2,000,000 gallons capacity in 1881. The engines deliver into a 10-in. main leading 1,000 ft. to a stand-pipe of wrought iron, 8 ft. in diameter and 200 ft. high on ground 35 ft. above the engine-house floor. It is inclosed in an octagonal brick tower.

Distribution is by cast-iron pipe of from 10 to 4 in. in diameter, of which 12¼ miles are in use, with 150 fire hydrants, 40 gates and 475 taps.

The population in 1880 was 17,184 and the daily consumption 400,000 gallons. The works have cost $122,000 and the receipts to date have been $27,267. The bonded debt is $75,000 at 8 per cent. interest. The interest is paid out of the city taxes. The expenses in 1880 were $5,426.60, and the receipts $7,613.91. The works are managed by a board of three members of the City Council, with the City Clerk as clerk to the Board. M. X. Chuse, has been the superintendent since the beginning.

CL.—JACKSON, MICH.

Jackson, Michigan, in lat. 42° 15′ N., long. 84° 20′ W., is on both sides of the Grand River. Settled in 1829, it was incorporated as a village in 1843 and as a city in 1857. Water-works were built in 1870 by a private company, and purchased by the city in the following year. The supply is taken from two artesian wells, 6 in. in diameter and 203 ft. deep. Another 10-in. well is now being bored; 1,500,000 gallons have been pumped from the wells in 24 hours.

Water is pumped directly into the mains by Holly pumps. Two rotary pumps were first used. In 1872 two piston pumps of 10 in. diameter and 27-in. stroke were added. A domestic pressure of 50 lbs. per square inch is maintained. The fire pressure is 120 lbs. Distribution is by cast-iron pipe of from 15 to 4-in. diameter. Thirteen miles are in use, with 76 fire hydrants, 85 gates, 182 taps and 4 meters.

The population in 1880 was 16,105, and the daily consumption 800,000 gallons.

The works cost $180,000. The bonded debt is $140,000, bearing interest at 8 per cent., and $28,500 at 10 per cent. The expenditures in 1880, not including interest, were $7,008.90, and the receipts $8,250.92.

Soon after the construction of the works some difficulty was experienced from the freezing of pipes, which had not been laid deep enough.

The works are managed by the Superintendent, John Anderson.

CLI.—RACINE.

Racine, Wisconsin, in lat. 42° 44′ N., long. 87° 47′ W., is on the west shore of Lake Michigan, at the mouth of Root River. The city is on a plateau about 40 ft. above the level of the lake. Settled in 1835, it was incorporated as a city in 1848. About 1870 an artesian well was bored 1,800 ft. by a private company, from which a supply was furnished to one ward of the city. About 1878 another well was bored by the city. The yield of each well is about 550,000 gallons per day.

The distribution was at first by wrought-iron and cement pipe. The distribution of the well owned by the city is by cast-iron pipe, and the company is also substituting cast-iron mains and lead service pipes for the kind at first used. The pipes are of 6-in. and 4-in. diameter. The length of the mains is not furnished.

There are 4 fire hydrants, 5 gates and 200 taps. No meters are used. The entire works have cost $14,000.

The population in 1880 was 16,081. The consumption is not stated. H. Raymond is the Superintendent of the Artesian Well Company.

CLII.—ALLENTOWN.

Allentown, Pennsylvania, in lat. 40° 36′ 24″ N., long. 75° 28′ 34″ W., is on high ground on the west bank of the Lehigh River, between the Little Lehigh on the north and Jordan Creek on the south. The streets leading into the city from the three rivers are all of steep gradients.

The town was settled in 1762, incorporated as a borough on March 18, 1811, and as a city on March 12, 1867.

The Northampton Water Company was incorporated in 1816, for the purpose of supplying water; but no active steps were taken towards that end until 1827. In 1833 the property of the company was valued at $18,000. Water was taken from Worman's Springs, which yield 2,500,000 gallons per day. The company was reorganized some years later as the Allentown Water Company, and in 1865 the works were purchased by the city for $140,000.

A timber dam 6 ft. high across the Lehigh River gives a water power, which drives two turbine wheels, which work piston pumps, forcing the water, which is brought from the spring, through 2,300 ft. of 12-in. pipe to the pump well into a stand-pipe 6 ft. in diameter and 55 ft high, and two covered reservoirs, one 48 by 29 ft. and 13 ft. deep, the other 96 by 32 ft. and 12 ft. deep, holding 410,242 gallons.

Distribution is by cast-iron pipe of from 16-in. to 2-in. diameter, of which 18 miles are in use, with 95 fire hydrants, 2,400 taps and 18 meters. During the summers of 1879 and 1880 low water in the river caused serious apprehensions and some deficiency in the supply on account of lack of pumping power.

The population in 1880 was 18,063 and the daily consumption 1,000,000 gallons.

The works have cost $189,054.76. The bonded debt is $135,622. The first bonds bore 7 per cent. interest. Those of this issue, falling due in 1879–1880, were refunded at 6 and 5 per cent interest.

