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# MICROSCOPIC ALGAE AND PROTOZOA IN THE WATERS NEAR PLYMOUTH IN AUGUST 1962

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Larger algae and protozoa plankton of inshore waters seem generally well known, except for a few groups of very small flagellates. The same statement cannot be made for the micro-organisms of the bottom sediment-water interfaces and intertidal sand. Many ecologists and physiologists would like to know more about what species and how many individuals can be expected in such locations as these.

## QUALITATIVE RESULTS

In August 1962, while investigating the colourless euglenids of the Plymouth area, we listed all microscopic algae and protozoa which could be identified, as shown in Table 1. This list is not exhaustive; it omits many organisms which could not be identified because too few were seen, or which could not be stilled, or because there was not enough time to run them down. Plankton diatoms are easy to identify, but bottom-dwelling ones demanded more time than was available. Hence few of them are included. Rhizopods and blue-green algae were omitted from the list for the same reason.

Material examined came from the following sources: (1) surface tow-nettings inside and beyond the breakwater with 600 m.p.i. nets, and centrifuged catches from the same locations; (2) organisms in the sand between tide marks on Drake's Island and near the laboratory; (3) sediment from the bottom of the Tamar River to a point several miles upstream, and sediment from the mud banks of the River Plym at low tide.

Sand was sampled by digging until water flowed into the hole, the water was then violently agitated, and a dip sample taken. Sediment was collected by the use of a grab sampler, or directly by hand. Material was brought into the laboratory in small containers and kept cool (18° C or thereabouts). Some material from each sample was examined at once, some was allowed to stand, and Petri dish moist chambers were used to keep slides overnight, giving many organisms a chance to become quiescent.

Winchester bottles were filled, kept cool, and on reaching the laboratory, 60 ml. portions of the water were centrifuged at 2200 r.p.m. in conical-ended tubes for 5 minutes, then the plankton was identified.

## ORGANISMS FOUND

Table 1 is a list of the organisms identified in the 100 or more samples examined. The current fauna list (Marine Biological Assoc., 1957) cites 89 ciliates and 10 zooflagellates. Table 1 lists 252 genera or species. Since none of the groups shown in Table 1 are comprehensive, this is a further indication of the richness of the Plymouth biota. This is especially true of the mud flats of the Plym estuary for sulphur bacteria and colourless euglenids, and of the region beyond the breakwater for chrysomonads. Only 13 ciliates from the fauna list are included in Table 1, so that at least 157 ciliates have been found at Plymouth.

