



# THE MIDLAND NATURALIST.

THE JOURNAL OF THE  
ASSOCIATED NATURAL HISTORY, PHILOSOPHICAL,  
AND ARCHÆOLOGICAL SOCIETIES AND FIELD CLUBS  
OF THE MIDLAND COUNTIES.

EDITED BY  
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"Come forth into the light of things,  
Let Nature be your teacher."  
*Wordsworth.*

VOLUME III.  
1880.

London: David Bogue, 3, St. Martin's  
Place, Trafalgar Square, W.C.  
Birmingham: Cornish Brothers,  
37, New Street.

PRINTED AND PUBLISHED AT THE HERALD  
PRINTING OFFICE, UNION ST., BIRMINGHAM.



## NOTES ON MARINE INFUSORIA.\*

BY W. SAVILLE KENT, F.L.S., F.R.M.S., ETC.

Among the treasure trove amassed by the Birmingham Natural History Society during their last summer's enjoyable outing on the Cornish coast, and at the gathering of which said material, availing myself of the kind invitation of the President, Mr. Walter Graham, I was permitted to assist, a considerable number and variety of Marine Infusoria were obtained. While none of these are new to science, several of them possess a more than ordinary interest with relation in some cases to their individual plan of structure and affinities, and in others to their marked diversity from the Infusorial types more frequently encountered by non-migratory "Midland Naturalists." To some few of these minute organisms, the produce of one day's wielding of the dredge and towing net, (July 11th,) I here propose to direct attention, accompanying my remarks with delineations of the more important forms.

Out of the eight types in all it is here proposed to select, the majority, five in number, were found associated with the horny polypidoms of the Hydroid Zoophytes, Polyzoa, and other organic

## REFERENCES TO PLATE IV.

- Fig. 1.—*Dictyocysta cassis*, empty silicious lorica, showing fenestrated pattern.  
 Fig. 2.—*Dictyocysta cassis*, animalcule with extended tentacula; the fenestræ of the lorica are not represented, in order to give a clear view of the occupant (after Hæckel)  
 Fig. 3.—*Tintinnus subulatus*.  
 Fig. 4.—*Ceratium fusus*.  
 Fig. 5.—*Zoothamnium alternans*, showing at a, a, a, the larger and axillary reproductive zooids.  
 Fig. 6.—*Zoothamnium dichotomum*, showing at a, a, a, the larger transversely-striate reproductive Zooids.  
 Fig. 7.—*Follicularia ampulla*, animalcule extended and inhabiting a lorica, with a moderately-produced neck—*Lagotia viridis*, S. Wright.  
 Fig. 8.—*Follicularia ampulla*, empty lorica, with very short neck.  
 Fig. 9.—*Follicularia ampulla*, lorica, with greatly produced neck, exhibiting annular growth markings; *Lagotia producta*, S. Wright.  
 Fig. 10.—*Hemiphrya gemmipara*, with tentacles of two orders fully extended.  
 Fig. 11.—*Hemiphrya gemmipara*, with two anteriorly developed buds.  
 Fig. 12.—*Ophryodendron pedicillatum*, proboscidiiform zooid, with characteristic organ extended.  
 Fig. 13.—*Ophryodendron pedicillatum*, with proboscis retracted.  
 Fig. 14.—*Ophryodendron pedicillatum*, vermiform zooid.  
 Fig. 15.—*Ophryodendron multicapitatum*, sessile zooid, with four proboscidiiform appendages.  
 Fig. 16.—*Ophryodendron multicapitatum*, stalked zooid, with two proboscidiiform organs, one immaturely developed vermiform zooid, and two supplementary spheroidal buds.  
 Fig. 17.—*Asterionella Bleakeleyii* (?) showing characteristic spiral disposition of the associated frustules.  
 Fig. 18.—*Asterionella Bleakeleyii* (?) a few detached frustules, exhibiting a substellate disposition.  
 Fig. 19.—*Asterionella Bleakeleyii*, single frustule.

