MC 0659

BOX 1 FOLDER 31

Ten years Experience with Broad Irrigation at Vassar College

1906

Reprinted from Journal of the Association of Engineering Societies, Vol. XXXVI, No. 4.

TEN YEARS' EXPERIENCE WITH BROAD IRRIGATION AT VASSAR COLLEGE.

— BY —

ELLEN H. RICHARDS AND
CHARLES W. MOULTON.

TEN YEARS' EXPERIENCE WITH BROAD IRRIGATION AT VASSAR COLLEGE.

By Ellen H. Richards and Charles W. Moulton.

[Read before the Sanitary Section of the Boston Society of Civil Engineers, March 7, 1906.]

An editorial in the *Engineering Record* of January 27, 1906, on recent views of the sewage problem, states that "The old idea that sewage farming is the best method of disposal was exploded long ago, and the sewage farms still in service are not kept in operation because they afford the most economical treatment, as a rule."

Soon after its promulgation, the farm disposal idea suffered a defeat from which it has not recovered. It came before the conditions of success were understood. Clayey soils, easily water logged, are, as we now know, unfavorable to the bacterial activity required. In the far-away decades of the sixties and seventies, even down to the eighties, there was no recognition of the fact that nearly all the value of one batch of sewage applied to land *may* be lost as gaseous nitrogen by the application of the next batch, and that a considerable portion always is lost. Hence the disappointment in the meagerness of results.

There are cases when the question "Will it pay?" has to be answered, "Not in money, but in sanitary service to mankind."

Such a case arose ten years ago when Vassar College, situated about two miles from the east bank of the Hudson River, and south of the city of Poughkeepsie, was enjoined from turning the sewage of 1 000 persons into Kaspar Kill Creek, a small tributary to the river. It was proposed to build a sewer some six miles in length to the Hudson at an unknown cost (estimated at $50 000). But, in view of the possibility that in 20 or 30 years the enlightened state authorities would prohibit the turning of untreated sewage into rivers, the trustees were willing to have an experiment tried involving much less expense.

An ideal field with most suitable material offered itself for irrigation and was laid out under the direction of the lamented Albert F. Noyes and of Allen Hazen.

No one of the advisers quite dared to risk broad irrigation by itself, and so the two filter beds were constructed. The

Looking Southeast from Outlet of Irrigation Pipe, showing Furrows for Distribution. Line of Trees in Front of Barn Marks Gully bounding Field.

Diagonal View across Filter Bed toward Corner where Sewage Empties. The Sewage sinks in without covering the whole Bed. Undisturbed Snow in Foreground. Dike in Distance running in Direction of Tree.

pipe line is 3 000 ft. long to the filter beds and extends 500 or 600 ft. farther to the irrigation outlets. The beds cover 1 acre; the filling is 0.3 to 0.4 mm. effective size. The ground water level being 15 ft. below, no underdraining is necessary. The line carries easily 10 000 or more gallons per hour. The original cost, including the engineering reports on abandoned projects, was $7 500.00.

The description of the installation will be found in the *Engineering Record* for June 27, 1896.

The filter beds have not been refilled in the ten years. The surface is plowed and harrowed over every four or six months. If the grade from the pipe is kept up (not allowed to sink so that water stands) and paper stirred up occasionally to prevent clogging, the sewage received from 8 A.M. to 2 P.M. (the usual hours of pumping) disappears before the next morning. The two *beds* are used alternately whenever the *field* is out of commission more than four weeks at a time. This use occurs between planting and harvesting, and whenever an intense cold is in danger of freezing the pipes leading to the field. These are laid only 4 to 5 ft. below the surface and on a raised dike. They have not broken and have not needed repair in the ten years.

When college opens in September, the silo corn is gathered, furrows are plowed out radially on each side of the dike, extending 40 to 50 rods, so that there is a grade of about 1 in. in 30 ft. At the end of 6 hours' pumping the water has reached a distance of 300 ft. in these furrows, the soil being porous enough to absorb about all the liquid within 6 hrs. of stopping the pumps.

Since fresh sewage gives no offense, it is only when the grade has been allowed to wash out and a puddle to form that cause for complaint arises.

The crop raised is silo corn, which grows to a height of 16 ft. The yield of the land has steadily increased and is now 50 tons ensilage per acre — double what it was at first. For 2 years there has been no good corn in the region except on this farm. About 10 acres have been irrigated with something like 100 000 gallons per day. Approximately 20 acres are available, at little expense, if branch pipes are laid.

