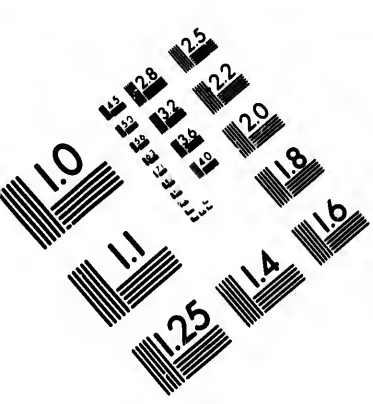


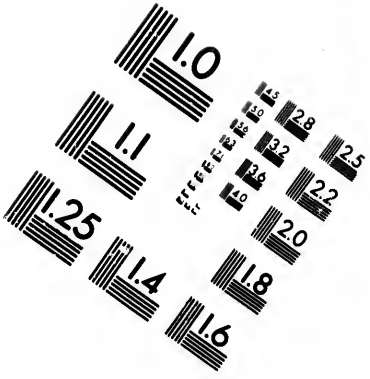
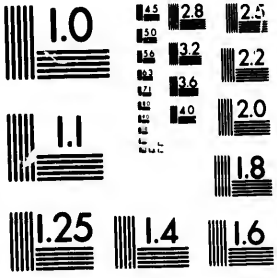
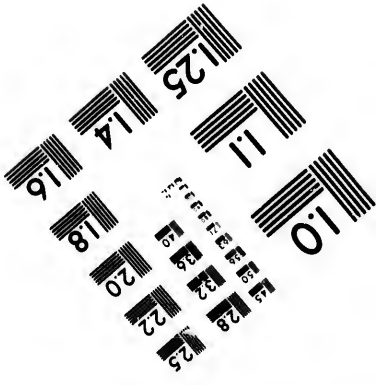


IMAGE EVALUATION
TEST TARGET (MT-3)





CIHM/ICMH
Microfiche
Series.

CIHM/ICMH
Collection de
microfiches.

Canadian Institute for Historical Microreproductions

Institut canadien de microreproductions historiques

1980

Technical Notes / Notes techniques

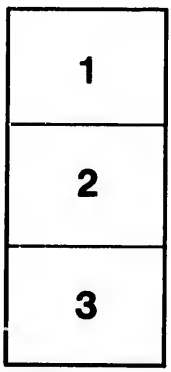
The Institute has attempted to obtain the best original copy available for filming. Physical features of this copy which may alter any of the images in the reproduction are checked below.

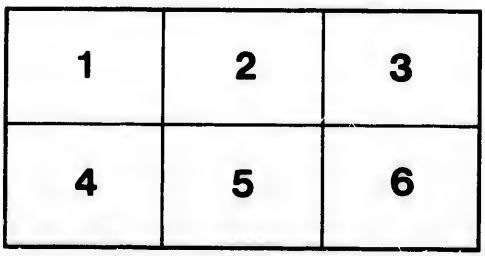
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Certains défauts susceptibles de nuire à la qualité de la reproduction sont notés ci-dessous.

- ☐ Coloured covers/ Couvertures de couleur
- ☐ Coloured maps/ Cartes géographiques en couleur
- ☐ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Tight binding (may cause shadows or distortion along interior margin)/ Reliure serré (peut causer de l'ombre ou de la distortion le long de la marge intérieure)
- ☐ Additional comments/ Commentaires supplémentaires
- ☐ Coloured pages/ Pages de couleur
- ☐ Coloured plates/ Planches en couleur
- ☑ Show through/ Transparence
- ☐ Pages damaged/ Pages endommagées

Bibliographic Notes / Notes bibliographiques

- ☐ Only edition available/ Seule édition disponible
- ☐ Bound with other material/ Relié avec d'autres documents
- ☐ Cover title missing/ Le titre de couverture manque
- ☐ Plates missing/ Des planches manquent
- ☐ Additional comments/ Commentaires supplémentaires
- ☐ Pagination incorrect/ Erreurs de pagination
- ☐ Pages missing/ Des pages manquent
- ☐ Maps missing/ Des cartes géographiques manquent





BIOLOGICAL

STUDY OF THE TAP WATER

IN THE SCHOOL OF PRACTICAL SCIENCE, TORONTO.

