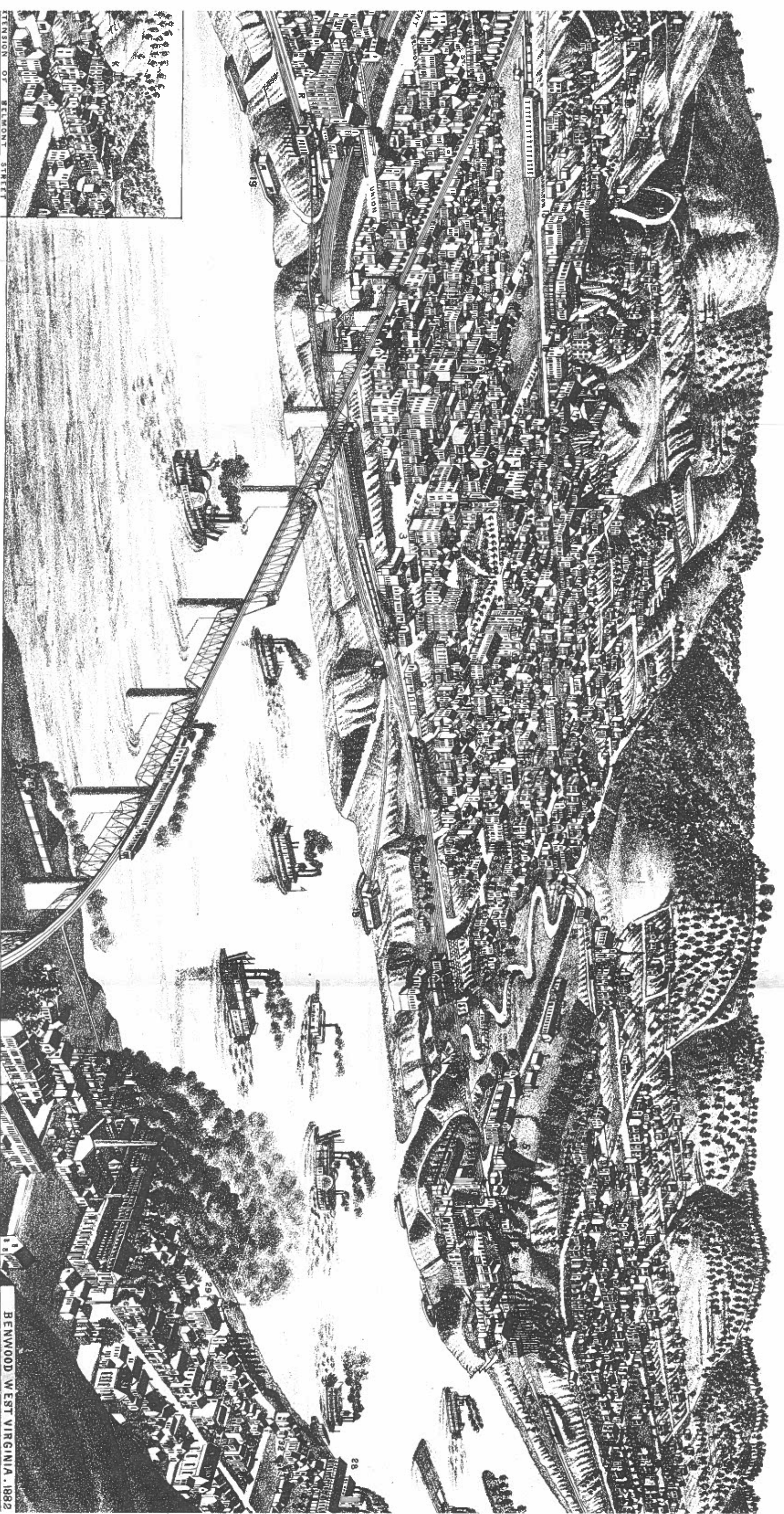


BIRD'S EYE VIEW OF BELLAIRE, OHIO — 1882



BELLAIRE, OHIO - 1882

BENWOOD WEST VIRGINIA - 1882

The Stone Bridge

The Bridge in Iron, Stone, and Steel
Compiled by Rik Rodefer

The history of the Stone Bridge reveals interesting facts and comparisons when one realizes the intrinsic values of the primary materials used; sandstone, cast and wrought iron, and steel. The original masonry arches and piers, using Ohio quarried sandstone, today still support the approaches and spans . . . "without evidence of deterioration attributable either to the action of natural agencies or to the great increase in weight of superstructure and moving loads which has characterized its long service-life." In contrast, the original superstructure utilized various elements including span designs approaching the end of their useful life as well as span designs utilizing the latest in engineering thought. The ever increasing size and weight of the railroad's rolling stock did not affect the service of the masonry design but did necessitate complete replacement of the wrought and cast iron elements of the superstructure. Thus, the Bridge today does appear different than the design revealed in the early photographs.