TABLE 1. MICRO-ORGANISMS OF THE PLYMOUTH AREA

Column 1, plankton beyond the breakwater; column 2, plankton inside the breakwater; column 3, organisms in the sand and mud flats; column 4, organisms in the sediment.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. BACTERIA-8 | | | | |
| *Beggiatoa alba* (Vaucher) Trevisan | . | × | × | . |
| *B. arachnoidea* (Agardh) Rabenhorst | . | . | × | . |
| *B. gigantea* Klas | . | × | . | . |
| *B. leptomitiformis* Trevisan | × | × | × | . |
| *B. minima* Winogradsky | . | . | × | . |
| *B. mirabilis* Cohn | . | . | × | . |
| *Thiothrix nivea* (Rabenhorst) Winogradsky | . | . | × | . |
| *Thiovulum majus* Hinze | . | . | × | . |
| 2. EUGLENOPHYTA-28 | | | | |
| *Anisonema* sp. A | . | . | × | . |
| *A. emarginatum* Stokes | × | × | × | . |
| *Anisonema* sp. B | . | . | × | . |
| *A. ovale* Klebs | . | . | × | . |
| *A. pusillum* Stokes | . | . | . | × |
| *Dinema grisoleum* Perty | . | . | . | × |
| *D. litorale* Skuja | . | . | . | × |
| *Entosiphon* sp. | . | . | × | . |
| *Euglena fenestrata* Elenkin | . | . | . | × |
| *E. vermiformis* N. Carter | . | . | . | × |
| *Eutreptia* colourless sp. | × | . | . | . |
| *E. lanowii* Steuer | × | . | . | . |
| *E. viridis* Perty | × | . | . | . |
| *Heteronema acus* (Ehrenb.) Stein | . | . | . | × |
| *Metanema variabile* Klebs | . | . | × | × |
| *Notosolenus apocamptus* Stokes | . | . | . | × |
| *Pentamonas spinifera* Lackey | . | . | × | . |
| *Peranema cuneatum* Playfair | . | . | . | × |
| *P. trichophorum* (Ehrenb.) Stein | . | . | . | × |
| *Petalomonas excavata* Skuja | . | . | . | × |
| *P. mediocanellata* Stein | . | . | × | × |
| *P. pusilla* Skuja | . | . | × | × |
| *Scytomonas pusilla* Stein | . | . | × | . |
| *Sphenomonas elongata* Lackey | . | . | × | . |
| *S. quadrangularis* Stein | . | . | . | × |
| *Tropidocyphus octocostatus* Stein | . | . | × | . |
| *Urceolus cyclostomus* (Stein) Mereschowski | . | . | × | . |
| *U. pascheri* Skvortzow | . | . | × | . |
| *U. sabulosus* Stokes | . | . | × | × |

TABLE 1 (*cont.*)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 3. CHLOROPHYCEAE-11 | | | | |
| *Chlamydomonas* spp. | × | . | . | . |
| *Collodictyon* sp.? | × | × | . | . |
| *C. triciliatum* Carter | × | . | . | . |
| *Bipedinomonas rotunda* N. Carter | × | . | . | . |
| *Pyramimonas grossii* Parke | × | × | . | . |
| *P. plurioculata* Butch. | × | . | . | . |
| *P. octociliata* N. Carter | . | × | . | . |
| *Thalassomonas minima* Butch. | × | × | . | . |
| *T. semiglobata* Butch. | . | . | . | × |
| *Halosphaera viridis* Schmitz | × | × | . | . |
| *Nannochloris bacillaris* Naumann | × | . | . | . |
| 4. CHRYSOPHYCEAE-6 | | | | |
| *Chrysococcus cinctus* Lackey | × | × | . | . |
| *Chrysochromulina strobilus* Parke & Manton | × | . | . | . |
| *Chrysochromulina* spp. | × | . | . | . |
| *Kephyrion ovum* Pascher | × | × | . | . |
| *Olisthodiscus luteus* N. Carter | × | . | . | . |
| *Pedinella hexacostata* Wyssotski | × | . | . | . |
| *Pseudopedinella pyriformis* N. Carter | × | . | . | . |
| Chrysophyceae, unid. | × | . | . | . |
| 5. CRYPTOPHYCEAE-5 | | | | |
| *Chilomonas marina* (Braarud) Halldal | × | × | . | . |
| *Chroomonas* spp. | × | × | . | × |
| *Cryptomonas* spp. | . | . | × | . |
| *Cyathomonas truncata* (Ehrenb.) Fromentel | . | . | × | . |
| *Rhodomonas* spp. | × | . | × | . |
| 6. CHLOROMONADOPHYCEAE-2 | | | | |
| *Thaumatomastix* sp. | × | . | × | × |
| *T. setifera* Lauterborn | × | . | . | . |
| 7. COCCOLITHOPHORA-2 | | | | |
| *Cricosphaera carterae* (Braarud & Fagerl.) Braarud | . | × | . | . |
| *Pontosphaera* sp. | × | . | . | . |
| *P. huxleyi* Lohmann | . | × | . | . |
| *Syracosphaera* sp. | × | . | . | . |
| 8. SILICOFLAGELLATA-2 | | | | |
| *Dictyocha fibula* Ehrenb. | × | . | . | . |
| *Distephanus speculum* Ehrenb. | . | × | . | . |
| 9. DINOPHYCEAE-49 | | | | |
| *Amphidinium bipes* Herdman | . | . | × | . |
| *A. ovum* Herdman | . | . | × | . |
| *A. scissoides* Lebour | . | . | × | . |
| *A. sulcatum* Kofoid | . | . | × | . |
| *A. testudo* Herdman | × | . | . | . |
| *A. vigrense* Woloszynska | × | . | . | . |
| *A. vitreum* Herdman | . | × | . | . |
| *Ceratium furca* (Ehrenb.) Clap. & Lachm. | × | × | . | . |
| *C. longipes* (Bailey) Gran | × | . | . | . |
| *C. minutum* Jörgensen | × | . | . | . |
| *C. tripos* (Müller) Nitzsch | × | × | . | . |
| *Dinophysis ovum* Schütt | × | . | . | . |
| *D. tripos* Gourret | × | . | . | . |
| *Diplopsalis lenticula* Bergh | × | × | . | . |
| *Diplopsalopsis orbicularis* (Pauls.) Meunier | . | × | . | . |

