central Avenue (Carnegie) on the East Side. The second bridge connected Abbey Avenue to Lorain Avenue at West 25th Street. The so-called Walworth Run section of 1,088 feet, which can be best be seen from Scranton Road, is still in daily use..²⁸ it is 70 feet wide and 76.5 feet above Scranton Road. Its iron and steel spans are supported by iron towers resting on masonry foundations. Its concrete mesh deck installed in 1930 belies the age of the underlying structure. The City Engineer's report of 1914 indicated that the "iron" had a tensile strength of 50,000 pounds per square inch, which may account for the long life."²⁹ The engineer in charge of the steel work was Frank Osborn (the founder of the Osborn Engineering Company). Both branches were constructed by the King Iron Bridge and Manufacturing Company.

The piers of the Central Viaduct were a masonry; the spans of the superstructure were steel trusses. Known as the "stilt" type, the bridge consisted of a series of braced towers and deck spans of varying lengths. Originally it had a swing section over the river to permit the passing of high-masted ships. This was removed in 1912 after a streetcar accident. The bridge was then converted to a true high level by replacing the draw with an overhead truss. The roadway was 101 feet above the river, with a 40-foot vehicle lane and two sidewalks of eight feet each. Its costs was \$675,000. The City Engineer's office furnished the design and construction specifications, with C.G. Force in charge in the beginning, followed by Walter W. Rice; W.W. Hughes was consultant in the design [Figure X].

Three years after approval of the ordinance of construction the bridge was opened on II December 1888. The steel trusses were draped with multicolored bunting and garlands of flowers. A parade of soldiers and civilians formed at 1 p.m. on Superior Avenue at Public Square, moved west across the old Superior Viaduct, then south along Pearl Street (West 25th Street) to Lorain; then it turned left across the New Abbey Street Bridge

over Walworth Run to the western approach of the new bridge. There the procession stopped for the dedication. Zenas King, who started manufacturing Cleveland bridges in 1833, and took out one of the earliest patents on swing bridges, spoke for the King Iron Bridge Manufacturing Company. The first iron arch and swing bridges in northern Ohio were manufactured by this firm, founded in 1858. In 1871 the King Iron Bridge and Manufacturing Company was organized by Zenas King, Thomas A. Reeve, A.B. Stone,



Figure X. Central Viaduct showing the fixed span that replaced the old movable span.

Charles E. Barnard, Charles Crumb, Dan P. Eells, and Harry Chisholm. Under Harry King, the founder's son, the firm furnished structural and wrought iron work for most major building projects. In 1876 annual sales reached nearly a million. A nation-wide business developed. By 1886 bridges built by the firm, if placed end-to-end, would have extended more than 150 miles.³⁰ And in 1893 the plant, located at East 69th Street and St. Clair Avenue, covered under one roof 155,000 square feet.

But to return to the opening ceremony of the Central Viaduct. Mayor Brenton D. Babcock accepted the bridge for the city. After this, the parade moved across the new bridge, to Central Avenue, turning north down Ontario Street to City Hall on Superior, where the city officials greeted the marchers. That evening, at the Hollenden Hotel, officials, governors, councilmen, congressmen, and distinguished citizens dined in grand style. After a banquet the assembly was addressed by Mayor Babcock, who read telegrams from illustrious persons unable to attend, among them being John

D. Rockefeller, and the President of the United States. The bridge was described and presented to the city by Mr. Walter P. Rice, the City Engineer, the Honorable Joseph Foraker who spoke for the State of Ohio; Mr. M.M. Hobart for the city of Cleveland; Mr. James Curtiss for the Cleveland Short Line Railway; F.C. McMillan spoke for the militia; the Honorable George W. Gardner for Cleveland's industries; and the Honorable W.W. Armstrong on behalf of the press.

But civic pride rose to even greater heights than it did in these oratorical speeches. It inspired poetry from the pen of a young newspaperman, W.R. Rose of *The Sun and the Voice*, who late joined the staff of the *Plain Dealer*, wrote an epic poem that described the old battle between the South and West Sides, of the city. (His son, W.G. Rose, wrote *Cleveland, The Making of a City*.)

Curtius at the Bridge

*The doughty West Side fathers-
By all the gods they swore,
That Curtius; bridge should never span
The smokey valley o'er;*

*They polished up their armor,
The bright war-paint they spread,
With sullen roar they rudely swore
To paint the South Side red.*

Curtius is, of course, James Curtiss, the councilman who introduced the original resolution for the bridge. The poem proceeds to describe in bloody images how Curtius and Caius Caskey (another councilman named A.C. Caskey, also active in pushing the construction of the viaduct) defended their bridge and finally quelled all resistance from the opposition, saving the structure for the city. The verse, is, of course, a parody on the classic "Horatius at the Bridge", familiar to every schoolchild of that time.

*They gathered in the Forum,
A dark and vengeful crowd,
And scoffed upon the Curtius' bridge
In speeches fierce and loud;
They claimed the bridge would ruin
Both Pearl Street and Lorain,
And so they fought the project
With fourfold might and main.*

*Up rose Horatius Curtius
And spake in haughty tones:
"Oh, craven dough heads that ye are,
I'll hold the bridge alone!
Now who will stand beside me,*

*Has no one got the sand?
"I have," cried Caius Caskey,
"Upon the right I'll stand."*

*In columns dark and serried
On came the angry foe,
Alone stood Curt and Caskey,
To stem the warlike flow.
Upon the Heights, affrightened,
Ten thousand eyes looked down,
And watched in nervous dread to see
Who'd wear the victor's crown.*

*Loud laughed the West Side legions
To see the little band,
And cried, "You soon, must bite the dust
As on your heads you stand.'
"But loudly fearless Curtius
Cast back that laugh on scorn,
"O me an' Caskey here will make
You wish you ne'er were born!"*

*Fierce waged the awful battle,
A score against but two.
Until the Teuton Herman dropped
And from the fight withdrew;
Bold Quintius Morrison was next
To beat a swift retreat,
And C. Pompilus Ford arose
To say that he was best.*

*Like zigzag lightnings flying
The swords of Cask And Curt,
Where 'er they fell, they left a mark
And made the crimson spurt.
Like beaten wolves back shrank the foe,
In sullen tones they raved,
Until they scattered in dismay
And Curtius' bride was saved!*

*In coming generations when
Our children's children tell
The famous stories of the past –
The tales they love so well –
With cheering and with laughter
One deed they'll keep alive,
How well brave Curtius saved his bridge
In eighteen eighty-five!."³¹*

But, spite of the gay dedication and festive spirit, the new viaduct soon became to be known as the "tragic" bridge. It had not been long use before disaster struck. On a cold, dark and foggy night, 16 November 1895, a crowded streetcar plunged into the river. The draw had been opened to

permit the passage of a tug, and the streetcar approached the span at a high rate of speed. A safety switch 150 feet from the draw was not working; parts of it had been removed for repairs. The motorman and one passenger saved themselves by jumping, but sixteen passengers and the conductor drowned. On 25 May 1914, disaster struck again; a section of the viaduct's wooden floor was burned during a fire in the lumber yard of Fisher and Wilson in the Flats below the bridge. Consequently the bridge was out of commission for a year. Then, later, an iron stairway from the lower level to the deck of the viaduct collapsed. A man on the stairs narrowly escaped death when his fall was broken by wires..³²

In January of 1941 the Central Viaduct was condemned and closed to traffic. The residents of the area fought for its preservation. They lost, however, for the bridge was torn down, and its five hundred tons of steel were converted into scrap during World War II.

The Inner Belt Bridge

Cleveland had to wait almost twenty years for a new bridge on the old Central Viaduct right-of-way. Delays were caused by war, by consideration of Cleveland's traffic needs, and by the need of long-range planning. It was not until 15 August 1959 that a new bridge was opened at a dedication and ribbon-cutting celebration.³³

The early replacement of this bridge was postponed as it was to become a part of the Inner Belt Freeway System. This freeway movement received its initial impetus in 1940, when the electorate of Cuyahoga County approved a bond issue in the amount of \$4,500,000 to purchase right-of-way for six isolated freeway projects. These projects as contemplated were to include portions of Willow, Lakeland, Newburgh and Jennings Freeways (as they were originally named), a section of Chester Avenue from East 55th Street to East 93rd Street, and a bridge over Rocky River to connect West Lake Road. In July 1940, the Ohio Department of Highways established a planning office in Cleveland to develop construction plans for these projects. These freeways were more or less isolated, but the need for a comprehensive freeway plan soon became apparent. Early in 1941, the Public Works Committee of the Regional Association of Cleveland established the Expressways Highway Subcommittee for the purpose of planning an express highway system in Cleveland metropolitan area. This subcommittee was composed of engineers representing the Planning Office of the Ohio Department of Highways, the Cuyahoga Planning Commission, the

Cleveland City Engineer's office, the Cleveland City Planning Commission and the Regional Association of Cleveland. This committee met weekly or bi-weekly for nearly three years to produce a freeway plan that would meet the immediate and future needs of this area. During that time the committee received cooperation and assistance from the Cleveland Transit System and the Cleveland Traffic Bureau.

In April of 1944 the committee submitted its report. "Express Highway Plan for the Cleveland Metropolitan Area", to the Public Works Committee. The Regional Association of Cleveland, in November of 1944, published the report labeled "Publication Number 19." The plan advocated an Inner Belt and an Outer Belt with a number of radial freeways. It also incorporated the six freeway projects included in the County Bond issue of 1940. Although adjustments and changes have had to be made in the interim, the basic concept of belt freeways was retained in Cuyahoga County. Numerous delays were encountered. An expediting committee was formed in 1947, consisting of three members representing the Planning Office of the Ohio Department of Highways, the Cuyahoga County Engineer's Office, and the City Planning Commission.

On 23 October 1953, the city retained Howard, Needles, Tammen and Bergendoff as consulting engineers to prepare preliminary plans for the approaches to the Central Viaduct, for the interchange with the Willow Freeway (commonly referred to as the Central Interchange), and for preparation of detailed contract plans for the Inner Belt from Fairfield Avenue to East 22nd Street which includes the Viaduct, its approaches, and the central interchange.

Cleveland's Inner-Belt Freeway forms a partial loop around the central business section, connecting with Memorial Shoreway near East 30th Street. The freeway runs southerly from the shoreway, passing under Lakeside, Hamilton, St. Clair, Superior, Payne and Chester Avenue. Curving to the southwest, it passes under Euclid, Cedar Avenue and East 22nd Street; and then it rises to become elevated as it goes over East 13th Street. Access to the Inner Belt Bridge from central business district is furnished by ramps from Broadway, Carnegie Avenue and East 9th Street; exit ramps are provided to Broadway for either eastbound or westbound traffic. Access on the southwest side is provided by a ramp from Fairfield Avenue, and exit ramps lead to Fairfield and Abbey Avenues.

The bridge spans the river, and numerous tracks belonging to the Erie, Penn-Central, Chessie System and the Norfolk and Western, and to the Cleveland Shaker transit systems which now are part of RTA. It crosses over Broadway Avenue, Commercial Road, Canal Road, University Road, Abbey

Avenue, and a number of streets in the valley. It spans the former Nickel Plate Freight House, the N&W Railroad trestle, the sand and gravel plant of Cleveland Builders Supply Company, and several local streets.

The Inner Belt Bridge is one of the major bridges in the country. It is the widest bridge ever built in Ohio, and the \$8,132,200 contract for the construction of the superstructure which forms the central part of the viaduct was the largest single such contract ever awarded by the Highway Department. It has eight traffic lane (four in each direction) and can accommodate a traffic volume of 95,000 vehicles per day. Three-foot safety walks are provided on each side of the bridge for emergency pedestrian use. The overall length of the bridge is 4,223 feet (eight-tenths of a mile), and it is 116 feet, 3 inches wide. The central portion of the viaduct consists of 2,721 feet of cantilever deck-truss construction, with a reinforced concrete deck and asphaltic concrete wearing surface. The deck-type construction provided substantial savings in pier cost, resulting in a pleasing appearance, and presented minimum interference with driver's vision. Vertical clearance was not a problem here.

The bridge has two main longitudinal trusses (which vary in depth from 21 feet 6 inches in suspended sections to 68 feet at the piers) parallel to each other and 90 feet apart. There are seven truss spans, varying in length from 226 feet 6 inches to 400 feet. The reinforced deck slab is supported by longitudinal stringers. These rest on transverse floorbeam trusses, which are spaced at 25-foot intervals and span the 96 feet between the two main trusses. High-strength manganese steel was used for many of the large truss members, for it was more economical than the customary structural carbon steel.

The approach spans and their connections with the central portion of the bridge are also interesting. The western approach comprises about 750 feet of embankment construction for ramps, and 371 feet of viaduct construction. For the four spans in this section, relatively deep continuous deck plate-girders with framed-in floor beams and stringers were used. On the east approach conditions were far more difficult; grades and vertical clearance were extremely critical, and spans had to be longer. This approach consists of 1,131 feet of viaduct construction, with additional embankment construction for the ramps. To clear the New York, Chicago and St. Louis Railroad (N&W) Freight Terminal and the adjacent roadway and tracks, a span of 239 feet was needed, and a span of 243 feet was required



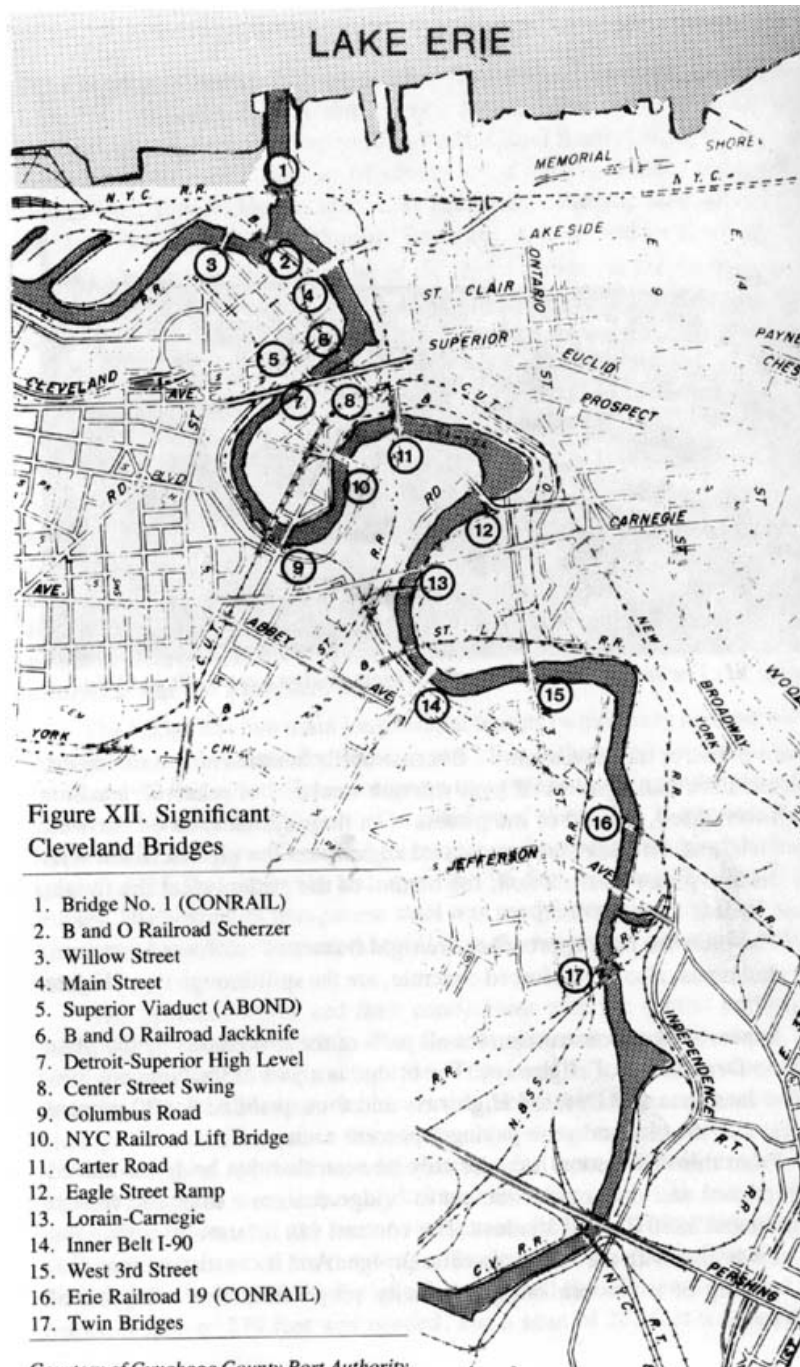
Figure XI. The Inner Belt Bridge, the widest bridge ever built in Ohio

for one of two of the access ramps. Because of the limited vertical clearance, multiple deck plate-girders of high-strength steel and of relatively shallow depth were used, instead of the girders with floor systems, as one on the west approach; and the deck slab was placed directly on the girders. Even with this shallow girder construction, the bottom of the girders clears the freight house by less than one foot.