At this point in time as we pause to commemorate the Bridge's Centennial anniversary, many of the technological developments of this era have been spawned by the aerospace endeavors. The technological innovations of the mid-nineteenth century were similarly conceived in the field of civil engineering. "Perhaps the greatest single step in the history of civil engineering was the introduction of iron as a primary structural material in the 19th century; it quickly released the bridge and the building from the confines of a technology based upon the limited strengths of masonry and wood."

"Wendel Bollman, self taught Baltimore civil engineer, was the first to evolve a system of bridging in iron to be consistently used on an American railroad, becoming one of the pioneers who ushered in the modern period of structural engineering. The recognition of Bollman's abilities was in the well-established tradition of the B&O, long known as America's first 'school of engineering,' having sponsored many early experiments in motive power, trackwork, and other fundamental elements of

railroad engineering." "The era of long span truss bridges in America may be considered as dating from the building of the first bridge over the Ohio River at Steubenville, between 1863-64, by Jacob Hayes Linville."

From a historical standpoint it is interesting to note that the Stone Bridge's superstructure represented the collaboration of these two men outstanding in the creation of the modern railroad bridge, namely Wendel Bollman (1814-1884) and Jacob Hayes Linville (1825-1906). The original cast and wrought iron superstructure consisted of nine deck truss spans of the Bollman type, four deck truss spans of the Linville and Piper designs and two through truss spans of the Linville and Piper type, about 242 and 348 feet in length respectively, the longer span crossing the channel. The total length of the bridge is approximately 3850 feet which includes 2317 feet in the iron work spans and 1433 in the 43 stone arches of the western approach. Design and construction of the bridge was coordinated with a similar B&O Bridge crossing the Ohio River between Parkersburg and Belpre.

"In the mid 1870's Bollman saw his truss pass into obsolescence. This was due primarily to the generally increasing distrust of cast iron for major structural members due to its brittleness, but advances in structural theory, availability of a greater variety of rolled structural shapes, and the increasing loading patterns of the period all contributed." Thus the nine Bollman trusses, spans 14 and 15 on the west and spans 1 through 7 on the east, were replaced first. "The rebuilding of this (Stone) bridge was not a continuous operation, but was done in sections extending over a number of years, the policy being to replace those spans which were the most expensive to maintain, or which developed weakness under the existing traffic, in the order in which this weakness was made evident. Each section was designed in accordance with the specifications in use on the Baltimore and Ohio Railroad at the time the design was made, the result being that the completed new structure is not of uniform strength."

As with any reconstruction, consideration of improving the bridge by increasing the channel's width was undertaken by the three involved parties; the railroad, the river men, and the War Department. With the latter two factions clamoring for a much wider channel, the railroad resisted the estimated \$250,000.00 cost increase by claiming their charter provided the right to maintain the bridge on the existing masonry. Finally in 1904, after all other spans had been rebuilt and with only the lack of strength in spans 11 and 12 prohibiting the use of the heavier locomotives operating on both sides of the bridge, the B&O proceeded to reconstruct the channel spans on the existing masonry. River men yet today profane their speech when discussing the navigational difficulties posed by the Ohio River's narrowest channel, the Stone Bridge with its 320 foot horizontal clearance.

The reconstruction of span 11 posed the greatest problem by being the longest and the channel span. The crucial requirement of maintaining both rail and river traffic was met by designing and constructing spans 11 and 12 so that the trusses and upper braces cleared the old spans. A device called the 'erection traveler' was utilized to ride atop the old span to handle the structural elements necessary to build a new span around the old span. All this was accomplished with no restriction to river traffic and only a slight restriction to the flow of rail traffic. The sketches below, prepared by Mr. J. E. Greiner for his engineering paper presented in 1905, reveal the original design as completed in 1871 and the reconstructed design as completed in 1904. Other minor design improvements were made on some of the approach later in the mid-1920's.

The Stone Bridge of iron, stone, and steel has now seen one hundred years of rugged service. Within that noble span of time, transportation has undergone a fantastic evolution from the horse and carriage to the rocket and lunar module. Neither the floods, ice floes, or runaway barges of the Ohio, the mammoth simple articulated locomotives (2-8-8-4) of the '50's, nor the unit trains of the '70's, found the bridge to be wanting. It has stood these many years as a landmark to engineering, to rail and river, and most importantly, a landmark for the people of Bellaire, wherever they may be.