BY GEO. ACHESON, M. A.

Science Master in Toronto Collegiate Institute.

BIOLOGICAL

STUDY OF THE TAP WATER

IN THE SCHOOL OF PRACTICAL SCIENCE, TORONTO.

BY GEO. ACHESON, M.A.
Science Master in Toronto Collegiate Institute.

The object of this paper is to give the results of investigations into the biological nature of the suspended matter in the tap-water of the School of Practical Science. No pretence is made of being exhaustive, for the work has only been carried on at intervals, and observations for any definite length of time have not been continuous. The results therefore are fragmentary, but may serve as a basis for future and more extensive research. A thoroughly systematic examination of the water should include not merely the determination of the animal and vegetable species which are to be found in it, but the physiological influence which these organisms exert, and their importance from a sanitary standpoint. This subject accordingly may be dealt with from both a morphological and a physiological point of view. It is with the first of these aspects only that the present paper is concerned. In regard however to the physiological and hygienic aspect it may be briefly observed, that the purity of water does not depend merely on the quantity of organic matters which it contains; for, if these be living vegetable growths containing chlorophyll, they have a beneficial influence on the water, by supplying oxygen to it and removing carbon dioxide, provided, of course, that their presence in large quantities does not counterbalance their salutary effects. On the other hand, there are organisms which, even if present only in small numbers, exert a very prejudicial influence, and which, if undoubtedly recognized as constantly occurring, should mark a water as unfit for use.

To obtain matter for examination two methods may be employed. One is to tie a muslin bag to the tap and allow the water to run in a slow stream for a few hours; then, taking off the bag, rinse it in a small quantity of water, which, on being allowed to settle for a

few minutes, will afford an abundant supply of sediment. The other plan is to open the tap to the full extent and allow it to run for a short time, so as to stir up whatever sediment may be in the pipe; then a tall glass cylinder is filled, and a watch-glass attached to a piece of platinum wire, by which it can be raised, is let down to the bottom of the vessel. The whole lightly covered is put aside for 24 hours to allow it to settle, and after this the water is siphoned off almost down to the watch-glass, which can then be raised without disturbing the sediment which it contains. This latter method possesses the advantage that the same quantity of water is always taken, and thus the amounts of sediment at different times can be compared; while it is almost impossible to fix a tap to run continuously at a given rate, owing mainly to variation in the pressure of the water in the pipes.

A little of the sediment obtained in either of these ways was transferred by a pipette to a slide, and examined with a Hartnack Objective No. 8 and No. 4 Eyepiece. This combination has a magnifying power quite high enough for diagnosing the most of the forms; though on one or two occasions a No. 10 Immersion was used.

The actual amount of suspended matter present in any definite quantity of the water varies very considerably, and depends upon several conditions, among which some of the most noticeable are the season of the year, the amount being greater in winter and spring than at any other time; the prevalence of stormy weather; the quarter of the city from which the water is taken; and the tap itself; for, if the water be drawn from a pipe which is seldom used, it is sure to contain more sediment than that from one in constant use, as it settles when allowed to rest for some time. There is no doubt also that organisms are often found in the mains which are not found in water taken directly from the lake. This, together with the fact that the number of individuals of some species is greater in the water of the mains than in that of the lake, may be explained on the supposition that the former habitat affords them a better food-supply, consequently they multiply more rapidly. The exclusion of light also seems favorable to the development of certain forms. Another marked result of these investigations has been the conclusion, that many of the forms seem to have a preference for certain times of the year, being much more abundant then than at any other

time; but the exact harvest time of each particular form has not been accurately determined, since the observations have not been sufficiently close. For the same reason, although the comparative frequency of most of the forms met with can be indicated generally, their relative abundance or scarcity at any particular time cannot be stated with any degree of accuracy.