The piers for both approaches are rigid frames of reinforced concrete. The abutments, also of reinforced concrete, are the spill through type [Figure XI].

Supervision of construction for all parts of the bridge was by the State of Ohio Department of Highways. The bridge is a part of the National System of Interstate and Defense Highways and thus qualified for 90 percent federal aid, the city and state and paying 5 percent each.

From this description it can readily be seen that this bridge is indeed an important and major achievement in bridge design, a dramatic change from the old 1880 Central Viaduct. The contrast can be seen by comparing this new bridge with the Abbey Avenue Bridge. And it can also be seen that the building of a modern bridge of major proportions is a complicated affair.



Chapter 3

MOVABLE BRIDGES

Railroads, rapid transit right-of-way and power pole are generally considered to be necessary evils, so utilitarian are they, that no one gives a thought to making them beautiful. Movable bridges, generally placed in this same category, are, however, prominent structures; indeed even more so than the ordinary highway bridges. In Cleveland these "ugly ducklings" among bridges are treated with disgust when they are closed to traffic to allow a ship to pass. But they perform functions vital to Cleveland industries. Cleveland is unique in one respect. He who travels up the Cuyahoga River from its mouth to the turning basin will probably see a greater variety of types of movable bridges than can be seen in any other place in the world. One reason is that one time seven different railroads entered Cleveland. All needed bridges to take them across the valley and the river to terminals, and each had a design peculiar to the location. From the mouth of the Cuyahoga River to Akron there are eighty-four bridges -- over three and a half per mile. Twenty of these are over the navigable portion of the river -- that is, from the mouth to the turning basin. One can see viaducts, stone-masonry arches, concrete arches, cantilever spans, and girder spans, swing bridges, vertical lift bridges, bascule bridges, jackknife bridges and Scherzer Rolling Lift Bridges. Clevelanders can take pride in this aspect of their city that has long gone unappreciated [Figure XII].

Let us journey up the Cuyahoga River from the channel entrance at Lake Erie and explore the history and development of the movable bridges in Cleveland's original "harbor". The first bridge as we enter the Cuyahoga River is a modern vertical lift bridge. This type is the most popular today, for ease and rapidity of operation and for navigation clearance. A vertical lift bridge operates in much the same fashion as does an ordinary window sash, which moves up and down in vertical guides and is hung from sash-cords that go over a pulley at the top, with a counter-weight at the other end. A vertical lift span is easily recognizable by the high skeleton towers, one at each end of the span. The cables which carry the counter-weights pass over giant pulley wheels, called "sheaves", at each end of the lift span.



Figure XIII. Vertical Lift Bridge in operation at Eagle Street

These counterweights equal the weight of the lift span, and the height of the tower is determined by the height to which the span has to be raised to provide the necessary clearance over the waterway. The towers are tied at the top with a truss that keeps them in perfect alignment. For long spans in the movable bridge class, the vertical lifts are the most efficient. The first vertical lift bridge of this type was built in 1894 by an eminent civil engineer H.A.L. Waddell, in Chicago [Figure XIII].

The Penn-Central Bridge (No. I) over the Cuyahoga, was designed by Howard, Needles, Tammen and Bergendoff, part of a \$13,236,000 program started in 1946 by the Corps of Engineers to replace six bridges. This fine specimen of a vertical lift is a double-track railway bridge, originally serving the main line of the New York Central and the ore traffic to the Pennsylvania Railroad docks on the main line of the railroad between Chicago and New York City. It replaced an old swing bridge that had a

center pier, which was an obstruction to traffic. The old bridge permitted the use of only half the channel for navigation purposes. Before we advance farther up the river, let us glance at the "old riverbed". Here are two bridges to interest us. The current structures replaced older spans in the same location.

The original Baltimore and Ohio Railroad bridge was a wing-type, swing bridge built in 1897. It handicapped the industrial growth of Whiskey Island because it limited crossings to ten-ton trucks. It had a channel width of 140 feet. In 1907 the Baltimore and Ohio Railway Company replaced it with a new bridge, from designs prepared by the railroad under the direction of J.E. Greiner, Chief Engineer. The structure was designed by the Scherzer Rolling Lift Company; the steel work was fabricated by the King Bridge Company of Cleveland and erected by the Pittsburgh Construction Company. This bridge introduces us to another type of movable bridge—the Scherzer Rolling Lift. This type was popular around 1900, designed by William Scherzer of Chicago. Steel trusses or girders across the navigable channel are supported by, and rigidly connected to, large steel rollers or rockers, that have a weight at the rear to counterbalance the front end. The rollers, or rockers, are only segments of a circle, because the entire movement of the structure to achieve a full clearance of the channel opening describes an arc of less than ninety degrees. At one time there were nine of these Scherzer Rolling Lift Bridges in Cleveland. This type is no longer being built; the trunnion bascule and the vertical lifts are today's favorites. The rolling action caused the pier to move under the variable load when the bridge moved [Figure XIV]. This particular bridge over the Cuyahoga River has a 230-foot span. When built in 1907, it was the longest single-leaf Scherzer ever built, and it still holds the record. The clear width of the channel is 210 feet; total strength of the bridge, including a short fixed plate-girder span at the east end, is 334 feet. The counterweights, placed in steel boxes in the planes, of the trusses, are balanced in all positions. The substructure consists of three piers at the heel that carry the track girders on which the bridge rolls, a rest pier, and a abutment for the rear end of the fixed approach span. All the piers are concrete supported upon piles. Another special feature of the bridge is the arrangement of the operating mechanism. The operating pinion is carried by the moving structure and by gears with a horizontal stationary rack on a tower erected upon the piers of the heel of the bridge. The axis of the pinion is located in the part of the truss which has merely a horizontal travel in the combined rolling and swinging movement of the bridge.

The second bridge is the present Willow Avenue Bridge, which provides vehicle access to Whiskey Island. The old Bridge (1898) was a swing



Figure XIV. Scherzer Rolling Lift Bridge near McKinney Steel Co.

bridge with a span of 170 feet. The present Willow Avenue Bridge is a vertical lift, designed in 1964 by Trygve Hoff and Associate. It is a handsome structure that proves a movable bridge need not be ugly. Its span is 310 feet long. The automatic electric skew control and four motors at the top of the tower give exceptional lifting power. The skew control equalizes both ends of the bridge for a uniform lift of its 750-ton span. It can be raised to its full height of 98 feet in one-half minutes. The counterweight cables provide the means of movement.

The next movable bridge on the river is known as Bridge No. 3. This bridge is also a B. and O. Railway Bridge. Built in 1956, it is a record-making, jackknife located just north of the Detroit-Superior Viaduct. It replaced a Scherzer rolling lift bridge that had a main span of 161 feet. The present structure has a main trunnion bascule span of 255 feet long and a clear channel distance of about 231 feet. It carries a single track on the 22-foot width of the trusses. There is a vertical clearance of about 23 feet from

the top of the track to the bottom of the counterweight when in the lowered position. The substructure consists of two concrete piers with 30-inch steel

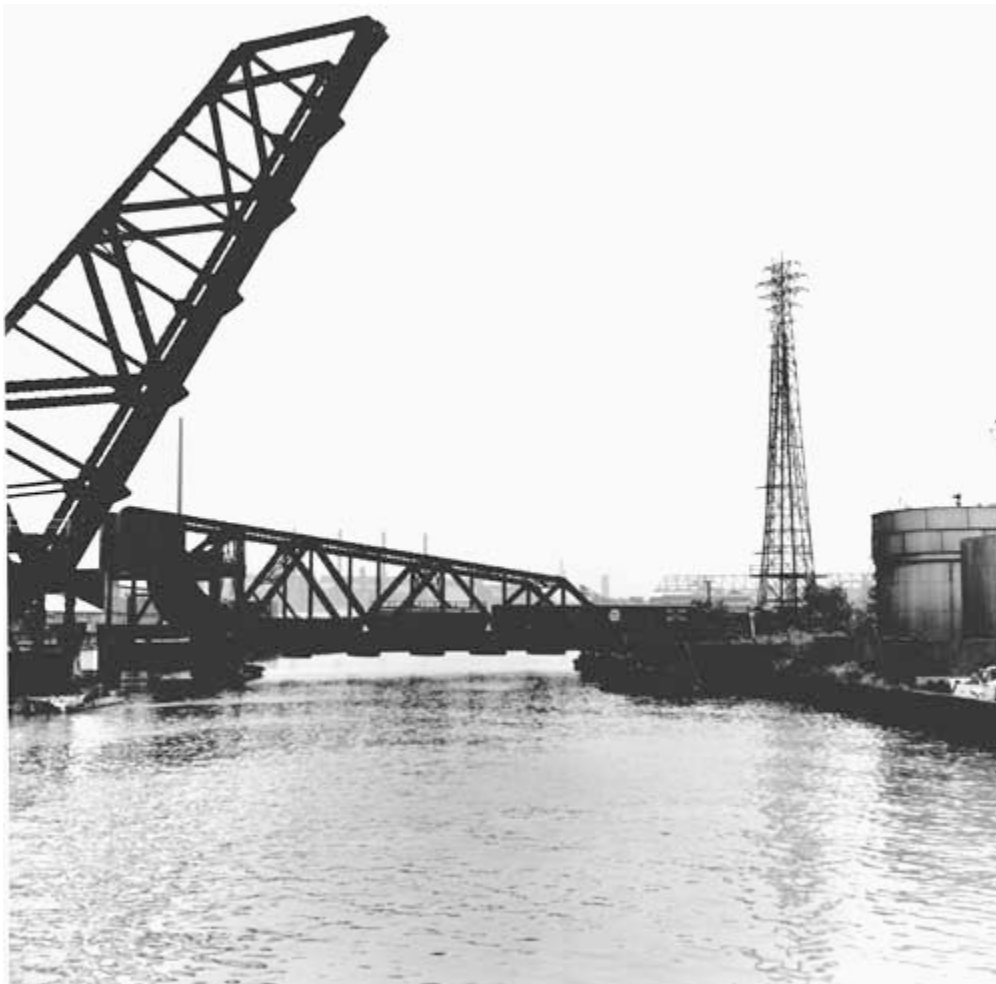


Figure XV. Twin bridges built for the Baltimore & Ohio Railroad and the Wheeling and Lake Erie Railroad, a jackknife bridge in the foreground and a Scherzer rolling lift bridge in the background.

caissons and 10-inch pipe piles. This bridge is an outstanding example of a single-track, jackknife bascule bridge. In this peculiar type, each rail is supported directly upon the lower chord of the truss. When the bridge is opened, the span pivots around one end. The weight of the bridge is balanced by a weighted lever arm supported by the tower located at the fixed end of the bridge. When in open position the lever arm folds against the upright truss -- hence the name "jackknife". However, J.A.L. Waddell, in his monumental work *Bridge Engineering*, dubbed this type as a "freak" and dismissed it as "defunct".³⁴ (It was first used in 1845 at Manchester, Massachusetts.) [Figure XV].

The Center Street Bridge, the only swing bridge in the area, and the oldest extant swing bridge, lies at approximately the spot where Moses Cleaveland landed in 1796. It is the site of the first bridge over the river, and it became involved in the notorious "Bridge War" because the Ohio City inhabitants wanted two bridges: the Center Street and the Columbus Road Bridge. Both are vehicle bridges. The first Center Street Bridge was a wooden structure that was replaced five or six times. One of these was the



Figure XVI. Sightseers pass under the Detroit-Superior Bridge as the Center Street Bridge swings open below.

"floating bridge" mentioned earlier. The present bridge, a steel truss with unequal arms, was built in 1901. This example of the center-pier, swing type, is fast disappearing from the American scene [Figure XVI]. This rim-bearing swing span is 249 feet; 8 inches; minimum channel clearance is 122 feet. The bridge turns horizontally about a vertical axis, like a railroad turntable. It is supported on a center pier, called the "pivot pier". The two projecting arms act as cantilevers when the bridge is open. When closed the

bridge becomes a truss. Since the two arms are unequal, a balancing counterweight is required on the shorter arm. This is accomplished by a solid deck of concrete on the short span and an open mesh deck on the long span. The span was originally operated by a small steam engine in the operator's house, but is now operated by an electric motor. Contractors for the substructure were L.B. and J.A. Smith Company. The King Bridge Company built the superstructure. This structure has the pivot pier on the north bank, similar to that of the old Superior Viaduct. When this type of bridge was first used, the pivot pier was placed in the middle of the channel. When the bridge was open, the free end of the bridge was protected by long fenders built of timber piles and walers. Little wonder that this type was replaced with longer -- and more expensive -- spans.

After passing under the Detroit-Superior Viaduct and the Union Terminal Bridge, we come to the other bridge site of the "Bridge War" -- the Columbus Road Bridge. Its history dates back to the very earliest days of Cleveland and Ohio City, as we have seen in Chapter 1. Its superstructure was of wood and covered -- probably the only covered bridge Cleveland ever had. By 1846 transportation demands had outgrown this bridge, and agitation for a new structure began. However, the city of Cleveland and Ohio City could not agree as to who should build it, whereupon the county settled the dispute and assumed the responsibility.

In 1870 an iron bridge was built, but this, too, soon had to be replaced. In 1895 a new bridge, designed by city engineer Walter F. Rice, was built. It was an extraordinary structure -- a double-swing span -- the first of its kind in the world. Each leaf was mounted on a separate pier and turntable. The clear opening between fenders was 115 feet. Each river arm was 65 feet; the short spans over the piers was 15 feet. The combined length of the two leaves was 279 feet. In 1940 the present Columbus Road Bridge was designed by Wilbur Watson and Associates. Its vertical lift span provides a 220-foot clearance [Figure XVII]. At present it needs repairs.

The Columbus Street crossing exemplifies the life-history of the low - level bridge over navigable waters. First came the crude and narrow structure, with a center leaf to open the channel to river traffic. By the middle of the nineteenth century, the timber bridge was followed by a light iron bridge with a wider roadway; it generally was a swing bridge. Near the end of the century, came a still heavier structure, generally of steel, to carry increased loads. Finally an entirely different bridge type emerged, designed to accommodate modern transportation needs; the vertical lift.

At a point of Columbus Road which was to be the hub of "Cleveland Centre" -- a pioneer real estate promotion for trade with an international

flavor -- we encounter an extraordinary railroad bridge built for the New York Central Railroad. This bridge serves the main tracks of the oldest railroads in Cleveland, dating from 1851. Founded by Alfred Kelley, mayor, canal commissioner and promoter, it was originally called the Cleveland, Columbus and Cincinnati Railroad. At a later date, Indianapolis was added making it the "Big Four". When extended to St. Louis, the name became abbreviated to CCC & St.L.R.R.



XVII. Detailed in silhouette of the present Columbus Road Bridge in the open position.

The present bridge, erected in 1953, replaced an older Scherzer Rolling Lift Bridge, built in 1902, with a clear channel opening of 110 feet. The new bridge was designed by Howard, Needles, Tammen and Bergendoff, and received the American Institute of Steel Construction Award of Merit for the most beautiful bridge in its class. It has a vertical lift span of 260 feet, with a clear channel of 200 feet. The two 135 hp motors are located at the top of the two girders, and a drive shaft activates the counterweight sheaves. Massive balance chains adjust the changing load. Normal lift is about 90 feet. The electrical contractors were Dingle-Clark, and McDowell Wellman erected the steel work.

The middle and lower West Third Street bridges were torn down as part of the Terminal Tower complex and the Collison Bend Cut 5A project. The present Carter Road Bridge, a vertical lift, designed in 1940 by Wilbur

Watson and Associates, replace the two older structures. Carter Road, appropriately named after Lorenzo Carter, the first permanent settler, has long been the site of an important vehicle crossing. There was a bridge at this general location as early as 1853. The first bridge collapsed in 1857 when "overloaded with cattle". This was followed in 1888 by an iron swing bridge with one pivot span of 180 feet and one fixed span of 105 feet. The fourth bridge on this site was a Scherzer Rolling Lift Bridge, built in 1903, and the first of its kind in the city. It had a double-leaf drawspan 138 feet long. The roadway was 23 feet wide with two 6-foot sidewalks.

The present structure formed part of the Cleveland Public Works Administration's 5.5 million dollar program for the widening and straightening of Cuyahoga River. The lift span is 220 feet long; the clear channel opening between fenders is 201 feet. Total length of the bridge is 284 feet. The concrete piers support the superstructure. And each pier foundation comprises six 30-inch steel cylinders about 140 feet in length, supplemented by steel batter piles and a steel pile enclosure. The normal lift of the bride is a about 75 feet, with a clearance of a little over 97 feet for a large lake freighters. The emergency lift provides for an extra 51/2 feet. Overall width of the bridge is 58 feet, 6 inches. The roadway has four vehicle lanes and is 46 feet, 6 inches wide, with two 5-foot sidewalks. The superstructure was fabricated by Mt. Vernon Bridge Company and was erected by the Bass Construction Company. The contractor cantilevered the center span out from each tower in a raised position. The foundations were built by the Western Foundation Company of Chicago.

