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Report of the Subcommittee on Water Pollution II

By: Note to Members
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THE ROCHESTER COMMITTEE FOR
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Bulletin

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Our last bulletin reported to you the findings of our subcommittee on water pollution from tests carried out in July, and summarized their interpretation of the data. Their conclusions, based on comparison with published standards, were that public bathing beaches on Lake Ontario are seriously polluted, and that the Genesee River is a major source of the pollution. You are undoubtedly well aware of the fact that the report was followed by a period of intense controversy on this subject, centering mainly on the question of whether the beaches should have been closed to bathers. Our Committee has at no point taken sides on this question, but has instead concentrated its efforts on extending its knowledge of the factual aspects of the problem. This bulletin will inform you on technical matters that have come to our attention in recent weeks.

I. Summary of Coliform Counts

Data from tests made by four independent groups during the summer months, covering three beaches on Lake Ontario, are now available. They are summarized, together with a commentary, in the table at the end of this bulletin. It is obvious that there are wide variations from day to day and from point to point along the shore. It also appears, from data provided by the New York State Department of Health, that different techniques of measurement give significantly different results. A striking fact, evident from the data, is the sharp drop in coliform level from July to August. Not given in our table are the dependences on depth and distance from shore, where wide variations have also been found. All of these sources of variation prevent us from reporting a typical and unambiguous level of coliform bacteria. The underlying causes of variation can, at present, only be guessed. And the full significance of the measurements, with respect to specific dangers to public health, is not a simple matter to decide. Local health officials, together with our own subcommittee, are exerting every effort toward clarifying the situation.

A further complication in interpretation arises from the attempt to differentiate "fecal coliforms" (i.e., the species E. coli, which is almost exclusively an inhabitant of the intestinal tract of man and other warm-blooded animals) from "non-fecal coliforms" (other species of bacteria which are measured, along with E. coli, in the various coliform tests). It is important to note in this regard that some "non-fecal" types, particularly the "aerogenes" group, are commonly found in human feces, as well as in some non-intestinal sources.

At this time, therefore, we can only compare the measurements once again with the standards and recommendations that have been published by others. We can also look at the coliform levels in the light of a recent amendment to Section 1205 of the Public Health Law of New York State.

II. Published Recommendations

We quote from an abstract of a paper by Kabler, Clark, and Geldreich (Public Health Reports 79, 58, (1964)). The authors are associated with the Taft Sanitary Engineering Center, U.S. Public Health Service, Cincinatti, Ohio.

> "Fecal coliform organisms may be considered indicators of recent fecal pollution by warm-blooded animals. Because no satisfactory method is currently available for differentiating human fecal coliforms from others of animal origin, it is necessary to consider all fecal coliform organisms as indication of dangerous contamination. The presence of the intermediate-aerogenes-cloace group of organisms ("non-fecal" coliforms) in untreated water may be the result of less recent fecal pollution or of soil runoff water."

The position taken by these authors is that, in view of present difficulties in tying down the causes of pollution, we must adopt an attitude of extreme caution. Thus, not only fecal coliforms, but coliforms of all kinds are indicators of possibly dangerous contamination.

Next, we reproduce the classification of waters adopted by the Michigan Control Commission, and reported in Sewage Works Journal 14, 1047 (1942):

"Total coliforms/100 ml	Type of water
10 - 100	Good water; normal for inland and Great Lakes; free of sewage pollution.
100 - 500	Normal for inland streams; free of detrimental sewage pollution; attributed to land wash.
1, 000	Suspicious; indicates mild pollution in natural waters, but dangerous in proximity to fresh sewage pollution.
10,000	Definite evidence of fresh sewage pollution; menace to health."

The average of all samples in our summary is over 5,000 coliforms per 100 ml; the median is 1,200. According to the Michigan classification, this level is at least ten times normal and may be hundreds of times normal. In view of sewage outflow into the Genesee River and Lake Ontario, the waters of Lake Ontario are no longer "natural" and the level is "dangerous", by this definition.