To the foregoing general remarks is now added an enumeration of the different organic species which from time to time I have found in the tap water of the School of Practical Science, with brief notes on some of the more interesting forms, and a more detailed account of one or two which I believe to be hitherto undescribed.

Diatomaceae.

The Diatoms are noticed first because by far the greatest part of the sediment consists of them, and because in the number of species they greatly exceed any other group. The diagnosis of species unless one is a specialist in this department of microscopy, is not a very easy matter, especially if the literature to which one has access is not very extensive. Accordingly a slide was prepared and sent to Prof. H. L. Smith, of Hobart College, Geneva, N. Y., who kindly named the following species:—

Melosira Crotonensis, Tabellaria fenestrata, Cyclotella Kutzingiana, Cyc. operculata, Cyc. astrea (a variety of Stephanodiscus Niagarae), *Stephanodiscus Niagarae, Fragilla ia Crotonensis, Frag. Gregoryana* (= Dimeregramma Grunow), *Frag. Capucina, Synedra radians, Synedra longissima, Synedra ulna, Cocconema parvulum, Coc. cymbiforme, Coc. gibbum, Cymbella dicephala, Navicula radiosa, Nav. carassius, Nav. Rheinhardtii, Nav. Saugerii, Nav. cryptocephala, Nitzschia lineata, Surirella pinnata, Sur. lineata, Cocconeis Thwaitsii, Coc. placentula, Cymatopleura (Sphinctocystis) solea, Pleurosigma Spencerii, Gomphonema tenellum, Gomph. acuminatum, Gomph. constrictum, Gomph. sp.? Amphiprora ornata, Odontidium mutabile,* and *Encyonema caespitosum.*

In addition to the above the following have also been noticed:—*Tabellaria flocculosa, Asterionella formosa, Meridion constrictum, Actynocyclus Niagarae, Nitzschia sigmoidea, Tryblionella gracilis, Epithemia turgida, Cymatopleura (Sphinctocystis) elliptica, Eunotia didyma, Melosira varians,* and *Melosira dentata, n. sp.*, with characters as follows:—Filaments, slender; frustules, scarcely twice as

long as broad, divided in the centre by a double line; extremities of the cells dentate; breadth, 0·0075 mm. —0·009 mm. Fig. 1.

The two species, *Rhizosolenia Eriensis* and *R. gracilis*, are also present, the former always and the latter quite frequently. As *R. gracilis* has only lately been described by Prof. Smith, by whom it was first discovered in filterings from the Niagara River water supply at Buffalo, its characters are appended :—" Frustules small, slender, round or but slightly compressed; annuli, obsolete; body, smooth; fifteen to twenty times as long as broad; imperfectly siliceous; calyptra, conical; bristle fully as long as the body, or longer; often slightly curved, and, with the calyptra, rigidly siliceous; length, ·004″ —·008″." It can be readily distinguished from *R. Eriensis* by its curved bristle, and by the absence of the markings which are so characteristic of the latter species.

It might be observed here in passing that the above are the only two fresh water species of *Rhizosolenia* as yet known, all the others being marine. The presence of these two species, together with others of genera, such as *Stephanodiscus* and *Actynocyclus*, mostly marine, would seem to point to the fact of the connection at one period of the great lakes with the ocean, and the survival of a few marine or brackish forms, which have been able to accommodate themselves to the altered conditions of their habitat.

Desmidiaceae.

Desmids as far as at present known are all inhabitants of fresh water, and, as stated by Wood in his "Fresh Water Algae," prefer "that which is pure and limpid." They have been found in stagnant water, but never in that actually putrid. Next to the Diatoms they are the commonest vegetable forms to be found in the filterings from our water supply, and they seem to be most plentiful in the latter part of winter and during spring. The commonest representatives of this family are several species of *Closterium*, some of which I have not been able to determine.

