# NOTES.

**ALGOLOGICAL NOTES. VI. THE PLANKTON OF SOME ENGLISH RIVERS.**—Unfortunately I have been unable to continue my investigations of Thames Plankton this year, although a few remarks on one or two samples which were taken in April and May will be found at the end of this note. The year has been a particularly favourable one for such work, as I imagine that the season has been almost absolutely normal. The object of this note is to describe some samples of Plankton taken from the Cam at Cambridge and the Trent at Nottingham during the month of August; as both were collected in the same week, they may be regarded as representing corresponding periodical phases in the Plankton of the two rivers. I was, however, unable to gather material in the Thames at the same time of the year, and consequently have had to fall back on samples collected in August, 1902, for purposes of comparison [1]. In respect of the strength of the current the Thames occupies a position almost midway between that of the other two rivers concerned, the rate of flow being markedly less than that of the Trent. The comparison of the Plankton of the three rivers is therefore an interesting one from this point of view alone. Zacharias [2] and Zimmer [3] have both shown that the rate of flow of a stream has a considerable influence on the quality of the Plankton. The latter finds that 'das Potamoplankton sich dem Plankton eines Teiches seiner Zusammensetzung nach um so mehr nähert, je langsamer der Fluss fliesst.' The slow-flowing Cam therefore should possess a Plankton approximately like that of a pond. Before proceeding to discuss this point in detail, reference must be made to the table, which shows the comparative composition of the Plankton of the Trent, Thames and Cam.

The samples of Plankton were collected from an ordinary rowing-boat. The Trent material was collected on the stretch of river between Trent Bridge and the Great Central Railway's bridge over the river at Nottingham; the current was a strong one, and it was no easy matter to row against it with the net out, and consequently part of the material was collected from a stationary boat with the tow-net playing out into the current [4]. The samples contained a very considerable percentage of mud, and a certain number of the Diatoms were dead and represented only by the empty frustules, although living specimens of all the species mentioned in the table were to be found; in these respects the Plankton recalled that of the

[1] Cf. Fritsch, Algol. Notes, No. III. Preliminary report on the Phytoplankton of the Thames; Annals of Botany, vol. xvi, 1902, table.

[2] Das Potamoplankton; Zoolog. Anzeiger, No. 550, 1898, p. 46.

[3] Das Plankton des Oderstromes; Plöner Forschungsber., Teil 7, 1899, pp. 4, 7.

[4] The samples obtained in this latter manner were, however, not nearly so satisfactory as those collected from the moving boat.

*Table, illustrating comparative constitution of the Plankton of the Trent, Thames and Cam during the month of August*[1].