TABLE 1 (*cont.*)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| *Entomosigma peridinioides* J. Schiller | × | . | . | . |
| *Gonyaulax tamarensis* Lebour | . | × | . | × |
| *Gymnodinium achromaticum* Lebour | . | . | × | . |
| *G. albulum* Lindeman | × | . | . | . |
| *G. aureum* Kofoid & Swezy | × | . | . | . |
| *G. lunula* Schütt | × | . | . | . |
| *G. minutum* Lebour | × | . | . | . |
| *G. puniceum* Kofoid & Swezy | × | . | . | . |
| *G. splendens* Lebour | . | × | . | . |
| *G. variabile* Herdman | × | . | . | . |
| *Gyrodinium pingue* (Schütt) Kofoid & Swezy | × | . | . | . |
| *Gyrodinium* spp. | × | . | . | . |
| *Hemidinium nasutum* Stein | . | . | . | × |
| *Katodinium glandula* (Herdman) Fott | . | . | × | × |
| *K. glaucum* (Lebour) Fott | × | . | . | . |
| *Minuscula bipes* (Pauls.) Lebour | × | . | . | . |
| *Oxyrrhis marina* Dujardin | . | . | × | . |
| *Oxytoxum belgicae* Meunier | × | . | . | . |
| *O. gracile* J. Schiller | × | . | . | . |
| *Peridiniopsis rotunda* Lebour | × | . | . | . |
| *Peridinium cerasus* Pauls. | × | . | . | . |
| *P. depressum* Bailey | × | × | . | . |
| *P. diabolus* Cleve | × | . | . | . |
| *P. pellucidium* (Bergh) Schütt | . | × | . | . |
| *P. trochoideum* (Stein) Lemm. | × | × | . | . |
| *Peridinium* spp. | . | × | . | . |
| *Phalacroma acutum* (Schütt) Pavillard | × | . | . | . |
| *P. ovum* Schütt | × | . | . | . |
| *P. rotundatum* (Clap. & Lachm.) Kofoid & Mich. | × | × | . | . |
| *Prorocentrum micans* Ehrenb. | × | . | . | . |
| *Protodinium balticum* Braarud | × | . | . | . |
| *Pyrodinium bahamiense* Plate | × | . | . | . |
| *Thecadinium kofoidi* Kofoid & Skogbury | . | . | × | . |
| *Torodinium robustum* Kofoid & Swezy | × | . | . | . |
| *Warnowia polyphemus* (Pouchet) Schiller | × | . | . | . |
| 10. BACILLARIOPHYCEAE-36 | | | | |
| *Amphiprora* spp. | . | × | . | × |
| *Amphora ovalis* Kütz | . | . | × | × |
| *Asterionella japonica* Cleve & Möll. ex Gran | × | × | . | . |
| *Bacillaria paxillifer* (Müll.) Hendey | . | . | × | . |
| *Chaetoceros simplex* Ostenfeld | × | . | . | . |
| *C. gracile* Schütt | × | . | . | × |
| *Chaetoceros* spp. | × | . | × | . |
| *Climacosphenia moniligera* Ehrenb. | . | × | . | . |
| *Coscinodiscus centralis* Ehrenb. | . | × | . | . |
| *C. concinnus* W. Smith | . | × | . | . |
| *C. excentricus* Ehrenb. | × | . | . | . |
| *Detonula* sp. (*Cyclotella nana* Hustedt) | × | . | . | . |
| *Ditylum brightwelli* (West) Grun. | . | × | . | . |
| *Grammatophora marina* (Lyng.) Kütz. | . | . | × | . |
| *Gyrosigma* sp. | × | . | . | × |
| *Leptocylindrus danicus* Cleve | × | . | . | . |
| *Licmophora abbreviata* Agardh | × | . | × | × |
| *Lithodesmium undulatum* Ehrenb. | × | . | . | . |
| *Melosira moniliformis* (O.F. Müll.) Agardh | . | . | . | × |