In every gathering are to be found considerable numbers of a form which is figured by C. M. Vorce in a paper on the "Microscopic Forms observed in the water of Lake Erie," and called by him *Clos. Venus*, but which is much smaller than the form described by Wood under this name, the diameter as a general rule being not more, and often less, than 0·0031 mm. (= 0·00015″). In shape they vary

considerably, being more or less lunately curved, semi-circular, bent into a loose spiral, or sometimes resembling very much a pair of cow's horns; extremities greatly attenuated. On one or two occasions a larger form was observed, which agreed very closely in characters with these smaller ones. The frond was lunately curved, varying to sigmoid or spiral; distance between the extremities about 30 times the breadth; upper margin very convex, lower very concave; no central inflation; tapering gradually to an acute point at the extremities; contents granular. Diam. 0·0038 mm. (= 0·000155″). Habitat, Lake Ontario, Fig. 2.

In one gathering a fine living specimen was noticed which in most of its characters seemed to approach more nearly to *Clos. parvulum, Naegl.*, than any other, though in some respects it resembled *Clos. Venus* as described by Wood. In size however it differed from both of these. The diameter was found to be 0·0186 mm. (= 0·00074″), and the length about 8 times as much. The measurements given by Rabenhorst for *Clos. parvulum* are diam. max. 0·00026″—0·00062″, and length 6–8 times as much; and according to Wood the diameter of forms referred by him to this species is 0·0008″. *Clos. Venus* has a diameter of 0·0004″, and is 8–12 times longer than broad. The general appearance of the form was very similar to that of *Clos. parvulum* as figured by Wood, and as the actual size of any species can hardly be regarded as fixed within narrow limits, it has been referred to *Clos. parvulum.*

Another interesting form which is nearly always present approaches in some respects the description of *Clos. setaceum*, but is not accurately described in any work at my command; accordingly I propose for it the name *Clos. filiforme*, with specific characters as follows :—

Closterium filiforme, n. sp. Frond very slender, greatly elongated, each extremity being a colourless beak as long, or nearly as long, as the body; filiform, cylindrical, smooth, not lunately curved, belly not inflated, gradually attenuated towards the apices, which are rounded and slightly curved downwards; vacuoles 3–8 in each limb in a single series. Breadth 0.0062 mm. (= 0·00025″), length 0·4154 mm.—0·62 mm. (= 0·0166″—0·025″), or say 60–100 times the breadth. Habitat, Lake Ontario, Fig. 3.

Clos. Griffithsii has also been observed. Other Desmids were *Staurastrum gracile, Staur. punctulatum*, and a species of *Cosmarium*, probably *Cos. cucumis.*

Other Chlorophyllaceous Algae present were *Protococcus sp.?* *Chlorococcus sp.?* diam. of cell itself being 0·0176 mm., and of cell together with its hyaline coat 0·0264 mm. *Ankistrodesmus* (*Rhaphidium*) *falcatus*, *Scenedesmus quadricauda*, *Pediastrum sp.?* *Pediastrum Boryanum*. The forms included in this latter species vary somewhat from the description given by Rabenhorst and Archer. The coenobium is circular in outline, cells in a single stratum, arranged in three rows round a central cell (1 + 4 + 10 15); inner cells variable, 4–6 angled, concave at one side; peripheral cells convex on the inner side, on the outer side notched and tapering into two long subulate points. Diam. of peripheral cells 0·0065 mm. (= about $\frac{1}{000}$″).

I have also seen another species of *Pediastrum* which is not described in any work to which I have had access. The cells are in a single stratum, and in two rows round a central cell (1 + 6 + 12); inner cells polyhedral, 4–6 angled; peripheral cells pentagonal; external angle produced into a single process about as long as the diameter of the cell. Diam. of coenobium 0·0434 mm. (= 0·00173″), and of peripheral cells 0·0124 mm. (= 0·0005″).

Spirogyra sp.? Sterile joints 10 times as long as broad; spiral single with 4 turns; cell wall at each end produced. Diam. 0·0124 mm. (= 0·0005″). Fertile joints not observed.

Phycochromaceae.

Belonging to the Phycochroms there were a few forms observed, viz.:—

Gleocapsa sparsa, which is probably only a zooglaea stage of Sirosiphon; *Merismopedia nova* (*sp.?*); and at least two species of *Oscillaria*, which have been referred to *Os. nigra*, *Vauch*, and *Os. chlorina*, *Kützing*, the former being quite common during the month of March, more so probably than at any other time.

