MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 257

INVESTIGATION OF SEDIMENT APPEARING ON FISH NETS IN OBSERVATORY INLET

by

D. B. Finn

1930

FISHERIES RESEARCH BOARD
OF CANADA

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 257

Title

INVESTIGATION OF SEDIMENT APPEARING ON FISH NETS IN OBSERVATORY INLET

Author

D. B. Finn

1930

INVESTIGATION OF SEDIMENT APPEARING ON FISH NETS IN OBSERVATORY INLET.

by

D. B. Finn

On April 17th, 18th and 19th, 1930, a trip was made to Observatory Inlet, the Naas River, and to Granby Bay in order to conduct an investigation as to the causes of the precipitation of silt upon fish nets, which was reported to have occurred during the summer of 1929. Water samples were taken from various stations as indicated on maps by numbers. The smelter was visited, samples were taken of the silt which collects in this loose way, as well as the sluice water itself.

The specific gravity, the pH and the amount of suspended material in the water samples was determined. The silt, which was collected from the smelter, was analysed--quantitatively and qualitatively. On the 19th of July, 1930, the first samples of silt which had collected on fish nets a few days previously reached the station and immediate examination was begun. This included qualitative and quantitative chemical analysis and a microscopical examination.

Gross Examination of Silt Secured from the Smelters

The silt secured from the smelter consisted of a grayish, finely-divided mud. It was obtained from the side of a wooden trough through which the waste waters from the flotation plant were conducted to the sea. It had caked in a hard mass upon the bottom and sides of this trough. No definite crystal formations or textures could be recognized by the naked eye. When dry, it became lighter in colour and was easily powdered.

From the sample of water which was obtained from this trough, there settled out a deposit which was very similar to the silt described above. This

settling commenced in a few minutes, but several hours elapsed before the supernatant liquid began to lose its turbid appearance. After standing for several days, the supernatant liquid still appeared to contain slight amounts of suspended material. The sediment appeared to consist of layers. In the bottom layer, which was evidently heavier than the rest, there crystals which to the naked eye resembled pyrites and thus imparted a golden yellow tinge to the predominating gray. The layers above this changed in character, appearing to be of much finer consistency, with an absence of visible pyrites and a slightly lighter shade of gray. The uppermost layer, which was still finer in consistency, had a greenish tinge to the gray and was easily disturbed by slight agitation of the supernatant liquid.

Gross Examination of the Silt Collected on Fish Nets As Furnished by the Department of Fisheries.

The samples received were a grayish mud, very similar in colour to the uppermost layer of the silt settlings described above. Mixed with this mud were chips of wood, sea-weed, and other organic matter of marine origin. The smell was typical of decaying sea-weed. The consistency was extremely fine and smooth to the feel as is wet clay. Upon drying, it became much lighter in colour and was difficult to distinguish from the sludge collected from the smelter, though the net sludge was a little lighter in colour. The smelter sludge was slightly more gritty and contained microscopic particles which became visible as the material dried. The net sludge was more tenacious when dry than was the smelter sludge.

MICROSCOPICAL EXAMINATION

Net Sludge

A small amount of the net sludge was suspended in water and placed on a microscopic slide. A drop of methylene blue was added and the whole covered with cover-glass. Examination of oil immersion lens (630 diameters) revealed masses of substance apparently without form which were stained blue. Amongst this material, and in the spaces about it, there appeared numerous grains of translucent crystalline granules which failed to take the stain. Some of these granules appeared to be fragments of monoclinic crystals, while others were plate-like, the sizes of the grain varying from 0.85 /u to 17.5 /u . An examination of the net sludge without the methylene blue revealed the presence of motile organisms, apparently protozoa, and large bacteria.

Smelter Sediment. (Sluice Settling)

A small portion of the mud collected from the walls of the sluice was suspended in distilled water and placed on a microscopic slide. Examination under 630 diameters magnification revealed large numbers of translucent crystalline granules varying from .85 to about 25 /u (microns). Some were mono-clinic in appearance and others mostly larger and plate-like; there were smaller numbers of dark-coloured granules, crystalline in structure. In a few places there were crystals which under the microscope appeared to have a reddish tinge. There was apparently very little amorphous material in the sample examined.