| | Trent. 25, viii. t = 14° C. | Thames. 19, viii. t = 18° C. | Cam. 29, viii. t = 16° C. |
|---|---|---|---|
| *Scenedesmus quadricauda* (Turp.), Bréb. | rc. | r. | — |
| ,, *acutus*, Meyen, var. *obliquus*, Rabh. | rr. | — | vr. |
| *Pediastrum Boryanum* (Turp.), Men. | r. | c. | r. |
| ,, *pertusum*, Ktz. | vr. | r. | — |
| *Chlamydomonas spec.* | vr. | vr. | — |
| *Eudorina elegans*, Ehrb. | — | c. | — |
| *Pandorina morum*, Ehrb. | vr.[2] | r. | — |
| *Volvox globator*, L. | vr.[2] | — | — |
| *Coelastrum microporum*, Naeg. | vr.[2] | — | — |
| *Closterium acerosum* (Schrank), Ehrb. | vr. | — | — |
| ,, *moniliferum*, Ehrb. | rc. | c. | rc. |
| ,, *lunula* (Müll.), Nitzsch | vr. | — | — |
| *Cosmarium margaritiferum*, Men. | — | rc. | rc. |
| ,, *granatum*, Bréb. | vr. | — | — |
| *Melosira arenaria*, Moore[3] | — | c. | r. |
| ,, *varians*, Ag. | rc. | vc. | c. |
| *Cyclotella operculata* (Ag.), Ktz. | rc. | rc.[4] | — |
| *Campylodiscus noricus*, Ehrb. | vr. | r. | vr. |
| *Surirella splendida* (Ehrb.), Ktz. | vr. | r. | — |
| ,, *ovata*, Ktz. | vr. | — | — |
| *Cymatopleura Solea* (Bréb.), Sm. | rr. | rc. | — |
| ,, *elliptica*, Bréb. | vr. | rc.[5] | — |
| *Himantidium faba*, Ehrb. | — | r. | — |
| *Cymbella gastroides*, Ktz. | rr. | c. | rc. |
| *Amphora ovalis*, Ktz. | — | rc. | — |
| *Cocconeis Placentula*, Ehrb. | r. | rc. | rc. |
| *Fragilaria virescens*, Ralfs | rc. | vc. | rc. |
| ,, *mutabilis* (Sm.), Grun. | — | rc. | — |
| *Synedra Acus*, Ktz. | rc. | r. | — |
| ,, *Ulna*, Ehrb. | rc. | rc. | c. |
| *Nitzschia sigmoidea* (Nitzsch), Sm. | rr.[5] | rc. | — |
| *Navicula gracilis*, Ehrb. | — | rc. | — |
| ,, *exilis*, Grun.? | — | — | c. |
| ,, *lanceolata*, Sm. | — | — | vc. |
| *Pinnularia viridis* (Ehrb.), Rabh. | — | r. | — |
| *Pleurosigma attenuatum* (Ktz.), Sm. | — | c. | r. |
| *Tabellaria fenestrata*, Ktz. | — | rc. | rr. |
| *Bacillaria paradoxa*, Gmel. | vr.[2] | — | — |
| *Merismopedia glaucum* (Ehrb.), Naeg. | vr. | — | — |
| *Microcystis spec.* | r. | — | — |
| *Oscillaria spec.* | r. | — | r. |
| *Euglena viridis*, Ehrb. | vr. | rc. | — |
| *Phacus pleuronectes*, Nitzsch | vr. | — | — |
| *Synura Volvox*, Ehrb. | — | r. | — |
| *Ceratium hirundinella*, O. F. M. | vr. | — | — |

[1] vc. = very common ; c. = common ; rc = rather common ; rr. = rather rare ; r. = rare ; vr. = very rare.

[2] Only one individual seen.

[3] I take this opportunity of correcting an incorrect determination. The species described as *Melosira moniliformis*, Ag., in the former papers is really *M. arenaria*, Moore.

[4] On looking through old preparations of Thames Plankton from Maidenhead I found this species present in some amount.

[5] Occasionally with epiphytic individuals of *Amphora minutissima*.

Thames during the winter months[1]. There is an abundant growth of Algae along the banks of the river (mainly *Cladophora* with epiphytic *Oedogonium*).—The Plankton of the Cam was gathered three days previously, and the samples were for the most part taken from the part of the river immediately below Cambridge. The current was scarcely noticeable, and the material obtained was practically free from mud. Large numbers of aquatic plants (*Sagittaria*, *Oenanthe*, *Potamogeton*, *Lemna*, &c., especially the first of these) grow in the river, and from this point of view a Thames backwater is recalled; these plants are covered with a more or less dense investment of Algae, whilst small floating masses (a mixture of Conjugates and *Oscillaria*) occur quite commonly on the surface of the water. These two points make Plankton-collecting a difficult matter, for it is almost impossible to prevent the net's coming in contact with the water-plants, and consequently to prevent the enclosure of some of the attached Algae in the sample[2]. I do not therefore regard my collections from this river as perfectly pure Plankton, although I consider it very probable that all the true Plankton forms develop amid the protection of the aquatic plants occurring in such a river (cf. below). For the sake of comparison I have chosen samples of Thames Plankton collected between Maidenhead and Cookham on August 19, 1902, i.e. from a part of the river sufficiently far removed from the estuary as to put a probability of marine influence out of the question[3].