TABLE 1 (*cont.*)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| *Navicula* spp. | × | × | × | × |
| *N. viridis* Ehrenb. | . | . | . | × |
| *Nitzschia closterium* (Ehrenb.) W. Smith | × | . | × | × |
| *N. longissima* (de Bréb.) Ralfs ex Pritch. | . | × | . | . |
| *N. seriata* Cleve | × | . | . | . |
| *N. sigmoidea* (Nitzsch) W. Smith | × | . | × | . |
| *Paralia sulcata* (Ehrenb.) Cleve | × | × | × | × |
| *Planktoniella sol* (Wall) Schütt | × | . | . | . |
| *Pleurosigma* spp. | . | × | . | × |
| *Rhizosolenia alata* Brightw. | . | × | . | . |
| *R. setigera* Brightw. | × | . | . | . |
| *R. styliformis* Brightw. | × | . | . | . |
| *Skeletonema costatum* (Grev.) Cleve | × | . | × | × |
| *Skeletonema* spp. | × | × | . | . |
| *Streptotheca tamesis* Shrubs. | . | × | × | . |
| *Thalassionema nitzschioides* Hust. | . | × | × | . |
| *Thalassiosira* spp. | × | × | . | . |
| 11. ZOOFLAGELLATA-19 | | | | |
| *Bicosoeca lacustris* J. Clark | × | . | . | . |
| *Bodo* sp. A | . | . | × | × |
| *Bodo edax* Klebs | × | . | . | . |
| *Bodo* sp. B | . | × | . | . |
| *B. globosus* Stein | . | . | . | × |
| *Bodo* sp. C | × | . | . | . |
| *Bodo* sp. D | . | . | . | × |
| *Bodo* sp. E | × | . | . | . |
| *Bodo* spp. | . | . | . | × |
| *Cercobodo crassicauda* (Alexeieff) Lemmermann | . | . | . | × |
| *Desmarella moniliformis* S. Kent | . | × | . | × |
| *Helkesimastix faecicola* Woodcock & Lapage | × | . | . | . |
| *Monas dangeardii* Lemmermann | . | . | . | . |
| *M. sociabile* Meyer | × | . | . | . |
| *Monosiga ovata* S. Kent | × | . | . | . |
| *Oikomonas termo* (Ehrenb.) S. Kent | . | . | . | × |
| *Pleuromonas jaculans* Perty | . | . | . | × |
| *Rhynchomonas nasuta* (Stokes) Klebs | × | . | . | . |
| *Spirochaeta plicatilis* Ehrenb. | . | . | . | × |
| 12. CILIATA-87 | | | | |
| *Amphisia* sp. | . | . | × | . |
| *Aspidisca costata* (Dujardin) | . | . | × | . |
| *A. hexeris* Quennerstedt | . | . | × | . |
| *A. lynceus* Ehrenb. | . | . | × | . |
| *A. pulcherimma* Kahl | . | . | × | . |
| *A. turrita* (Ehrenb.) | . | . | × | . |
| *Chaenea minor* Kahl | . | . | . | × |
| *Chilodonella* sp. | . | . | . | × |
| *C. uncinata* (Ehrenb.) | . | . | × | . |
| *Chilodontopsis caudata* Kahl | . | . | × | . |
| *Chlamydodon triquetrus* (O. F. Müll.) | . | . | × | . |
| *Codonella cratera* (Leidy) | . | × | . | . |
| *Coleps pulcher* Spiegel | . | . | . | × |
| *C. remanei* Kahl | . | × | . | . |
| *Coleps* sp. | . | × | . | . |
| *Condylostoma patens* (O. F. Müll.) Dujardin | . | . | . | × |
| *Cothurnia plectostyla* Stokes | . | . | . | × |