Settlings from Water Obtained in the Sluice.

Water from the sluice, together with its settlings, was agitated and a drop placed upon a microscopic slide. A drop of methylene blue was added and examination conducted under 630 diameters magnification. Large numbers of

translucent crystalline granules, varying from .85 to 10/u were apparent. There was little or no matter present which took the methylene blue stain. Numerous clusters of purple crystals made their appearance. It was later found that these crystals did not exist in the original suspension and were the result of a reaction between the sluice water and the methylene blue solution.

Comparison of Microscopic Examinations

In comparing the net sludge with the samples of sediment which appeared on the walls of the sluice and those which settled from water taken from the sluice, there was revealed a similarity in the type of crystalline granule, both as to size, structure, and general appearance under this magnification. In neither of the smelter samples was there encountered the organic amorphous substances which were observed in the net sludge.

pH, Specific Gravity and Suspended Material in Samples of Water

Station		Tide	pH	S.G.	Suspended Material in Gms. per liter	Time Collected	Date
1	Sur.	Ebb	7.8	1.0223	0.0802	14.00	Apr. 7
2	50'	Ebb	7.8	1.0230	0.4964	14.30	Apr. 7
	Sur.	Ebb	7.8	1.0217	0.0430	14.35	Apr. 7
3	50'	Ebb	8.0	1.0230	0.0194	14.45	Apr. 7
	Sur.	Ebb	8.1	1.0230	0.0422	14.45	Apr. 7
4	50'	Ebb	7.7	1.0233	0.0126	15.00	Apr. 7
	Sur.	Ebb	8.0	1.0225	0.0204	15.00	Apr. 7
5	Sluice		9.6 +	1.0005			Apr. 8
6	50'	Ebb	7.8	1.0221	0.0166	11.30	Apr. 8
	Sur.	Ebb	7.7	1.0130	0.0412	11.30	Apr. 8
7	50'	Ebb	7.9	1.0224	0.0300	12.00	Apr. 8
	Sur.	Ebb	7.8	1.0153	0.0280	12.00	Apr. 8
8	50'	Ebb	7.9	1.0224	0.0150	12.45	Apr. 8
	Sur.	Ebb	7.6	1.0069	0.0180	12.50	Apr. 8
	4'	Ebb	8.4	1.0213	0.0282	12.55	Apr. 8
9	Sur.	Low	7.6	1.0115	0.0494	16.00	Apr. 8
10	50'	Low	8.0	1.0230	0.0242	16.30	Apr. 8
	Sur.	Low	8.4	1.0190	0.0642	16.30	Apr. 8
11	Sur.	Full	7.8	1.0229	0.0156	11.40	Apr. 9

TIDE April 8 High 7.25 and 21.42 Low 1.51 and 15.01

TIDE " 9 " 9.27 " 22.43 " 4.38 " 17.10

NOTE pH

The pH was determined colorimetrically. Since it was impossible to make this determination until the samples were returned to the laboratory, there is a probability of slight error.

Specific Gravity

The specific gravity of the samples were determined by the Westphal balance at a temperature of 60°F.

Suspended Material

Suspended material was determined by filtering 500 centimetres of the water through a weighed gooch crucible which was then dried at 103°C. and the sediment determined by difference. After drying the sediment was in most cases yellow, but turned green on heating. It was therefore tested for manganese both by the blow pipe test and the bismuthate method. These tests showed the presence of traces of manganese. The tests were not, however, sufficiently pronounced to enable judgment to be formed as to the distribution of this element amongst the various samples.

THE EFFECT OF pH ON SETTLING OF NET SLUDGE .

In order to determine the effect of pH and salt concentrations upon the suspended net sludge the following preliminary experiments were tried.

Equal portions of the net sludge were placed in test tubes containing:

(1) Sea water brought to pH 6.8 with NaOH and acetic acid.

(2) Sea water brought to pH 8.4 with NaOH and acetic acid.

(3) Sea water not treated at pH 8.

(4) Distilled water not treated at pH 5.6 (pH of the distilled water due to dissolved CO_2).

The settling was visible after three minutes in Tubes 1, 2 and 3. After ten minutes the settling in these tubes was almost complete. In tube 4, the heavier parts had settled at the end of ten minutes but the upper strata were still filled with suspended material.

