

An Amended Terminology for the Siliceous Components of the Diatom Cell

by

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Introduction

At the Diatom Symposium held in Oslo in 1976 a working party was appointed to prepare amendments and additions to the terminology part of the "Proposals for a Standardization of Diatom Terminology and Diagnoses" that had been published in the Report of the Kiel Symposium (Anon. 1975). This working party consisted of the first six of the authors listed above, with R. Ross as its convenor; the six members appointed at Kiel decided to co-opt Miss Sims as an additional member of the working party.

The working party prepared a report setting out the amendments and additions to the previous document that they proposed and this report was discussed at the Fifth Diatom Symposium in Antwerp. There is presented here a new version of the suggested terminology incorporating the proposals of the working party as modified after the discussion in Antwerp. This confines itself as far as possible to the siliceous components of the diatom cell. In so far as the organic parts of the diatom cell need a terminology special to the group, as distinct from one applicable to other groups of algae, the amount of information currently available is not sufficient to enable suggestions to be made of a standardized form for this.

In preparing the suggested terminology set out below, the working party has tried to ensure that it follows established practice as far as possible. However, they considered that the same term should not be

used in two different senses within the diatoms. This has led them to suggest the use of "partectum", one of the boxes surrounding the circus, for what has been called "loculus" in *Mastogloia* (see II.B.4 below), because of the use of loculus for the chamber type of areola (see III.C.2 below), and "otarium", a latinized form of the Greek word for a little ear, for what has been termed "wing (ala)" in *Rhizosolenia* (see II.A.8.f below), retaining wing for the structure so termed in the Surirellaceae (see II.A.7.a below).

It will of course be the case as further diatoms are examined with the electron microscope that structures will come to light for which there is no provision in this terminology. In addition, the working party is aware that there are structures already known for which they have made no provision. The structure of the valve in lightly silicified diatoms such as *Lauderia annulata* Cleve, *Porosira glacialis* (Grun.) Jørg. (see Hasle 1973) and *Chaetoceros debilis* Cleve (see Evensen & Hasle 1975) is one example where nothing in our terminology fits. It is also, as we are well aware, not fully adequate for describing the structure in many Pennales, and especially those with more than one row of areolae between strong interstriae, e.g. *Gomphoneis olivaceum* (Hornem.) P.A. Dawson ex Ross & Sims (see Dawson 1974). We have made no proposals in these areas because, in both cases, no survey has been made of the range of structures that occur and of their relations with one another and with the structures found in other diatoms. It is not possible to make sound suggestions about terms without such a survey, and we were not able to undertake it.

Another area that we have not dealt with is the description of the shape and symmetry of those diatoms that are not radially symmetrical about the pervalvar axis or bilaterally symmetrical about the apical plane. We realize that the treatment by O. Müller (1895) in his classical paper on the subject cannot now be considered comprehensive, but we have not been able to produce an alternative in the time available to us. There is, however, one point on symmetry that we do wish to make. The raphe and associated structures are not normally symmetrical about the apical axis even in those diatoms with a symmetrical outline; in almost all cases the Voigt fault (see III.B.3 below) occurs on the same side of the axial area in both halves of the valve, the central and terminal fissures are often turned in the same direction in both branches of the raphe, and the point of inflexion of a

plicate raphe (see II.A.14 below) is usually to the same side of the valve in both branches of the raphe. There is as yet little information about the relationship of the Voigt fault, the direction of flexure of the terminal fissures, and the position of the inflexion in plicate raphes. However, if these normally have the same relationship to one another, it will be possible to distinguish the two sides of the valve on this basis. Accordingly, their relationship should be stated in descriptions of diatoms whenever it is possible to observe them.

