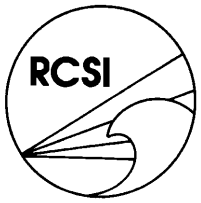

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Industrial Radioactive Waste - Bulletin #2

By: George G. Berg & E. Grant Pike
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ROCHESTER COMMITTEE

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Strontium 90 in Buttermilk Creek

Summary: Effluent from the nuclear fuel reprocessing plant in Cattaraugus County, N.Y., sampled by the Rochester Committee for Scientific Information, had over three million picocuries per liter of strontium - 90. The concentration limit allowed for soluble strontium-90 by State and Federal regulation is one hundred picocuries per liter . Buttermilk Creek, which receives this effluent, was found by the R.C.S.I. to contain 280,000 picocuries per liter of strontium - 90, two thousand eight hundred times over the limit.

The State of New York has not published data on strontium - 90 in Buttermilk Creek, but computations by the R.C.S.I., based on other data published by the State, indicate that the average December 1965 to March 1967 concentration of strontium - 90 in the creek, was over 600 picocuries per liter. Similar computations indicate that the average discharge rate from the reprocessing plant is at least 70 times that allowed for an industrial waste outlet.

I. Background: The New York State Atomic and Space Development Authority owns a 3,300 acre industrial park for atomic industry in the West Valley of Cattaraugus County. The first private tenant of this park and the only user of large amounts of radioactive materials is Nuclear Fuel Services, Inc., a plant devoted to the chemical reprocessing of used reactor fuel elements. On 1 March 1963, the Rochester Committee for Scientific Information attended an A.E.C. hearing in Olean. After the hearing, a construction permit and a temporary operating license was issued by the A.E.C. According to the R.C.S.I. bulletin 14 June 1963, the hearing for a permanent operating license is due in 1968.

Nuclear fuel processing uses large quantities of water, some of which comes in contact with radioactive materials.

The monitoring for radioactivity released to the environment is done by the State Radiation Surveillance Network, under the State of New York Department of Health, Division of Environmental Health Services (Assistant Commissioner H. Thompson), Bureau of Radiological Health Services (Director S. Davies). The results are published after a few month's delay in bulletins of the State Network signed by Dr. Thompson. The bulletins are outstandingly praiseworthy for frank and complete reporting of data, which is of benefit to scientists and to the public.

The R.C.S.I. has been concerned for over a year with evidence of excessive radioactive pollution in the Cattaraugus Creek watershed. This evidence , coming from the Bulletins of the State Radiation Surveillance Network, is presented in the report that follows.

We have hesitated to publish potentially disturbing interpretations based solely on computations from official data. We therefore secured our own samples and had them tested. The results were even worse than expected, and prompted the release of this report.

II. Observations and Computations:

1. Geography. An outflow pipe pours water into a small stream on the fenced grounds of the Nuclear Fuel Services plant. The stream then passes under the fence and carries the wastes from this outfall into Buttermilk Creek, which runs through land to which the public has unrestricted access. Buttermilk Creek is a tributary of Cattaraugus Creek, which it enters downstream from the Bigelow Bridge. Cattaraugus Creek flows in a northerly and westerly direction, forms a reservoir at Springville behind a power dam, continues through the town of Gowanda and the Cattaraugus Indian Reservation and enters Lake Erie at Irving.

The State Network takes samples from a number of locations along Cattaraugus and Buttermilk Creeks. For some reason, most of the information reported by the State Network concerns the Springville Reservoir, and we are consequently forced to begin our computations there and move gradually upstream towards the Nuclear Fuel Services plant.

2. General Radioactive Pollution of Cattaraugus Creek. The State Network measures the concentration of radioactive pollutants in water in units of picocurie per liter (pCi/l). These are simply called "units" in our report. Waters throughout New York State show a few units of overall beta radiation. This is the background concentration of radioactive (beta-emitting) isotopes in water. The background concentration, which is quite uniform in the State of New York, is distinguished from local concentrations of radioactive isotopes. Local high concentrations always have a traceable source, such as a naturally radioactive spring, or a man-made discharge of radioactive waste materials.