Schizophytae.

Under the name Schizophytes are included all the organisms commonly known as Bacteria, together with a few parallel green forms, multiplying chiefly by transverse fission, though in some cases spores are formed. These organisms at best have but a doubtful reputation; and if Intermittent and other malarial fevers, Anthrax, Diphtheria, Septicaemia, Pyaemia, Tubercle, and other virulent contagious dis-

eases are produced directly by these forms, it is quite proper that we should be very careful that the water we drink is free from them if possible. If we look for natural water however which is absolutely free from Bacteria, probably we shall look in vain. But we must remember that all forms of Bacteria are not capable of producing disease, even if some are, or at any rate that they do not do so under ordinary circumstances, but only in particular and well-marked conditions of the organism or organ attacked by them. We must not be surprised then to find Bacteria in our water supply. I have observed even in fresh filterings all the common forms, micrococci, rod-like forms, vibrios, spiral forms, and zooglaea stages. But if the filterings be allowed to stand exposed to the air for a few hours, it is amazing how rapidly they increase in numbers, and after a day or two the whole becomes converted into one mass of Bacteria in all stages, growing at the expense of the other organisms, and eventually leaving nothing but the siliceous frustules of Diatoms, and whatever other matter like this defies their digestive power. Probably there is no place where they thrive better, and where they exist in greater numbers, than in the School of Practical Science; for they are certain to be found there in everything which is not positively destructive to them. There is no doubt then that their presence in such abundance in sediment which has been allowed to stand for some time exposed may be in great measure accounted for by germs getting into it from the atmosphere, as well as those already there multiplying.

Adopting the view held by Billroth, Nägeli, Cienkowski, Ray Lankester, and Zopf, that all the forms usually described under the generic names Micrococcus, Bacterium, Bacillus, Leptothrix, Cladothrix, Vibrio, Spirillum, Spirochaete, &c., are only development stages of Schizophytes, in opposition to that of Cohn and others, that they are distinct species without morphogenetic connection, all the forms observed have been referred to the two species, *Cladothrix dichotoma, Cohn*, and *Beggiatoa alba, Vauch.*

Concerning the first of these two Zopf remarks, that "what the common bread mould (Penicillium crustaceum) is among the aerial mould fungi, *C. dichotoma* is among the aquatic fungi, and therefore it might be quite properly denominated the 'water-fungus' ('Wasserpilz') par excellence."

There are Leptothrix forms besides the ordinary Cladothrix filaments, which, by the breaking up of the threads, produce micrococci and rod-like forms. The cocci are circular in outline, and have a diameter equalling, or at most double, that of Micrococcus prodigiosus, Cohn. In from 24 to 48 hours these micrococci develope into rod-like forms (Bacterium, Bacillus), which again give rise to Leptothrix, and by branching to Cladothrix filaments. These filaments are often rolled into a loose spiral, and these spirals give rise to Vibrios, Spirillum—and Spirochaete—forms. All the forms already mentioned may pass into a zooglaea or resting stage.

Beggiatoa alba goes through pretty much the same modifications. There are Leptothrix-like filaments of considerably larger size than those of Cladothrix dichotoma, Bacillus, Bacterium, and Micrococcus forms. Spiral forms are also developed, which however I have never seen in any of the sediment I examined, all the spiral forms noticed having been referred to Cladothrix.

In the study of these organisms it will be found of great advantage to stain them first with rose-aniline, or iodine.

Before proceeding to enumerate the species belonging to the Animal Kingdom, a form must be described which I am puzzled to know where to locate. I have only noticed it occasionally; and I am inclined to regard it as a Desmid.

