

THE EFFECT OF THE EFFLUENT FROM THE SIOUX  
FALLS SEWAGE TREATMENT PLANT ON THE  
FAUNA OF THE BIG SIOUX RIVER

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This report embodies the results of a study made of the occurrence of living organisms found in the Big Sioux River for some distance above and below Sioux Falls, South Dakota. The investigation was made at the request of Mr. Leland Bradney, Director of the Sioux Falls Sewage Treatment Plant. The plant is located near the Penitentiary and receives and treats not only the sewage from the City of Sioux Falls but the trade wastes and sewage from the Morrell Packing House. The effluent finally resulting from the treatment of the sewage and wastes is discharged into the river below the Plant at the northeastern edge of the City. The purpose of the study was to ascertain whether or not any deleterious effect is resulting to the waters of the River from the discharge of this product so far as may be judged by noting, as the case may be, the normal or abnormal condition and occurrence of the animal and plant life of the River.

The author wishes to express appreciation to the officials of the Sioux Falls Sewage Treatment Plant and to the Director, Mr. Leland Bradney, in particular for providing boats, labor and other facilities for the furtherance of the investigation.

The work was carried out between September 11 and 21, 1940, inclusive. The Big Sioux River was traversed by boat from Elmwood Park to Olson's Bridge, samples of the animal and plant life in the water being taken by the use of a No. 20 silk plankton net. The mud or sand of the bottom and edges of the river was examined from samples taken at frequent intervals. From Elmwood Park up river to above Renner, South Dakota, and from Olson's Bridge down river to Klondike, Iowa, the river was visited by car and samples taken.

Thirty-two plankton samples in all were taken by the net as just stated and examined microscopically for the presence of animal and plant forms. The kinds and relative abundance of such forms were recorded.

Sixteen samples of the mud or sand from the river bottom or edge were secured and the kinds and numbers of organisms noted both macroscopically and microscopically.

On one day the author accompanied a party that carried on seining operations for fish in portions of the river between Olson's Bridge and the next bridge down river.

While no detailed survey of the birds was made, several of the more common ones noted along or near the river were recorded.

The detailed results of such examinations are included in the Appendix at the close of this report.

To deal with the results of the investigation. In the main, there seems to be not a great deal of difference between the kinds and quantities of organisms found in or along the river below the outlet of the Sewage Plant and those found above it. There are, however, some minor differences which will be discussed now.

The kinds and abundance of organisms found in a river vary to some extent with the kinds and abundance of material entering that stream. In regions where considerable organic material is washed in there might be expected to be more forms of life such as Protozoa, small crustaceans such as Daphnes and Cyclops, Rotifers, and the like, since some of these animals subsist upon organic material entering the water, and others in turn upon these animals. Parts of the river which were wooded would receive more organic material such as leaves, etc., than regions of the river flowing through open prairie.

A study of the life in the water samples taken shows some correspondence between the presence or absence of trees along the bank and the abundance of forms taken in the samples. It will be noted that there were fewer forms in samples 1 to 3 inclusive, more in 4 to 14, quite a number

more in 15 to 26, fewer in 27 and 28, and more again in 29 to 32. The abundance of trees along the banks fits in with this—the first three samples, in the region of Renner, were in almost open prairie; there were more trees along the banks from about the upper part of Elmwood Park to just below the Morrell Plant; from this point, which is just at the outlet of the Sewage plant, the banks are heavily wooded down river nearly to the Bridge on Highway No. 16; from there to the East Sioux Falls Bridge there are few trees; below this point the banks are fairly heavily wooded as far as Klondike, the limit of the investigation.

The abundance of living forms in the river would then be expected to rise and fall with the abundance of trees, just as we find it does from a study of the samples taken. The somewhat greater abundance of living forms noted in the samples for a distance below the Sewage Plant is, no doubt, explained by the fact that the banks of the river are heavily wooded throughout this region.

So far as the kinds of animals and plants are concerned, a study of the samples will show that both above and below the plant are found the same kinds of forms with three exceptions. It will be seen that both above and below are Cyclops, Daphne, Rotifers, Vorticella, Stentor, Beetles, Arcella, Aeolosoma, and so on through the list. The one form found above which was not noted below was Diffugia, a species of shelled Amoeba. There cannot be anything significant about this since another form of shelled Amoeba, the Arcella, was found to be abundant below as well as above the outlet of the Sewage Plant. Stylonychia were not found above but were quite numerous below in the first sample. They will be discussed below.

Considering the samples of mud or sand it will be noted that small Chaetopod worms, Lumbriculus, were found beginning some hundred yards above the outlet of the Sewage Plant and on down the river. These are small worms, relatives of the earthworm, and are found commonly in the mud of lakes and rivers, near the edge of the water. No especial significance need be attached to their presence.