In order to determine the effect of acid and alkali in themselves, equal parts of net sludge were placed in three test tubes and treated as follows:-

(1) 50 c.c. distilled water untreated pH 5.6,

(2) 50 c.c. distilled water plus 3 cc. $\frac{N}{10}$ H_2SO_4 ,

(3) 50 c.c. distilled water plus 3 cc. $\frac{N}{10}$ NaOH.

The material in test tube No. 2, which contained the acid, flocculated and settled almost immediately. Tubes 1 and 3 still contained suspensions after ten minutes. After thirty minutes certain portions had settled out in 1 and 3 with no apparent difference between tubes. Twenty-four hours later, the settling was complete in tube 2 and visible in Tubes 1 and 3, but the supernatant liquids still contained quantities of suspended material in tubes 1 and 3 and after 48

hours there was little apparent difference. These test tubes were then again agitated and 5 cc. of NaCl 5% were added to each. Flocculation and precipitation occurred almost immediately in tubes 2 and 3 but the addition of the chloride seemed to make very little difference to the settling in tube 1 which contained distilled water without acid or alkali.

The effect of addition of $\frac{N}{10}$ normal acid and alkali was tried upon sea water, equal portions of net silt were placed in three test tubes.

(1) 50 cc. sea water plus 1 cc. $\frac{N}{10}$ H_2SO_4

(2) 50 cc. sea water untreated,

(3) 50 cc. sea water plus 1 cc. $\frac{N}{10}$ NaOH.

The material in tubes 1 and 3 flocculated immediately and settled. The settling occurred a little more quickly in the tube containing the alkali than in that which contained the acid. Material in tube 2 also settled fairly rapidly but not as rapidly as in tubes 1 and 3, the degree of flocculation being slightly less.

DETERMINATION OF THE SPECIFIC GRAVITY OF NET AND SMELTER SILTS

A portion of smelter silt as collected from the trough, through which the sluice waters are conducted to the sea, was dried in vacuo for twelve hours and a determination of its specific gravity was made by the pyknometer method. Its specific gravity was 2.942. The same determination was made upon the silt collected from the nets but in this case sea weed and chips of wood were removed from the sludge by sifting after it was dried. The specific gravity - 2.679.

REPORT ON SAMPLE OF SILT FROM NETS OF NAAS RIVER

One gram of sample put into solution by fusion with Na_2CO_3 + $NaHCO_3$ + KNO_3. Took up with dilute HCl. Evaporated to dryness once. Large amount white insoluble residue suspected to be SiO_2.

Filtrate yellow. Passed H_2S. Murky precipitate. Not very voluminous. Nothing definite in group II. Suspect trace of either Sb, As, Bi, or Cd but no positive reaction for any of these.

To filtrate added NH_4OH + $(NH_4)_2Sx$. Black precipitate of group III. Fe and Al only identified in this group, Co, Ni, and Zn absent. An unsatisfactory dry test for Zn was obtained which could not be confirmed.

In group IV calcium only was obtained. The ppt. was very slight. Gave a definite though faint flame test.

DRY TESTS

Beads	Ox	Red	Conclusion
Borax	Cold pale yellow	Cold pale yellow	Fe
$NaCO_3$	Brownish		Nothing definite
$NaHNH_4PO_4$	Grey	Grey	Nothing definite

Charcoal	oxidizing
Powder alone	Diff. fusible Black slag Brown coat - maybe Cd?
Na_2CO_3	Yellowish green slag.
"Bismuth" flux	Easily fusible. Black residue. Heavy white coating.
Closed Tube	Coloured mirror near the substance. Did not appear to be arsenic. Sulphur present.

A sample of net sludge was examined for basic constituents. It was dried in vacuo at 105°C. for three hours and then a weighed portion was analysed.

The following analysis was obtained:

Loss on ignition at 950°C.	8.90%
Silica	58.41%
Other insolubles (aqua regia)	14.59%
Calcium	0.82%
Iron	6.23%
Aluminium	2.87%
Bismuth	0.37%

Traces of sulfides found present qualitatively.

Small amounts of carbonate found present.

Silica present.

Phosphates and silicates from basic analysis.