To rake the field and beds requires two men and a team, 8 days for each bed, twice a year.

The inspector should visit the outlet every second day to see if anything is going wrong.

The great element of success is the character of the soil —

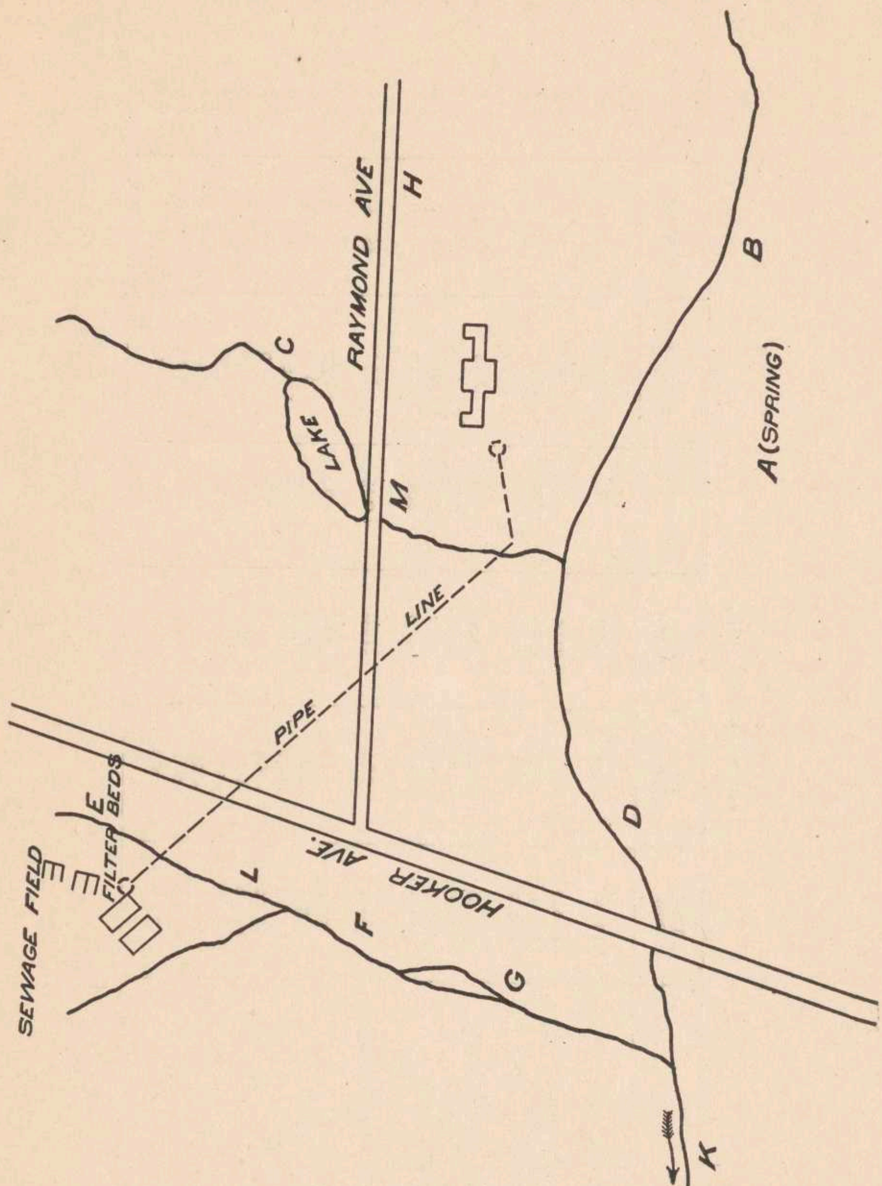
a sandy loam. The lime, iron and humus content make a favorable combination for utilizing the values of the sewage. Sand is a good filter medium, but lime and humus will purify more efficiently.

ANALYSIS OF THE SOIL.