In our last Bulletin, we referred to standards set by the Ohio Valley Water Sanitary Commission. The following quotations are from their report in Public Works of January 1952, where the basis for their recommendations is reviewed.

The Suggested Standards

"For bathing or swimming waters, monthly arithmetical average 'most probable number' of coliform organisms should not exceed 1,000 per 100 ml during any month of the recreational season; nor exceed this number in more than 20% of the samples examined during any month; nor exceed 2,400 per 100 ml on any day."

Correlation of Coliforms and Typhoid Exposure

"As a fresh approach, consideration was given to the findings of Kehr and Butterfield (Public Health Reports, April 1943) as a rough check on the rationality of bathing water standards of water borne disease hazards. These studies formed a basis for correlation between morbidity rates from typhoid fever and the ratios of E. coli to E. typhosa in dewage and sewage-polluted waters. Although typhoid morbidity rates in the Ohio Valley are low, they are measurable; and the rates for such enteric diseases as dysentery and diarrhea-enteritis are sufficiently high to indicate a carrier reservoir which might be a factor in bathing water sanitation.

"The average typhoid mortality rates for the seven Ohio Valley states for 1945-47 was 0.4 per 100,000. Assuming a morbidity-mortality ratio of 10 to 1, the morbidity rate would be 0.4 per 10,000. From the curves of Kehr and Butterfield, the corresponding ratios of E. typhosa to E. coli in sewage and sewage-polluted waters in such an area would be six E. typhosa per million coliforms. . . Assuming that each bather ingests 10 ml of water each day he swims, the chance of exposure can be computed for Ohio River conditions. For each bather for each day, the chance of ingesting a single E. typhosa would be 1 in 1700. In a 90-day bathing season, the daily swimmer would have a chance of about 1 in 19 of ingesting a single typhoid bacterium.

"Kehr and Butterfield estimated that 2% of the persons exposed to the ingestion of a single E. typhosa actually contract the disease. On this basis, the chance of getting typhoid fever would be 1 in 950, for a person swimming every day for 90 days in water containing 1,000 coliform organism per 100 ml in an area having a typhoid morbidity rate of 0.4 per 10,000."

Coliforms and other Enteric Diseases

"From extimates by Wolman and Gorman, it appears that water-borne diarrhea-enteritis morbidity rates tend to average about 20 times those of typhoid fever. In the seven Ohio Valley states, the ratio was 22 to 1 during 1945-47. This provides a general basis for estimating the risk of contracting such diseases in water containing 1,000 coliforms per 100 ml."

The Need for Arithmetical Averages

"On the basis of these backgrounds of experience and data, it was recommended that , for bathing and other recreational requirements, excepting boating, the bacterial quality objectives stated elsewhere in this article be established. The term 'average' in these recommendations is intended to mean the ordinary arithmetical average. By the use of this method, the full effects of wide deviations from the average are not excluded or minimized, since in this case these are believed to be of definite public health significance."

III. New York State Law

On February 15, 1965, the Legislature enacted an amendment to paragraph (c), subdivision 5, section 1205 of the public health law, as added by chapter 490 of the laws of 1961. The amendment was to take effect on July 1, 1965. It reads, in part, as follows:

"The extent to which organisms of the coliform group (intestinal bacilli) or any other organisms of human origin may be permitted in the water provided that the number of organisms of the coliform group shall not exceed the following prescribed standards for best usages of the waters of the state:

. . . "Sources of water for bathing and any other usages except as a source of water supply for drinking, culinary, and food processing purposes: an average MPN to to exceed 2,400 coliform organism per 100 ml sample in a series of four or more samples collected during any thirty-day period; an MPN exceeding 2,400 per 100 ml in not more than 20% of the samples collected during the period."

We observe that the wording of the amendment is similar to that of the Ohio recommendation, but that their maximum count now appears as an average, and that no maximum is specified at all. The complete meaning of this law, and the basis for its specifications, are matters that remain to be clarified.