A sample of silt from the smelter was examined for basic constituents. It was dried in vacuo at 105°C. for three hours and then a weighed portion was analysed.

The following analysis was obtained:

Loss on ignition at 950°C.	8.23%
Silica	16.32%
Other insolubles	44.19%
Calcium	3.04%
Iron	6.03%
Aluminium	8.26%
Magnesium	0.58%

Sulfides were found present.

Traces of carbonates were also found.

REPORT ON THE CONDITION OF THE EDIBLE CRABS NEAR THE MOUTH OF THE NAAS RIVER.

The crabs in the vicinity of the Naas River, being somewhat larger in size than those obtained locally, it is not unusual for local crab-fishermen to make trips there at certain seasons of the year. As under existing conditions it is absolutely essential that all such crabs be returned home alive, it is customary to take along a number of large boxes which permit a free circulation of water. These boxes when filled with crabs and boarded up, are enchored in a convenient place where they float with the upper surfaces awash. Usually such trips have a duration of from seven to ten days during which time very few crabs are lost through death, despite close confinement and lack of food. In June of this year, however, an expedition of the type just referred to resulted in the deaths of all the crabs which had been anchored in the boxes--approximately ninety dozen males. Unfortunately no samples of the dead crabs were at that time brought back for examination so that, except for the opinion of the crab-fishermen themselves that the mud had "smothered" the crabs, no light had so far been shed upon the problem. In addition to this evidence the writer was informed by an Indian in the employ of the Cannery at Arrandale that he had observed thousands of dead crabs on the nearby flats during March of this year. Whether or not this report had been exaggerated the writer was unable to learn but in any event it is probable that it had some slight foundation in fact. Added to this is the fact that crab-fishing in that region is considered very unsatisfactory in comparison with other years. So much was ascertained from men interested in the crab fishery.

On July 22, however, a number of crabs from the district to which reference has been made, were secured by means of a beam-trawl in the ordinary course

of shrimp trawling and were brought back by special request of the writer. These crabs when caught were either just dead or were on the point of dying. A chemical and microscopic examination the day following their capture revealed the following facts:-

The gills were first examined since the recent turbidity of the water had been remarked upon by the fishermen. They were found to be covered to a varying degree with a comparatively thin, more or less uneven, semi-transparent covering. Dotted here and there through this covering darker patches were to be observed which when isolated were found to be crystalline granules, flinty in texture and characterized by sharp edges. On comparing these granules with others obtained from the sluice water of the smelter which is located some distance away, the resemblance was found to be very great. That the quantity of foreign material so present was considerable was clearly demonstrated by cutting away the gills and washing them in a beaker containing distilled water. Upon doing this the water became murky and very similar in appearance to that in which the crabs had been captured. On filtering this liquid and testing the finer particles by means of Methylene Blue for organic matter, it was found that a considerable proportion became dyed, thus pointing to a probable organic origin. At this point a further sample was taken, the organic material burned away and the remainder tested for iron. As a consequence a considerable proportion of the material was shown to be inorganic and to contain a very high percentage of iron compounds, thus again pointing to a similarity with sluice water from the smelter which had also been found to have a high iron content.

Further, on examining the stomach contents they were found to contain considerable quantities of material closely resembling that to be found upon the gills including the crystalline granules referred to above.

Whether or not the water from this region contains any materials of a toxic nature in so far as crabs are concerned, the writer is not aware. However, he does feel that the materials referred to might prove injurious in at least three ways. Firstly and of greatest importance would be the "smothering effect" upon the organs of respiration thus hindering the normal interchange of gases, and hence the purification of the blood. Were this to become sufficiently pronounced the effect would be rapidly fatal. Secondly the sharp-edged crystalline granules referred to might injure the delicate tissues of the gills and alimentary tract and, thirdly, the presence of greatly increased quantities of indigestible material in the stomach might, to some degree, upset the process of digestion and thus weaken the vitality of the animal.

Hence, in conclusion, it is the opinion of the writer that the material found on the gills and in the stomachs of crabs from the vicinity of the Maas River would have a detrimental effect upon their health and that in the case of several of the crabs recently examined would in all probability be sufficient to cause death by means of the mechanical effect upon respiration alone.