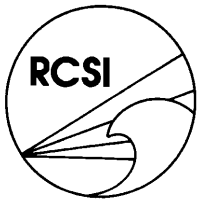

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Pollution of Waters of the Lower Genesee River

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POLLUTION OF WATERS OF THE LOWER GENESEE RIVER

The recent controversy concerning pollution of Lake Ontario beaches near Rochester and the determination of extremely high coliform bacteria counts in the lower Genesee by Drs. Christensen and Bannister suggest the extensive pollution of the Genesee River. Although coliform counts are certainly of great importance, the quality of water in a river may be strongly affected by additional factors.

As an extension of the earler investigations, a general survey of the quality of water in the lower Genesee has been made. The results of this brief survey indicate massive pollution of the Genesee River between the Elmwood Avenue bridge and the mouth of the river. This pollution consists of industrial wastes (chemicals and brewery wastes) and sewage. Some of the sewage is not chlorinated, and most of it contains solids (an infraction of the existing state law). The extent of this pollution is such that the river is unable to cleanse itself by bacterial oxidation before it empties into Lake Ontario.

Bacterial oxidation is the natural process by which bacteria, with the aid of oxygen dissolved in the water, destroy certain pollutants, thereby restoring the quality of the water. This class of pollutants (food processing wastes, many industrial organic chemicals, sewage, etc.) is called oxidizable pollutants. If, however, the water's load of oxidizable pollutants is sufficiently large, the supply of oxygen dissolved in the water will be insufficient for this purification to take place. All of the dissolved oxygen is used up; this in essence "kills" the water, making life impossible for fish and other aquatic animals. The remaining pollutants frequently give the water a foul smell; abnormal plant growth - slime-producing algae - often appear.

Unfortunately, the maximum amount of dissolved oxygen possible in waters of rivers and lakes is rather small even under the most favorable circumstances. At 15° C (59° F), water can dissolve no more than about 9.6 milligrams (mg) of oxygen per liter. This figure decreases somewhat as water temperature rises and increases as temperature drops, but not by a great deal. The rate of oxygen uptake by the water of a lake or slow moving stream is rather slow. Thus, if a stream becomes charged with a higher concentration of oxidizable material than can be oxidized by approximately 10 mg of oxygen per liter of water, the oxygen content of the water drops to practically zero as oxidation of this material takes place, and normal plant and animal life in this water becomes impossible.

When it is necessary to dispose of sewage which has not had proper secondary treatment, it is possible to sterilize it by treatment with chlorine, which is a cheap and powerful disinfectant. Chlorine is a powerful oxidizing agent; it withdraws electrons (negative charges) from many organic substances, such as are found in sewage, and thereby destroys bacteria.

In so doing, it is converted to chloride ion, which is quite ineffective as a disinfectant. When chlorinating sewage, therefore, it is necessary to make sure that enough chlorine has been added to maintain a concentration lethal to bacteria for a period of time long enough to kill them, and to make sure that this chlorine is able to get to the bacteria. If the sewage contains solids, the chlorine is unable to penetrate the particles and kill the bacteria which they contain. Furthermore, once the sewage has been discharged into a river or lake, the chlorine is very rapidly diluted and dissipated. Therefore the discharge of sewage containing solids is not a safe practice even if the sewage is chlorinated.

It should be noted that the samples reported in the following table do not exhaust all the possible sources of pollution. As yet only four samples have been taken between Elmwood Avenue and the Beebee Power Station, and many of the outfalls south of the Hawkeye Works have not been sampled.

Still some conclusions can be drawn. The figures given for sample number 3 suggest that considerable pollution is entering the river south of the Beebee Power Station. At least a portion of this apparently comes from the Genesee Brewing Company (samples 2, 18). Samples 6, 7, and 8 indicate that the Kodak Park Works puts a significant load of pollution in the river. Samples 5, 13, 14, and 17 (sewage outfalls) indicate some probable sources of the extremely high coliform counts observed by Bannister and Christensen.