\* The full title of this paper is "Notes on Certain Marine Infusoria, obtained during the Summer Excursion (1879) to Falmouth of the Birmingham Natural History and Microscopical Society, communicated by W. Saville Kent, F.L.S., F.R.M.S., and Honorary Corresponding Member of the Birmingham Natural History and Microscopical Society." It was read before the Society January 20th 1880.

matter brought by the dredge from the sea-bottom. By the use of the towing-net, employed, however, on one occasion only, and when the elements were by no means propitious for such operations, the small minority, including, as it eventually proved, the most interesting capture of the series, was secured. The contents of the net, as emptied on board the steam-boat into the glass receivers, were by no means promising, consisting merely of a little flocculent matter, at first distributed indifferently through the mass of water, but which, after a short interval, collected at the surface in the form of a pale yellow unsubstantial scum. Specimens of this scum examined fresh, and permanently mounted, both on board and later on in the evening, on our return to Falmouth, demonstrated that almost its entire mass was composed of two minute pelagic diatomaceous types. One of these, (Plate IV., Figs. 17 to 19,) forming substellate or long spiral and corkscrew-like aggregations, each component frustule having a somewhat inflated triangular body, and a long median and spine-like apical prolongation, is apparently identical with, or closely allied to, *Asterionella Bleakeleyii*. In no account of the several species of this same genus, at this moment accessible, however, do I find any record of their formation of long symmetrically twisted spiral aggregations, which in the present case is so eminently characteristic of the fully developed and perfect organism. The second, but less dominant diatomaceous type, accords essentially with the figures and descriptions given of *Rhizosolenia setigera*, consisting of perfectly straight, attenuate cylindrical frustules, chiefly remarkable for their finely produced and needle-like axial terminations. In some of the larger frustules a single or double spiral pattern was faintly discernible.

A more leisurely examination of the mounted slides of these diatomaceous skinmings has led to the detection among the same of the three infusorial forms placed first on this list. All these are, like the diatoms, essentially pelagic in their habits, and, possessing in each case an indurated lorica or carapace, adapt themselves readily for permanent preservation.

1.—*Dictyocysta cassis*, Hkl., (Plate IV., Figs. 1 and 2).—Of this type, the most interesting capture on my list, unfortunately only the empty test or lorica has been preserved. The form and structure of this skeletal element are, however, so definite and characteristic as to leave no doubt whatever regarding the nature and relations of its former occupant. The lorica, which resembles in shape a conical cap or helmet, is of silicious consistence, perforated throughout with closely-set, irregular, polygonal foramina, and, in the absence of the knowledge that has recently come to hand, would be regarded as the silicious test of one of the simpler pelagic Radiolaria, and be referred in that same group to Ehrenberg's Polycystine genus, *Dictyocysta*. Professor Hæckel, however, has lately shown in an account of some now pelagic Infusoria, published in the "Jenaische Zeitschrift," for the year 1873, that the original fabricators and inhabitants of these elegant helmet-shaped tests are not Radiolaria, but belong to the more highly organised group of the Ciliato

