

ORIGINAL COMMUNICATIONS.

On the genus Triceratium, with Descriptions and Figures of the Species. By T. BRIGHTWELL, F.L.S.

THE genus *Triceratium*, with several other genera of Diatomaceæ, was established by Ehrenberg in a Memoir communicated by him to the Berlin Academy in 1839-1840.* He founded it upon two species, described and figured in the Memoir, *T. favus* and *T. striolatum*, the former of which is commonly taken as the type of the genus.

Several new species were afterwards described by Ehrenberg in the monthly reports of the Berlin Academy, most, or all of which, are given in Pritchard's 'History of Infusorial Animalcules,' ed. 1852, pp. 448, 449, and in Kutzing's 'Species Algarum,' 1849, pp. 140, 141, but no figures have been given of these species. Professor Bailey, of New York, has described and figured one or two species discovered by him.

We purpose, in the present memoir, to give descriptions and figures of the known species, and to add some others which have hitherto been unnoticed.

The *Triceratia* are all marine. We have detected nearly all the recent species described in this memoir in material obtained from the surface of the large sea-shells of the genera *Hippopus* and *Haliotis*, before they have been cleaned. Many of them, in this state, are covered with small zoophytes, minute algæ, and other parasites, and by a careful examination of these, *Triceratia* and other Diatomaceæ have been obtained.

I have been indebted for a supply of one new and interesting species, collected by Dr. Sutherland in the Arctic Regions, to Dr. Baird of the British Museum. It is noticed as '*T. striolatum*, Ehr,' in the appendix to Dr. Sutherland's 'Journal of his Voyage in Baffin's Bay and Barrow's Straits,' 1850-1851, vol. ii. pp. cxcv-cxcix. 'Diatomaceæ.' Having, by the means above mentioned, obtained a good supply of *T. striolatum*, and finding it to be clearly distinct from the arctic one, I have named the latter *T. arcticum*. Dr. Sutherland

* Über noch jetzt zahlreich lebende Thierarten der Kreidebildung und den Organismus der Polythalamien. Von Hrn Ehrenberg. Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1839, p. 81.

land has given the following note with this species—"Taken from a depth of fifteen fathoms, shingly bottom, calcareous district. Temperature of the water $31^{\circ}.8$; covered with ice for nine months of every year. Union Bay, Beechey Island, lat. $74^{\circ} 43'$; long. $92^{\circ} W$. September 4th, 1850."

The frustules of this species were found in a mass unmixed with any other Diatomaceæ, and very much broken. Many of the perfect frustules have the endochrome in them, and when examined as first received, had very much the appearance of being attached to a minute alga found among them. This is, I believe, the only instance in which a large number of living frustules of *Triceratia* have been found isolated, and almost compacted together. Among the *Diatomaceæ* collected by Dr. Sutherland in other parts of the Arctic Seas, I have found a few frustules of *T. arcticum*, but these occur, as do most of the other species, sparingly. I have not been able to detect among all the specimens of *T. arcticum*, furnished me, a single one, in which the fissiparous division appears to have commenced; all the specimens are, however, nearly equal in size, and agree in form and structure, not presenting any of the variations which I have noticed in *T. striolatum*, and in one other species as hereafter mentioned.

Ehrenberg has given elaborate figures of the end and front view of *T. striolatum*, in the memoir above mentioned, but he has not noticed any varieties of this, or, I believe, any other species.

The general form of *T. striolatum*, on an end view, is triangular, but I have found among the frustules obtained, from the shells above mentioned, several specimens of a pentagonal form, and having the appearance of being composed of a number of pentagonal plates united together. The colour and sculpture of these five-sided frustules is precisely the same as that of the triangular ones. I have also detected another variety of a cubical form, presenting nearly a perfect square on the end view, and agreeing in colour and sculpture with the triangular specimens. I have not met with variations of this kind in any other species except in *T. scitulum*, mihi, a small species in which the surface is marked with large hexagonal cells, and in this species I have detected a variety with four concave sides on an end view, of which I have given a figure. Among the specimens of *T. favus*, obtained from Thames mud, I have found one presenting a very remarkable singularity. A semi-circular arch is hollowed out of the centre of the end walls, having a regular arched rim of square cells around it, resembling the

key-stones of a bridge, and leading to the conclusion that the frustule, in its formation, meeting with some impediment, had formed its walls around it.