Comparing in the first place the Trent with the Thames, it is noticeable that as regards the number of different species there is little to choose between the two rivers; but if we look at the constitution of the Plankton from the point of view of number of individuals, we find that eight species occur commonly (c) or very commonly (vc) in the Thames, whereas in the Trent one is not able to talk of any species as common. Altogether, a glance at the table will show at once that the majority of species are rarer than in the Thames, the exceptions being the two species of *Scenedesmus*, *Synedra Acus*, Ktz., and a few forms (e.g. *Volvox globator*, *Bacillaria paradoxa*, *Ceratium hirundinella*) which were not observed in the Thames. This quite agrees with the observations which have been hitherto made on the Plankton of rivers; for in the rapidly-flowing Danube Brunnthaler found a Plankton very poor in number of individuals[4]. If the commoner species of the Plankton of the Trent (i.e. those designated rather common) are picked out, we shall find that a number of the common forms in the Thames Plankton are not included; thus *Scenedesmus quadricauda*, *Closterium moniliferum*, *Melosira varians*, *Cyclotella operculata*, *Fragilaria virescens*, *Synedra Acus*, *S. Ulna* may be called the dominant forms of the Trent Plankton, of which only the first and last but one play no important part in the Thames at the corresponding time of the year. Yet to make the list of dominant forms in the Thames complete we must add *Pediastrum Boryanum*, *Eudorina elegans*,

[1] Cf. Fritsch, Further observations on the Phytoplankton of the River Thames; Ann. of Bot., vol. xvii, 1903, pp. 633, 634.

[2] The leaves of the *Sagittaria*, for instance, are covered with a mass of the species of *Navicula* observed in the Plankton.

[3] The distance of Maidenhead from the estuary of the Thames is approximately the same as that of Nottingham from the mouth of the Trent.

[4] Cf. Brunnthaler, Plankton-Studien. I. Das Phytoplankton des Donaustromes bei Wien; Verhandl. d. k. k. zool.-bot. Gesellsch. in Wien, Jahrg. 1900, p. 309.

*Melosira arenaria*, *Cymbella gastroides* and *Pleurosigma attenuatum*, of which three were not observed in the Plankton of the Trent at all. These remarks will suffice to show the difference in the constitution of the Plankton both as regards quantity and quality in the two rivers under discussion.

We must now consider the resemblances between the Plankton of the Thames and Trent, and these are very marked. In the first place, the filamentous Diatoms, *Melosira* and *Fragilaria*, are important constituents in both cases. Further, both rivers have a number of species characteristic of Potamoplankton in common, viz. the species of *Synedra* and of *Cymatopleura*, *Cyclotella operculata*, *Nitzschia sigmoidea*, *Surirella splendida*, *Campylodiscus noricus*, *Pediastrum Boryanum* and *Scenedesmus quadricauda*. Apart therefore from a certain difference in composition and a general decrease in number of individuals, the Trent may be said to possess a typical river Plankton[1], the nature of which is similar to that of the Thames. Lower stretches of the latter river (i. e. those at Richmond or Teddington) of course show more marked differences, owing to the influence of the tide[2]; and it will be interesting to compare the lower portions of the Trent with them.

A few interesting forms were found in the Trent Plankton. *Ceratium hirundinella* has for the first time been observed in the Plankton of English rivers, as also *Volvox globator*. The individuals of the former species were provided with one upper and three lower processes, of which the middle one was the longest, whilst the lateral ones were of unequal length. The occurrence of *Bacillaria paradoxa* in the Trent is of considerable interest, as I also observed it last year in the Thames near Teddington[3]; it would seem as though this species could live in perfectly fresh water, although the number of individuals found in the two rivers is very small.

