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THE BIOTA OF THE CEDAR RIVER AS RELATED TO ODOR AND TASTE PRODUCTION

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This paper presents a brief summary of surveys carried through the past two years, as an aid in the control of odor and taste in city water. So far as the writer is aware, no work of this kind has previously been done at Cedar Rapids, hence comparisons can only be drawn between the years covered, or amongst the months represented.

Amongst the many organisms encountered, a few are here selected as representatives of the numerous odor and taste producers. The plant records used are only those of algae and a few bacteria; while the fauna, with the exception of Pectinatella, are represented by a few protozoa which occur sporadically, and are difficult to correlate with odor or taste. Although the water chemist can be largely guided in his treatment of odors by such daily quantitative surveys, he can also be warned of impending changes in several other ways. The first consists in actual odor tests wherein a rapidly rising index indicates changes which will occur in the numbers of algae to be expected. These indices do not, however, parallel the enumeration. The second consists of weekly up-stream surveys of two kinds; viz., riparian and tributary. Still another index of great value is what might be denominated "fragmentation" or "breakdown," in which organisms in various stages of physical deterioration or mutilation point to unfavorable ecologic factors which are generally associated with odor, taste, and color production. This index very closely parallels the odor-taste index, and is therefore assigned a high value. However, it represents a very difficult procedure.

The use of some of these data in water purification may now be briefly illustrated. If *Asterionella* is on a decidedly daily increase, the characteristic fishy odor may be expected to reach a maximum in from five to ten days, and preparations may be made to meet it. Should *Euglena* suddenly increase at a high rate, it is desirable, for efficient odor removal, to know whether the incidence is local, and near the purification works, or whether it is a general condition of the stream, miles away.

Moreover, by the aid of such data, the selection of procedure

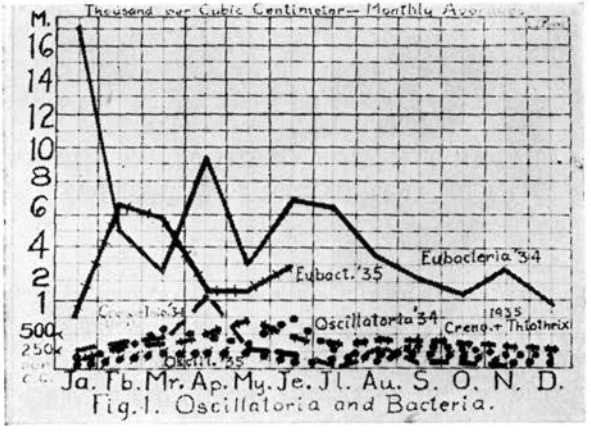

Fig.1. Oscillatoria and Bacteria.

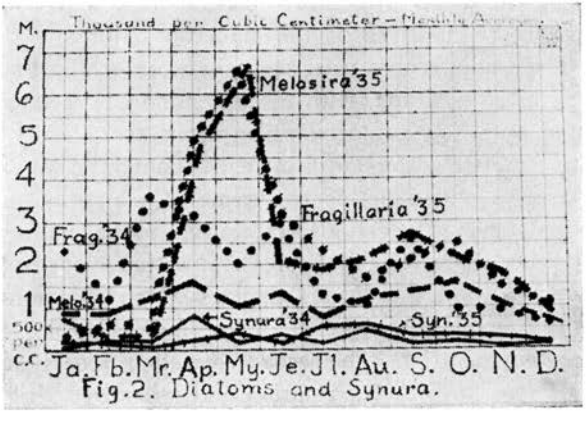

Fig.2. Diatoms and Synura.

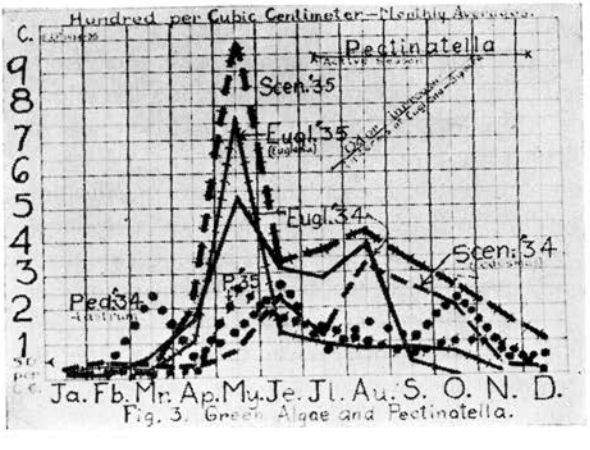

Fig. 3. Green Algae and Pectinatella.