The body is spheroidal, in optical section broadly oval, surrounded by a firm cytioderm; color, bright green; chlorophyll, disposed in two lenticular masses; vacuoles, four; body surrounded by 7—9 (?) stiff, colorless, more or less curved bristles (setae), coming off radially, and 3—5 times the long diameter of the body in length. Three individuals gave the following measurements:—

Diam. (1). 0·0093 mm. by 0.0124 mm.
(2). 0·01142 mm. by 0·01428 mm.
(3). 0·0121 mm. by 0·0154 mm.

Habitat, Lake Ontario. Fig. 4.

Wood describes a globular form of *Scenedesmus* with radiating bristles, to which the organism above described is possibly allied.

In addition to the foregoing species the vegetable kingdom is represented by starch grains, spores of fungi, and occasionally some remains of the higher plants, such as pollen grains, cuticle of aquatic plants, woody fibre, &c.

Protozoa.

The animal forms belong mostly to the Protozoa, being nearly all included in the groups Rhizopoda and Flagellate Infusoria.

Rhizopoda.—Among the Rhizopods were noticed at least two species of Amoeba—*A. proteus* and *A. radiosa*, but not very frequently; on several occasions also *Difflugia globulosa*, *Actinophrys sol*, and *Acanthocystis turfacea* (*sp ?*).

Flagellata—Belonging to the Flagellata Infusoria there are a few interesting forms, some of which I shall notice in detail.

Monas lens is occasionally seen, but by far the commonest species is *Dinobryon sertularia*, and a brief description of this beautiful animalcule will not be out of place. In the spring and early summer they are to be found in large numbers in every filtering, but in autumn and through the winter they are rarely met with.

In the classification adopted by W. Saville Kent, in his "Manual of the Infusoria," they are placed in the *Order Flagellata Eustomata*, and *Family Chrysomonadidae*. The characters of the order are as follows: "Animalcules possessing one or more flagelliform appendages, but no locomotive organs in the form of cilia; a distinct oral aperture or cytostome invariably developed; multiplying by longitudinal or transverse fission, or by subdivision of the whole or part of the body-substance into sporular elements;" and of the family: "Animalcules bi-flagellate, rarely mono-flagellate, social or solitary, free-swimming or adherent, naked, loricate, or immersed within a common mucilaginous matrix or zoocytium; endoplasm always containing two lateral, occasionally green, but more usually olive-brown or yellow differentiated pigment bands; one or more supplementary eye-like pigment spots frequently present," and, as far as at present known, they all inhabit fresh water.

The genus *Dinobryon* consists of animalcules with two flagella, one considerably longer than the other; attached by a contractile ligament to the bottom of a colorless horny lorica, the individual loricae being connected together so as to form a colony or compound branching polythecium; endoplasm containing two lateral green bands, and a conspicuous eye-like pigment spot situated anteriorly.

In the species *D. sertularia Ehr.* the individual loricae are perfectly hygaline and transparent, and are shaped in general like an

inverted cone, though they are seldom seen perfectly symmetrical, but usually more or less twisted and deformed, especially at the posterior end; the mouth is everted, and below this anterior rim there is a slight constriction, then a slight expansion, below which it tapers to the posterior pointed end; they are joined into colonies by the posterior end of one lorica being attached to the interior face of the rim of the one immediately below it, without any intermediate pedicle; very often the ends of two loricae are inserted into one, and this produces dichotomy. Empty loricae like this are found in large numbers, either connected or floating free during the time of the year already mentioned; but in many cases the zooid itself is to be seen attached by its delicate transparent ligament to the bottom of the lorica, and rarely exserted. In shape the zooids are elongate-oval, with the two flagella coming off quite close together from the anterior end, and on a little lip-like projection is situated the reddish eye-spot. According to Stein, the oral aperture is close beside the point of insertion of the two flagella. By the aid of these flagella they propel themselves rapidly through the water with a rolling motion, and as they sail across the field of the microscope, with their shapely loricae, oval green bodies, red eye-spots, and rapidly vibrating flagella, they present one of the most beautiful objects to be seen in the miscroscopic world. The length of the separate loricae as given by Kent is $\frac{1}{1200}''$, and of the contained zooid $\frac{1}{2000}''$; but these measurements have always been found too small. The average length of the lorica is 0·033 mm. (= 0·0013″) and of the contained zoid 0·0132 mm. — 0·0176 (= 0·000528″ — 0·0007″).