Prior to June 1966 the Springville reservoir water had no more than background radioactivity (Table 1). In June 1966 the water started showing radioactive pollution, and since October 1966 there has not been a sample with less than 8 units of radioactivity. The State Survey sampling was done by continuous collection, analysed at intervals ranging from twice a week to daily. This is our summary of all the published results on a quarterly basis.

TABLE 1

Gross beta radioactivity in the Springville Reservoir of Cattaraugus Creek, in units of pCi/l

Period	Average	High
Before June 1966	less than 3	3
Oct. through Dec. 1966	231	3051
Jan. " March 1967	108	315
Apr. " June 1967	75	177
July and Aug. 1967	99	203

After Cattaraugus Creek leaves the Springville Reservoir, it becomes gradually augmented by tributary streams, and the level of pollution decreases in proportion. The water at the Irving Bridge outlet still has half or more of the concentration of radioactive materials seen in the Reservoir. The July-August average, for instance, was 57 units at the outlet into Lake Erie, as compared to 99 in the reservoir.

What kind of pollution is indicated by all this radioactivity

in water? The nuclear fuel elements brought into the Nuclear Fuel Services plant for reworking have many radioactive isotopes. Some of these are a much greater hazard to human health per unit ingested radiation than others. To estimate this hazard from measurements of radiation, we must know which isotopes are involved in producing the radiation.

The State Survey does not identify these isotopes. In a situation where the identity of some radionuclides is not known, the law prohibits the discharge of waste water containing more than 10 units of radioactivity (see Discussion). Springville Reservoir water is ten times more radioactive than this.

3. Pollution of Cattaraugus Creek with Strontium-90. The State Survey tested for the presence in the water of three radioactive isotopes which are of special importance in fallout: strontium-90, strontium-89 and cesium-137. Given the same amounts in radiation units, strontium-90 is probably the most potent of the three in causing cancer.[1]

The tests for strontium require a very laborious chemical separation, take much time, and must be rationed among various test sites. The Mohawk River at Cohoes, which showed negligeable amounts of radioactivity, received regular strontium tests at least once a month according to State Survey reports. Although the Springville Reservoir of Cattaraugus Creek showed radioactive pollution, it was not tested regularly. Strontium-90 tests were reported for late October 1966, but were subsequently discounted by the State Survey with the explanation that something went wrong with the method of measurement. Fifteen measurements were reported during the period 12/2/66 through 5/2/67, and none thereafter. The average was computed by the R.C.S.I.

TABLE 2

Strontium-90 in the Springville Reservoir, in pCi/l

Period	No. of samples	Average Concentration	Highest Concentration
12/2/66 - 5/2/67	15	43.7 units	93 units

How much of the radioactive pollution of water could be attributed to strontium-90? The R.C.S.I. compared the figures for strontium with the gross beta counts reported for the Springville Reservoir at the same dates (14 paired samples). The average of the ratios (strontium-90: gross beta count) was 32%. The ratios varied greatly from one date to another. The

[1] (Federal Radiation Council Report. Washington, D.C., December 1964: "Implications to man of irradiation by internally deposited strontium-89, strontium-90, and cesium-137").

standard deviation of the ratios (n= 14) was ± 24%. On two of the fourteen dates, the strontium count was more than 50% of the gross, and on three of the 14 dates it was less than 10%. The gross beta counts were not calibrated in terms of Sr-90.

It is the opinion of the R.C.S.I. that the figures do not show a correlation between gross beta radiation and strontium-90. In other words, we cannot tell how much strontium-90 is present in a sample of Springville Reservoir water in which only the gross beta radiation was measured, but we know that some strontium-90 is probably there. Under these circumstances the legal limit for radioactivity in the discharge fluid can be no higher than the limit for strontium-90, which is 100 units (pCi/l). The reservoir averaged more than this since October 1966.