The Eagle Avenue Viaduct replaced the middle West Third Street Bridge, which was a double Scherzer lift. Built in 1908, it had a channel opening of 116.2 feet. The present viaduct has an overall length of 1,998 feet from Scranton Road to Ontario Street. The ramp includes the vertical lift span over the Cuyahoga River, built on the same grad as the viaduct. This lift span has the distinction of being the first vertical lift in Cleveland, having been built in 1931, and the sixth such structure in the United States. The span is 225 feet, with a clear channel opening of 187 feet, and is 52 feet wide. Designing engineer was F.L. Gorman, and the engineer in charge of construction was Noah H. Suloff. The resident engineer was G. Brooks Earnest, who later became President of Fenn College, (predecessor of Cleveland State University). The bridge has been recently remodeled with new electrical controls, but the original 100 hp motors were retained in service.

The electric motors are above the operator's cab and drive a pair of drums that have several wraps of cable. As the motors turn to lift or lower

the bridge, the drums haul in and feed out the cable that are connected to the top and bottom of the towers, thus pulling the bridge up and down.

The bridge has free-standing towers, a design no longer used because the alignment shifts, and then the bridge binds.

Under the Lorain-Carnegie High Level Bridge, there is another type of movable bridge—a trunnion bascule with a single leaf. This replaced a Scherzer type of draw that had a span length of 125 feet and was built in 1902. In 1920 the Cleveland, Columbus, Cincinnati and St. Louis Railway erected the present structure. It has a clear channel length of 140 feet and opens to a full angle of 82. A single track runs through a riveted truss with a length of 175 feet and a width of 18 feet. In addition to the lift span, the bridge consists of a 45-foot tower span and a 42-foot deck plate girder approach. The three piers are of concrete. It is worth more than a casual glance, for the concept is old.

The prototype of the bascule bridge is the drawbridge across the moat of a medieval castle. The modern prototype is the Tower Bridge over the Thames in London, built in 1894. The present-day trunnion bascule bridge comes with one leaf or two. The leaf (or leaves) is supported at the shore and on a trunnion or shaft. In opening, the bridge rotates about this shaft and raises its leaves to a nearly vertical position; in the opening position the trunnion supports the entire dead weight of the structure. The river arm is longer, of course, than that part of the bridge extending to the rear of the trunnion. This makes necessary the use of counterweights at the rear of the bridge.

This particular bridge was designed by the Strauss Bridge Company and built by the American Bridge Company. Joseph Strauss was the famous American engineer who designed the Golden Gate Bridge, and he held numerous patents on bascule bridges. He designed many of the lift bridges in Chicago, where one can see excellent examples of both the single-leaf and the double-leaf bascule. Strauss also designed the drawspan in the Arlington Memorial Bridge over the Potomac at Washington, D.C.

Another railroad movable span is the structure on the High Level Norfolk and Western Viaduct at University Avenue. This structure was built in 1917 for the original Nickel Plate Road and designed by the Chief Engineer, E.E. Hart. It consists of a plate girder viaduct and six deck and through riveted truss spans of moderate length. A double-track viaduct, the total length is 3,010 feet. The height above the river is 68 feet. At one time it was the longest viaduct in the United States. The river span at present is a 267-foot vertical lift, erected in 1957 to replace the 167-foot Scherzer Rolling Lift. The engineers were Hardesty and Hanover and the railway

company engineers R.T. Hewitt, H.H. Whitmore and E.F. Marley. The first river span at this point was a swing bridge with a pier at the center of the river. Then in the 1800's the New York, Chicago and St. Louis Railroad extended its line through Cleveland. In 1882 a wrought-iron viaduct with alternate tower spans and intermediate spans of Fink truss design, supported on sandstone masonry piers, carried the double tracks across the valley. J.A. Latcher, Chief Engineer, W.M. Hughes, Bridge Engineer, and W.D. Boch, Substructure Engineer, designed the viaduct. The present West Third Street Bridge is a vehicle crossing that has a long history in the city of Cleveland.

The present structure is a vertical lift, built in 1940. Years ago this street was known as Central Way, which was opened in 1872, under the tracks of the Cleveland and Mahoning Railroad. It became the principal thoroughway for the heavy traffic to the first iron refineries in that area. In 1883, a wooden drawbridge, the last of the wooden bridges, was swept away by flood. This was replaced by an iron, pivot-span bridge 138 feet long, which stood until replaced by the present bridge was being built. A temporary pontoon was constructed of welded steel with a roadway 20 feet wide 123 feet long. Electric driven winches pivoted the deck in a ball-socket device in the anchored pontoon; and when swung open, there was a clear channel of 80 feet. The vertical lift has a span of 200 feet and is identical with a Columbus Road Bridge.

The Erie Railroad Bridge, a jackknife, is currently on the river replacement program. This crossing of the river is also one of the earliest, dating from 1850. The present bridge replaced an older swing bridge, the east pier of which is still in use. The bridge collapsed in the 1900's as a result of a train wreck. The present bridge is to be replaced by a single-track lift bridge, but the current bankrupt Erie Railroad, now in the hands of Conrail, and the closing of the Erie Ore dock make its replacement and uncertainty.

The Newburgh and South Shore Railroad Bridge one of the "twin bridges", has been retired from active service since 1967 and remains in the upright position. One of the oldest remaining such movable bridges, in the United States, it had a glorious past. It is a Scherzer rolling lift bridge, built in 1903-4 by H.L. Schuler. It is a double-track single-leaf span 160 feet long, with two 50-foot deck plate girder spans on two concrete abutments. The original 50 hp General Electric motors are still there. At the time of erection, it was the longest single-leaf truss span Scherzo bridge.

The rail traffic is now being carried by its twin, a Baltimore and Ohio bridge. It too is a Scherzer rolling lift, built in 1906 to serve the American Steel and Wire Company's Central Furnance via the West Third Street yards

of the railroad. D.D. Carothers and J.F. Greiner supervised the work. It is a double-track railroad structure with an overall length of 205 feet and a lift span of 160 feet. It is supported on concrete piers with pile foundations. The main span is composed of triangular-shaped trusses 29 1/2 feet apart on centers, with inclined top chords supported intermedially between panel points. The trusses have a maximum depth of 44 feet and are connected by top and lateral sway-bracing. All connections are riveted. Like its twin, the rolling mechanism was originally powered by two General Electric 50 hp railway-type motors. But in 1950 two new motors were installed. The operating mechanism is on the movable part of the bridge, while the operator's house is on the shore. The bridge was built at the Toledo plant of the American Bridge Company from plans furnished by the Scherzer Rolling Lift Bridge Company. At present the structure is owned and maintained by the Chessie System.

Just north of the Clark Avenue Bridge at low level is the River Terminal Railway Bridge. Built in 1913, the Scherzer Rolling Lift span is 148 feet long, with a channel opening of 130 feet. It is of great importance to the Republic Steel Corporation, since the bridge provides the rail connection across the river to link the company's blast furnaces with its open hearths. It was originally designed for Cooper's E50 loading. In 1950, the River Terminal Railway Company strengthened this single-track structure. Subsequently all of the stringers in the Scherzer Rolling Lift span and approach spans were strengthened by adding cover plates to the top and bottom flanges. The floor beams and trusses in the life span were likewise strengthened. These improvements were made while the bridge continued to carry normal railroad traffic. When completed the bridge exceeded the load carrying capacity of any railroad bridge in the country. The dual 1560-ton hot metal cars require utmost safety and pose unusual loading conditions on the bridge. Hazelet and Erdal, Chicago, acted as consultants on the strengthening work. Leonard Larson, Chief Engineer of Republic Steel, and E.J. Lisy, Mayor of Maple Heights, and engineer for the River Terminal Railway Company, reviewed the plans and supervised the field operations. The Bethlehem Steel Company contracted for the work, using high strength steel.

Although there are more lift bridges on the river, we need not discuss them all. In a river trip of only few miles one can see movable bridges of all of the principal types and in addition can witness the evolution of movable structures. The city is fortunate in having a specimen of an old swing span with its center pier, Scherzer rolling lift bridges (popular at the turn of the century), and jackknife bridges (original built from the early 1900's), the

trunnion bascule, notably of the Strauss type and finally the modern vertical lift. This is truly and unique experience which Clevelanders and visitors to the city should enjoy when exploring the Flats.

A postscript might be in order to mention the men who operate and maintain the movable bridges in the valley. Their job is a lonely one: even the view can become boring. The bridges are all subject to the prior demands of water traffic which call for the bridges to open upon signal. (A list of the bridges and the rules for opening may be found on the Fold Out).

Since most of the bridges are manned twenty-four hours a day, year round, several shifts are required for each bridge. In the case of the vehicular bridges, a bridge operator, stationed in the control house at the center of the bridge above the roadway, actually runs the mechanism. The "end man" is stationed at the end with the most traffic, to act as eyes for the operator and to flag down the speeding motorist or to make sure no pedestrian gets a ride (deliberately or by accident). The boat's signal for opening the span over the main river is one long and two short whistles; for opening the two bridges over the old riverbed, one long, one short, one long, one short. Then the operator on the movable bridge, which is equipped with a whistle synchronized with a white light, will answer with a long, and a short whistle, plus a light signal. If a bridge cannot be opened immediately, three blasts of the whistle and the light will be given as a check signal. During certain rush hours, the bridge operator has to alert, and, while the current in the river is running, he knows not only the exact location of each bridge and the depth of the water under it; he also knows the type of bridge, its vertical clearance and the clear width of the open span.

When a lift bridge is to be opened, a series of steps take place. The traffic lights turn to red, the alarm bell clangs, and the gates are lowered. Then the barrier cable is lowered, which will stop a vehicle from plunging into the river. Next the bridge lock is drawn that allows the bridge to move. A switch can be energized that will raise the bridge. Interlocks prevent premature movements. As the bridge rises, the operator gets a ride. When the span reaches, full height a guide tells the operator the height of the opening, and automatic stops prevent override. When the navigation lights turn from red to green over the channel, the ship can pass.

The bridge motors actually turn a drum mechanism that literally pulls the bridge up and down by the cables. The counterweight and cables are used to balance the bridge. In fact, compensating cables are used to adjust even this weight change. In spite of the mass of several thousand tons, the bridges move very easily and have ample power. Most bridges have two

motors, although one is adequate. Most have a gasoline motor-generator of auxiliary means as standby in case of power failure.

The six city movable bridges are part of the over 300 bridges that fall under the responsibility of the City Engineer's office. The top priority is to keep the six movable bridges in operations. The bridges, being electrically operated, must be constantly inspected to ferret out malfunction and to repair the controls, to replace the navigation lights and to keep the motors in working order. Each bridge has its own peculiarities, and the newest movable bridge is eleven years old. Being movable, the bridges have to be oiled and greased on a routine basis. And a general construction foreman coordinates all maintenance of the city's bridges.

Repairs to the deck, railings, expansion plates and other structural steel are done by the steel worker foreman and his crew. The towers of the bridges move inward towards the river, and, coupled with expansion of the span, the bridges appear to grow -- which requires instant modification of the end plates and guides. In summer the operators on the West Third Street Bridge are often seen watering down the end -- not to keep the down, but to keep the steel cool so the bridge does not bind.

The chief bridge operator schedules the work force and steps in for unexpected absences. Each bridge has its own support facilities, and the operators do their own housekeeping. All of the men are motivated by a high degree of responsibility and have long years of service. In winter a reduced work schedule allows for earned vacations, to be taken when navigation is curtailed.

There have been amusing experiences as well as tragic ones. The Center Street Bridge, as the oldest, is a swing bridge. The long end and the short end can swing in either direction, short going around. When a boat passes the operator opens the bridge so that he can follow the boat when he is closing the draw. This way, traffic is accommodated with less delay. On occasion, he overshoots, and takes the fence down at the old Fireboat Station, now the International Longshoremen's Union Office. This bridge operator usually is the first to observe the suicides from the Superior High Level Bridge. The Columbus Road Bridge was the scene of an unusual accident when a pedestrian one dark night climbed under the barrier, sat on the sidewalk, and let his feet dangle when the bridge came down. One night the Center Street Bridge operator heard calls of distress and finally realized that a man was trapped on the B. and O. Bridge (No. 3) which was in the raised position. Evidently he was walking across the railroad bridge when the operator went off shift. Since no trains were scheduled, the bridge was

raised for the night and our pedestrian had an unwelcome ride. The Fire Department rescued him.

Once a dump truck body opened up on the Eagle Avenue Bridge and demolished the operator's control room -- with the operator inside. He was not seriously injured, however. A similar accident occurred on the West Third Street Bridge. The No. 1 bridge at the mouth of the river recently has had two accidents. The span was raised when an engine ran through the block signal and hit the west counterweight. The undercarriage passed under, shearing the engine and cab completely off, killing the crew. A detailed car recently was dragged along through the span, tearing up the steel. This accident required extensive replacement of main members. A bridge of lighter construction might have completely collapsed. Repairs were made by re-routing the trains during daytime.

Constant maintenance and excellence of engineering have made these structures endure for decades. Only changes in the use of the river have been responsible for replacement of most of the bridges.

Chapter 4

THE RAILROAD ERA IN CLEVELAND BRIDGE HISTORY

As the Ohio-Erie canal made Cleveland the focal point of northern Ohio transportation in the 1820's, so the railroad era, beginning in the 1850's left a lasting mark on the growing city. The success of the canal in providing an exchange of goods and service was not lost upon the railroad promoters who quickly discovered the advantages of rail, and the disadvantages of water. The railroads brought industry and prosperity to Cleveland in the 1870's and 1880's, although they had their start as early as the 1850's. At first many people were reluctant to accept this new form of transportation. The industrialists were the first to see the commercial possibilities of rail. By the 1880's seven railroads served the city. To stimulate passenger service, railway guides were printed in the 1850's, among them *The Ohio Railway Guide* (1854), which described in extravagant terms the delights of rail travel and the sights to be seen along the way, including the bridges.

It may be best to start with the origins of the lines now entering Cleveland. Located in the Western Reserve of the northwest territory, Cleveland was reached with difficulty by land routes along the shores of Lake Erie or by water from Buffalo. Not until the Ohio Canal was opened in 1827 did a north-south route move goods from inland state to market. Ohio granted charters to railroads, by act of the Legislature, to meet the increasing needs of the state for improved transportation, because the canals, funded by the state of Ohio, were found to be a financial disaster, in spite of the fact that they had moved substantial tonnages and people over the 600 miles of mainline canals in the state.

Although the foresighted Canal Commissioner former mayor of the village of Cleveland, realtor and lawyer, Alfred Kelley, obtained a franchise for a Cleveland, Columbus and Cincinnati Railroad in 1836, his was not the first railroad in Cleveland.

The Cleveland and Pittsburgh Railroad, organized in 14 March, 1836, was the first one to serve Cleveland. A group of businessmen formed the Cleveland, Warren and Pittsburgh railroad to build a railway from Cleveland

to the Ohio River and on to Pittsburgh. These men chose the route judiciously, for it eventually became one of the heaviest traveled routes in the nation. It still carries iron ore from docks on the lake front to the mills of Pittsburgh. The railroad had financial troubles, and in 1845 reorganized, eliminating Warren from its name. Still in trouble, at a public meeting on 23 March, 1847, it was decided to ask Cleveland residents to back the enterprise with public funds. In an election held in April the electorate voted to contribute \$200,000 of the city funds for stock to aid in construction.

It took another three years for the road to reach Hudson, and another few years before track was laid to Pittsburgh. On 4 March, 1852, the mayor of Cleveland and the entire City Council boarded a train and rode to Wellsville on the Ohio River, where they joined in a three-day celebration. ³⁶In 1864 the C. and P. Railroad replaced a wooden trestle across Tinker's Creek with a 200-foot long, 20-foot wide masonry arch bridge. The four arches were approximately 50 feet wide. In 1901 the line abandoned the viaduct.

This railroad is still in existence as it was leased by the Pennsylvania Railroad for 999 years. The C. and P. eventually became the main line of the Pennsylvania, from Cleveland to Bedford, Ravenna, Alliance, Steubenville, Wheeling and Pennsylvania.

The C. and P. took an easy route from the lakefront passenger and freight station erected on city-owned property, i.e., "The Bathe Street Tract" set aside by the city fathers for navigation and commerce at the mouth of the Cuyahoga River. Climbing from the lake level and crossing Euclid Avenue at Wilson Avenue (now East 55th Street) a few farsighted people protested that this doomed Euclid Avenue, and further objected to the loss of access to the shoreline. Leonard Case, with large real estate holdings east of Case Avenue (East 40th Street) promptly built an "industrial park" to be served by the railroad. At Warner Road, the railroad followed Mill Creek southeast. The only bridge of note was a stone arch over Tinkers Creek in Bedford -- still in use -- although now widened to double track. In 1911, the Pennsylvania Railroad built the ore docks on Whiskey Island at a cost of \$3,000,000, and crossed the Cuyahoga on joint trackage with the New York Central, each using its own single track on a shoo-fly arrangement. Not until the present lift bridge (discussed in Chapter III) was built did the bridge become double-tracked, where it still shared track rights, although now both roads belong to Conrail. About 1912 the Pennsylvania Railroad spent several million dollars in building steel girder bridges in Cleveland.