TABLE 1 (*cont.*)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| *Cristigera media* Kahl | . | . | × | . |
| *C. phoenix* Penard | . | . | × | . |
| *Cyclidium* sp. (*candens* Kahl?) | . | . | . | × |
| *C. glaucoma* O. F. Müll. | × | × | × | . |
| *Diophrys* sp. | . | . | × | . |
| *D. scutum* Dujardin | . | . | × | . |
| *Dipleurostyla* sp. | . | . | × | . |
| *Dysteria aculeata* Clap. & Lachm. | . | . | . | × |
| *D. monostyla* (Ehrenb.) Stein | . | . | × | . |
| *Epiclintes ambiguus* (Müll.) Bütschli | . | . | . | × |
| *Enchelyodon farctus* Clap. & Lachm. | . | . | . | × |
| *Euplotes harpa* Stein | . | . | × | . |
| *E. harpa* var. *marinus* Rossolimo | . | . | × | . |
| *Euplotes* sp. | . | . | × | . |
| *E. vannus* (O. F. Müll.) | . | × | × | . |
| *Favella franciscana* Kofoid-Campbell | . | × | . | . |
| *Frontonia marina* Fabre-Dom. | . | . | . | × |
| *Geleia fossata* Kahl | . | . | . | × |
| *Gruberia uninucleata* Kahl | . | . | . | × |
| *Holosticha discocephalus* Kahl | . | . | . | × |
| *Keronopsis flavicans* Kahl | . | . | . | × |
| *K. multistilata* Kahl | . | . | . | × |
| *Lacrymaria pupula* (O. F. Müll.) | . | . | . | × |
| *Lembus pusillus* Quennerstedt | × | . | . | . |
| *Litonotus cygnus* (O. F. Müll.) | . | . | . | × |
| *L. fasciola* (Ehrenb.) Wrzeseniowski | . | . | × | . |
| *Loxophyllum uninucleatum* Kahl | . | . | × | × |
| *Mesodinium cinctum* Calkins | . | . | × | . |
| *M. pulex* (Clap. & Lachm.) | . | . | × | × |
| *M. rubrum* Lohmann | × | × | . | . |
| *Metacystis truncata* Cohn | . | . | × | . |
| *Nassula aurea* Ehrenb. | . | . | . | × |
| *Opisthostyla sertularium* (S. Kent) | . | . | . | × |
| *Oxytricha pellionella* (O. F. Müll.) Ehrenb. | . | . | × | . |
| *Peritromus californicus* Kirby | . | . | × | . |
| *P. emmae* Stein | . | . | × | × |
| *Placus luciae* (Kahl) | . | . | × | . |
| *P. striatus* Cohn | . | . | . | × |
| *Pleuronema crassum* Dujardin | . | . | . | × |
| *P. marinum* Dujardin | . | . | × | × |
| *Prorodon morgani* Kahl | . | . | × | . |
| *Protocrucia pigerimma* (Cohn) Da Cunha | . | . | × | . |
| *Remanella margaritifera* Kahl | . | . | × | . |
| *R. rugosa* Kahl | . | . | × | . |
| *Spathidium procerum* Kahl | . | . | . | × |
| *Stenosemella nivalis* (Meunier) | . | × | . | . |
| *Stephanopogon colpoda* Entz | . | . | × | . |
| *S. mesnili* Lwoff | . | . | × | . |
| *Strombidium cinctum* Kahl | . | . | × | . |
| *Strombidium* sp. | . | × | . | . |
| *S. lagenula* Fauré–Fremiet | . | . | . | × |
| *S. sulcatum* Clap. & Lachm. | × | . | . | × |
| *Telostoma ferroi* R. &. L. Grandori | . | . | × | × |
| *Tiarina fusus* (Clap. & Lachm.) | . | . | . | × |
| *T. levigata* Kofoid–Campbell | . | × | . | . |
| *Tintinnopsis beroidea* Stein emend. Jörgensen | . | × | . | . |
| *T. minuta* Wailes | × | × | . | . |
| *T. urniger* (Entz, Sr.) Daday | . | . | × | . |
| *Tintinnopsis* spp. unid. | . | × | × | . |