These variations in form appear to me to confirm the view now generally taken of the vegetable character of the *Diatomaceæ*, while, on the other hand, they are in opposition to the general law regulating the multiplication of the species. Such forms could not proceed from a spontaneous longitudinal division, in which each half produced a counterpart of itself. They are perhaps the result of that specific mode of reproduction to which Mr. Smith has alluded in his valuable papers on the *Diatomaceæ*, in the 'Annals,' series 2nd, of Natural History' (series 2nd, vol. ix. p. 5). In this mode of reproduction it is quite possible that abnormal variations of form may take place.

For some excellent observations on the structure, mode of growth, and general physiology of the *Diatomaceæ*, I beg to refer the reader to the above-mentioned paper by Mr. Smith, and particularly to that contained in the 'Annals,' series 2nd, vol. vii. pp. 1-5, and also to his Introduction to, his most useful 'Synopsis of the British *Diatomaceæ*,' the first volume of which has been recently published.

Nearly one-half of the described species of *Diatomaceæ* are fossil, the greater number being found in the Bermudas. Several of the fossil forms are also found among the living species. One of the difficulties attending the study of this genus, and the determination, especially in the fossil forms, of the species, arises from the difficulty of obtaining perfect frustules, and examining them in their front aspect. The imperfect frustules present only the end or triangular wall, from which alone no perfectly satisfactory specific character can be obtained. For this reason several of the species here described and figured must be adopted only provisionally, *i. e.* till perfect frustules can be examined.

Many of the species also vary extremely in size. I have observed this to be the case with nearly all the species of which I have had an opportunity of obtaining many specimens. In *T. striolatum* and *T. alternans*, and in the latter both in the recent and fossil specimens, the variations in size are such as force one to the conclusion that they have been formed by conjugation of frustules, or some mode of reproduction varying from that of self-division. In the outline figures of varieties of *T. striolatum* (Pl. IV., fig. 11), will be found two, in which small frustules are adhering to larger ones, as if they were budding or growing from them; this whole group were gathered from a shell of *Hippopus*

maculatus, and are figured as they appeared, lying in a watch-glass, with a little water over them.

The species of the genus *Triceratium* may, for the most part, be recognised by the triangular form they present, on an end view of the frustules. The normal form of the frustule may be represented by a vertical section of a triangular prism. If the frustule be placed upon one of its flat sides, we look down upon its ridge and obtain a front view of its two other sloping sides. If it be placed upon one of its ridges, we have a front view of one of its flat sides, generally broader than long, and of its smooth or transparent suture, or connecting membrane. If the frustule be progressing towards self-division, it is then often considerably longer than broad, and when nearly matured for separation, presents the appearance of a double frustule.

A simple frustule, when dissected or broken up, consists of two triangular plates or walls of siliceous material, forming the ends, and of three oblong rectangular pieces or bands, forming the three sides; the latter usually dividing themselves into several elongated paralleliform pieces. These siliceous plates themselves are formed of several distinct layers of siliceous material, dividing, like the thin divisions of talc, and are frequently found of such exquisite delicacy as to be difficult of detection.

Synopsis of the Species.

Section I.—*Sides concave with the angles protruded. Valvular cells minute.*

1. *T. Solennoceros*, Ehr. Sides deeply concave. Angles extended into long arms rounded off at the ends. Cells radiating in straight lines to the extremity of the arms. Diam. 1-276th.

Fossil, in Bermuda earth. Perfect specimens of this singular and beautiful species are rarely found. Ehr. describes the arms as tubular.

Kützing, Species Algarum, p. 140.

Plate IV., fig. 1.

2. *T. brachiolum*, mihi. Sides concave. The angles extended into short arms, rounded at the ends, which are perfectly smooth, while the rest of the valve is covered with minute cells. Diam. 1-250th.

New Zealand. Recent; from the cleanings of shells and small algæ. Rare.

Plate IV., fig. 2.

N.B.—This species appears allied to *T. pileolus*, Ehr.; but is much larger, and probably distinct.

3. *T. tridactylum*, mihi. Sides concave. Angles carried out into a distinct papilliform extremity. Surface of the valves covered with minute cells. Diam. 1-318th.

Fossil, in Petersburg earth, N. A. Rare.

Plate IV., fig. 3.

Section II.—*Sides straight, or somewhat convex.**a, Surface with large hexagonal cells.** *Angles spinose.*

4. *T. contum*, Ehr. Sides straight. Angles extended into a short stout spine. Sides of the angles with a projecting fringe, the fringe having a row of oval depressions. Surface covered with large hexagonal cells. The edge of the fringe is sometimes broken off, leaving the appearance of small spines. Diam. 1-218th.