The need for east-west movement promoted a Cleveland, Painesville and Ashtabula Railroad to the east. This original road to the state line

opened in 1852. The successor was the Lake Shore and Michigan Southern, formed in 1869 by merging the Michigan-Southern and Northern Indiana Railroad (Detroit to Chicago), with the Cleveland and Toledo and the Buffalo and Erie Railroads into a system extending from Buffalo to Chicago. This railroad was principally a passenger road to provide transportation to the growing west. The Lake Shore and Michigan Southern became the water-level route between New York and Chicago. When acquired by Vanderbilt, it crossed the Cuyahoga River on a swing bridge at the mouth of the river. The road then headed southwest to Berea, to avoid the deep Rocky River gorge. Here the railroad crossed over the east branch of Rocky River on a four-arch stone masonry bridge, made from local sandstone. Berea was famous for the manufacture of grindstones and for its stone quarries. The original bridge is still in use, but widened with concrete side spans. Another four-span stone arch bridge at Painesville crossed the Grand River at a height of 90 feet. When this bridge became obsolete, it was replaced in 1909 by a four-track, single concrete arch. Proportioned as a solid masonry arch, reinforcing steel was used to unite the concrete into a solid monolith.

A classic stone masonry arch built in 1898 for the successor to the Lake Shore and Michigan Southern Railroad crosses over Liberty Boulevard in Gordon Park. The bridge was designed by Charles F. Schweinfurth, eminent Cleveland architect, whose Romanesque buildings are now to be found on the register of the National Society for Historic Preservation. It is a double-track bridge, 150 feet long and 40 feet wide. This bridge is reinforced according to the Melan system. Professor Joseph Melan (1853-1941), a Viennese, became an international figure in the engineering world. He simplified structural analysis and contrived a novel and economical construction method. His principal was to construct a relatively light fabricated steel arch between piers, which served as a centering to support the forms for pouring concrete and as stiff reinforcement, to which, when necessary, additional bars could be added. Melan's system was used in building the first concrete arch—a twenty-foot span in Golden Gate Park in 1889. This structure may have influenced the design of the Schweinfurth bridge. However, unlike the Cleveland bridge, the concrete of the Golden Gate span had an imitation, rough-stone finish. Schweinfurth's use of natural stone with colored decorations and ornaments is unique.

As reinforced concrete became popular, in the early decades of the 1900's, the New York Central erected a fine example at Willoughby, over the Chagrin River. It is a massive ribbed-arch, designed by Samuel Rockwell, Chief Engineer of the railroad, assisted by O.W. Irwin. Several stone arches exist in Elyria and Wakeman.

The Cleveland, Columbus and Cincinnati Railroad, although chartered as early as 1836, did materialize until 1845. Mayor Alfred Kelley, pushed the completion of the road. A \$200,000 stock subscription from the city helped considerably. William Ganson Rose tells us that at one time the C.C.C. Railroad was built by the physical labor of its president, directors and financial backers to keep the franchise active.³⁵

The Cleveland, Columbus and Cincinnati Railroad terminated on the lakefront, where it crossed the main line of the Lake Shore and Michigan Southern to reach the roundhouse and docks. The railroads shared a "Union Station" on Front Street between West Third and West Ninth. The C.C. and C. railroad crossed the Cuyahoga River and the Ohio Canal near where the Carter Road Bridge is now. By following the Walworth Run to Clark Avenue, it reached Berea adjacent to the Lake Shore and Michigan-Southern tracks. There the tracks crossed Rocky River on a stone-arch bridge. Although abandoned, and with one arch removed, the single track structure still spans river. Its replacement, a reinforced concrete structure built in 1909, is virtually a duplicate of the original bridge.

With discovery of oil in Pennsylvania, and the need to transport it to markets, the Cleveland and Mahoning Railroad was founded. Chartered in 1848, the right-of-way for a broad-gauge road was acquired, and the railroad reached Youngstown by way of Warren in 1857. Transporting coal by rail from the Warren area put the Pennsylvania and Ohio Canal and important tributary of the Ohio-Erie Canal, out of business. The Atlantic and Great Western Railroad, imposing in name only, leased the Cleveland and Mahoning in 1863 for a direct rail line to New York City.

The railroad crossed the Cuyahoga River at Broadway, adjacent to the Standard Oil Company, and followed Mill Creek and the Kingsbury River valleys into Cleveland. The docks for the transfer of the coal to lake freighters were situated along an extensive river frontage north of Columbus Road. For years a coal loader operated under the High Level Bridge, to serve the freighters that were coal-fired.

Continuing northward, the railroad crossed under Detroit Street. Here may be found the oldest bridge in Cleveland still standing and in use. It was originally built for the Cleveland and Mahoning Valley Railroad Company and dates from 1853. The bridge-support consists of skewed double stone arches, each 15 feet wide, with the tracks on a curve. Both arches are about 17 feet from the top of the arch to the ground. The overall length is about 55 feet center-to-center of abutments. Curving under the Superior Viaduct, the railroad continues to the dock still referred to as NYPANO Docks, one of the railroad's many names.

After the Civil War, the Erie Railroad leased the Atlantic and Great Western Railroad to get to Chicago. The latter went into receivership in 1880 and was recognized as the New York, Pennsylvania and Northern Ohio Railroad (NYPANO) and leased again to the Erie in 1883. In 1896 the Erie acquired the NYPANO by stock purchase. In 1938 the Erie was in financial trouble and bought the Cleveland and Mahoning stock to save rentals of the leased line.

The Atlantic and Great Western obtained track rights from the C.C.C. and St. Louis line and ran passenger trains to the station under the Detroit-Superior Bridge, now occupied by "Diamond Jim's restaurant. Why the Atlantic and Great Western did not enter the Union Station is not known.

It is interesting to note that General John H. Devereux, a Cleveland, was credited with saving the Union during the Civil War, by virtue of being Superintendent of Military Railroads. As General Superintendent of the C. and P., President of the L.S. and M.S. in 1869, President of the A. and G.W. and of the Big Four in 1876, he had excellent opportunity to weld four lines into one unit, one hundred years ago, and he failed to act. Devereux is also interesting because of a collection of engineering drawings which he made in the 1850's and 1860's. This collection is in the Western Reserve Historical Society. The drawings include many bridge structures, both iron and masonry. One drawing is labeled "Cuyahoga Bridge", a Howe truss, but its location has never been established.³⁷

The Baltimore and Ohio railroad, the oldest in the country, was incorporated in 1827. It had by 1853, crossed the Appalachians as far as Wheeling. Some of the greatest engineers of the latter half of the nineteenth century were employed by this road: Jonathan Knight, Benjamin Latrobe Jr., Wendell Bollman and Albert Fink.

In 1909 the B. and O. acquired two small lines to extend its trackage into Cleveland. One of these lines was the Cleveland and Valley Railroad, organized in 1871 to extend rail by way of Akron and the northern end of the Ohio-Erie canal. For the right-of-way and for a 99-year lease the B. and O. paid \$265,010. Bankrupt in 1880, the railroad was recognized in 1894 as the Cleveland Terminal and Valley Railroad with a branch line to Newburgh. The second line was a small one serving Lorain from Tuscarawas Valley via Medina. It was extended into Cleveland in 1895 by way of the big Creek Valley and terminated at Literary Street, where it connected with the Erie. All the trackage that the B. and O. acquired was single-track and has so remained to this day. The Baltimore and Ohio crosses the Cuyahoga River at West Third Street and Quigley on a bascule -- one of the twin bridges. The fixed span at Denison Avenue is above the navigation limit.

The former Wheeling and Lake Erie Railroad started out as the narrow gauge Conotton Valley Railroad, which ran from Canton to Cleveland. In 1883 passengers were discharged at Ontario and Huron in 1882 to a temporary depot at Commercial Street. A freight station without trackage and some bridge abutments remain. After reorganization in 1885 as the Cleveland and Canton, the now standard gauge road was extended to Zanesville. Several mergers with some additional small roads extended service to Chagrin Falls. Renamed as the Wheeling and Lake Erie, the line opened up coal fields in the Zanesville area. The road in Cleveland is single-track and is now part of the Norfolk and Western System. The bridge crossing the Cuyahoga River is not used.

The history of "Nickel Plate Road" is most interesting. The name "Nickel Plate," which was coined by a Norwalk editor, intended to indicate a superiority much as we use the term "chrome plated". The road was formerly known as the New York, Chicago and St. Louis Railroad. The line was to parallel the Lake Shore and Michigan Southern route from Chicago to Buffalo. Organized in 1881, the line sold \$16,000,000 of stock in three days. It was built in twenty-one months! In order to traverse the City of Cleveland, two small railroads -- the Rocky River Railroad (from Lakewood to West 58th Street) and a part of the old Cleveland, Painesville and Ashtabula Railroad -- were bought for the right-of-way. The latter line, popularly named the "dummy line", was so-called because at first the trains were run with "dummies" -- steam locomotives with boilers entirely concealed to resemble streetcars. A multiple-span timber trestle bridge, built about 1865, carried the dummy line over Kingsbury Run near East 55th Street. But soon the Nickel Plate was erecting major wrought-iron viaducts to replace the cumbersome wooden structures. As loads increased and production of iron became practical and economical, the iron truss bridge dominated the scene. By the 1880's all major railroad bridges were of wrought-iron.

The Nickel Plate hired the best engineers available to execute its determination to connect Chicago and New York City by the shortest route. To cut the running time, the Rocky River gorge was to be spanned at the lake by a high trestle, as was also the Cuyahoga Valley. The bridge at Rockport, (now Rocky River) was a multiple-span Bollman-truss bridge, built in 1882, It was 673 feet long and 88 feet high -- a remarkable structure in its day.

A viaduct over the Cuyahoga River was likewise a wonder in its time. Its length of 3,000 feet contained 2,500 tons of wrought-iron. The river span was a 222-foot swing-draw. The first plan was to cross the river with a short,

low-level bridge and to bore a tunnel through the west bank. However, this plan was dropped in favor of a double-track iron bridge, 68 feet above the valley. Work on the one hundred odd masonry piers was completed in May of 1882; but it took most of the summer to erect the iron towers and girder spans. The Cuyahoga span was the last link in the system to be completed. And at 6 p.m. on 25 August 1882, the drawspan was fitted into place. The structure was built by the Cleveland Car and Bridge Company, in accordance with plans designed by W.M. Hughes, designing and supervising engineer of the movable span. Over one hundred sheets of detailed drawings were prepared. At first the draw was manipulated by hand and took four minutes, but later steam-power opened the span in about one minute. The *Cleveland Herald* reported that "when the massive structure was moved for the first time, it swung around easily without friction or jar, to the satisfaction of William Hughes and Henry Claflin, designer and builder, who were anxiously watching it."³⁸

Three days after construction of the swing span had been completed, the first train passed over the viaduct. The *Bellevue Local News*, on 2 September, 1882, reported the event:

Not a jar or vibration not calculated for in the construction of this great piece of engineering and mechanism was perceptible. The locomotive, as it crossed the draw going towards the eastern end had got fairly on its way, heralded in triumphal blasts from its whistle the tidings of the tactical completion of the great iron thoroughfare...[sic] aware of what is going on, by the sight of No. 20 as she steamed away, high overhead, a few moments to transverse the 3000 feet of tracks stretched across the valley on its girders of iron. Although it was to be expected, yet the sight of the locomotive and its load brought multitudes out to see it."³⁹

This construction marked the completion of the Nickel Plate Road between Buffalo and Chicago. The first passenger train, from Chicago, entered Cleveland at Rocky River on 31 August 1882. The *Cleveland Herald* described the event:

The depot was beautifully decorated with flags and bunting, and a large crowd awaited the train as it dashed up. An P. Eells met the party here and accompanied them into Cleveland. The entrance of the road into this latter city is by way of a wonderful system of bridges, viaducts, and grades, and evidence of the fact that a great triumph in engineering has been accomplished. The system of bridges embraces more than 3,000 feet, and carries the tracks through the heart of the "Flats" above all streets and roads."⁴⁰

On 23 October, 1882, the first regular passenger train left in Chicago for Cleveland, and at the same time a train started westward from Cleveland.

The train started its journey by rumbling slowly across the great viaduct over the Cuyahoga Valley, passing first at Columbus Street. Having passed under Lake shore and Michigan Southern through an arch, the train ran almost in a beeline to Rocky River, pausing an instant on the east bank before crossing the "gigantic" bridge to the west side. Then it drew up in front of a neat little depot which has been christened River Bank, directly opposite the magnificent country home of Dan P. Eells."⁴¹

The viaduct over the Cuyahoga was twice remodeled, in 1904 and in 1944. George Roberts, President of the Pennsylvania Railroad and outstanding engineer, expressed admiration for the design and construction of the Nickel Plate's iron bridges. These were engineered to withstand 10 to 15 percent greater stress than the bridges on the Cincinnati Southern, then reported to be the best-built in America.

The Nickel Plate has the best grade and most direct route across northern Ohio. Both the New York Central and the Pennsylvania cross the Cuyahoga River at near lake level. These roads also cross the city streets on overhead bridges, hence have steeper ruling grades. The Nickel Plate, now part of the Norfolk and Western crosses the Cuyahoga at 68 feet above water and passes under Cleveland streets both east and west.

After the first passenger train had completed its run, the New York Central bought controlling interest in the stock and manipulated the line until 1915, when the Attorney General ordered it sold under the Clayton Anti-Trust Act. The Van Sweringens purchased control of the railroad and with it the unused right-of-way that is now the roadbed of the Shaker Rapid Transit. They built the Cleveland Union Terminal complex, which opened in 1930 (without the Pennsylvania Railroad) serving the New York Central, the Big Four, the Nickel Plate and the Shaker Rapid. The Baltimore and Ohio and the Erie entered at a later date.

In order to reach the Public Square Terminal, a new viaduct and trackage were needed. The impressive Cleveland Union Terminal Railway Bridge, a fixed, high-level structure, crosses the Cuyahoga River directly south of the Detroit-Superior Viaduct, at Irish Town Bend. Built in 1929, this four-tracking railway bridge carries two Cleveland Union Terminal tracks and two Cleveland Transit System (Rapid Transit) tracks. Except for the main span, which is a deck-truss over the river, the thirty spans, are of the deck plate-girder type, and vary in length from 49 feet to 270 feet. The foundations of the structure are about 150 feet below the valley floor, being the depth of the post-glacial material that overlies the native shale. The 3,350-foot structure is owned by the Cleveland Union Terminal Company. Trains entering the station were originally pulled by electric locomotives.

The bridge was never used to capacity, the magnificent train concourse is now a tennis court, and the train platforms are now a parking lot. The Cleveland Transit System uses the spare tracks.

The Cleveland "Short Line" Railroad, popularly known as the "Belt Line", was built about 1910 by the New York Central Railroad to interconnect all the rail lines entering Cleveland. This connector railroad is double-tracked. Although it was necessary to cross over or under a good many streets, there are no street crossings. The river was spanned on a 100-foot high structure near Van Epps and Schaaf Roads on the west to East 49th in Cuyahoga Heights Village on the east.

The Newburg and South Shore Railroad serves the steel mills the Cuyahoga Valley and connects with the Belt Line at Harvard Road. This line and that of the Cuyahoga Valley Railroad are short service railroads. The River Terminal Railroad serves Republic Steel, the Cuyahoga Valley Railroad serves Jones and Laughlin, and the Newburgh and South Shore Railroad, the United States Steel Company.

Disaster Leaves a Legacy

In the latter half of the nineteenth century, the railroads became the nation's greatest bridge builders, as they demanded cheap and effective stream crossings. As the railroads grew, the number of bridge failures mounted in the 1870's and 1880's. One of these failures happened near Cleveland, at Ashtabula -- a disaster that had world-wide repercussions. The story of this bridge failure is worth retelling.

The story begins with William Howe, a Massachusetts housebuilder and millwright, whose invention of the Howe truss, which he patented in 1840, brought about a near monopoly in railroad bridge building. The appearance of this truss marked the end of bridges built entirely of wood and the beginning of the use of iron. Designed primarily for railroads, it could be quickly and cheaply built of the greenest wood. Its chief innovation in design was the introduction of wrought-iron vertical rods that could be adjusted and readjusted long after the bridge was in service. The rods had screw-ends with washers and nuts. The parts could be easily shipped and the rods and truss timbers prefabricated, making possible quick assembly. In the Howe truss, timber was used for the chords and for the web diagonals. Iron rods used for the verticals were in tension, and the wood diagonals were in compressions.