TABLE 1 (*cont.*)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| *Trachelocerca* sp. | . | . | × | . |
| *T. entzi* Kahl | . | . | × | × |
| *T. phoenicopterus* Cohn | . | . | × | . |
| *Trachelostyla pediculiformis* (Cohn) | . | . | × | . |
| *Trichopelma torpens* Kahl | . | . | × | . |
| *Trochilia fluviatilis* Smith | . | . | × | . |
| *T. salina* Entz | . | . | . | × |
| *Uronema filificum* Kahl | . | . | × | . |
| *U. marinum* Dujardin | × | × | × | . |
| *Uronychia setigera* Calkins | . | . | × | . |
| *U. transfuga* (O. F. Müll.) | . | . | × | . |
| *Urostrongylum caudatum* Kahl | . | . | × | . |
| *Vaginicola doliolum* Penard | . | . | . | × |
| Vorticellidae, unid. | . | . | × | × |

## QUANTITATIVE RESULTS

Comparison of the sand and sediment population with that of the plankton indicates that the latter is poor in number of species, the former rich. This statement applies even if the blue-green algae, bacteria and rhizopods are included. These, except for the sulphur bacteria, are omitted from this consideration because identification of many was impossible. Biomass may be another matter, because the sand and the sediment interfaces are thin layers in which bacteria, colourless euglenids and ciliates are concentrated, whereas the plankton Chrysophyceae, diatoms and dinoflagellates tend to be distributed through a considerable water column. No estimates of the total sediment and sand populations were made, but on two occasions the population of plankton per ml. was counted. The numbers are large, as shown by Table 2, which is a count obtained by centrifuging water freshly obtained from beyond the breakwater. However, 1267/ml. is not a large population in comparison with bacterial populations, or blooms of *Eutreptia*, or *Gymnodinium breve*. The 17 largest organisms in Table 2 account for only 60·75 individuals per ml. Of the others many are but 1·5–5·0 $\mu$ in length, and virtually impossible to identify with ordinary light microscopy. Probably a large number belong to such organisms as *Micromonas pusilla* whose status is in doubt (Manton, 1959; Manton & Parke, 1960), *Chrysochromulina strobilus* (Parke, Manton & Clarke, 1959), and others of similar size. The large group of 'Cells, incertae sedis' cannot even be called colourless or coloured except under the oil-immersion objective; and it seems probable that accurate counting and identification can be done only on fixed and stained material.