Kutzing, S. A., p. 140.

From the cleanings of Tridacnidae and other shells.

Plate IV., fig. 4.

5. *T. muricatum*, mihi. A minute species. Sides straight. Angles ending in a stout spine. Front view nearly square, resembling an Odontella or Zygoceos. Diam. 1-583rd.

From the cleanings of Tridacnidae and other shells.

Plate IV., fig. 5, *a, a*, front view; *b*, end view.

6. *T. spinosum*, Bailey. Sides furnished with 4 lateral setae.

Kutzing, S. A., p. 141.

In North America; a doubtful species. No figure has been given of it, and I have not seen a specimen.

* * *Angles not spinose.*

7. *T. favus*, Ehr. Angles having an obtuse projection. Cells on the surface large, and the hexagonal figure of them well defined.

Kutzing, S. A., p. 140. Diam. 1-200th to 1-150th.

Smith's 'Brit. Diatomaceae,' vol. i., p. 26; plate v. 44, end view; and supp., plate xxx. 44, front view.

Thames mud, at the junction of the Yare and Waveney, near Yarmouth. This species appears pretty generally distributed. I have found it on shells, from various regions, and fossil in Petersburg earth, N. A.

Plate IV., fig. 6. This figure presents the remarkable formation noticed before.

8. *T. megastomum*, Ehr. Sides straight. The hexangular cells smaller and more delicate than in *T. favus*. Diam. 1-350th to 1-175th.

Kutzing, S. A., p. 140.

Allied to *T. favus*; but distinguished from it by its smaller size, more delicate structure, and sharp triangular form.

Found in Ichaboe and other guano, and among the cleanings and small algæ from foreign shells, varying much in size.

Plate IV., fig. 7.

9. *T. grande*, mihi. The largest and stoutest species of this genus. Sides convex. Angles attenuated, obtuse. Hexagonal cells numerous.

Found on Tridacnidae and other shells from the Indian Seas, not unfrequent. Diam. 1-100th.

Plate IV., fig. 8.

Ehrenberg has described a large species (*T. ocellatum*) from the Indian Seas. See Kutzing, S. A., 141; but his description differs altogether from the present one.

10. *T. scitulum*, mihi. A small species, but varying in size; on some of the frustules I have reckoned on an end view, about 45 cells only; very slightly convex on the sides. Angles open. Diam. 1-350th.

From the cleanings of shells from the Indian Ocean.

Plate IV., fig. 9; *a*, end view.

Var. β . Having four concave sides. I have detected this curious variety on several occasions.

b. *Cells very small.*

11. *T. striolatum*, Ehr. Frustule on a front view longer than broad with the ends deeply concave, transparent; colour, pale brown. The whole, under a high magnifying power, delicately marked with minute cells. Diam. 1-290th.

Kutzing, S. A., p. 140.

Var. β . Frustule pentagonal; end view quinqueangular; each angle concave.

Var. γ . Frustule cubical; end view square.

Recent: found among the small Algæ, &c., on *Hippopus maculatus*.

Plate IV., fig. 10. *a*, front view; *b*, end view. Fig. *c*, pentagonal frustule; *d*, square ditto; *e e e e*, various aspects of the frustules.

12. *T. arcticum*, mihi. Front view broader than long, with the ends straight; clearly distinct from the last species. Diam. 1-250th. Beechy Island, Arctic Regions, Dr. Sutherland: and sparingly among Diatomaceæ from other parts of the Arctic Seas.

Plate I., fig. 11. *a*, front view; *b*, end view.

13. *T. condecorum*, Ehr. Sides nearly straight, or slightly convex; angles slightly rounded off. On an end view the rows of the cells diverge from the centre in elegant curved lines. Diam. 1-384th.

Kutzing, S. A., p. 140.

Fossil in Bermuda earth.

Plate I., fig. 12.

14. *T. undulatum*, Ehr. Sides undulated; three or four undulations on each side. Angles pointed. Cells radiating in lines from the centre of the valve. Diam. 1-480th.

Kutzing, S. A., p. 140.

In all the specimens I have seen, the posterior plates of siliceous project beyond the undulations of the front plate, giving this species a unique aspect.

Fossil, in Bermuda earth.

Plate IV., fig. 13.

15. *T. amblyoceros*? Ehr. Sides convex; very slightly undulated. Angles rounded off. Posterior plates not conspicuous.