After its introduction it became the standard truss for railroad bridges and remained preeminent in the field for thirty years. This popularity was not accidental. A group of determined New Englanders took every opportunity to praise the truss. It was no coincidence that they also happened to control the sales rights of the Howe truss. Howe himself was, as Richard Sanders Allen tells us in his *Covered Bridges of the Middle West*, "content to be just the inventor, a friendly man who like music and the good things in life which his bridge royalty payments brought him."⁴²

But Howe's brother-in-law, Amasa Stone, Jr., was more ambitious. Although only a young cabinet-maker who was breaking into heavy contracting, he foresaw the possibilities in a bridge design that the expanding railroads would need. So, together with Azurich Boody, a Canadian-born ex-school teacher and railroad brakeman. Stone scraped up \$40,000, and in 1841, bought exclusive rights for building Howe truss bridges in New England. Again, in the words of Richard Sanders Allen, "The two formed a company to build bridges, employed their relatives and friends to learn to work, and laid the foundation for a dynasty of bridge-building firms that would blanket the nation."⁴³ But after a few years with Boody, Stone and three brothers and nearly a dozen other men related by marriage, formed their own company.

In 1849 Amasa Stone moved to Cleveland, where, with two new partners, he contracted for all aspects of construction for the Cleveland, Columbus and Cincinnati Railroad. This line became a showcase for the Howe truss; most of these bridges were of the deck type on masonry piers. With the original owners now railroad magnates, the rights were sublet to others, Thatcher, Burt and McNary took over the work in Ohio. A younger Stone brother, Andros, with his brother-in-law, Lucius B. Boomer, founded in Chicago the firm of Stone and Boomer. They soon were fabricating Howe trusses for the western railroads. During the 1850's Stone and Boomer erected bridges on twenty-four different railroads in Illinois, Wisconsin and Missouri.

Meanwhile in Cleveland, Amasa Stone became President of the Lake Shore and Michigan Southern Railroad and the city's first millionaire. At this time the Lake Shore crossed the deep gorge of the Ashtabula River on a wooden trestle[Figure XVIII]. Amasa Stone, who, with some justification considered himself a bridge designer, sketched out a new bridge. Basically it was old Howe truss with more than twenty years of success, but all of the components of Stone's new bridge design were to be made of



Figure XVIII. Ashtabula Bridge on the Lake Shore and Michigan Railroad, scene of one of the worst railroad disasters in U.S. history.

wrought-iron. A company engineer ventured to question the wisdom of this innovation, but Amasa Stone would not listen. The length of the structure was 165 feet between massive stone abutments, It was 191/2 feet in width and the truss depth was 20 feet. "Mr. Stone's pet bridge" had tracks on the deck, which were about 70 feet above water. For thirteen years the bridge carried all the heavy traffic of the railroad's main line.

Shortly after Christmas, 1876, a northeast gale blowing in from Lake Erie piled snow along the shore. Westbound out of Buffalo came the Pacific Express, two and a half hours late. In the village of Ashtabula no persons stirred out of their homes, except those few whose work kept them out in the cold. An employee of the road, sitting by the fire in his house near the tracks, heard a series of terrific crashes, sounding like explosions. He jumped to his feet when his wife rushed into the room, crying "My God, Henry; No. 5 has gone off the bridge!" Quickly putting on his coat and boots, he ran to the bridge and saw the crumbled mass of cars and iron beams lying at the bottom of the gorge. The train -- composed of two locomotives, two express cars, two baggage cars, two day-passenger coaches, a smoking car, and a drawing-room car, and three sleepers -- was filled with holiday travelers.

As the train pulled onto the bridge, Dan McGuire at the throttle of the lead locomotive heard a thunderous report, felt the bridge sinking, and, with great presence of mind, opened the throttle valve and drove his engine full steam ahead. Although he declared that "it was like going uphill," he reached the other abutment and was safe. But one by one the other cars fell through the gap into the gorge below. Of the 157 persons aboard, only one survived the plunge and the fire that ensued. Eighty-three were killed, drowned, or burned to death on the spot.

Charles Collins, Chief Engineer of the railroad, who was highly esteemed by members of his profession, tendered his resignation, saying: "I have worked for thirty years, with what fidelity God knows, for the protection and safety of the public, and now the public, forgetting all these years of service, has turned against me." However, his resignation was not accepted; the Board of Directors gave him a vote of confidence. But a few days later Collins committed suicide, as a consequence of the attitude of both public and press who blamed him for the disaster.

This disaster carried reverberations throughout the United States. The Iron Age voiced the fears of the people in the statement, "We know there are plenty of cheap, badly built bridges, which the engineers are watching with anxious fears, and which, to all appearance, only stand by the Grace of God." The Nation for February declared: By such disasters and by shipwreck are lives in these days sacrificed by the score, and yet except through the clumsy machinery of a coroner's jury, hardly anywhere in America is there the slightest provision made for inquiry into them. Here are wholesale killings. In four cases out of five someone is responsible for them; there was a carelessness somewhere, a false economy has been practiced, or a defective discipline maintained, or some appliances of safety dispensed with, or some [one] has run for luck and taken his chances.⁴⁴

The coroner's verdict of the Ashtabula disaster put the blame upon the design of Amasa Stone. Charles Collins, in his testimony, stated that "The bridge was in the nature of an experiment." So public opinion turned against Amasa Stone. His money was of little use. Six years later he took his own life. While there was the possibility of the failure of one or more of the cast-iron angle-blocks, this bridge was unusual in design. Most Howe trusses built in the East and the Midwest had two diagonal braces and one counterbrace in each panel, with two vertical rods between. Often the end panels had three rods. The testimony stated that there were but five Eastern bridges not so designed, and might be called "Single Howe", inasmuch as they had but one diagonal brace and one or more panel rods. The Ashtabula bridge failure was due to the insufficient diagonal bracing in the truss

design. The dead load caused by heavy members and by the snowstorm were factors. Although the bridge was badly designed, the chief reason for the failure was the general lack of knowledge in handling the new material, wrought-iron.

Three benefits were derived from this disaster. The railroad companies thereafter discarded completely the use of cast-iron. Attempts were made to lighten the weight of structural members. Most importantly, the railroads realized the need to hire specialists in bridge construction -- a need which led to the establishment of private and independent firms of civil engineers especially equipped to handle the design and supervise the construction of bridges.⁴⁵

A local benefit grew out of this disaster. Amasa Stone, with some associates, provided the money to purchase a large piece of property on Euclid Avenue adjacent to Case School of Applied Science. This enabled the Western Reserve Academy at Hudson, Ohio, to move to Cleveland in 1881. Stone made no stipulation. The school was to be known as Adelbert College of Western Reserve University. Recently the Case Institute of Technology and Western Reserve University merged to form Case Western Reserve University.

Thus a major bridge disaster left indelible marks on the local history of the Western Reserve and upon the nation.

In all parts of the world the railroads have played a large role in the history of development of bridge-building. Especially significant was their contribution in industrial centers like Cleveland. Although this era seems to have come to a close, and few great railroad viaducts will probably be built in the future, the railroad will remain an essential mode of transportation for certain industrial and commercial purposes; and existing railroad bridges will have to be maintained in good repair.



Figure XIX. Forest Hills pedestrian bridge, near site of John D. Rockefeller's home.



Figure XX. The graceful concrete arches of the Monticello Bridge.

Chapter 5

ORNAMENTAL AND PARK BRIDGES

Cleveland is divided into the East Side and the West Side by the Cuyahoga River, which flows through the heart of its downtown. While it is the only river made navigable for lake freighters, there are two other rivers of smaller watersheds that also empty into the Lake Erie. To the east of the city flows the Chagrin River, and to the west Rocky River. Both of these pass through fine residential and park districts in suburbs surrounding Cleveland. In addition there are lesser streams -- such as Tinker's Creek, Euclid Creek, Big Creek and Doan's Brook -- that have been bridged, for most of the water courses are in well-defined valleys.

Cleveland has long been famous for its system of parks, which form a green ring around the city's environs. As early as 1915 Henry Grattan Tyrrell wrote that Cleveland's beautiful system of parks, including Wade, Rockefeller, Gordon and Edgewater, are known all over America.⁴⁶ The Cleveland Metropolitan Park Board has jurisdiction over this continuous band of parks (parks which contain picnic grounds, museums, sports facilities and nature trails) known as the "Emerald Necklace." Over the years the engineers have been called on to build handsome bridges that fit the natural environment. Most have met the approval of the public. There are numerous examples of small, ornamental bridges that are esthetically satisfying.

The pioneering work that produced esthetically pleasing bridges over the Cleveland Parkways was the result of the efforts of William A. Stinchcomb, the Chief Engineer of the Cleveland Park Board until that agency was integrated into the city of Cleveland politic. Mr. Stinchcomb pursued his goals in the creation of the "Emerald Necklace" with the help of the Cleveland Metropolitan Park Board. This agency of countywide scope and with a Board of Directors, all of whom serve without pay, has been noted for its benevolence and dedication to public service. The Cleveland Metropolitan Park Board is renowned for its conservation efforts because of the leadership of William A. Stinchcomb; a monument commemorating his

achievements is in the Rocky River Reservation, the first of the acquisitions of the Park Board.

During the late 1870's and early 1880's, postcards of Cleveland featured a little ornamental bridge in a park setting at the Public Square. It had the distinction of being the smallest bridge in Cleveland, for its span was only fifteen feet long. It was a timber beam footbridge with an ornamental iron railing. The postcards showed a picturesque corner of the Square in the southwest section that included two small lakes, with a waterfall from the upper pond to the lower. In the center of the upper lake was a rustic fountain, and plying around it was a three-foot model of a passenger boat, called the E.B. Nock (named after an Ontario Street photographer) that was operated by a mechanical arm under the water.

Another interesting small bridge, this one built in 1896 but no longer standing, was to be found in Riverside Cemetery. It was a parabolic, two-hinged steel arch 142 feet long, with a total length of 300 feet. The arch had a rise of 27 feet; its depth was two feet near the ends and five feet at the crown, so that its shape was that of crescent. The middle section of the arch was a lattice web, whereas the ends had solid web plate. Henry Grattan Tyrrell found these plates the only flaw in an otherwise esthetically satisfying bridge.⁴⁷ This bridge spanned a lake and was built by the Cemetery Association for its eye appeal. The design was notable because the arch was erected with a crown hinge at the upper flange, the work of the Osborn Engineering Company, Cleveland's oldest engineering firm.

The most famous park bridges in Cleveland are the stone masonry arches over Liberty Boulevard (earlier called East Boulevard) in the oldest park system in Cleveland. Rockefeller, Wade and Gordon Parks were created in the late nineteenth century. There are four bridges of note, all of them designed by the famous Cleveland architect Charles F. Schweinfurth (1858-1919). After working in the New York office of Boston architect Guy Lowell, Schweinfurth moved to Cleveland in 1883 and opened up his own office, which he shared with his brother, Jules., Charles Schweinfurth's practice apparently started in high gear. His structures were characterized by unusual excellence of materials and by careful workmanship. Many stories are told of his tyrannical methods of supervision and of his disdain for economy. He numbered among his clients many Euclid Avenue millionaires. During his first year in Cleveland, he designed a palatial residence for Sylvester Everett, the streetcar baron, at the corner of Euclid Avenue and East Fortieth Street. During the ensuing years, he built many important structures, including the Samuel Mather House (which now belongs to Cleveland



Figure XXI. The Wade Park Bridge over Liberty Boulevard, designed by Charles Schweinfurth in 1900.

State University); Trinity Cathedral, in the Union Club, and Harkness Chapel on Case-Western-Reserve campus. His own residence, at 1951 East 75th Street has been recently restored.

The four Schweinfurth bridges over Liberty Boulevard are at St. Clair Avenue (1899), which is 120 feet long and 100 feet wide; at Wade Park (1899); at Superior Avenue (1900) which is 145 long; and at Gordon Park, built for the Lake Shore and Michigan Southern Railway (1898), which is a 100 feet long. For the Superior Avenue Bridge, John D. Rockefeller contributed the first \$100,000 to the city of Cleveland, because of the extra costs involved by the ornamentation. These bridges, in the Richardson style, look like massive Romanesque structures with solid barrel arches. Two of them are of rubble fill with stone facings of sandstone. One has arch rings of brick, and one is reinforced concrete (the Melan type) with stone facings.

Let us take a closer look at the Wade Park Bridge, built in 1899 [Figure XXI]. It is of brick, stone, and concrete. On 7 June, 1899, the chief engineer of the city was authorized to advertise for proposals to construct a bridge at Wade Park Avenue, crossing over Rockefeller Park. The contract was approved by the council on 28 June 1899, at a cost of \$61,164. The bridge crosses the valley of Doan Brook, which passes through a vaulted stone masonry culvert just east of the arch over the roadway. The single arch of 88 feet spans Liberty Boulevard; total length of the bridge is 220 feet; its width is 100 feet; and its height is 19 feet, 2 inches above the street level. It is of

yellow brick, faced with voussoirs of stone. The pylons, which receive the thrust of the arch, are below grade at each end of the bridge and are supported by concrete slabs poured around driven piles. At the top of the pylons are niches or overlooks, and there is a winding staircase on the south approach of the bridge-both of which add interesting architectural features...

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While the original Cleveland Park Commissioners engaged the city's outstanding architect for bridge design in the Gordon-Wade-Rockefeller Park chain, the bridges served in another manner. The parkway, extending from the lake of Cedar Glen, was separated from St. Clair, Superior and Wade Avenues, all important city arterial streets. The local access from the aforementioned as well as from the local streets is by a series of winding roadways from both sides, so that intersections were avoided. All this at a time when automobiles were still a curiosity!

The stone and concrete arches over Liberty Boulevard need attention, because some of the decorative stone work is showing neglect. Ironically, these bridges, built at the turn of the century, are capable of supporting higher loads than are the so-called "modern" bridges of the freeway system, for they were designed in the age of 50-ton streetcars [Figure XXII].

One final reference to a stone masonry arch. The Warren Road Bridge over Mill Creek was built in 1899. Its overall length is 72 feet, 10 inches; the arched span is 40 feet. The bridge contractors were Spillacy-Mayer and Carlisle.

But the stone masonry arch bridge was already an archaic construction technique in the 1890's. Superseding stone masonry was the material "concrete" and "reinforced concrete." Cleveland, at the end of the nineteenth century, and the beginning of the twentieth, played a significant role in the evolution of the use of these new materials. Concrete, with its potential for architectural treatment, demanded careful attention to esthetics and good design matters that were quickly realized by Cleveland engineers.

Concrete and Reinforced Concrete Bridges

Concrete was not, to be sure, a new material. It had been known and used by the Phoenicians, the Carthaginians, and especially the Romans. These ancient civilizations had a natural cement, a volcanic ash called by the Romans "Pozzuolana". In 1796 the English discovered a vein of natural



Figure XXII. Bridge over Rockefeller Park crossing Liberty Boulevard, also designed by Charles Schweinfurth.

cement on the Isle of Sheppy, in the Thames, and consequently named it "Sheppy stones" or Roman cement". John Smeaton used a concrete embodying these "Sheppy stones" in the building of the Eddystone Lighthouse.

In the United States natural cement was unearthed, in 1818, along the Erie Canal, a few miles east of Syracuse, by Canvass White, who used it in building the stone canal locks. But after 1889 the mining of natural cements declined rapidly, for an artificial cement called Portland Cement then appeared on the market. Its invention in 1824-25 is generally attributed to one Joseph Aspin England, who patented the material he labeled "Portland Cement" because it resembled Portland stone in color and in texture. This cement was imported to the United States as early as 1868, but its adoption was slow. The first American experiments in the manufacture of artificial cements were made at Coplay, near Easton, Pennsylvania, in the seventies, under the direction of David O. Saylor. At the Centennial Exhibition of 1876 in Philadelphia, samples of "Saylor's Cement" were displayed as novelty.

In 1867, M. Joseph Monier, a Parisian, began to use metal bars embedded in concrete, and so "reinforced concrete" made its appearance. In America the pioneer in reinforced concrete construction was William E. Ward, a manufacturer of bolts; but the first American to analyze correctly

the stresses in a reinforced concrete beam was Thaddeus Hyatt, a New York lawyer who in 1877 published a treatise on the subject.

It is apparent that the construction of concrete and reinforced concrete bridges was largely experimental in the United States during the late nineteenth century. At first, concrete was made to resemble stone masonry, with voussoirs and the usual classic ornamentation associated with the stone masonry. But soon it was realized that the new material demanded new design, new treatment -- and the ribbed arch with open spandrel design became standard. Gradually the members became thinner, more attenuated, until one could no longer mistake the material. This process, and the improvement of concrete, took about thirty years, starting in 1900.

Clevelanders may take pride in having witnessed some of this pioneer work. Two of its engineering firms in the first decade of the twentieth century contributed to this advancement. The Osborn Engineering Company and Wilbur Watson and Associates pioneered in concrete design. Many existing buildings and bridges in Cleveland attest to their skill.