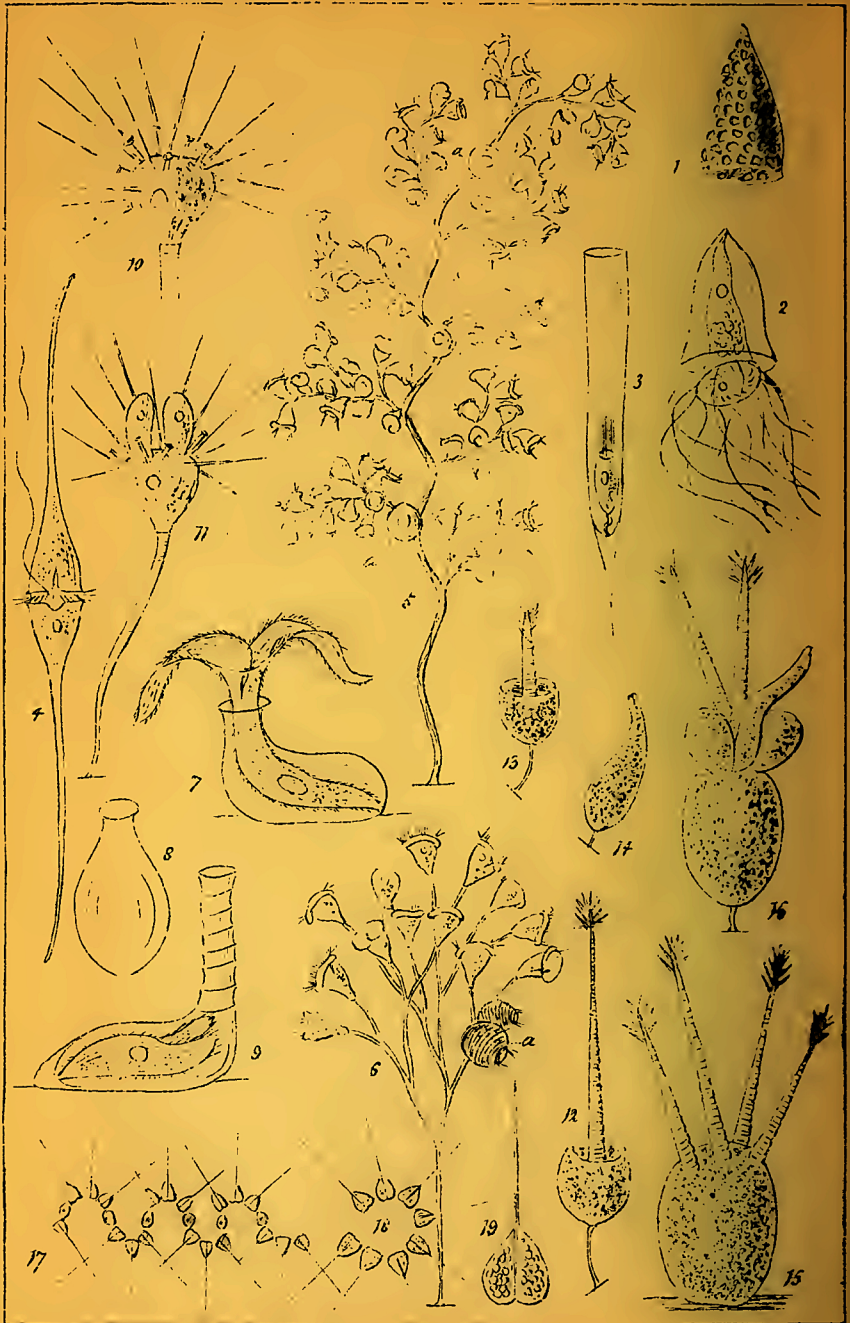
Infusoria, representing among the same a specially modified form of the Vorticellidæ and other familiar members of the section Peritricha. The test itself, except for its silicious consistence and cancellated structure, corresponds morphologically and physiologically with the horny or chitinous protective lorica of a *Cothurnia* or *Vaginicola*. It is a secretion or exudation of the external cuticula. The enclosed animalcule, however, as shown by Hæckel, exhibits a very wide divergence from the ordinary Peritrichous type. The body of the same is attached posteriorly to the proximal or hinder extremity of the cavity of the lorica, while the more expanded oral or distal region is projected, when the animalcule is extended, beyond its everted anterior margin so far that the *tout ensemble* may be compared to a minute bell, in which case the lorica represents the bell-body, and the posteriorly attached animalcule the clapper. It is in the projecting oral region of the animalcule that the essential points of modification are found to obtain. Here, in place of the customary simply circular or spiral wreath of cilia, the margins of the oral disc are produced into about twenty long tentacle-like organs, probably of a prehensile nature, which, as the animalcule swims mouth downwards through the water, impart to it the aspect of a minute jelly fish or medusa. Inside the outer wreath of tentacles, which would appear to represent outgrowths or prolongations of the raised peristome-border of an ordinary *Vorticella*, is situated an inner circlet of stout vibratile cilia, which conducts to the oral aperture. This is apparently homologous with the adoral ciliary wreath of the same peritrichous type. *Dictyocysta cassis*, with which the minute silicious lorica taken in the towing-net on the Cornish coast entirely corresponds, was originally discovered by Professor Hæckel, in the neighbourhood of Messina, and its recent encounter in so much more northerly a latitude is of itself a feature of considerable interest. Three other species of *Dictyocysta*, all distinguished by various modifications of the form of the lorica, or in the pattern of its perforations, were obtained by Professor Hæckel from the same Mediterranean station, which would appear to lie within its most congenial and favoured area of geographical distribution. Two remaining species, upon which, in the year 1854, the genus was first founded by Ehrenberg, were encountered in deep Atlantic soundings, and no doubt originally lived, like *Noctiluca* and the *Radiolaria*, in the surface waters. Three infusorial types, having tentacle-like appendages, similar to those of *Dictyocysta*, but with loricae formed of chitine, with an admixture of agglutinated sand grains and other foreign particles, have been described by Professor Hæckel, in the serial above quoted, in association with the new generic title of *Codonella*. The delineation here given of the animalcule of *Dictyocysta cassis* is reproduced from Hæckel's illustrations, that of the lorica being a sketch from the Falmouth specimen.