4. Radioactive Pollution of Buttermilk Creek. Radioactive pollution enters Cattaraugus Creek from Buttermilk Creek. No other source of radioactive pollution of Cattaraugus Creek is found in the State Survey reports. The survey, however, did not report testing the polluted portion of Buttermilk Creek until March, 1967, and then reported only 14 samples taken from March through June. The R.C.S.I. compared these measurements with measurements given for the Springville Reservoir on the same dates.

TABLE 3

Average gross beta radioactivity of Buttermilk Creek, at Thomas Corners, March through June 1967: ...515 units
Average of dilution factors on mixing with Cattaraugus Creek: 15x

The comparison of the two creeks shows that the pollution brought in by Buttermilk Creek is diluted 15 times on the average by clean water in Cattaraugus Creek. The counts in the two creeks go up together and fall together. This is confirmed, for instance, by a comparison of three individual high counts in Buttermilk Creek with counts for the same periods in Cattaraugus Creek.

TABLE 4

Individual high counts in Buttermilk Creek	2100 units	448 units	2622 units
Paired counts in Springville Reservoir, same date	146 units	37 units	139 units
Dilution factor	14.3 x	12.1 x	18.9 x

We can now work back, and estimate the condition of Buttermilk Creek from the data on the Springville Reservoir, as follows:

TABLE 5

Estimated* radioactivity in Buttermilk Creek, in units of pCi/l

	Gross beta activity		Strontium-90	
Period	Average	High	Average	High
Before June '66	6*	15*		
Oct.-Dec. '66	3,460	45,000		
Jan.-March '67	1,500	4,700		
Apr.-June '67*	606*	2,622*		
Apr.-June '67	1,125	2,655		
July and Aug. '67	1,480	3,040		
Dec. '66-May2,'67			655	1,385

*figures marked with asterisk are averaged measurements of Buttermilk Creek. Remaining figures are computed on basis of dilution factor = 15x from measurements at the Springville Reservoir, as explained above.

All the values since October 1966 are grossly in excess of legal limits. There is no radioactive pollution upstream from the Nuclear Fuel Services plant. State Survey tests show only a background level of radioactivity in Buttermilk Creek at Fox Valley Bridge.

5. Release of radioactive pollutants by Nuclear Fuel Services. The State Survey did not sample the radioactive effluent of the Nuclear Fuel Services plant, so the R.C.S.I. collected its own samples. Samples were taken on December 16, 1967 at two points: The effluent of the pipe within the fence, and Buttermilk Creek water 3/4 mile downstream from the outfall. The R.C.S.I. tested these samples for cesium-137 and strontium-90.

a. Methods Cesium-137 was measured on a Victoreen 200 channel analyzer gamma ray spectrometer using a single sodium iodide crystal, with calibration against a cesium-137 standard.

Strontium-90 was determined by the New York Health and Safety Laboratory of the United States Atomic Energy Commission.

b. Results

TABLE 6

Radionuclide concentration, in units of pCi/l, on December 16, 1967

Location	Cs-137	Sr-90
Nuclear Fuel Services outfall	160,000	3,600,000
Buttermilk Creek	6,600	280,000

In this case, the dilution factors from the outfall pipe to Buttermilk Creek are 24x for cesium and 13x for strontium. If we take the factor of 13x as the most conservative estimate available, and use it with our estimates of strontium-90 in Buttermilk Creek, (Table 5), we arrive at the conclusion that the effluent from the Nuclear Fuel Services plant into a public creek averaged over 7,000 picocuries of strontium-90 per liter for half a year. Our sample of effluent was five hundred times more radioactive than this estimated average, and our sample of Buttermilk creek was two hundred times more radioactive than our own estimated maximum for Buttermilk Creek. This is just as would be expected, since our estimates were based on measurements of pooled water behind a dam. It is evident that the Nuclear Fuel Services plant sends slugs of very hot effluent into Buttermilk Creek and that our two samples did not necessarily catch the problem at its worst.