A little concrete bridge for pedestrians was designed in 1906 for Brookside Park spanning Big Creek. This was the first three-hinged concrete arch built in America. It was the design of A.W. Zesiger, Assistant Park Engineer. This bridge was removed when a culvert enclosed the creek bed to increase the usable park area. However, another structure, patterned after the old arch, was erected nearby, in 1910. This bridge is at the entrance to the Bear Dens. It is a flat, semi-elliptical arch, with a span length of 82 feet between abutments. Like its predecessor, the concrete arch is reinforced. Overall length of the bridge is 108 feet, 6 inches. The roadway width is 266 feet, plus two 6-foot sidewalks. The bridge was built into the creek bed and rests upon solid shale. The hinges are built up of plates, angles, steel shafting, and cast-iron bearing plates, and are completely embedded in concrete. The railing is of concrete, faced with rubble stone, with the semicircular openings filled with wrought-iron grill work. The bridge is now used primarily by pedestrians. Plans of the bridge were signed by William A. Stinchcomb, Chief Engineer of the Park Commission.

Another bridge remarkable in its day was the Rocky River Bridge, built in 1910. It carried Detroit Avenue over Rocky River near its mouth, the fourth bridge to be built at this location. The first bridge was built in 1821. And in 1875 there was a timber trestle bridge, with two iron girder spans that crossed the river at low level [Figure XXIII]. In 1890 a high-level Baltimore deck truss was built with trusses 28 feet wide, and oak-plank floor, and stone abutments. Heavy interurban streetcars required its

replacement. The 1910 Rocky River Bridge, at the time of erection, held the world's

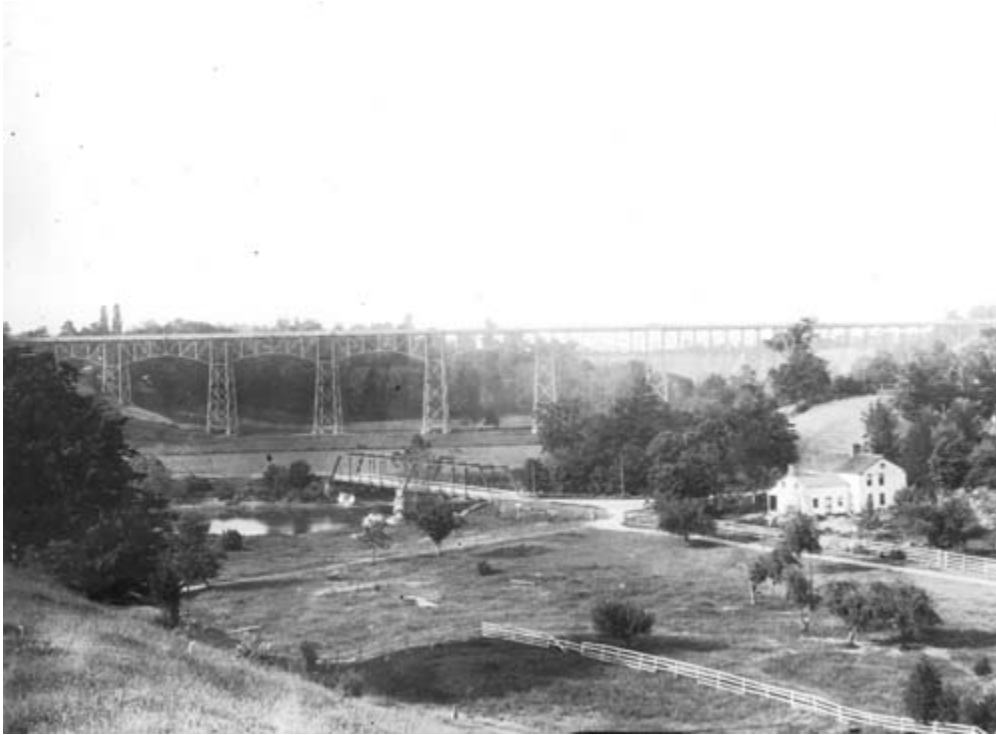


Figure XXIII. The old Lorain Avenue Bridge over Rocky River, engineered by F.C. Osborn in 1894.

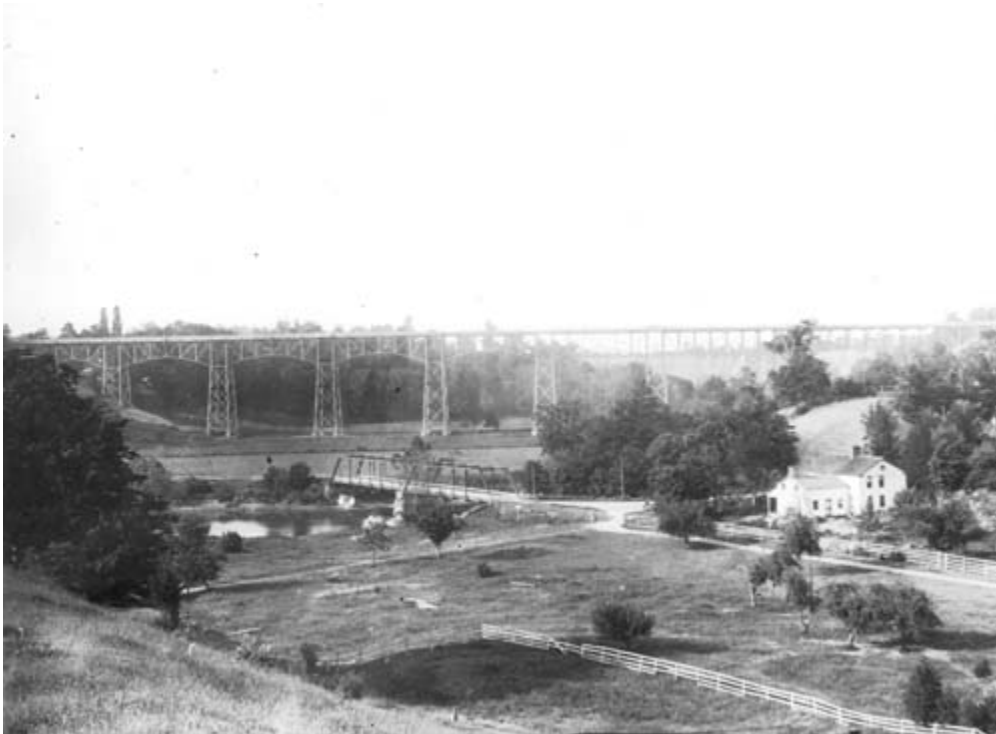
record for length of span for a concrete arch-280 feet [Figure XXIV]. The main span, with two arch-ribs 18 feet wide and 16 feet apart, was not reinforced. The five end-spans were 44 feet each. Overall length of the structure was 708 feet; its width 60 feet. It was an early instance of the two-ribbed, open spandrel type. The facing mixture, composed of carefully selected aggregate, was used for all exposed surfaces. The concrete columns and deck were used for the first time. The centering was designed by Wilbur J. Waston, consulting engineer; A.M. Felgate, County Engineer, designed the bridge under the direction of County Engineer A.B. Lea.

Wilbur J. Watson, who had formed his own firm in Cleveland in 1907, was a pioneer in concrete construction and in the next few years established a national reputation as an authority in this field. Shortly after the turn of the century, he was the first to recognize the possibilities of pre-casting bridge beams and slabs, as may be seen in his *General Specifications for Concrete Bridges* published in January 8, 1908. Included therein is a chapter entitled "Reinforced Concrete Unit Construction," in which he wrote:

When slabs, beams, girders, or other parts are made in units in an established factory, the

formulae given herein for the design and proportioning thereof may be disregarded, at the option of the Engineer, and the results of tests may be used.

In such cases all units shall be subject to testing under the direction of the Engineer at the Contractor's expense, the number of such tests and manner of testing to be agreed upon between the Contractor and the Engineer....⁴⁹



XXIV. Rocky River Bridge, ca. 1910, showing the steel centering arches that were one of Wilbur Watson's innovations.

The Rocky River Bridge was demolished and on 8 September, 1980, a new Rocky River span was opened. It is a multi-span, steel structure, with five lanes. Total length is 625 feet.

Other early notable multiple-span concrete bridges in the Cleveland area are the Brooklyn-Brighton Bridge over Big Creek (1916), the Hilliard Road Bridge (1926), and the Brookpark Bridge (1933).

The Brooklyn-Brighton Bridge (also known as the Pearl Road-West 25th Street Bridge) is the third bridge at this site. The original bridge, built in 1865, is a stone-masonry arch at the lower level on the old road. It is still in use, was part of the Medina-Wooster Pike, and has the distinction of being the oldest County bridge in the city. In 1894 the County erected a steel viaduct, which was quite remarkable in its day. It was composed of trestle

spans of 28 and 56 feet alternately. But the central arch-span was its magnificent feature: a parabola in outline and an open-web, three-hinged arch of 168-foot span. Trusses were 26 feet apart on centers. The center line of the lower chord was a parabola, but the upper panel points were in three straight lines. The viaduct was 1,540 feet long, 31 feet wide, and 73 feet above water. Though not so large, it resembled Eiffel's Famous Garabit Viaduct. Engineers were the Osborn Engineering Company. This bridge was torn down in 1916.

It was replaced by the present multiple-span, reinforced-concrete bridge of four lanes, including streetcar tracks. It is composed of eighteen arches, the longest of which is 139 feet. Total length is 2,365 feet, the distance between end-abutments being 1,726 feet. The bridge is 76 feet wide, and at its lowest point the height above the roadway is 98 feet. The bridge was the work of the County Engineer's office, with the Osborn Engineering Company acting as consultants. The median still carries the street lighting, a residual from the streetcar days when the trolley wires were cantilevered from the light poles. Recently the bridge has been extensively remodeled.

The Hilliard Road Bridge spans the Metropolitan Park and Rocky River at the intersection of Hilliard Road and Riverside Drive [Figure XXVI]. Built in 1926, its designer was A.M. Felgate, County Bridge Engineer. The most notable feature of this open-spandrel, ribbed-arch bridge is the pronounced batter of the piers. The bridge has three large arches. The roadway is 135 feet above the water, and the structure is 896 feet long. In July, 1979 Cuyahoga County Commissioners hired Howard, Needles, Tammen and Bergendoff to rehabilitate this bridge.

At the confluence of the east and west branches of Rocky River, at Cedar Point in the Metropolitan Park, is a five-span, reinforced-concrete bridge built in 1913. Its flat arches and simple, functional design make it extremely attractive. It replaced a famous two-span "Bow-string" Whipple truss" -- a type most popular during the latter half of the nineteenth century.

In the same park system is the Brookpark Bridge, built in 1933 by W.H. Rabe, and D.H. Overman. It carries State Route 17 over the Rocky River Valley, near the Cleveland airport. It is a reinforced concrete multiple-arch structure, of the type often found in bridges of the "twenties and thirties. The parabolic arches are two-ribbed, with open spandrels. Six of the spans are 192 feet, 6 inches long; two are 176 feet, 10 1/2 inches. Total length is 1,918. This bridge received an American Concrete Institute award for its outstanding design. In 1977 it was extensively repaired.

Other bridges of the same type are the Brecksville Bridge (1931) and the Bedford Bridge (1932). The Brecksville structure is 1,132 feet long and 145 feet high. The Bedford one is 1,665 feet long. Trygve Hoff and Roy F. Weston will replace the Northfield Road Bridge over Tinkers Creek in Bedford.

A charming footbridge may be found in Forest Hill Park, East Cleveland. Designed in 1939 by Wilbur Watson and Associates, it crosses a ravine and Forest Hill Boulevard, very near the site of the former Forest Hills residence of John D. Rockefeller. Although faced with warm yellow Berea sandstone, it is a reinforced-concrete bridge designed to carry work-trucks as well as pedestrians. A single arch of 140-foot span springs across the roadway 48 feet below. The total is 347; width between railings is 16 feet, 3 inches. Great care was taken to make this little bridge beautiful;



Figure XXV. The Hilliard Road Bridge over the Rocky River, built in 1926 with A.M. Felgate the engineer.

A.D. Taylor, landscape architect and F.R. Walker, of Walker and Weeks, architects, were the consultants.

Another example of an esthetically pleasing concrete bridge is a three-span structure that carries Monticello Boulevard over Euclid Creek. the center span is 140 feet, and the two side-spans are almost 108 feet each. There are

two 28-foot roadways. It was designed by the Osborn Engineering Company in 1955 [See Figure XX].

Modern Steel Structures

According to modern taste, the Lorain Road Bridge, opened in 1935, is a fine example of steel construction. It replaced a structure which was remarkable in its day. Built in 1897, the old bridge was a steel trestle viaduct 1,219 feet long. There were nine spans on metal towers, with a deck 32 feet wide and 130 feet above the river. Henry Grattan Tyrrell described this bridge, in his *History of Bridge Engineering*:

Trusses, with curved bottom chords, are without arch action and their central depth is slightly less than ordinarily used for trusses with parallel chords... trusses were connected and assembled on the ground, and afterwards hoisted into place. [It] is probably the finest work of its kind in the district, being designed with due consideration to its esthetic features.⁵⁰ The Osborn Engineering Company designed the structure.

The Osborn Engineering Company designed the structure.



Figure XXVI. The Lorain Road Bridge crossing the Metropolitan Park near Rocky River.

The present Lorain Road Bridge spans the Rocky River Valley in the heart of the Metropolitan Park System [Figure XXVI]. Special care was taken to make the structure fit its natural environment. The bridge consists of four parabolic, two-hinged steel arches: two have a span of 256 feet center-to-

center of piers, and the two unsymmetrical end-spans are about 237 feet in length. Height above the valley is about 130 feet; the roadway width is 40 feet, flanked by two five-foot walks. The plate-girder arch ribs of uniform depth are carried on vertical posts without diagonal bracing—a feature that enhances the architectural beauty of the structure. Also, the use of a minimum number of members and the tapering of the piers add to its beauty. Considerable welding was done in order to eliminate rivet heads where they were deemed objectionable; and for the same reason a great amount of counter-sinking of rivet heads was resorted to. The railing design of welded shapes and of open malleable iron panels is unique. The colors of the bridge complement those in the natural setting: a warm grey for the masonry and a pale green for the steel. The bridge was designed by the engineers of the Ohio State Highway Department, with J.R. Burkey, Chief Engineer, and W.H. Rabe, Chief Designer. It received an award from the American Institute of Steel Construction for being the most beautiful steel bridge in its class erected 1935.

The most northerly bridge over Rocky River has spectacular view and carries U.S. Route 6 (or East Lake Road) across the river. Called the Clifton-Westlake Bridge, it is steel girder structure, completed in 1964. It took 35 years and 10 lawsuits before construction could begin. The total project length is 1.27 miles, but the length of the bridge proper is 1,135 feet. Although this structure was proposed as early as 1929 by Albert S. Porter, then a young engineer in the County Engineer's Office, many others matters intervened to hinder its erection. In 1951 the voters passed a million-dollar bond issue. Then, early in 1952, with the consent of the State Highway Department, Mr. Porter hired Knappen-Tippetts-Abbot-McCarthy, New York Consultants, to do a bridge study. The firm recommended the site actually chosen ten years later. The recommendation was approved by the city of Rocky River, by the State Highway Department, and by the U.S. Bureau of Public Roads. But Lakewood would have none of it, for the proposed route would go through Clifton Park, -- a wealthy, exclusive residential section. In April of 1957 the state held public hearings on the Clifton Park route; but Lakewood still objected. However, the state acted under a seldom used law that allowed building of projects of "urgent necessity" without the consent of the municipality. In October, 1957, Lakewood file suit in Cuyahoga County Pleas Court, contending that the law was unconstitutional and that the state had failed to establish "urgent need." Judge Earl Hoover ruled in favor of the state, as did also the Court of Appeals in April, 1959. This affirmed by the Ohio Supreme Court in June of 1960. But the opposition had one more card to play. A taxpayers' suit was

filed on 22 July 1960, on behalf of seven Rocky River residents, to prevent County participation in the project. The suit denied by the Court of Appeals. The Ohio Supreme Court refused to hear the case. That was the end. A contract was to let the National Engineering and Contracting Company on 11 September 1962, and construction started three weeks later. Today Clifton Park is still a fine residential area, and the extension to Clifton Boulevard is nicely landscaped along the right-of-way.

An attractive span is the footbridge over the Shoreway at Gordon Park. The overhead, tied arch is clean and simple in design.

The eastern suburbs have several small attractive bridges. One is the Snake Hill Bridge on Fairmont Boulevard over the Chagrin River. It received a 1942 award from the American Institute of Steel Construction for being the most beautiful bridge in its class. Its steel girder of 236 feet was built by County Engineer John O. McWilliams and designed by M.E. Friedman, Bridge Engineer.

Another small, attractive bridge over the Chagrin River is at Gate Mills on the Old River Road. It is a tied arch, with the roadway suspended. The story is told that, when the county engineers wanted to paint the structure, the selection was based on the shade of green to be found on the shutters of the mayor's house.