More Protozoa in the form of *Stylonychia* (as noted above) *Vorticella*, *Spirostomum*, etc., occurred in the first two samples taken below the outlet of the Sewage Plant. Feeding on these Protozoa were more Rotifers, Cyclops, etc. This condition was, no doubt, due to the fact that, as noted before, somewhat above the outlet to the Plant the banks began to be quite heavily wooded and leaves and similar debris would be more abundant in the water. More Bacteria would arise in the richer condition of the decaying organic matter of the leaves, etc.; more Protozoa would develop from feeding on the Bacteria, and more Rotifers, Cyclops, and the like, would feed on the Protozoa. So the conditions below the outlet on down the River so far as these forms are concerned, are normal.

Living forms of all sorts were more abundant, as stated earlier, from about the region of the Plant as far down as sample No. 14 near the bridge on Highway No. 18. This condition is due to the fact that the banks are more heavily wooded than in some other regions.

As noted in the Appendix, fishes were found living in normal fashion at least as near the Plant as just below Olson's Bridge. Seining was not made by the author at other points on the river.

So far as could be observed birds were able to live near or about the river.

Scrutiny of the Appendix will show that the third form, which was not found both above and below the Sewage Plant, was the Chaetopod worm known as *Tubifex*. This was found only below the Plant, beginning about halfway between McKee's Bridge (two miles below the Plant) and the next lower one, Olson's Bridge, or in other words at a point about three miles down the river from the Plant, and at intervals on down to Brandon Bridge. Small colonies of this worm were seen in the mud along the edge of the river, the ends of their bodies protruding and waving in the water, making red patches on the mud. Since this worm feeds upon decaying organic waste, it may be that it constituted some evidence that there had been, in the past,

some pollution in the river. From the fact that no *Tubifex* were found above the point three miles below the Plant, it would seem to mean that if any pollution were existing at the time of the investigation, it must have been the results of deposits made some time before which had not yet been covered by sand carried down the river by high water. Since quantities of sand are moved down the river at spring floods, any old deposits that might be present will eventually be covered and rendered harmless, and gradually be absorbed into the earth.

Since no *Tubifex* were found further down the river than the region of Brandon Bridge, there is no evidence that there ever has been any pollution further down the river than this bridge, whatever the conditions may have been above.

To sum up—examination of the living organisms in the Big Sioux River from a point one mile above Renner, South Dakota, to Klondike, Iowa, would lead to the conclusion that at present the effluent from the Sioux Falls Sewage Treatment Plant is not introducing any pollution into the Big Sioux River. As noted, there is some evidence that there may have been pollution in the past, possibly as far as the Brandon Bridge, but, if so, it is being covered up by sand and mud deposits occasioned by seasonal rains. This would operate to remedy any condition of pollution that may have been present in the past and any possible remnants of a former pollution, if such were present, will be cured if the Plant remains in its present state of efficiency.

### Appendix

List of kinds and relative numbers of living organisms found in the samples collected from the Big Sioux River in connection with this investigation.

#### Plankton Samples.

The figure after each item indicates the approximate number of forms found in one cubic centimeter of the material which had been collected by the plankton net and allowed to settle in the bottom of a sample bottle.

1. Near bridge one mile above Renner, South Dakota.
 

Rotifers	6
Aeolosoma	1
Suctorina	1
Diffugia	1
Vorticella	6 clusters
Stentor	1
Gyrinid Beetles	1 group
2. Near bridge one mile west of Renner, South Dakota.
 

Rotifers	12
Euglenas	7
Diatoms	34
Diffugia	14
Pediastrum	25
Filamentous alga	5
Cyclops	1
3. In Elmwood Park near the golf course.
 

Daphne	1
Rotifers	4
Diatoms	1
Pediastrum	25
Scenedesmus	1
4. Just down river from No. 3.
 

Ostracods	2
Daphnes	25
Cyclops	25
Rotifers	50
Euglenas	6
Alga	About as No. 3
Various beetle larvae	5
Aeolosoma	1
5. In Elmwood Park near the Izaak Walton Club.
 

Daphnes	2
Rotifers	50
Cyclops	25
Euglenas	12
Desmids	6
Alga	As No. 3
6. Near the footbridge in Elmwood Park.
 

Daphnes	50
Diffugia	1
Euglenas	Thousands — made a green scum on water. Not viridis, but a larger species. Now and then a red one.
Cyclops	6
Ostracod	1
7. Near lower boundary of Elmwood Park.
 

Euglenas	Thousands — heavy green scum on water.
Cyclops	6

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|----------|----|
| Arcella  | 6  |
| Rotifers | 25 |
| Daphnes  | 25 |
8. Near the wagon bridge below the dam just below Elmwood Park.
 

Minnow	1
Ostracods	6
Daphnes	6
Diffugia	25
Rotifers	5
Scenedesmus	6
Pediastrum	6
Chironomus larva	1
  9. Short distance below No. 8.  
About as No. 8 with the addition of 6 Euglenas.  
Water strider 1
  10. Some distance below No. 9.  
About as the two preceding samples.
  11. Some distance below No. 10.  
About as No. 10.
  12. Near the Northwestern Railroad Bridge.  
About as No. 11 with the addition of 50 Euglenas.
  13. Near the 12th street Bridge.  
About as No. 12 with the addition of about 50 Diffugias
  14. Near Green Gables Camp just north of Minnesota Avenue.
 