Sieve Mesh.	Per Cent. passing through.	Per Cent. Humic Acid.	Color Am. Standard.	Parts per Million.	
				Loss on Ignition.	Oxygen Consumed.
30	10.0	1.51	18.5	55	69.7
40	12.1	1.03	18.5	60	70.9
60	28.8	1.60	13.9	53	—
80	12.6	1.78	12.5	—	59.8
100	17.7	—	11.7	48	—
120	8.5	—	13.5	—	—
170	16.6	2.66	25.0	84	116.6

Doubtless much of the nitrogen is lost by denitrification, but no great increase in that of the deeper ground waters has taken place, as shown in the analyses. Samples have been taken at least twice a year by Professor Moulton and a close watch kept of the general conditions. The table gives selected results covering the ten years, together with those of surrounding localities for comparison.

This is a valuable record of the possibility of sewage utilization without offense, and of the right principle in taking care of the wastes of an establishment by itself, instead of fouling a stream to become a menace to the health of others, and an expense to helpless dwellers farther down. It is thus in the line of modern economic and sociological investigation — a line which must be followed up if the land is to remain safely habitable.



A is a spring on the slope of Sunset Hill, unpolluted water. B is from the creek as it enters the college grounds on the North. D is the same creek just before it leaves the grounds on the South below the gas works. It was, at this point, very offensive at the beginning of the investigation. C is a small stream coming into the grounds from the West and feeding the boating lake. H is the well from which the college supply has been pumped. E is taken above the sewage field and beds from a small stream parallel to C, flowing through farming country. L is the stream just below the beds. F is the stream after receiving a tributary, draining a large stock barn and the sewage field. K is the creek after the junction of this drainage stream.

ANALYSES.

PARTS PER MILLION.

Point of Collection.	Date.	Total Solids.	Alb. Amm.	Free Amm.	Nitrites.	Nitrates.	Hardness.	Chlorine.
A Spring	May 28, 1896	73.0	.014	.000	.000	.050	44.0	1.1
B	September 30, 1895	190.0	.232	.014	.007	.200	94.3	9.8
	May 5, 1896	135.0	.058	.006	.000	.070	81.0	3.0
	October 13, 1905	160.0	.264	.024	.001	.300	73.0	6.6
C	September 30, 1895	214.0	.090	.000	.007	.800	120.6	7.1
	May 5, 1896	224.5	.126	.034	.014	1.560	152.0	8.1
	March 5, 1902	186.0	.124	.092	.014	1.900	103.7	7.7
	October 13, 1905	247.0	.140	.010	.006	.750	153.0	9.2
D	September 30, 1898	193.0	.162	.120	.025	.750	103.0	7.2
H Water Supply of Vassar College	October 10, 1895	157.0	.012	.002	.000	2.600	90.0	3.6
	May 5, 1896	136.0	.006	.000	.003	1.050	87.0	3.6
	November 12, 1897	153.0	.006	.000	.000	1.203	84.0	3.6
	September 30, 1898	133.0	.000	.000	.000	1.100	74.0	4.0
	November 6, 1900	140.0	.001	.000	.000	1.600	88.0	5.1
	December 10, 1902	161.0	.006	.000	.000	1.500	104.0	6.1
	October 29, 1903	—	.000	.000	.000	2.000	88.0	4.4
	March 16, 1905	170.0	.008	.004	.001	1.000	105.0	5.6
	October 13, 1905	173.0	.004	.000	.000	1.250	107.5	5.24

PARTS PER MILLION.

