

## Bacterial Counts of a Section of the Red River -- Summer, 1970

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Senator Gaylord Nelson of Wisconsin stated in 1967 that "America the affluent is well on the way to destroying America the beautiful and the most tragic and most costly development is the rapidly mounting pollution of our lakes and streams." Senator Nelson could well have been talking about the Red River of the North, since numerous surveys by state and federal agencies from 1935-1969 indicate that this interstate river has become progressively more polluted as the municipal and industrial populations along its banks increase. In 1935, a North Dakota State Health Department survey team made the recommendation that, since the average yearly flow rate of the Red was so low (a 1 in 10 chance that the flow for 30 consecutive days will be 50 cubic feet a second or less), there should be no untreated domestic or industrial waste added to the river because there was so little chance of natural purification of the water. Thus, as long as 36 years ago it was recognized that the capability of the Red River to degrade other than natural pollution from run-off was severely limited.

More recently (in 1969), an extensive survey of the Red River conducted by the Federal Water Pollution Control Administration revealed that the population of the Red River basin served by municipal waste treatment systems has risen from 94,547 in 1956 to 274,918 in 1968. This represents 51 per cent of the total basin population of about 541,113. The waste load on the river due to domes-

tic wastes after treatment is approximately that of 34,443 persons, representing an 87 per cent removal of organic wastes by sewage treatment plants.

A partial inventory by the FWPCA of major industries in the basin indicates that the major industrial pollution sources are sugar beet refineries, potato processors, poultry and meat packers and milk, cream and cheese processors. The last three industries do not contribute wastes directly to the river since their wastes are combined with domestic wastes and sent through the sewage treatment plants; however, the possibility of overloading these facilities certainly exists. Until recently, when recycling of transport water was instituted, the most severe pollution has resulted from the sugar beet refineries since these wastes were produced during the severe winter months of low stream flow and low biological activity. The gross waste load on the Red River due to the four sugar beet processing plants in the river basin was estimated to total over a 1,600,000 population equivalent per day during the processing season. The sugar processing industry during 1970 and at present is engaged in diligent research efforts to alleviate this problem.

During the summer of 1970, from June 8 through July 28 an intensive biological and bacteriological survey of the Red River was undertaken by graduate students in the Bacteriology and Biology departments of North Dakota State University.

Surface and bottom water samples were taken at weekly intervals from five to seven sites on the Red River from 5 miles south of Fargo-Moorhead to 100 feet downstream from the Fargo sewage treatment plant outfall. The samples were collected

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from a boat with a Van Dorn water sampler. Those samples intended for bacteriological analysis were subjected to analytical procedures designed to give total bacterial counts, coliform counts, and counts of pathogenic intestinal bacteria (**Salmonella** and **Shigella** species). The latter were of particular interest in this survey since the accepted procedure in sanitary science is to describe the bacteriological quality of water by coliform density on the basis that these organisms are indicators of fecal pollution with the attendant hazard of pathogens, but the pathogens usually are never identified.

Biological and chemical analyses on each sample included the following determinations: dissolved oxygen, nitrate ions, phosphate ions, number of animals resistant to pollution, number of animals sensitive to pollution, and total suspended solids.

Comparisons with the maximum permissible levels derived from state and federal standards for these pollutional parameters gave evidence of gross pollution of the Red River with several factors clearly indicating the extent of the pollution, namely:

1. The bacterial counts, especially the coliform counts, were far over the 5,000/100 ml allowable by North Dakota and Minnesota standards for potable or recreational water.
2. **Salmonella**, the dysentery group of pathogens, were found at all stations, with **Salmonella typhi**, the typhoid fever organism, present at one time in the river near the Fargo Water Treatment Plant Intake.
3. There was consistently present a high concentration of bacteria in the Red River at the Fargo intake averaging 500,000 bacteria per milliliter of water. Since there are no industries upstream of the Fargo water intake this seems to indicate an unknown source of contamination by animal and/or human wastes.
4. The dissolved oxygen level at several sites was below the two-state standard (5 ppm) minimum.
5. With no final disinfecting treatment of the effluent at American Crystal Sugar, the presence of high coliform densities suggested dangerous and inexplicable contamination.
6. The continuous presence of **Clostridium perfringens** at the Fargo Sewage Plant outfall indicates the need for more rigorous treatment of the wastes.
7. The summer of 1970, a period of drought,

had serious effects on the pollution levels in the Red River as was indicated by a rise in total bacterial numbers, a fall in numbers of pollution sensitive invertebrates and a rise in numbers of pollution tolerant organisms.

8. The presence of **Shigella dysenteriae** in the Wild Rice River when the coliform count was very low (500/ml) is remarkable for two reasons:
  - a) This is a form of **Shigella** very rarely found in the U.S.
  - b) This finding points up the need for more extensive bacteriological analyses of polluted water than mere coliform densities.

After a prolonged drought during the late summer and early fall months of 1970 the level of the Red River at Fargo-Moorhead dropped and the river flow ceased, with a resulting fish kill of serious dimensions. Bacteriological analyses of water from four sites on October 4, the date of the fish kill, and October 12, after water was released into the river from a reservoir upstream, indicated an enormous increase in total and coliform bacterial densities (up to 150,000,000 bacteria per milliliter) with a concomitant decrease in dissolved oxygen (down to 0.5 ppm). When isolation techniques for intestinal pathogens of the dysentery group were employed, every sample from every station on both dates gave evidence of **Salmonella** and/or **Shigella** species of bacteria.

Thus, when there was no flow of water through the river the enormous bacterial count reflected the concentration effect of insufficient dilution constituting a severe health hazard with an accompanying lowering of dissolved oxygen to levels incompatible with the survival of fish. When water was released south of the Fargo-Moorhead area, the bacterial count dropped due to this dilution (15,000,000 bacteria per milliliter) but remained far above the North Dakota-Minnesota recommended levels for potable, recreational or industrial uses of water.

The results of both surveys clearly indicate the serious extent of pollution of the Red River of the North. Further, the problem of continuing contamination by municipal and industrial wastes cannot be solved by dilution alone. Finally, these results point up the need in routine water analysis for more extensive bacteriological analyses than coliform counts, since many disease-producing organisms have been found when coliform counts were within standard limits.