Pritchard's 'Infusoria,' 1852, p. 448. Fossil, Richmond, Virginia. Diam. 1-456th.

Plate IV., fig. 14.

16. *T. membranaceum*, mihi. Walls of the frustule extremely delicate; sides convex. Angles attenuated, ending in minute papillæ. Frustule dotted over with very minute cells. Diam. 1-233rd.

From the Thames mud. Rare.

Plate IV., fig. 15.

17. *T. acutum*, Ehr. Sides straight or slightly convex, and drawn to a point more or less lengthened out. Diam. 1-720th.

Surface with irregular cells.

Kützing, S. A., p. 140.

Plate I., fig. 16.

Fossil, in Bermuda earth; varying much in form.

18. *T. reticulum*, Ehr. A minute species. Sides straight. Cells small and somewhat irregular. Front view twice as broad as long. Suture narrow. Ends round, projecting, somewhat like a Bidulphia. Diam. 1-388th.

Kützing, S. A., p. 140.

Fossil, in Bermuda and Richmond earth, and recent from shell cleanings and small algæ.

Plate IV., fig. 17. *a*, end view; *b*, front view.

Section III.—Ends of the angles entirely rounded off.

19. *T. Montereyi*, mihi. Ends of the angles enlarged and bluntly rounded off. Structure of the frustule stout. End wall elevated in the centre of the triangle, with the cells in that part stouter, and gradually diminishing in size to the sides and ends, where they nearly disappear. Diam. 1-300th.

Fossil, in a stratum of earth occurring near the shore of Monterey Bay, N. A., abounding in Diatomacæ. Furnished by Mr. A. J. Taylor, of Monterey.

Plate IV., fig. 18.

20. *T. alternans*, Bailey. Ends of the angles divided from the rest of the valve by a transverse line. Cells circular. Diam. 1-500th.

Bailey's 'Microscopical Observations made in S. Carolina,' &c., p. 40; and 'Soundings,' fig. 55, 56. Smith's 'Synopsis Brit. Diatom.,' p. 26; plate v. 45; plate xxx. 45.

On the shores of the British Atlantic and Pacific Oceans.

Fossil in several of the Diatomaceous earths from North America and from Monterey, and in Peruvian guano.

This well-defined species varies greatly in size, both in the recent and fossil states.

Plate IV., fig. 19. *a*, front view; *b*, end view.

21. *T. obtusum*, Ehr. Sides straight or somewhat concave. Ends rounded off. Cells small; irregular. Diam. 1-700th.

Kützing, S. A., p. 140.

Fossil, in Bermuda and Richmond earth. Recent in Thames mud. Plate IV., fig. 20.

22. *T. semicircularis*, mihi. Ends rounded off, and one end so much so, as to reduce the frustule to a semi-circular figure.

Fossil, in Bermuda earth, not uncommon, about the size of the last species, but varying in breadth.

Plate IV., fig. 21. A narrow variety.

In the preceding arrangement of species we have indicated characters of division which must be received with caution. It is remarkable how, in these minute and obscure organisms, we find ourselves met with the same difficulties, as to any positive laws governing the formation of any generic types, as in the larger and more complex forms of animal and vegetable life. It appears as if we could carry our real knowledge little beyond that of species, and, when we attempt to define kinds and groups, we are met on every side by forms which set at nought our definitions. With reference to the species of the present genus, looking upon *T. favus*, or *megastomum*, as what we conceive to be the most perfect plan (if any) on which this group is constructed, we find all the species diverging from it, and carrying us to analogous forms in other groups, or lost in them. Placing the perfect triangular form of *T. favus* in the centre, we may diverge in lines to a circumference ending in one line, in the long-armed *T. Solennoceros*; itself nearly resembling *Desmidiium tridens*, or *hexaceros*, Ehr.; in another line ending in a form resembling *Desmidiium apiculosum*; in another like *Zygoceros rhombus*, especially in the front view; in another analogous to *Amphitetras antediluviana*; and in another to *Campilodiscus cribrosus*.

Norwich, June, 1853.

On certain Appearances occurring in Dentine, dependent on its Mode of Calcification. By S. JAMES A. SALTER, M.B., F.L.S., &c.

In Kölliker and Siebold's *Zeitschrift* for 1850, Czermak published a paper, on some points of the minute anatomy of the teeth, whose importance has not, as it seems to me, been sufficiently appreciated in this country. No abstract or translation of this paper has yet appeared in English, though the interest and value of its contents probably equals any single other that has appeared since the earlier writings of Purkinje and Retzius.