A new bridge north of the Brookpark Bridge is the most recent structure, designed to carry I-480 traffic across Rocky River Valley, just north of Hopkins International Airport. Since the valley is a part of the Metropolitan Park system, care was taken to design an attractive structure. The valley here is heavily wooded with sycamore, maple, ash, and a few elms. The I-90 Bridge north of the Hilliard Road Bridge is similar. These bridges carry eight lanes of interstate traffic. The I-480 Bridge has a 26-foot median strip, and 10-foot wide shoulders. Contracts were signed in 1968. Because of the terrain at the west end and because the deck is 140 feet wide, the bridge is divided into two halves. Each half is structurally independent of the other. The continuous haunches and the steel -- girder spans with transverse floor beams are plain in design-the soffit is curved for esthetic reasons. The structure was designed by Alden E. Stilson and Associates.

It is significant that, generally speaking, pains have been taken to make bridges in the parks esthetically satisfying, to harmonize with their environment. It seems that natural environment demands that man-made structures be beautiful. Surely, every effort should be made to design structures, no matter how significant or utilitarian, to be as beautiful as possible.



Figure XXVII. A jackknife bridge in the open position to allow passage of an ore boat on the Cuyahoga River.



Figure XXVIII. A concrete arch railroad bridge over East 92nd Street is now a part of the Cleveland area RTA system.

Chapter 6

UNUSUAL BRIDGES IN AND ABOUT CLEVELAND

There are a number of unusual bridges that deserve attention. An early one is the Warner Road stone-and-brick arch bridge over Millcreek, built in 1899. The arch has a 40-foot span. The road-way is 44 feet wide, with two sidewalks of 12 feet. Its overall length is 72 feet, 10 inches, exclusive of wing walls. Its location was a significant one in the early part of the century because it was near the center of Newburgh, which was then larger than Cleveland. In 1906 it was necessary to raise the sidewalks of the arch, since the grade of Warner Road had been raised. Stone arch bridges are becoming rare; so we should cherish those we have.

Generally bridges symbolize goodwill and enhance friendly relationships between communities. Cleveland has a bridge that stands as mute testimony to the opposite: fear prejudice, neglect, and violence. This is very remarkable *per se*, but the fact that it serves no useful purpose, and is barricaded at both ends, symbolizes the polarization of the communities it once served.

This bridge is the Sidaway Bridge, named after a short street that begins at Kinsman Road and ends at East 65th Street. Engineers were Wilbur Watson and Associate, with Fred Plummer, Chief Designer [Figure XXIX]. Upon its completion in 1931, this structure provided a simple solution for spanning an old gulley, the Kingsbury Run. Until the 1950's children tripped over the bridge on their way to and from school. But, with a Polish community on the south bank and a black one on the north, a feud broke out. In July, 1966, someone set fire to the wooden deck and ripped out fifteen feet of the southern portion. The bridge now is considered a nuisance. Those who wish to cross the valley on foot go through the Garden Valley playfield created by filling in a portion of Kingsbury Run Valley as



Figure XXIX. The Sidaway Bridge over Kingsbury Run is Cleveland's only suspension bridge.

part of the Garden Valley Project.⁵¹ This bridge over the shops of the Shaker Rapid Transit could be dismantled and relocate. At one time, the Cleveland Metropolitan Park Board was interested in relocating it to the Bedford Reservation.

Julius Caesar was proud of the fact that his men built a timber beam bridge over the Rhine in ten days. During World War II the U.S. Army erected many a "Bailey Bridge" in a few days. But years ago, in Cleveland, a bridge was constructed overnight. The story, as narrated by William A. Stinchcomb in 1918, tells of most unusual proceedings:

Unique amongst the bridges of Cleveland is one that was constructed in a night over the Lake Shore and Pennsylvania Railroad tracks at the foot of West 6th Street (formerly Bank Street) in connection with a dispute which arose between the city officials of Cleveland and those representing the railroads, as to the right of the city to fill in the lakefront and make land opposite Lake View Park (now the site of the Willard Park Garage).

The dispute came to a head during the closing months of 1896, and the bridge was built between ten o'clock at night and dawn of the following morning, following a meeting of the City Council one Monday evening. It was the result of careful maneuvering on the part of Mayor Robert S. McKesson and his aides. Material for the bridge, which was of wood, had been carefully cut and hidden at a convenient point, so that it might be speedily transported to the scene of action.

A Corps of Engineers was in readiness to superintend the work, and several large gangs of men from the city's street repair department were held in hiding until the signal was given to get into action. They then swooped down on the railroad tracks at the foot of West 6th Street erected their timber, and by daylight a completed bridge spanned the tracks and gave access to a small fill of land north of the railroad right-of-way.⁵²

Having won its point, the bridge did not last long. But the city continued to fill in the land, without any further interference from the railroad.

The original Harvard-Denison Bridge now belongs to history rather than the present. The bridge might be considered a World War II casualty, for the acid fumes from the valley severely corroded the steel. During the war, top-secret processing of uranium using corrosive hydrofluoric acid caused irreversible damage. The bridge was torn down in 1970. In its day it was considered an imposing structure. Erected in 1910 under the auspices of Cuyahoga County, it was one of the longest bridges in the Cleveland area. On 10 October 1910, Cleveland celebrated a County Centennial with yells of Chippewas, with the flag-raising by pioneer citizens and daring aerial feats. The week's program included a military and historical pageant, a carnival, and dedications of the Harvard-Denison and Rocky River Bridges. The overall length of the Harvard-Denison was 3,233 feet; the length between abutments was 2,781 feet. It consisted of twenty-two steel deck truss spans—the longest being 153 feet. The width was 56 feet, with a 40-foot roadway and two 7-foot sidewalks. It was 100 feet above the lowest point in the valley.

Construction plans for the new bridge were made by the firm of Howard, Needles, Tammen and Bergendoff. The bridge, completed in 1978, was built with federal funds under the direction of the Ohio Department of Transportation but will be maintained by the county. The new structure occupies the same site as the old, except that the west end will be curved about 150 feet to the north, to a connection with Denison Avenue and West 14th Street, both of which will be relocated. The purpose of this design is to accommodate the Jennings Freeway, which will cross under a new span to connect ultimately with I-480 near Schaaf and the Van Eppes Road. The bridge is 3000 feet long.

The Clark Avenue Bridge was Cleveland's longest. Built by the city in 1912, of steel truss construction, it had a total length of 6,687 feet. The bridge was really three bridges. The oldest comprised a series of pony through -- trusses over the B. and O. tracks adjacent to Quigley Avenue. The west end connected to West Third Street and provided safe access to the Jones and Laughlin Steel Company's plant. The east section, which included the river span, extended from Pershing Avenue to West Third Street.

The river span was a massive truss with the lower chord of pin-connected members. The balance of the span was of deck construction with deep built-up members and truss construction, designed to accommodate the tracks and take care of clearance problems. The concrete piers were short, with steel towers typical of viaduct construction. The west end extended between West 14th Street and Quigley Avenue. This whole structure was demolished in 1980.

An outstanding example of a modern steel structure is a handsome bridge over East 222nd Street. This four-track bridge, built in 1959, in Euclid, Ohio, has the distinction of being the first welded rigid-frame railroad bridge in the United States. The bridge is divided into three parallel single-span structures. The center bridge carries the east-and west-bound tracks; each outside bridge supports an industrial track and four-foot sidewalks with steel railings. Structural steel elements comprise a series of welded frames of 91 feet. Five frames spaced on 21/2 feet centers were needed for each track, twenty frames in all. The frames support a composite reinforced concrete deck. Alloy steel was used to reduce the weight of sections and the thickness of material to be welded.

The bridge had clean lines, was economical to build, will be easy to maintain, and is free from columns on the underpass. The cost of approximately sixteen million dollars were divided between Cuyahoga County and the city of Euclid (85 percent), with the railroad paying the remainder (15 percent). The railroad is the designated owner of the structure. The overall design was worked out by the Osborn Engineering Company, in consultation with the bridge engineers of both the railroad and the county. Structural analysis was prepared by John B. Scalzi, and the late Ralph Scott and Gregory Chacos, with the assistance of Paul Montgomery from the Nickel Plate. The National Engineering and Contracting Company was the general contractor.

This advance in the art of steel bridge construction is due to the general acceptance of arc-welding. Cleveland has pioneered in this development, through the efforts of the James F. Lincoln Arc-Welding Foundation. The Lincoln Electric Company, which has been for many years a leader in arc-welding, is internationally famous.

A new type of welded structure is at the Snow Road Crossing of Engle Road and the former Big Four Railroad tracks in Brookpark. The new feature concerns the piers, which are inverted delta or V-shaped columns. This construction is economical, but unfortunately the bridge itself is at a skew to the roadway and railroad, which exposes to view a multiplicity of the supporting members. The design is best used for simple spans.

Fabrication problems and poor welds have delayed the project for a year. However, it is to the credit of the county engineer that he was willing to try a new concept in design.

The Willow-Freeway, serving the southeast side, had a number of firsts to its credit. Extending from Broadway south to connect to Independence Road at Schaaf, the depressed roadway south has recently been upgraded to Interstate standards, for it is now a part of I-77. The section from Harvard Avenue south to Canal Road was the most expensive mile because of the four bridges in this section. The "cloverleaf" at U.S. Route 21 and Route 17 was the first in the state. The ornamental railing and post have deteriorated, and repair work has destroyed the designer's intent. This pioneer cloverleaf is in sharp contrast to the new Interstate interchange just to the south of the aforementioned. This complexity of interchanges is an engineer's dream (or nightmare). A part of the Outerbelt system, it is a 218-acre interchange at I-77 and I-480 in Independence. The Outerbelt takes a dramatic leap over Cuyahoga Valley just east of the interchange on a dual bridge, the third largest bridge in Ohio history. The thirty-span steel-girder structure is 4,025 feet long and rises 200 feet above the valley floor. It rests upon a reinforced concrete substructure, founded on piling. This bridge really consists of two parallel bridges one hundred feet apart. Designing engineers were Howard, Needles, Tammen and Bergendoff.

Work was started in 1972, and the structure was completed in the following year. The contracting firm of Vogt and Conant introduced several innovations in construction, in order to increase job safety and to speed erection of the steel. A Manitowoc crane was used to lift the steel girders, weighing as much as 99 tons, as high as 200 feet and at a radius of 90 feet. The firm devised a concept of steel erection utilizing a work-access platform, work platforms, and a hoist-operated passenger elevator. The elevator delivered workmen to the steel work platform hanging between the twin bridges. The 20,000 tons of steel were supplied by Allied Structural Steel, Hammond, Indiana, and by Chicago Heights Steel Division of Allied Products, Chicago Heights, Illinois.

A somewhat unusual structure may be found about twenty miles south-east of Cleveland on State Route 8 over the Ohio Turnpike. It is a 216-foot, two-hinged steel trussed-arch, with box-girder ribs. It has a 28-foot roadway. Completed in 1955, this beautiful span received an American Institute of Steel Construction award. It was designed by Howard, Needles, Tammen and Bergendoff.

Only the people who keep statistics will be interested to note that the approach span on the Main Avenue Bridge over the tracks south of the

stadium was the longest plate-girder in the country in 1940, with a span of about 271 feet. Another record breaker was the girder over the Erie tracks on the I-77 bridge. Such is fleeting fame that one is not even aware of these tributes to the skill engineers, as traffic speeds over the bridge at expressway speeds.

All in all, Cleveland has its share of unusual bridges. In this connection, the "movable structures" over the Cuyahoga River should especially be remembered.

Chapter 7

THE PRESENT DAY PROBLEM

After World War II, automobiles, which began about twenty five years before to change transportation planning, now proliferated and jammed the roads. Something had to be done, and that something proved to be highway turnpikes and freeway systems. The Ohio Turnpike Commission built a toll road from the Pennsylvania border to the Indiana border and was sharply criticized because it failed to serve the major cities. Clevelanders had to go to Lorain County, Strongsville or Brecksville to gain access. But it was and still is an overwhelming success. Now the news media criticize the Interstate System as being no solution to the urban traffic problems.

The limited access highways and the Interstate System funded 90 percent by the federal portion of the gasoline tax, are the present-day answer to traffic needs. The Interstate Highway System, whose standards of design and construction are the most advanced in the field of highway engineering is finally nearing completion and the end will soon be reached. However, these systems demanded that bridges, hundreds of them in the Cleveland area, be built quickly and economically. They are now a maintenance problem. The freeway system is of necessity built of look-alikes, for standardization was inevitable. A certain dullness results. What a relief it is to the motoring public to see and occasional stone-masonry or concrete arch bridge, or a ribbed structure of steel, with an open functional design.

But what of the hundreds of bridges we already have? Old bridges are like old friends; they remain faithful in spite of neglect and inattention. Highways demand attention by developing chuckholes and cracking up, but bridges usually conceal their ills, carrying loads much greater than they should, until they collapse. This usually creates great consternation -- even our state legislature passed a law after the Point Pleasant Bridge disaster but provided no money! Bridges are supposed to last forever, at least so the general public seems to think.

How did all these bridges get this way? There are a number of factors -- ignorance, complacency, or lethargy -- but the principal factor is lack of money. These bridges have been neglected while the country turns its attention to the construction of a much-needed and well-used Interstate Freeway System. During those years, pleas for money to build, repair, or

even improve the roads and their bridges usually met with a request for patience. As soon as the Interstate was done, there would be money. Now the Interstate is nearly done, and the popular cry of politicians and commentators is to cut off this highway money and divert it to mass transit or other uses. They have found people who believe them, for state after state has broken the agreement that gas tax money would be spent only on the roads. Now the money that would have improved these old roads and bridges is going for experiments in mass transportation, many untried and untested. Apparently the people who vote for this diversion of funds, this halting of spending money on highways (which sounded so good at the time, did not realize that it meant that the old bridge between their house and their job may well fall before anyone gets enough money to repair it. A new approach to the responsibility of maintenance is needed. The present governmental divisions are not geared to cope with this problem.

The city of Cleveland alone is responsible for about 333 bridges within its municipal boundaries and has been in the business of building bridges for over a century. The county of Cuyahoga has built the major stream crossings in its territory. The Interstate System has resulted in the State of Ohio being responsible for the bridges in the urban areas -- but only after a lawsuit decided in favor of the cities over 100,000 population. However, division of responsibility has never been clear.

Early in the 1900's the City of Cleveland started a grade crossing program in the city. Of the 240 street crossings, fifty-nine were completed by 1914, and steps were taken for thirty more, Perhaps the danger to streetcars was the prime incentive. In any event this was no small undertaking. Consider that the mainline track of the Pennsylvania Railroad from Hamilton Avenue at the Lakefront to Quincy Avenue was elevated on trestle work and the streets crossed the structures. The concrete retaining walls along the right-of-way placed the entire system at the second-story level. The crossing at Euclid Avenue extends over East 55th Street and Euclid Avenue -- a remarkable structure in its day -- now , eyesore for lack of paint and repairs.

The Big Four grade separations at West 65th Street, Clark Avenue on the West Side, and the New York Central at Detroit, Madison and Lake Avenues were typical of the scope of this concept.

The entire Nickel Plate Railroad on the West Side from West 110th Street to the Cuyahoga River was grade-separated. The City spent over \$2,000,000 of matching money on this project which would represent \$20,000,000 at today's prices. Finally, after years of red tape and stalling, a new bridge at East 55th Street and Chester Avenue has been built by Alden

Stilson and Associates. The first part of the project was to erect a temporary trestle to keep two of the four Conrail tracks open. At first the railroad wanted to close Chester Avenue. The new railroad bridge is completed and Chester Avenue has been widened to three 35-foot lanes on each side of a center strip.

But there are still grade crossings in the urban areas that need a new look. Would Lakewood, Bay Village and Rocky River -- the affluent western suburbs -- pay their local share for grade crossing elimination today? These are real hazards as the yearly death toll on their guarded crossings marches on. One solution is to eliminate the railroad. It can be done by routing this trackage from Vermilion over the old New York Central (Conrail) to enter Cleveland via that trackage, and meet the existing grades near Fulton Road where they cross each other's right-of-way. The existing trackage would make a logical light-rail extension of RTA to the western suburbs from the Detroit-Avenue-98th Street station. The only deterrent is leadership.

Cleveland does not need many new bridges, it needs to replace and refurbish hundreds of the old spans. At least one-fifth of these are in poor condition because repairs and maintenance have been neglected for years.

The total problem of bridge building today and certainly in the future is linked to the highway and freeway systems. Greater Cleveland is backward in its long-range planning for improvements and beautification of the inner city. We need to know the transportation needs, traffic patterns, and modes of transportation estimated for the next ten years, but no such study seems to be underway.

Curiously enough, the age of a bridge is not the chief reason for decay. Like many other structures, the primary problem is proper maintenance. Neglect, corrosion, lack of periodical examination, insufficient forces and skilled supervisors, increased live loads, lack of money -- these are the real enemies of a bridge. Public safety demands eliminating hazardous structures.