On one occasion two separate zooids were seen in one lorica, one in the usual position at the lower end, and the other just at the mouth partly extruded. This most probably was the result of fission, and the newly formed zooid had not yet secreted its protecting calyx.

The spheroidal encystments recorded by Bütschli and Stein have also been observed. They are to be seen at the mouths of otherwise empty loricae, and also floating free. They are of a yellowish-brown colour, and consist of an outer dense cuticular cyst enclosing a smaller more or less eccentric one with protoplasmic contents. No eye-spot was observable. At one point on the outer capsule there is a little conical protuberance standing out prominently from the rest

of the circumference, and on the opposite side of the inner cyst there is a similar projection. Stein figures these as occurring about the same place on both cysts, but in all that I observed they were on opposite sides, and on the outer cyst there was only one. The diameter of the outer cyst in several instances was found to be about 0.0155 mm,, and through the protuberance 0.0217 mm. ; and of the inner 0.0124 mm. Figs. 5, 6.

Dinobryon stipitatum, Stein, was also present once or twice. This species differs from the one just described in the greater proportionate length of the loricae, which are trumpet-shaped, widest at the mouth, and tapering off into the acuminately pointed posterior end, being about 7 or 8 times as long as their greatest breadth. The zooids very much resemble those of *D. sertularia*, but are more elongated, and occupy the anterior half of the lorica, being attached by a thread-like ligament to its lower side wall. A large amylaceous more or less spheroidal body is situated near the posterior part of the endoplasm. The length of the lorica according to Kent is $\frac{1}{300}''$.

Two or three other species of Flagellata have also been seen, though rarely.

One, belonging to the *Choano-Flagellata*, *i.e.*, monads with a collar surrounding the single flagellum, I have referred to *Salpingoeca fusiformis, Kent*. Kent gives the following characters for this species: "Lorica sessile, sub-fusiform, or vase-shaped, widest centrally, tapering equally towards the two extremities, but expanding again anteriorly into a somewhat prolonged and everted neck; contained animalcule flask-shaped as in *S. amphoridium, J. Clark*, but of larger size. Length of lorica $\frac{1}{1000}''$. Hab., fresh water, solitary."

This form was seen only on one occasion, attached to a frond of Rhizosolenia Eriensis. The lorica was empty and corresponded closely with the above description. In another part of the field however I found what probably was the zooid of this species which had been set free, though it is possible that it might have been *Monosiga socialis, Kent*, with the description of which it closely agreed. The body was somewhat pyriform, widest posteriorly, with no pedicle; a single long flagellum surrounded by a collar. Length of the body 0·0062 mm. ($=\frac{1}{4000}''$), breadth 0·00465 mm. ($=\frac{9}{5000}''$).

On one occasion I got a glimpse of a colony which I think belonged to the family *Codonosigidae* of this order. Unfortunately I lost

sight of it, and never succeeded in finding any of the same kind again. It was probably a species of *Asterosiga*, in which the monads are arranged in a stellate fashion.

Another form has been doubtfully referred to the *Flagellata-Pantostomata*, family *Bikoecidae*, which includes sedentary animalcules with an anterior lip-like prominence, either solitary or in colonies, secreting separate horny loricae, mostly stalked; flagella two, one long and one short; no distinct oral aperture. In certain of its characters this form resembled *Bicosoeca lacustris, J. Clark*, and in others *Stylobryon petiolatum, Duj. sp.*, while in general appearance it was very like a large Dinobryon. I was unable to make out whether there was a distinct oral aperture or not. The individuals as far as observed were solitary, and characterized as follows:—Lorica sub-cylindrical, a little more than twice as long as its greatest breadth, with a pedicle of about equal length, widest posteriorly, slightly everted anteriorly, tapering towards and conically pointed at the posterior extremity; zooid broadly ovate, plastic, with an anterior lip-like prominence, occupying the posterior half of the lorica, to the bottom of which it is attached by a contractile thread-like ligament on which it rotates: flagella two in number, one long and one short, inserted at the base of the lip-like prominence; endoplasm containing two lateral greenish-yellow bands, and a reddish eye-spot situated anteriorly at the base of the lip-like projection; contractile vesicle single, located posteriorly. Length of the lorica 0·0314 mm. ($= \frac{1}{800}''$), and of the contained zooid 0·0171 mm. ($= \frac{17}{2500}''$). Hab., fresh water, Lake Ontario. Fig. 7.