The chemical oxygen demand (COD) analysis, as described to us by Dr. Clarence Calbert of the U.S. Public Health Service, is a rather simple and quite reproducible method for assaying the total amount of oxidizable material present in water and hence whether or not the burden of oxidizable pollutants is more than the water can be expected to handle. The method involves treatment of a sample of the water with a known quantity of standard potassium dichromate solution under extremely acid conditions in the presence of mercuric ion (to prevent interference in the analysis by chloride ion) and silver ion (to catalyze the oxidation). The excess dichromate is then back titrated with standard ferrous ammonium sulfate solution.

Samples were taken from the river on October 8, 10, 16, and 24, and on November 27, 1965. The sampling sites, chemical oxygen demands, some other analyses and tests, and qualitative observations are listed in the attached table starting at the Elmwood Avenue Bridge and proceeding downstream to the river's mouth. (Sample 18, out of order, was taken after the table had been prepared.) Other analyses indicated in the table include: $KMnO_4$ test to detect easily oxidizable chemicals, pH test with hydrion paper to indicate acidic or basic character of the water, starch-iodide test to detect free chlorine (this test readily detects the chlorine in the tap water in Rochester), and lead acetate paper test for detection of sulfides. All of these additional analyses were made at the various sites using fresh samples. The titration with standard acid performed on sample 18 was done with .5 N sulfuric acid, with bromthymol blue as indicator. All analyses were done in duplicate.

Sample Number	Date	Site	COD[1]	Results and Observations
1	8 Oct	East bank of river approx. 50 yds. North of Elmwood Avenue Bridge	23	COD somewhat in excess of saturation concentration of oxygen (about 10mg/liter). Water had no appreciable odor.
2	24 Oct	East bank, North of Platt St. bridge, immediate vicinity of Cataract St. sewer outfall.	1000 plus	COD in excess of 100 times the saturation concentration of oxygen. Very strong odor, large amounts of partly decomposed grain present. pH of 5-6, samples reduce $KMnO_4$ slowly. Rats were seen feeding on the brewery waste; seven were seen in a period of 2 min.
3	10 Oct	West bank of river just below Beebee Power Station.	48	COD almost 5 times greater than saturation concentration of oxygen. Some odor. Noticed that trash is being dumped in the river at this point, apparently by the City of Rochester.
4	16 Oct	Middle of river, near Hawkeye Works	26	No odor, tests for free chlorine and sulfide negative. pH about 6.
5	16 Oct	Sewage outfall, inlet off East bank just below Hawkeye.	133	COD about 13 times the saturation concentration of oxygen. Solids seen-dung. No residual chlorine present, as indicated by several starch-iodide tests. pH about 6, does not reduce dilute $KMnO_4$.
6	16 Oct.	West bank, outfall from grey tanks near Kodak Park	350	COD about 35 times saturation concentration of oxygen. Odor of H_2S, bluish color, foam reduces dilute $KMnO_4$ readily. Chlorine test negative. Slight positive test for sulfide.

[1] Chemical oxygen demand expressed in mg of equivalent oxygen per liter of sample.

Sample Number	Date	Site	COD[1]	Results and Observations
7	16 Oct	West bank, small concrete outfall just below sample No. 6 site.	75	Milky white discharge, does not reduce $KMnO_4$, tests for free chlorine and sulfide negative. No odor. pH greater than 10.
8	16 Oct	About 20 feet off West bank of river approx. 100 yds. below main Kodak Park outfall.	90	COD about 9 times saturation concentration. Sweetish odor, pH about 6, sulfide and free chlorine tests negative, dilute $KMnO_4$ not reduced. In view of the fact that this sample was taken from the river (the main outfall was not accessible), this COD is a very high value.
9	16 Oct	West bank, concrete sluiceway quite near Kodak Park.	19	COD about twice saturation concentration. Distinctly sweetish smelling effluent of whitish, slightly milky tinge does not reduce $KMnO_4$. Chlorine and sulfide tests negative, pH about 6.
10	16 Oct.	Approx. 50 ft. up creek off West bank just south of Charlotte coal loader.	19	COD about twice saturation concentration. No odor, pH about 6.
11	16 Oct	Near West bank by Charlotte coal loader.	29	COD about 3 times saturation concentration. Slight odor. Starch-iodide test for chlorine negative, dilute $KMnO_4$ not reduced, pH about 6.
12	10 Oct	West bank just below coal loader	42	COD 4 times saturation concentration. Some odor. Large amounts grey slime on water plants.
13	10 Oct	East bank, Irondequoit sewage outfall at Genesee Yacht Club.	398	COD 40 times saturation concentration of oxygen. No odor of chlorine but marked odor of sewage, sporadic appearance of solids (dung, toilet paper). People at the club stated that the smell was very bad and the volume of solids quite large at about 7:30AM this date. A series of turbidity tests with silver nitrate indicated that this sewage contained about 20 ppm total chlorine (both free Cl and Cl ion), which suggests this sewage is being chlorinated.