The receipts and expenses since 1875 (except 1878, which are not furnished), have been as follows:

	1876.	1877.	1879.	1880.
Expended for interest.....	$0,589.53	$9,642.74	$8,823.01	$11,259.99
Expended for maintenance, etc.....	5,777.96	2,905.38	5,086.33	3,403.68
Receipts.....	20,262.96	16,864.08	15,486 30	16,438.75

The works are managed by a board of four water commissioners appointed by the councils.

Russell A. Thayer was superintendent to 1879. Samuel S. Thompson is the present superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks. From Samuel W. Waddle, City Clerk, statistics and water rates of Bloomington, Ill., Water-works. From John Anderson, Superintendent, statistics and water rates of Jackson, Mich., Water-works. From H. Raymond, Superintendent, statistics of Racine, Wis., Artesian Well Company. From W. O. Munson, Secretary, reports of Trustees of Zanesville, O., Water-works for 1874–'5–'6–'7–'9–'80. From H. H. Forsyth, City Clerk, statistics of Peoria, Ill., Water-works, and reports of city officers for 1871 and 1880. From J. Nelson Tubbs, Chief Engineer, report of Rochester, N. Y., Executive Board, April, 1881. From Frank Doherty, Superintendent, report of Trustees of Columbus, O., Water-works, March 31, 1881. From Samuel S. Thompson, Superintendent, statistics of Allentown, Penna., Water-works and reports for 1876–'7–'9–'80.

Speaking of the enlarged Welland Canal, the *St. Catharines Journal* says: "So complicated is the machinery of the locks that it is thought unsafe to go through except under the immediate supervision of an experienced engineer. Outsiders and vessel men are not able to elucidate the mysteries connected with the enlarged Welland Canal, through which vessels are only allowed to pass, it seems, by special favor. Only two vessels have been permitted to lock up and one down, so far. Practically the canal is not yet open for a twelve-foot navigation. When it will be seems to be known only to the chief engineer. The scheme of canal enlargement cannot be fully realized until the aqueduct at Welland is built, a work not even under contract, although it is one which will require two or three years to complete."

CORRESPONDENCE.

TOTAL CURVATURE OF ANY LENGTH OF CURVE.

CAMP DEEP CREEK, Nev., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I notice in your issue of Oct. 15 Mr. Hollingsworth's article regarding method of ascertaining total curvature for any length of curve. I suppose that Mr. Hollingsworth's idea is that you are to cut his table of multipliers out and paste it in your hat.

I give you the following method as being, in my judgment, very much simpler: Divide the total number of minutes in the index degree by 100, which gives the curvature for one foot; then multiply this quotient by the number of feet in the curve and you have the total curvature expressed in minutes. For example, to find total curvature of a 3° 20′ curve of 1,279 ft. length: 3° 20′ = 200′ + 100 = 2′ × 1,279 = 2,558′ + 60 = 42° 38′ = total curvature.

F. C. HAND.

THE DISEASE OF NEW YORK AND ITS REMEDY.

NEWPORT, R. I., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I have carefully read your editorial review of my letter of Nov. 15, and beg space for a reply.

Let me first state that I have not so much objected against the views entertained by "W." in his communication, "The Disease of New York and its Remedy," as against the tone of the article. As a constant reader of ENGINEERING NEWS, I would have much preferred to find in its columns an impartial criticism on the "separate system of sewerage." The article of "W." may do very well for a daily paper, but personal controversies do not, in my opinion, belong to the columns of an engineering journal.

As I understand the article of "W.," it condemns the principle of the system proposed for the city of New York by the writer of the *Scribner* article. And just here I dissent from his views. While I do not believe that the separate system is adapted for New York City, nor that one method of removing human excreta, etc., from inhabited localities can be applied with equal success to all cases; and furthermore, while I do not think that the existing condition of the sewers of New York is "unavoidable in all works of combined sewerage," I do believe that there are many instances in which the separate system may be adopted with advantage.

Reference to the *Sanitary Engineer*, vol. 3, p. 379, will show that my opinion in regard to sewers of both systems was expressed as follows: "Both may be so planned and constructed as to insure the instant removal of all liquid and solid excreta with sufficient velocity to prevent deposits (in either case, if necessary, flushing arrangements may be provided)." I see no reason for deviating from my opinion now. As an instance of a successful system of "combined" sewerage I would cite the sewers of Franfort-on-Main, designed and built by William Lindley, Esq., C. E., which are pronounced, by all who have carefully examined them, model sewers in every respect, and probably as free from sewer gas as the sewers of Memphis are said to be.

But when you say "that the intelligent engineer who advocates the separate system for populous cities lays himself open at least to suspicion as to his motives, in view of the present condition of the sewerage question in this country," I beg to differ from your opinion. Mr. C. H. Latrobe, C. E., who in his recent report upon the sewerage of Baltimore recommends the separate system for that certainly "populous" city, could have no other motive in advocating the system than the desire to benefit the citizens of Baltimore with his