We now come to the Plankton of the Cam, and in considering it we must bear in mind that we are dealing with a slow-flowing river, which is only tributary to the main stream, the Ouse. Owing to the inconsiderable current large numbers of aquatic plants are able to develop (cf. p. 165), and this point has already led me to compare the Cam with a Thames backwater. In such a river all the Plankton probably develops on the leaves, &c., of the aquatic plants (which are for instance covered with a sediment of those Diatoms which occur so commonly in the Plankton); the rate of flow is probably not sufficiently strong to interfere with their development. In 1903 I was able to study the Plankton of a number of backwaters of the Thames, and in looking through the Cam material I was at once struck by the great similarity of the Plankton from some points of view. As in the backwaters, the quantity of individuals is much greater, although the number of different species (Cam 16, Thames 30, Trent 32) is markedly less than in a main river like the Thames or Trent. Diatoms, however, are by far the most dominant forms in the Cam, although

[1] i. e. the Plankton is dominated by the Diatoms, only a few green forms being present in at all sensible numbers.

[2] Cf. the table in my algological note III. From all that I have seen it seems that the influence of the tide is perceptible considerably above Teddington Lock; the Plankton even at Hampton Court is not so rich in green forms as in the higher reaches of the river. This is only one of the many problems that the Thames and other big rivers present.

[3] Cf. Fritsch, Further observations, &c.; *loc. cit.* pp. 638, 639.

*Closterium moniliferum* and *Cosmarium margaritiferum* occur in sensible numbers. The Plankton of the Cam, therefore, agrees with those Thames backwaters which, although richer in number of individuals, still have the Diatom element predominant (small backwater at Walton, backwater at Shepperton [1]). Yet, as I was led to conclude in the case of the Thames backwaters, the Plankton of the Cam is still rather far from resembling that of a pond, and, however different from the Plankton of a big stream, still shows the essential characters of a river Plankton.

I may just add a few remarks on the Plankton of the Thames, based on three samples collected in April and May of this year. In correspondence with the mildness of the season, the number of individuals was already very considerable at this time of the year, and, as is to be expected, the green forms had reached a greater degree of development than at the corresponding season last year. Further, I was only able to recognize the *Melosira*-stage in one of the three samples (from Cookham), the other two having apparently already passed on to the *Synedra*-stage. It thus appears possible that some important changes in the periodicity of the Thames Plankton may take place according to the character of the season—a point which I hope to settle by periodical observations extending over a number of years.

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**ON A BRILLIANT PIGMENT APPEARING AFTER INJURY IN SPECIES OF JACOBINIA (N. O. ACANTHACEAE).**—(Abstract.) [2]—Shoots of certain species of *Jacobinia* [3], when bruised and extracted with water, yield a beautiful purplish liquid. Liebmann discovered these species while travelling in Central America about half a century ago, and found the Indians using them for dyeing purposes. Thomas [4], while in Mexico, submitted the colouring principle of *Jacobinia Mohintli* to a brief examination. Since then these plants seem to have received no further investigation, and their peculiarity is apparently little known to botanists. The object of the present paper is to direct attention to this conspicuous example of pigment-formation, and to give a few details concerning the chromogen and the colouring matter resulting from it. The author hopes to make a full investigation later. So far, the observations have been made on the two very similar species, *Jacobinia tinctoria* and *Jacobinia Mohintli*. The peculiar behaviour of the former plant was brought to the writer's notice, when in Ceylon, by Mr. Willis, the Director of the Royal Botanic Gardens, Peradeniya.

The pigment does not exist as such in the living plant, but appears only on death. Leaves, however, killed by boiling water remain green and do not darken. Hence the pigment most likely arises through enzymic action. Slight alkalinity hastens its appearance. Oxygen is also necessary for its formation. It is readily soluble in water and gives a fluorescent solution, purple to violet by transmitted and blood-red by reflected light. A trace of acid robs the solution of most of its colour. The original tint reappears on neutralization. Alkali turns it bluer, and if strong

[1] Cf. Fritsch, Further observations, &c., pp. 639–646.

[2] Read before the Botanical Section of the British Association, Cambridge, August, 1904.

[3] *Jacobinia tinctoria*, *J. Mohintli*, *J. incana*, *J. neglecta*, and *J. verrucosa*.

[4] Journ. de Pharm. et de Chimie, 1866, sér. iv. t. iii. p. 251.