Table 2 is intended only to give an indication that a sizeable plankton population may be expected, at least during the summer. There is little doubt that huge numbers of very small non-bacterial cells are quite important ecologically. Such has been the experience of the oyster industry with *Nannochloris bacillaris* in Great South Bay, New York (Lackey, Vanderborg &

Glancy, 1949); and with *Detonula* sp. ( = *Cyclotella nana* Hustedt: see Guillard & Ryther, 1962).

TABLE 2. ORGANISMS PER ML. OF RAW WATER, FROM THE REGION OUTSIDE THE BREAKWATER AT PLYMOUTH, 20 AUGUST 1962

| | | | |
|---|---|---|---|
| Chlorophyceae, unid. | 54·00 | *Phalacroma rotundatum* | 3·00 |
| Volvocales | | *Minuscula bipes* | 0·25 |
| *Pyramimonas grossi* | 3·00 | *Protodinium balticum* | 6·00 |
| Chrysophyceae | | *Torodinium robustum* | 0·25 |
| *Chryschromulina*, unid. | 123·00 | Zooflagellata | |
| *Kephyrion ovum* | 3·00 | *Monosiga ovata* | 3·00 |
| Chrysophyceae, unid. | 327·00 | Monads, various | 156·00 |
| Cryptophyceae | | Cells incertae sedis | 330·00 |
| *Chilomonas marina* | 0·75 | Bacillarieae | |
| *Rhodomonas* spp. | 108·00 | *Asterionella japonica* | 2·00 |
| Coccolithophora | | *Detonula* sp. | 45·00 |
| *Pontosphaera* sp. | 45·00 | *Paralia sulcata* | 1·25 |
| *Syracosphaera* sp. | 3·00 | *Navicula* spp. | 3·00 |
| Silicoflagellata | | *Nitzschia closterium* | 36·00 |
| *Dictyocha fibula* | 0·25 | *Thalassiosira* sp. | 0·75 |
| Dinoflagellata | | Ciliata | |
| *Gymnodinium* spp. | 1·50 | *Mesodinium rubrum* | 0·25 |
| *G. albulum* | 1·25 | *Uronema marinum* | 0·25 |
| *Gyrodinium* sp. | 1·50 | | |
| *G. pingue* | 0·50 | | 1267·00 |
| *Katodinium glaucum* | 0·25 | | |

Our intent at Plymouth was to ascertain the kinds and distribution of the colourless euglenids. Four distinct habitats were studied: open water, sediment interfaces in the Plym and Tamar rivers, and the sand between high and low tide. The Plym flats with their clay deposits and large numbers of sulphur bacteria, denoting considerable $H_2S$ and organic deposits, were expected to have low populations in both number and kind. Actually they were highest in both categories. The Tamar, on the contrary, with a very large attached seaweed population, had low numbers of microbiotic types, wherever sampled. Its waters, however, contained many *Gonyaulax tamarensis*. The differences between the habitat types are clearly indicated by sulphur bacteria, saprophytic flagellates, and a relatively small ciliate group. The harbour sand has a large ciliate group, a number of saprophytic flagellates including the recently described *Pentamonas spinifera* Lackey, 1961; and certain sand-dwelling dinoflagellates. Because of organic matter entering the harbour, larger numbers were expected than were found. The same statement applies to the plankton. Evidently the high rise and fall of the tides affords ample dilution so that fertilization in the harbour area is low. While blackening of the mud and some slight odour of $H_2S$ in the Plym estuary indicates active decomposition of organic matter there, neither loss of $O_2$ nor accumulation of $H_2S$ become limiting factors. Very few anaerobic organisms were found there.

Most of the organisms have been found in tidal waters elsewhere. Some are members of well recognized associations, and a few, denoted in Table 1 by the use of letters as a provisional designation, have not been sufficiently

studied for taxonomic inclusion. Though as yet without a name, they are indicated in a special way because they occur in sufficient numbers in this and other places to be available for taxonomic study.

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