Cyclops	25
Ostracods	6
Euglenas	50 (Made a green scum on the water.)
Diffugias	50
Rotifers	25
Pediastrum	6
  15. Five hundred feet below outlet of the sewage disposal plant.
 

Rotifers	50
Cyclops	50
Arcella	50
Pediastrum	6
Euglenas	6
Filamentous alga	one-half dozen strands
Diatoms	25
Stylonichia	6
Vorticella	50
Stentor	25
Colpidium	1
Daphne	2
Spirostomon	1
Parameciums	25
Round worms	1
Scenedesmus	1
Desmids	6

A few other small Ciliates which were unidentified.

16. Near the Fifth Avenue Bridge.
- |                                       |           |
|---------------------------------------|-----------|
| Aeolosoma (small chaetopod worm)..... | 25        |
| Rotifers .....                        | 50        |
| Euglenas .....                        | 6         |
| Filamentous alga .....                | 6 strands |
| Phacus .....                          | 3         |
| Vorticella .....                      | 25        |
| Paramecium .....                      | 6         |
| Gastrotricha .....                    | 1         |
| Pediastrum .....                      | 6         |
| Arcella .....                         | 25        |
| Desmids .....                         | 6         |
| Diatoms .....                         | 50        |
17. Just below the Fifth Avenue Bridge.
- |                        |           |
|------------------------|-----------|
| Cyclops .....          | 6         |
| Rotifers .....         | 100       |
| Aeolosoma .....        | 3         |
| Arcella .....          | 25        |
| Stentors .....         | 6         |
| Filamentous alga ..... | 6 strands |
| Pediastrum .....       | 6         |
| Desmids .....          | 3         |
| Diatoms .....          | 6         |
18. Two blocks below the Fifth Avenue bridge.
- |   |    |
|---|----|
| Rotifers .....  | 25 |
| Euglenas .....  | 25 |
| Chaetopods (Aeolosoma and the like.)..  | 12 |
| Filamentous alga  |    |
| Layer of green alga and Euglenas on mud along water's edge; this layer existed most of the rest of the way down the river as far as the examinations were made. |    |
19. A short distance above the rendering plant.
- |                                     |   |
|-------------------------------------|---|
| Cyclops .....                       | 25  |
| Rotifers .....                      | 100   |
| Daphne .....                        | 1   |
| Chironomus larva .....              | 1   |
| Diatoms .....                       | 100   |
| Desmids .....                       | 25  |
| Arcella .....                       | 25  |
| Pediastrum .....                    | 1   |
| Filamentous alga .....              | a strand                                      |
| Aeolosoma .....                     | 2   |
| Whirligig beetles (Gyrinidae) ..... | Group of perhaps 100 moving about near shore. |
20. Immediately below outlet of rendering plant.
- Quite a growth of the blue green alga Phordium sp. on the sandy bottom in about a foot of water—extended for a hundred feet perhaps.

21. About one-fourth mile below the rendering plant.
- |                   |     |
|-------------------|-----|
| Round worms ..... | 1   |
| Cyclops .....     | 50  |
| Rotifers .....    | 100 |
| Aeolosoma .....   | 1   |
| Pediastrum .....  | 6   |
| Euglena .....     | 6   |
| Diatoms .....     | 50  |
| Desmids .....     | 6   |
| Arcella .....     | 1   |
| Daphnes .....     | 2   |
22. Just below McKee's bridge.
- |                        |           |
|------------------------|-----------|
| Cyclops .....          | 50        |
| Rotifers .....         | 100       |
| Aeolosoma .....        | 1         |
| Daphne .....           | 2         |
| Filamentous alga ..... | 6 strands |
| Diatoms .....          | 100       |
| Pediastrum .....       | 12        |
| Arcella .....          | 6         |
| Euglenas .....         | 6         |
23. Not far below sample No. 22. About one-half way from McKee's bridge to Olson's bridge.
- Began finding colonies of Tubifex in slimy mud just under the edge of the water. Each colony was a patch of red, waving worms. Colonies were about six inches across.
- Two or three groups of whirligig beetles along the river in this region.
- Now and then a colony of Tubifex along the edge of the water from here on until almost to Olson's bridge.
24. Some distance below No. 23.
- |  |     |
|--|-----|
| Daphne .....   | 2   |
| Chironomus larva .....   | 1   |
| Cyclops .....  | 12  |
| Rotifers .....   | 100 |
| Desmids .....  | 12  |
| Diatoms .....  | 25  |
| Pediastrum .....   | 12  |
| Euglenas .....   | 12  |
| Arcella .....  | 6   |
| Water strider .....  | 1   |
| Chironomus larvae in cases under rocks. Several under rocks along shore. |     |
25. Near Olson's Bridge.
- |   |     |
|---|-----|
| Cyclops .....   | 25  |
| Rotifers .....  | 100 |
| Daphne .....  | 11  |
| Diatoms .....   | 25  |
| Pediastrum .....  | 12  |
| Euglenas .....  | 12  |
| Arcella .....   | 2   |
| Chironomus larvae in cases under rocks. Under almost every rock and pebble in water's edge. |     |