Kent regards *Stylobryon petiolatum* as undoubtedly a compound modification of *Bicosoeca lacustris*, and possibly the form above described is a variety of the same species, considerably larger than the one described by H. James-Clark, if it is not a species of *Dinobryon*.

The *Cilio-Flagellata* are represented by a species of *Peridineum* not determined.

Infusoria Ciliata.—Belonging to the Ciliated Infusoria there is a large species of *Vorticella* frequently seen, either attached or free-swimming; *Stentor* is rare; also a few *Holotrichous* and *Hypotrichous* forms, free and encysted are to be found occasionally.

METAZOA.

The other animal forms which have been noticed are not very numerous.

VERMES.—The worms are represented by the *Nematoid Anguillula fluviatilis*, which is not very common; and by one or two species of *Rotifera* belonging to the family *Brachionidae*, in which there is a carapace and one or more eye-spots. These are *Anuraea stipitata*, and another species with the back of the carapace ornamented with facets, as well as furnished with teeth in front. A species of the genus *Brachionus* itself has also been observed.

ARTHROPODA.—The *Crustacea* are represented by at least two species, *Cyclops quadricornus* and *Daphnia pulex*, or a nearly allied form. Cyclops especially is common both in the adult and larval stages.

Belonging to the *Tardigrada* I have noticed a species of *Macrobiotus* rarely present, probably *M. Hufelandii*.

Epithelial cells, bristles of crustacea and insects and other fragments are to be found among the debris which is always present in considerable quantity, and which is generally described as "flocculent matter." It consists mainly of broken Diatom frustules, as a good deal of it remains after boiling in nitric acid, partly also of decomposed organic matter in a fine state of division, as well as a small quantity of mineral matter.

The bearing which the foregoing observations have on the question of the purity of Toronto's water supply may now be briefly alluded to. Judging from the miscroscopical examination of the suspended matter in the water, I would characterize it as one of the purest of natural waters, inasmuch as it is almost entirely free from any organisms which are either themselves directly injurious, or which, by their presence, would show that water containing them must necessarily be injurious. The great bulk of the sediment consists of vegetable matter, and that in a living condition. The animal forms are chiefly Flagellate Infusoria, which are inhabitants of fresh water, not depending for their food on dead, decaying, and poisonous matter.

The absolute amount of sediment in the water I cannot accurately state; but the chemical analyses show the amount of albuminoid ammonia to be very small (averaging ·003—·007 grains per gal.);

and I have found it necessary to run the tap a considerable time to collect any appreciable quantity.

As already stated, my investigations have been confined to the tap water in the School of Practical Science; and, while admitting that other taps in different parts of the city would probably give different results as to quantity, yet I think the quality would be found to be practically the same.

April 7th, 1883.

EXPLANATION OF THE FIGURES IN PLATE.

Fig. 1.—*Melosira dentata, n. sp.*, filament of 4 frustules.

Fig. 2.—*Closterium, sp. ?*

Fig. 3.—*Clos. filiforme, n. sp.*

Fig. 4.—Unknown form—probably a Desmid.

Figs. 5, 6.—Encysted forms of *Dinobryon sertularia, Ehr.*

Fig. 7.—Flagellate Infusorian allied to *Bicosoeca lacustris, J. Clark,* and *Stylobryon petiolatum, Duj.*; *e*, eye-spot; *cv*, contractile vacuole; *lb*, lateral bands.

le time to

ed to the
admitting
ably give
would be

TE.

lark, and
e vacuole;