Record of Total Coliform Count on Samples of Lake Ontario

for the period 6/17/65 to 9/7/65

Laboratories are designated as follows:

A: Department of Health, Monroe County
B: United States Public Health Service
C: Rochester Committee for Scientific Information
D: New York State Department of Health

Date	Loc.	Lab	Count	Notes
6-17	Ont.	B	1,200	cool; uncrowded
6-25	D-E	A	240	
6-25	Ont.	A	11,000	
6-25	Web.	A	24,000	
6-28	Ont.	B	1,100	warm
7-6	Ont.	B	3,700	warm; after storm; wind N; uncrowded
7-6	Ont.	A	43	
7-6	D-E	A	46,000	
7-6	Web.	A	2,400	
7-10	Ont.	C	20,000	wind NW
7-10	D-E	C	50,000	wind NW
7-12	D-E	A	11,000	
7-12	Ont.	A	11,000	
7-12	Web.	A	240	
7-20	D-E	C	2,000	wind SW
7-21	D-E	A	7,240	
7-21	Ont.	A	2,400	
7-21	Web.	A	46,000	
7-28	D-E	A	4,600	
7-28	Ont.	A	460	
7-28	Web.	A	1,500	
8-2	D-E	A	460	
8-2	Ont.	A	240	
8-2	Web.	A	700	
8-10	Ont.	B	2,100	cool; rain; wind W; fecal component 1,970
8-12	D-E	A	2,400	
8-12	Ont.	A	240	
8-12	Web.	A	53	
8-13	D-E	B	2,700	rain; wind N; fecal component 2,500
8-16	D-E	A	460	
8-16	Ont.	A	4,600	
8-16	Web.	A	390	
8-17	Ont.	B	1,400	no wind; uncrowded
8-17	D-E	B	520	no wind; uncrowded
8-23	Ont.	B	8,400	cool; wind N; uncrowded
8-23	D-E	B	16,000	cool; wind N;uncrowded; fecal component1,700
8-23	Web.	B	5,300	cool; wind N; uncrowded
8-24	D-E	D	560	6-sample average, MPN
8-24	D-E	D	210	6-sample average, filter technique
8-24	Ont.	D	790	6-sample average, MPN
8-24	Ont.	D	610	6-sample average, filter technique; max 2200 (fecal)
8-25	Web.	B	210	no wind; uncrowded
8-25	D-E	B	410	no wind; uncrowded
8-25	D-E	A	460	
8-25	Ont.	A	460	

Date	Loc.	Lab	Count	Notes
9-3	Ont.	B	160	uncrowded
9-3	D-E	B	110	uncrowded
9-3	Web.	B	180	uncrowded
9-7	Ont.	B	330	beach closed
9-7	D-E	B	1,600	beach closed
9-7	Web.	B	150	beach closed
			5,850	overall average
			1,200	overall median
			1,340	overall log average
			11,700	average 6-17 to 7-28
			4,000	median 6-17 to 7-28
			1,740	average 8-2 to 9-7
			500	median 8-2 to 9-7

Comment

1. Lab A (Monroe County) took measurements at two depths; 3 feet and 6 feet. The count was usually higher at the 3-foot depth; these are the data summarized above. At Webster Beach, for example, the average at 3 feet was 9,400; the average at 6 feet was 2,100.

2. Lab D (NYS) took measurements at the same two depths, at three positions along each beach, and reported the results of two techniques of analysis: "multiple tube" and "membrane filter". Counts by the latter technique were generally lower. The fecal component was usually a small fraction of the total coliforms. But there are wide variations in this fraction, and there are inconsistencies between the two techniques. For example, the total count at 3 feet at the west end of Ontario Beach on August 24, by the multiple tube technique, was 1,090 of which 50 were fecal coli. Filter analysis of the same sample gave a total of 2,200 consisting <u>entirely</u> of fecal coli.

3. Lab B (USPHS) took measurements at several distances from shore. Points closest to shore generally gave the highest counts; these are the data summarized above. The fecal fraction was usually small. But on August 10, 200 feet from the shore of Ontario Beach, the total count was 2,100 of which 1,970 were fecal.

4. It is perfectly clear from the data that the levels of coliform dropped sharply in August.