Sources

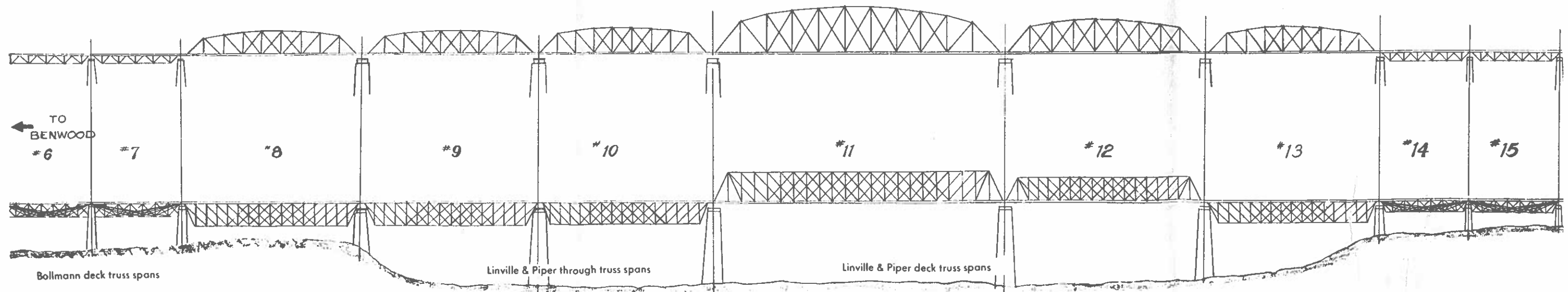
Baltimore & Ohio Railroad - P. C. Lang Jr., Engineer of Bridges. 1936.

"American Railroad Bridges" - Theodore Cooper, paper: American Society of Civil Engineers, 1889.

"The Reconstruction of the B&O RR Bridge over the Ohio River, at Benwood, W. Va." - J. E. Greiner, paper: American Society of Civil Engineers, 1905.

"The Engineering Contributions of Wendel Bollman" - Robert M. Vogel - United States National Museum Bulletin 240. 1964.

SOUVENIR BOOK \$1.00



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- A—Presbyterian Church
- B—Deciples Church
- C—United Presbyterian Church
- D—Methodist Church
- E—Episcopal Church
- F—German Evangelical Church
- G—Catholic Church
- H—Methodist Church South Bellaire
- I—High School
- J—Gravel Hill School
- K—South Bellaire School
- L—African School
- M—City Hall
- N—Market House
- O—Gas House
- P—B. & R. R. Depot
- Q—C. & P. R.R. Depot
- R—B. & S.W. R.R. Depot
- S—Water Works
- T—Reservoir
- U—B. & O. Round House and Shops
- V—C. & P. Round House and Shops
- W—B. & S. W. Round House and Shop
- X—Soldiers Monument

1. First National Bank
2. Globe Hotel
3. Belmont House
4. Bellaire Nail Works
5. Union Window Glass Works
6. Lantern Globe Manufacturing
7. Bottle Works
8. Belmont Glass Works
9. Buckeye Lantern Co., Pack. Room and Store House.
10. Aetna Glass and M'fg. Co.
12. National Glass Works, Rodefer Bro's.
13. Window Glass Works.
14. Ohio Glass Works.
15. Bellaire 'stamping Co.
16. Plaining Mill and Lumber Yard, DuBois & McCoy.
17. Bellaire Boiler Works, J. B. Barnhill.
18. Upper Wharf Boat, C. H. Dankwerth, Agt.
19. Lower Wharf Boat, Wm. Manley, Prop.
20. Carriage Factory, A. H. Marsh.
21. Wagon and Machine Shop, Shipman & Nevil.
22. Marble and Granite Works, M. W. Jordan.
23. Brick Yard, David Crozier.
24. Smith & McClain, Contractors and Stone Masons.
25. Cooper Shops, G. W. Grodhaus.
26. J. Sinclair, Drugs and Medicines, Benwood.
27. Benwood Nail Works.
28. Riverside Furnace.
29. Benwood School.
30. Catholic Church, Benwood.
31. Methodist Church, Benwood.
32. Lutheran Church, Benwood.
33. John B. Heils, Slaughter House and Residence.
34. Glass City Flouring Mill, Fred Muhleman.