III. Discussion:

1. Failure to comply with the law.

The federal standards for protection against radiation (AEC regulation Title 10 CFR 20) have the force of law in New York State. The Nuclear Fuel Services plant comes under Section 20.106, which forbids the release into water, in any unrestricted area, of effluent exceeding the following limits:

a) If the identity of any radionuclide in the effluent is not known, the limiting value for the concentration of radioactive materials is 10 units (pCi/l).

b) If all radionuclides in the mixture are known, but only the combined radioactivity was measured, then the radionuclide with the lowest legal limit sets the limit for the mixture.

c) The limit for strontium-90 is 100 units (pCi/l), averaged for not more than a year.

A strict interpretation of the law shows that the Springville Reservoir was polluted with radionuclides in excess of legal limits all year. If we grant the State Survey the most lenient possible interpretation of the law and of the data (Table 5), the conclusion remains that Buttermilk Creek was unlawfully polluted. The average half-year concentration of forbidden radioactive material in a public creek was six times higher than would be allowed for an industrial radioactive waste outlet. Our measurement at the sewer outlet was thirty thousand times higher than the permissible limit!

2. Fumbling of monitoring.

The State Survey annual report for 1966 closed with a statement that "No samples showed levels that exceeded the concentration limits set forth in 10 CFR 20 of the Atomic Energy Commission regulations". State Radioactivity Bulletin 67-4, ending 15 Nov. '67, states, "The higher than background levels.....are expected and the concentration levels to date have not exceeded the limits set forth in Atomic Energy Commission Regulations". The violations were there, however, as shown

by this report. Why is it then, that "no samples showed levels that exceeded limits"? Simply because appropriate samples were not taken at the place where the limits were exceeded.

The authors of this report wish to see in this nothing more than an error of judgment. The planner of the Survey may have tried initially to do most of the tests in the first populated stretch of water. It was just bad luck that the only strontium-90 measurement that had to be discarded by the survey were the early ones from Cattaraugus Creek. We must criticize, however, the adherence to routine that allowed the Survey to continue testing for radioactive pollution in one place when it was obvious for a year that the pollution was concentrated somewhere else. High counts in a creek should be to the Survey what a fire alarm is to a fire engine. To maintain routine testing instead of following pollution to the source is like polishing the fire truck while letting the fire burn.

3. Where are we headed?

The Bureau of Radiological Health of the New York State Department of Health presented its plans for coping with this problem in a pamphlet entitled "Nuclear Fuel Surveillance Program - 1967, Revised as of January 24, 1967". The R.C.S.I. evaluated these plans using the following yardstick. For completeness, the outflow of radioactive pollution must be monitored continuously at the source, preferably with an automatic recording monitor. It must also be completely defined analytically, so that the radiation is accounted for by known amounts of radionuclides. For effectiveness and economy, monitoring programs must be flexible, so that polluting materials can be traced and intercepted at critical points in their distribution (at the water intake rather than at the faucet, and at the stream rather than in the milk). Effectiveness depends on prompt reporting. Economy calls for using each report to target the next series of tests.

Judged by these standards, the proposed State Survey proceedures appear incomplete, overly rigid, and much too slow in reporting to provide for effective surveillance of the Nuclear Fuel Services plant.

The Nuclear Fuel Services plant is currently operating at a fraction of its licensed capacity: it receives cores from only one nuclear power reactor(The Yankee in Massachusetts), while it is licensed to handle up to 2000 pounds of radioactive uranium per day and service the numerous nuclear power plants under construction in New York State. If the plant has not managed to clean up its outflow after a year under minimum load, the R.C.S.I. sees reason for serious concern about its performance under full load.

4. The Consequences.

Nuclear Fuel Services, Inc. holds an operating license which may be revoked by the U.S. Atomic Energy Commission for unsafe or unlawful operating practices. The R.C.S.I. would consider it a major economic setback for New York State if we lost an industry which holds the key to the economical use of atomic power. We trust that our report is issued in time for the plant management to revise their operations and earn the approval of the AEC.

This report calls for changes in the operation of the State radiation survey. Such changes are needed if New York State is to have a growing and safe atomic power industry.

Subcommittee for Radioactive Pollution

George C. Berg

E. Grant Pike

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