and deodorants is facilitated, and maximum efficiency is assured. Sometimes it is easier and more economical to maintain an actively adsorbing aluminum floc, while at other the manganese or a superchlorination treatment is preferable. Should the fragmentation percentage run high, the last-named materials will be consumed in large quantity without adequate effect. If the bacterial content is now very high, pre-carbonation or pre-chlorination may have to be combined with a very active aluminum or iron flocculation at a low pH, to get clean odorless water. Where the water is customarily greatly softened, such conditions are especially difficult of control. It may at times be necessary to produce a much less soft water for a few hours in order to obtain a more active aluminum floc. When the break-down is very heavy, hourly odor and color determinations are necessitated, because activated carbon, though of great value in normal ranges of odor, may be over-taxed by this condition. A Spaulding odor index above 150 or 200 calls for every available facility for odor reduction, because these maxima often fluctuate violently, necessitating a high factor of safety. In a survey of numerous water-treating works, the writer found that some had only one or two points of odor control, while others had many. It is obvious that algal surveys were far more imperative in the former than in the latter.

Finally, attention is called to the incidences of a few of the more constantly present species of significance in the odor-taste complex. The following are graphically presented, with brief seasonal characteristics:

Cyanophyceae — *Oscillatoria* spp., odor moldy to foul. (Fig. 1).

Chrysophyceae — *Synura Adamsii*, G. Smith, — bitter, spicy-cucumber odor. Often associated with other "heavy" or foul odors. (Fig. 2).

Bacillariae — *Fragillaria virescens*, Ralfs, and *Melosira granulata*, (Ehr.) Ralfs., — "grassy" odors. (Fig. 2).

Chlorophyceae — *Scenedesmus quadricauda* and varieties, mainly; *Pediastrum Boryanum* (Turp.) Menegh. mainly, and *Euglena viridis* mainly — the first two species having grassy or oily odors, while the latter produces foul odors, especially when breaking down rapidly. (See Fig. 3).

The Peridineae and Phycomycetes occurred too irregularly and in too small quantities to indicate definite ecologic conditions, and are therefore omitted from the figures.

Bacteria are represented by Crenothrix sp. and Thiotrix sp., while the total counts of Eubacteria taken from the Bacteriologist's

daily report, are added to Fig. 1 for comparison with Oscillatoria. The general relation of these groups of bacteria is the production of foul or "decaying" odors.

From Figs. 1, 2, and 3 it may be seen that the different groups of algae only roughly parallel from April to September; the diatoms coming somewhat earlier than the Green algae, *Pediastrum* and *Scenedesmus*; but the variations within the two years are so great as to make it impossible to draw conclusions of seasonal relations, except that from April to September the heaviest growths occur. This is correlated with higher odor-taste intensity, but it does not always follow that cool months produce better water. The cause for this is found in high bacterial incidence in the cooler months, as related to sewage pollution and the decay of riparian spermatophytes which occupy large areas of shallow water along this stream. Daily graphs would show many more fluctuations in counts that are far more significant to the purifying engineer than these monthly averages can possibly indicate.

Finally, the fauna may be considered briefly. While such forms as *Amoeba Stylonychia* and *Vorticella* among the Protozoa; and *Anuraea, Brachionus,* and *Rotifer* among the Metazoa occurred too sporadically to have much significance as indicators, there remains the very significant metazoan *Pectinatella,* to which must be assigned a very high rank as an odor-taste producer. A relatively few large-sized colonies of this metazoan distributed in brush or root-covered areas along the shore will often spoil large quantities of water during their period of decomposition, which may begin early in September and last till December or longer. The odor-taste effect of this organism, as it decomposes in the cooling autumn waters, is best described as that of a mixture of decaying fish and mussels. Riparian surveys for this organism alone have saved large expense by early removal. Chemical treatment is both difficult and expensive, and rarely succeeds well.

It is believed that the résumé here given may stimulate more ecologic and technical study of a much neglected field.

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