Point of Collection.	Date.	Am. Standard Color.	Total Solids.	Loss on Ignition.	Total Alb. Amm.	In Sol. Alb. Amm.	Free Amm.	Nitrites.	Nitrates.	Oxygen Consumed.	Hardness.	Chlorine.
	September 9, 1895	0.03	99.0	—	.020	.010	.000	.002	1.220	1.131	56.	3.4
	September 30, 1895	0.10	110.0	19.0	.038	.020	.000	.003	1.000	1.248	59.	3.4
	October 14, 1895	0.45	239.5	75.5	.396	.300	.452	.043	1.600	7.566	122.	10.0
	October 28, 1895	1.30	187.5	42.5	.288	.204	.032	.009	0.150	14.820	115.	7.6
	April 16, 1896	0.23	150.0	33.5	.150	.130	.060	.005	0.330	3.388	109.	3.7
	May 28, 1896	0.30	158.0	42.5	.172	.148	.016	.012	0.350	2.120	90.	3.4
	November 19, 1896	0.12	180.0	30.0	.146	.118	.022	.011	0.300	2.847	139.	4.2
E	November 12, 1897	0.17	209.7	35.0	.100	.088	.056	.007	0.700	—	94.	5.6
	September 30, 1898	0.18	196.0	34.0	.066	—	.022	.012	0.580	—	126.	4.5
	March 5, 1902	—	175.0	35.0	.116	—	.090	.015	1.900	—	104.5	3.7
	October 29, 1903	—	213.0	—	.048	—	.030	.030	1.900	—	150.0	4.0
	December 3, 1904	—	—	—	.090	—	.040	.005	0.500	—	—	3.4
	October 13, 1905	—	190.	38.	.262	—	.084	.011	0.350	—	128.0	6.0
	December 26, 1905	0.03	207.	29.	.042	—	.038	.001	1.700	—	170.	3.6
	October 28, 1895	0.70	145.5	30.5	.148	.112	.004	.003	0.030	10.920	94.	5.0
	November 11, 1895	0.20	135.0	22.5	.080	.074	.008	.001	0.280	2.379	86.	4.4
	April 16, 1896	0.25	144.5	23.5	.140	.114	.024	.004	0.330	3.080	109.	3.2
	May 28, 1896	0.30	131.5	21.0	.142	.096	.042	.006	0.400	2.574	103.	4.2
	September 16, 1896	0.22	156.0	31.0	.116	.090	.090	.020	0.400	2.106	97.	5.8
	November 19, 1896	0.12	175.0	43.0	.094	.078	.018	.002	0.600	2.301	116.	8.5
	November 12, 1897	0.10	205.0	45.0	.094	.064	.026	.005	0.850	—	101.	10.9
L	September 30, 1898	0.18	217.0	64.0	.046	—	.012	.008	1.900	—	127.	13.6
	November 6, 1900	0.20	310.0	72.0	.046	—	.004	.010	6.500	—	161.4	25.1
	March 5, 1902	—	198.0	33.0	.112	—	.114	.016	2.250	—	121.1	9.96
	October 29, 1903	0.17	203.0	—	.032	—	.014	.020	2.500	—	139.1	6.8
	December 3, 1904	—	—	—	.122	—	.038	.006	2.500	—	—	11.2
	October 13, 1905	—	206.0	49.0	.180	—	.044	.009	1.000	—	133.0	9.0
	December 26, 1905	0.10	219.0	37.0	.046	—	.052	.002	2.300	—	175.4	6.7

PARTS PER MILLION.

Point of Collection.	Date.	Solids.	Alb. Amm.	Free Amm.	Nitrites.	Nitrates.	Chlorine.
	September 30, 1895	142.0	.122	.094	.010	.300	5.0
	October 14, 1895	198.0	.276	.192	.033	1.000	8.0
	December 17, 1895	123.0	.082	.090	.006	.530	2.4
	April 16, 1896	150.0	.122	.014	.004	.500	4.0
	May 28, 1896	141.5	.112	.048	.011	.400	6.8
	September 16, 1896	153.0	.940	.148	.030	.400	6.2
F	November 21, 1896	177.0	.094	.030	.002	.800	10.6
	April 14, 1897	—	.072	.014	.006	.400	6.0
	November 12, 1897	210.0	.102	.042	.005	.850	11.1
	September 30, 1898	235.0	.182	.018	.010	2.000	15.6
	December 3, 1904	—	.064	.060	.007	2.650	13.8
	October 13, 1905	210.0	.216	.034	.008	1.000	8.2
	December 26, 1905	231.0	.042	.092	.003	8.000	11.0
	October 14, 1895	204.0	.496	1.008	.050	.300	10.4
	December 17, 1895	215.5	.228	.696	.020	.800	6.9
	April 16, 1896	143.5	.202	.088	.007	7.200	4.5
	May 28, 1896	167.5	.244	.018	.040	.400	5.8
	September 16, 1896	192.0	.246	.072	.080	.400	7.5
	November 21, 1896	185.0	.268	.264	.014	.500	7.2
K	April 14, 1897	—	.244	.078	.012	1.000	5.1
	November 12, 1897	87.0	.312	.144	.007	.550	7.0
	September 30, 1898	190.0	.148	.116	.040	.700	6.2
	December 3, 1904	—	.128	.256	.007	1.400	6.4
	October 13, 1905	176.0	.204	.164	.009	.400	11.10
	December 26, 1905	168.0	.120	.370	.006	1.800	6.4