However it must be admitted that the major problem facing us now and in the future is the economic one. Money for repairs and maintenance are often harder to obtain than money for new structures. The Bridge Responsibility Act of the State Legislature provided inspection but no money. Bridges are never half safe. Does it take another Silver Bridge disaster to make us act? One way to insure competent inspection is to make one agency responsible for all bridges. The local governmental agencies are much too deeply infested by politics to be effective.

The need to put all bridge replacement under the state's Department of Transportation is evident. The need to establish priorities and provide adequate funding cannot be done on a local level. While the State Legislature is not notable for producing long-range solutions, it is the only means we have to insure that a program funded by earmarked monies will not be diverted or made to compete with other programs.

We know of no other reliable alternative. It is costly even to demolish a bridge. The plight of the central cities is well known and no solution seems in sight. The fact remains that many bridges are dangerous. There was a time when the citizens of greater Cleveland took pride in the appearance of their city. Let us hope that all of Cleveland may someday become a city beautiful, and may the citizens once again be stimulated to work towards achieving that goal.



Figure XXX. Panorama of Cleveland bridges, looking out over the Flats ca. 1930.



Figure XXXI. Main Avenue Bridge today, looking south toward the Detroit-Superior Viaduct.

Appendix A

Notes

¹ Elroy McKendree Avery, "The Early Bridges of Cleveland", in *Bridges of Cleveland and Cuyahoga County* (private printed, Cleveland, Ohio, 1918). p. 24.

² William Ganson Rose, *Cleveland: The Making of a City* (World Publishing Company, Cleveland, Ohio, 1950) p. 26.

³ Henry W.S. Wood, "The Old Detroit-Superior Viaduct", in *Bridges of Cleveland and Cuyahoga County*, p. 14.

⁴ Avery, "The Early Bridges of Cleveland," pp. 24-25.

⁵ *Ibid.*, pp. 26-27.

⁶ George E. Condon, *Cleveland: The Best Kept Secret* (Double-day and Co., Garden City, New York, 1967) pp. 46-54.

⁷ Oliver P. Baldwin, in *Bridges of Cleveland and Cuyahoga County*, pp. 38-39.

⁸ F.T. Wallace, "Viaduct Reflections" (Cleveland, 1879).

⁹ *Loc. Cit.*

¹⁰ Wood, "The Old Detroit-Superior Viaduct," p. 19.

¹¹ *Ibid.*, p. 20

¹² *Ibid.*, pp. 21-22

¹³ Nathan P. Payne, *Message to the City Council* (delivered on April 11, 1876).

¹⁴ Wallace, "Viaduct Reflections"

¹⁵ Jim Didas, "Old Superior Viaduct Waiting for its Doom," in *Cleveland Press* (December 20, 1971).

- ¹⁶ Quoted from B.F. Morse's report, see Appendix C.
- ¹⁷ Stanley L. McMichael, "The New Detroit-Superior High Level Bridge", in *Bridges of Cleveland and Cuyahoga County*, p. 7.
- ¹⁸ Henry Grattan Tyrrell, "The Bridges of Cleveland," in *The Ohio Architect, Engineer, and Builder* (1915) p. 5.
- ¹⁹ Builders of the New High-Level Bridge," in *Bridges of Cleveland and Cuyahoga County*, p. 37.
- ²⁰ Ralph E. Robinson, "Reconstruction of the Detroit-Superior Bridge," in *The Ohio Engineer* (June, 1986) pp. 6-7.
- ²¹ "Civic Brevities", in *The Clevelander* (December 19, 1927).
- ²² Wilbur J. Watson, *A Decade of Bridges: 1926-1936* (J.H. Jansen, Cleveland, Ohio, 1937) pp. 11-26.
- ²³ "Maskers Dance at Lorain Span Fiesta", in *Cleveland Plain Dealer* (November 10, 1932.).
- ²⁴ Dan F. Bradley, "The Bridge As Sermon in Steel," in *Cleveland Plain Dealer* (December 8, 1932).
- ²⁵ Rose, W.G. p. 356.
- ²⁶ For a detailed study of this investigation see William J. Eney, "Model Analysis of Continuous Girders," in *Civil Engineering*, II, 9 (September, 1941) 521-523.
- ²⁷ Howard Beaufait, *Cleveland News* (March 8, 1939).
- ²⁸ Data taken from Stanley L. McMichael's article, "Other Important Bridges of Cleveland." in *Bridges of Cleveland and Cuyahoga County*, p. 33. For information on the Abbey Street Bridge, see Thomas Palko's report in the Haer Inventory (August 11, 1975).
- ²⁹ City, Engineer's Report of 1914
- ³⁰ Rose. W.G., p. 287.

³¹ The account of the Central Viaduct, written by Sara Ruth Watson, published in *The Plain Dealer* on December 4 10, 1938, in commemoration of the fiftieth, anniversary of the bridge.

³² See Henry Grattan Tyrell's article, "*The Bridges of Cleveland*," p. 6

³³ The authors are greatly indebted to Ralph E. Robinson of Howard, Needles, Tammen and Bergendoff for information on the Inner Belt Viaduct.

³⁴ J.A.L. Waddell, *Bridge Engineering* (John Wiley and Sons, New York, 1916) Vol. I, p. 668.

³⁵ The account of the Cleveland and Pittsburgh Railroad Company is taken from a feature article by Bruce Ellison, "City's First Railroad on Track to Oblivion," in the *Cleveland Plain Dealer*, Sec. 2 March 14, 1976) p. 1.

³⁶ Rose W.G., p. 145.

³⁷ Eric Johannessen, "Drawings by Some Western Reserve Architects," in *Western Reserve Historical Society News* (March-April, 1976) p. 15.

³⁸ Taylor, Hampton, *The Nickel Plate Road* (World Publishing Company, Cleveland, Ohio, (1947) pp. 96-7.

³⁹ *Ibid.*, p. 97.

⁴⁰ *Ibid.*, p. 131.

⁴¹ *Ibid.*, p. 144

⁴² Richards Sanders Allen, *Covered Bridges of the Middle West* (Bonanza Books, New York, 1952) pp. 112-124

⁴³ *Loc. Cit.*

⁴⁴ D.B. Steinman and Sara Ruth Watson, *Bridges and Their Builders*, (Dover Publications, New York, 1975) p. 164.

⁴⁵ *Ibid.*, p. 165.

⁴⁶ Tyrell, H.G., p. 4.

⁴⁷ Ibid., p. 5.

⁴⁸ The account of this structure is taken from Edmund H. Chapman, "Wade Park Bridge 1899" in *The Architecture of Cleveland: Twelve Buildings* (Western Reserve Historical Society Publications, 1973) pp. 47-51.

⁴⁹ Wilbur J. Watson, *General Specifications for Concrete Bridges* (Privately printed, Cleveland, Ohio, 1908) pp. 15-6.

⁵⁰ Henry Grattan Tyrell, *History of Bridge Engineering* (Privately printed, Chicago, 1911) p. 386.

⁵¹ Russ Musarra, "A Monument to Fear," in the *Cleveland Press*, (February 6, 1970).

⁵² W.A. Stinchcomb. "The bridge That was Built in a Night," in *Bridges of Cleveland and Cuyahoga County*, p. 36.

Appendix B

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Appendix C

A Chronological List of Notable Bridges in Greater Cleveland

Prize-Winning Structures are designated by an asterisk.

- 1853 -- Old Detroit Avenue (Low Level Bridge).
- 1865 -- Stone Arch over Big Creek.
- 1878 -- Old Detroit-Superior Viaduct (Seven arches remain).
- 1888 -- Abbey Avenue Viaduct.
- 1898 -- Lake Shore and Michigan Southern R.R. Bridge in Gordon Park.
- 1899 -- St.Clair Avenue Bridge over Liberty Blvd.
- 1899 -- Wade Park Avenue Bridge.
- 1899 -- Warren Road Stone Arch over Millcreek.
- 1900 -- Superior Avenue Bridge over Liberty Blvd.
- 1901 -- Center Street Swing Bridge over the Cuyahoga.
- 1903 -- Newburgh and Lake Shore R.R. Bridge over Cuyahoga.
- 1906 -- Wheeling and Lake Erie R.R. Viaduct (In 1960 a vertical lift replaced the Scherzer Rolling lift span over the Cuyahoga).
- 1906 -- B. and O. R.R. Bridge over the Cuyahoga.
- 1907 -- B. and O. R.R. Bridge over the old river bed of the Cuyahoga.
- 1909 -- Brookside Park Bride over Big Creek.
- 1910 -- Old Rocky River Bridge.
- 1913 -- River Terminal R.R. Bridge over Cuyahoga (renovated in 1950).

- 1916 -- Brooklyn-Brighton Viaduct over Big Creek.
- 1917 -- Clark Avenue Viaduct.
- 1918 -- Detroit-Superior Viaduct (renovated in 1968).
- 1920 -- C.C.C. and St. Louis R.R. Bridge over Cuyahoga.
- 1926 -- Hilliard Road Bridge.
- 1929 -- Cleveland Union Terminal Viaduct.
- 1931 -- Sidaway Bridge (Suspension).
- 1931 -- Eagle Avenue Bridge over Cuyahoga.
- 1932 -- *Lorain-Carnegie Viaduct, Award from the American of Steel Construction.
- 1935 -- *Lorain Road Bridge. Award from the American Instiute of Steel Construction.
- 1937 -- *Brook Park Bridge. Award from the American Concrete Institute.
- 1939 -- *Main Avenue Viaduct. Award from the American Institute of Steel Construction.
- 1940 -- Carter Road Bridge over Cuyahoga.
- 1940 -- Columbus Road Bridge over Cuyahoga.
- 1940 -- Upper West Third Street Bridge over Cuyahoga.
- 1941 -- *Snake Hill Bridge over Chagrin River. Award from the American Institute of Steel Construction.
- 1947 -- *Penn-Central Vertical Lift Bridge over Cuyahoga.
- 1953 -- *C.C.C. and St. Louis Bridge over Cuyahoga. Award from the American Institute of Steel Construction.
- 1955 -- Bridge over Euclid Creek on Monticello Blvd.

1955 -- *Bridge at Route 8 over the Ohio Turnpike. Award from the American Institute of Steel Construction.

1956 -- B. and O. Railroad Bridge over Cuyahoga.

1959 -- Inner Belt Viaduct.

1959 -- E. 222nd Street Underpass.

1964 -- Clifton-Westlake Bridge.

1964 -- Willow Avenue Bridge over the Old River Bed of the Cuyahoga.

1965 -- Willow Freeway Bridge (I-77 over Kingsbury River Valley).

1968 -- Medina-Jennings Interchange (I-71).

1973 -- Bridge at Interchange at I-77 at I-480.

1976 -- I-480 Bridge (under construction).

STRUCTURES ACROSS THE CUYAHOGA RIVER

No.	Location and name	Kind	Miles above West Pierhead light	Draw or span openings -- clear width in feet proceeding upstream			Clear height in feet above water datum		Remarks
				Right	Left	Center	Low	High	
Main River									
1.	Penn. Central (New York Central R.R.) bridge	Railway	0.76	--	--	250	8.6	--	Vertical lift. Open clearance 98.6 feet.
	Old River	Junction	0.86						
	Tunnel and submerged pipeline	--	0.98	--	--	--	--	--	Approx. depth 60.4 feet. (48" dia.)
2a.	Main Avenue Viaduct	Highway	1.01	--	--	218	92.7	--	Fixed. Minimum in the center 165 feet is 97.7 feet.
	Tunnel and submerged pipeline.	--	1.14	--	--	--	--	--	Approx. depth 57 feet. (40" dia.)
	Submerged cables	--	1.16	--	--	--	--	--	Approx. depth 34.5 feet.
	Tunnel and submerged pipeline	--	1.20	--	--	--	--	--	Approx. depth 56.7 feet. (48" dia.)
3.	Baltimore & Ohio R.R. bridge	Railway	1.28	--	--	229	8.7	--	Lift.
4.	Center Street bridge	Highway	1.39	--	--	113	17.7	--	Swing.
5.	Detroit-Superior Viaduct	do	1.42	--	--	113	98.0	--	Fixed.
6.	Union Terminal Viaduct	Railway	1.89	--	--	200	98.2	--	Do.
7a.	Columbus Road bridge	Highway	1.93	--	--	220	17.6	--	Vertical lift. Open clearance 98.4 feet.
8.	Cleveland, Columbus, Cincinnati, & St. Louis R.R. bridge.	Railway	2.24	--	--	200	8.4	--	Vertical lift. Open clearance 97.7 feet. <u>See note 7.</u>
9.	do	do	2.42	--	--	200	23.5	--	Vertical lift. Open clearance 98.8 feet.
9a.	Carter Road bridge	Highway	2.43	--	--	201	22.6	--	Vertical lift. Open clearance 97.3 feet. <u>See note 6.</u>
12.	Eagle Avenue bridge	do	2.80	--	--	187	15.6	--	Vertical lift. Open clearance 97.5 feet.

	Submerged cables	--	2.80	--	--	--	--	--	Approx. depth 34 feet (6 cables).	
13.	Lorain-Carnegie Viaduct	Highway	3.14	--	--	178	96.4	--	Fixed. Minimum in the center 140 feet is 97.7 feet.	
14.	Cleveland, Columbus, Cincinnati, & St. Louis R.R. bridge.	Railway	3.19	--	--	134	20.8	--	Lift.	
	Submerged cable	--	3.33	--	--	--	--	--	Approx. depth unknown.	
15.	Norfolk & Western Ry. bridge	Railway	3.34	--	--	200	64.2	--	Vertical lift. Open clearance 97.7 feet.	
16.	Inner Belt Freeway bridge	Highway	3.42	--	--	230	93.8	--	Fixed. Minimum in the center 199 feet is 98.6 feet.	
17a.	West Third Street bridge	do	3.69	--	--	200	10.5	--	Vertical lift. Open clearance 97.3 feet.	
	Aerial cable	--	3.72	--	--	--	118.0	--		
	Submerged cable	--	4.32	--	--	--	--	--	Approx. depth 32 feet (2 ea. 6" dia.).	
19.	Erie-Lackawana Railroad bridge	Railway	4.33	--	--	117	29.3	--	Lift.	
	Submerged cable	--	4.50	--	--	--	--	--	Approx. depth unknown.	
20.	Jefferson Avenue bridge	Highway	4.51	--	--	100	--	--	Superstructure removed.	
	Submerged cable	--	4.52	--	--	--	--	--	Approx. depth 30 feet.	
	Submerged pipelines	--	4.65	--	--	--	--	--	Approx. depth 32 feet (3 ea. 6" dia.).	
21.	Newburgh & Shore Railroad	South Railway	4.71	--	--	110	11.1	--	Lift.	
	Aerial cable	--	4.73	--	--	--	118.0	--		
22.	Baltimore & Railroad bridge	Ohio Railway	4.75	--	--	110	10.3	--	Lift.	
	Submerged cables	--	4.76	--	--	--	--	--	Approx. depth 30 feet (2 cables).	
	Aerial cable	--	4.77	--	--	--	118.0	--		
	do	--	4.78	--	--	--	118.0	--		
	Turning Basin	Junction								
	Overhead bridge	conveyor	--	5.35	--	--	210	99.0	--	Fixed. Republic Steel Corp.

	Overhead pipeline bridge	--	5.39	--	--	210	99.0	--	Do.	
	Tunnel	--	5.40	--	--	--	--	--	Approx. depth 45 feet.	
23.	River Terminal R.R. bridge	Railway	5.42	--	--	129	15.5	--	Lift.	
24.	Clark Avenue Viaduct	Highway	5.43	--	--	184	98.4	--	Fixed. <u>See note 5.</u>	
25.	Norfolk & Western Ry. bridge	Railway	5.47	--	--	200	28.9	--	Vertical lift. Open clearance 97.7 feet.	
	Submerged pipelines	--	5.48	--	--	--	--	--	Approx. depth unknown (5 pipes).	
	Submerged pipelines	--	5.78	--	--	--	--	--	Approx. depth unknown.	
	Extent of Project	Limit	6.05							
26.	Newburgh & South Shore R.R. bridge	do	6.09							
	Aerial cable	--	6.10	--	--	--	118.0	--		
Old River										
	Main River	Junction	.86							
32.	Baltimore & Ohio R.R. bridge	Railway	.89	--	--	170	6.9	--	Lift.	
33.	Willow Avenue bridge	Highway	1.02	--	--	--	12.6	--	Vertical lift. Open clearance 98 feet. Channel through the draw is limited to 150 feet measured from the right fender (looking downstream).	
	Submerged cable	--	1.04	--	--	--	--	--	Approx. depth unknown.	
	Submerged pipeline	--	1.04	--	--	--	--	--	Do.	

Whistle Signals for Opening Draws:

Main river: 1 long, 2 short. (_ _ _)

Old River: 1 long, 1 short, 1 long, 1 short. (_ _ _ _)

All movable bridges are equipped with a whistle synchronized with a white light. Bridge operator will answer boat signal by a long and short whistle with light signal, and if bridges cannot be immediately opened, 3 blasts of whistle with light will be given as a check signal.