2.—*Tintinnus subulatus*, Müller, (Plate IV., Fig. 3.)—A single example of this type has been found mixed with the preserved diatomaceous skimmings. The lorica is of glass-like transparency, sub-cylindrical, and produced at the proximal or posterior extremity into an acute

and often much attenuated spine-like point; it bears, in fact, no inconsiderable resemblance to the segment of a frustule of the diatom, *Rhizosolenia setigera*, with which it is so abundantly associated. The contained animalcule, resembling an elongate *Vorticella*, is fixed by a contractile pedicle to the bottom, or sometimes to one side of the lorica, and does not project beyond its anterior margin. The oral cilia, forming a spiral wreath at the distal extremity, are exceedingly long and powerful, and in its normally free-swimming state serve to propel the animalcule and its associated lorica backwards through the water with great rapidity. According to Claperède and Lachmann, the entire body in the representatives of this same genus is clothed throughout with fine vibratile cilia, and thus assimilates the typical characteristics of the section Heterotricha; the presence of these finer cilia, however, could not be detected in the spirit-preserved example recently examined.

3.—*Ceratium fusus*, Ehr. (Plate IV., Fig. 4).—Several examples of this cilio-flagellate type have been found scattered through the prepared slides referred to, this species being remarkable among its associated family group of the Peridiniidæ on account of the production of the two segments of the carapace into single attenuate axial prolongations, the other representatives of the same genus, as *C. tripos* and *C. furca*, having usually two antero-lateral and not axially disposed processes. Although *Ceratium* is usually regarded as an essentially marine type, one form, *C. Kumaonense*, has been described by Mr. Carter (Ann. Nat. Hist., Vol. VII., 1871,) as occurring in prodigious numbers in the lakes of Kumaon, Hindostan, at an elevation of from 4,000ft. to 6,500ft. above the sea level, while the *Ceratium* (*Peridinium*) *longicorne* of Perty, (having, like *C. Kumaonense*, three anterior horn-like prolongations,) originally found in Switzerland, has been recently encountered in the neighbourhood of Birmingham, whence I have received specimens for identification from the hands of Mr. Levick. Among the Falmouth specimens of *Ceratium fusus*, one example in which the carapace had been crushed, and the enclosed yellowish and granular protoplasm extruded, exhibited a well marked oval nucleus-like body, while the aspect of the fractured edges of the carapace seemed entirely to support the suggestion recently made to me by Mr. Charles Stewart, F.L.S., and arrived at by his burning *C. tripos* on platinum over a spirit lamp without the destruction of the carapace, that this latter, in the case at least of the marine types, is probably of a silicious nature. The animalcule of *Ceratium* corresponds essentially with that of *Peridinium*, having a monadiform structure, and single long lash-like flagellum, which projects from a medially situated oval aperture; the carapace consists of an anterior and posterior valve, closely approximated, with an equatorial groove or channel between them upon which a circlet of fine vibratile cilia is developed, and upon the ventral face of which groove the oral aperture with its associated lash-like flagellum debouches. The fresh-water *Peridinium tabulatum* recently supplied to me from the neighbourhood of Birmingham through Mr. Thos. Bolton's excellent microscopic agency, is a form admirably adapted for the observation of this same fundamental type of structure, the carapace valves in this instance being moreover composed of elegantly reticulated polygonal facets that amply repay microscopic investigation.

(To be continued.)



*M. Saville-Kent del.*

Marine Infusoria.