[1] Chemical oxygen demand expressed in mg of equivalent oxygen per liter of sample.

Sample Number	Date	Site	COD[1]	Results and Observations
14	16 Oct	Same as above	424	COD more than 42 times saturation concentration. Foul smell, no odor of chlorine but starch-iodide test indicates presence of free chlorine in effluent. Test for sulfide negative, dilute $KMnO_4$ not reduced. pH about 6.
15	10 Oct	East bank near Triangle Marine, but above sewage outfall.	37	COD about 4 times saturation concentration. Some odor, not much suspended matter.
16	10 Oct	East bank between Triangle Marine and USMC Reserve Training Center dock.	231	COD 23 times saturation concentration. Apparently there is a sewage outfall here, although the outfall itself was not observed. A foul odor and some fairly fine solids were observed.
17	16 Oct	Triangle Marine near sample No16 site.	90	COD 9 times saturation concentration. No solids seen. Tests for free chlorine and sulfide negative. pH about 6.
18	27 Nov	South Genesee Brewery outfall, approx. 50 yd. north of Cataract St. sewer outfall	>1000	COD over 100 times saturation concentration. Heavy flow, paper, foa extensive discoloration of the river. pH greater than 10 (hydrion paper), sample found on titration with acid to be about .04 N base. Strong odor.
19	27 Nov	See Sample No.5.	-	Dung seen, strong odor.

1 Chemical oxygen demand expressed in mg of equivalent oxygen per liter of sample.

It should be noted that these results are not sufficient to give a detailed picture of the state of the river. In particular, samples should be taken from well below the surface to eliminate the effects of surface oxidation. All of the river samples reported here were taken from quite near the surface.

The analyses were run by Dr. D.J. Wilson, and the samples were collected by Mr. Neal Dunkleberg and Dr. Wilson.

ADDENDA

Since preparation of this report, information has been received from both Eastman Kodak and the Genesee Brewing Company concerning these findings. Mr. Howard E. Smith of Kodak Park informs us that Kodak has made and continues to make a major effort on this matter, that Kodak wants to be a good neighbor in the community and that, "Because of the current investigation with respect to pollution in the Genesee River, we would consider it inappropriate to discuss our position in detail with any particular group."

Mr. Carl Myers of the Genesee Brewing Company, in a phone conversation with Dr. Wilson, told us that the presence of spent grain at the Cataract St. sewer outfall was due to an accidental stoppage of the brewery's sewer line to the city sewage main on Cataract Street. This stoppage has been cleared, and the company has requested that the city raise their outfall to prevent further backups. Mr. Myers also stated that the large number of rats observed was primarily due to this accident and that the brewery carries on a rodent control program. A later examination of the area around this outfall by Dr. Wilson revealed no further grain spillage and rat bait in the area. No rats were observed. Pollution of the river from the company's outfalls, however, is continuing, as indicated by sample no. 18.

On December 2 samples were collected at three of the outfalls. The results were as follows:

Sample Number	Observations
19	Sewage outfall just north of Hawkeye Works. No free chlorine (2 tests performed), specimens of dung collected. Odor fairly strong. Several chunks of dung some roughly the size of a marble, were seen coming out of the outfall.
20	Sewage outfall, Genesee Yacht Club. Some discoloration and sediment, no course solids, no free chlorine (2 tests performed).
21	Sewage outfall at Triangle Marine. Lots of discoloration, some paper, lots of fine to medium solids, 4 condums, no free chlorine.
22	Genesee Brewery outfall discharging profusely, discoloration of river extensive, much foam in the river for a distance of at least 200 yards downstream.