- James F. Anderson, Ed's, Independent, 313 Union St.
- Poorman & Woodbridge, Ed's, Tribune, 339 Union St.
- C. N. Allen, Ed'r, Democrat, 137 Belmont St.
- Husbands & Inskeep, Drugs and Medicines, 314 Union St.
- M. Sonneborn, Clothing, Hats & Caps, Boots & Shoes, (Gents Furnishings 324 & 326 Union St.
- Fred Hoffman, Furniture and Undertakings 324 232 Union St.
- Mayer & Klotz, Dry Goods, Carpets, &c., 234 Union St.
- J. B. Smith, Attorney and Notary, 229 Union St.
- D. M. Corbett, Groceries and Provisions, 206 Belmont St.
- Joseph Burtoft M'f'r and Dealer in Tobacco & Cigars, 302 Union St.
- Alex Mayer, Dry Goods Clothing & Carpets, 322 Union St.
- S. Klotz, Clothing, Hats, Caps and Gents Furnishings, 336 Union St.
- I. N. Grafton, Undertaker and Practical Embalmer, 317 Union St.
- John B. Heil, Meat Market, 308 Union St.
- O. C. Genther 99c. Store, Belmont St.
- Rees & Gallaher, Attorneys at Law, Bank Building.
- Fred Eberle, Groceries and Feed, 329 Belmont St.
- R. W. Muhleman, Physician and Surgeon, 104 Belmont St.
- Wiley & Wetherald, Dry Goods and Notions, 215 Belmont St.
- Geo. H. Muth, Boat Store, Groceries and Provisions, 220 Union St.
- Jas. Fitton, Steam and Gas Fitter, 318, 33rd St.
- W. S. Carroll, Groceries and Provisions, 33rd St. near Belmont St.
- A. Stahl, Liquor Store, 552 Union St.
- F. J. Smith, Boot and Shoes, 118 Belmont St.
- J. J. McDermott, Saloon and Eating House, 137 Union St.
- Wm. Shindewolf, Saloon and Restaurant, 224 Union St.
- Amelia Winkler, Bakery and Ice Cream Saloon, 402 Union St.
- A. V. Honeywell, Groceries and Provisions, 628 Belmont St.
- Mrs. S. J. Neal, Groceries and Prov., Guernsey St. West End 25 St.
- Wm. H. Risler, Meat Market, 221 West 25 St.
- Fred Rodewig, Bakery, 330 Belmont St.
- J. A. Pedicord, Grocery and Ice Cream Saloon, 401 Belmont St.
- Wm. Manley, Groceries and Provisions, 31st bet. Belmont & Union.
- O. C. Adair, Groceries and Provisions, 405 Union St.
- Jennie C. Tucker, Confectionery and Cigars, 501 Union St.
- John Steger, Cigar Manufacturer, 538 Union St.
- Conrad Gantert, Bakery and Confect., 533 & 535 Union St.
- Mrs. R. H. Sherry, Saloon and Billiard Parlor, 137 25th St.
- Mrs. S. Goetze, Groceries and Provisions, 1013 Jefferson St.
- R. E. Williams, Groceries and Provisions, 1029 Jefferson St.
- Mrs. L. Cooper, Ice Cream and Confectionery, 335 Belmont St.
- John E. Vogel, Groceries and Provision, 224 Hamilton St.
- Conrad Rumbach Globe House Saloon.
- Mrs. A. Gray, Ice Cream Saloon and Confectionery, 115 Belmont St.
- C. Lashley, Groceries and Provisions, 515 Union St.

- I. L. Fawcett, Groceries and Provisions, 1100 South Belmont St.
- M. Huffman, Palace Drug House, 1102 South Belmont St.
- Glass City Drug Store, 1121 South Belmont St.
- A. T. Lockwood, Groceries and Prov., 1208 South Belmont St.
- John Zweig, Hardware, Stoves, &c., 334 Union St.
- Matt. Auftring, Bakery, Belmont, cor. 22nd Sts.
- Mrs. H. Miller, Dry Goods, Millinery, Fancy and Gents Furnishing (Goods, 338 Union St.
- Andrew Truman, Globe House Barber Shop.
- Schramm Bro's, Groceries and Provisions, 141 Belmont St.
- D. Koonce, Groceries and Provisions, 128 Noble St.
- D. Lash, Groceries and Provisions, 300 Noble St.
- Jacob Reitz, Groceries and Provisions, 401 Noble St.
- J. G. McCollough, Physician and Surgeon 929 Noble St.
- J. G. McCollough, Drugs and Medicines, 931 Noble St.