It is a matter of great regret to us that so few of our colleagues took advantage of the announcement in the preliminary programme of the Antwerp Symposium that copies of our proposals were available and would be sent on request. Had the discussion of them there been based on a longer and more detailed consideration of them by those taking part, it would, we feel sure, have resulted in improvements to what is put forward here. There will be time, however, for such consideration between the appearance of this volume and the next symposium that is being arranged for 1980 in Budapest. This is one justification for publishing now a version that we realize is imperfect. Another is that we believe that our suggestions will provide acceptable definitions for a large proportion of the terms that authors will wish to use when describing the siliceous parts of diatoms, and will encourage them, where they find our proposals inadequate or unacceptable, to define the terms that they do use. If this is so, the result will be to reduce ambiguity in such descriptions, which is the purpose for which this working party was formed.

The terms which we recommend for use are printed below in bold letters at the place where they are defined. Certain other terms that have been used in the past are mentioned but do not appear in bold letters. These terms have, in our opinion, been rendered inappropriate by recently gained knowledge but are included, to show their relation to the terminology that we recommend. Terms marked with an asterisk are included in the Glossary at the end of this paper.

It has not been possible to produce figures additional to those used to illustrate the previous paper (Anon. 1975) and references are therefore given, where necessary to illustrations in the literature.

Recommended Terminology

I. Types of cells

A. **Auxospore:** cell resulting from sexual fusion or autogamy (i.e. zygote), or one formed by purely vegetative processes that swells to maximum size. Its wall is different from that of the normal cell and is of specialized structure. **Initial cell:** cell formed from auxospore by the laying down of valves which usually differ morphologically from the valves of the normal vegetative cell.

1. **Free auxospore:** auxospore not in any direct connection with the **parent cell**. *Lithodesmium undulatum* Ehrenb. (Fig. 1).
2. **Terminal auxospore:** auxospore at the end of the parent cell. *Rhizosolenia alata* Brightw. (Fig. 2).
3. **Lateral auxospore:** auxospore emerging from the girdle of the parent cell with its perivalvar axis transverse or oblique in relation to the perivalvar axis of the parent cell. *Rhizosolenia shrubsolei* Cleve (Fig. 3).
4. **Intercalary auxospore:** auxospore with epi- and hypotheca of the parent cell or their remains attached (the cingula often break away more or less completely during enlargement of the auxospore). *Melosira varians* Agardh (Fig. 4).
5. **Semi-intercalary auxospore:** auxospore attached at one side to one theca of the parent cell, the other side free or in contact with a second auxospore. *Odontella regia* (Schultze) Simonsen (Fig. 5).

B. **Vegetative cell:** cell formed by mitotic division. Its **cell wall*** consists of silica components, which together constitute the frustule (see II below), and organic components. These latter include **coating membranes***, thin coatings enveloping the silica elements, that may be missing on the inner or outer surfaces or both in mature cells. The terms for the components of the frustule (valves and girdle elements — see II below) will often be used to refer to the silica elements together with the coating membranes, and when it is important to make plain whether or not this is so, authors should do this unless it is obvious from the context. The axes and planes of symmetry of a bilateral frustule (Fig. 6) are:

apical axis (A)
pervalvar axis (B)
transapical axis (C)

valvar plane (a)
apical plane (b)
transapical plane (c)

Where the symmetry is not bilateral, only the pervalvar axis and the valvar plane can be recognized.

C. **Resting spores***: specialized cells formed in chains of four, in pairs or singly by means of equal or unequal cell divisions or of a cytokinetic mitosis and by deposition of a heavily silicified wall usually differing structurally from that of the vegetative cell and consisting of two valves, in many cases without a girdle. **Primary valve**: the first valve formed; **secondary valve**: the next valve formed. These two valves may or may not differ structurally.

1. **Exogenous resting spore**: mature resting spore neither completely nor partially enclosed in its parent frustule. *Detonula confervacea* (Cleve) Gran (Fig. 7).
2. **Semi-endogenous resting spore**: one valve of the mature resting spore enclosed in the parent cell, the other free. *Stephanopyxis turris* (Grev.) Ralfs (Fig. 8).
3. **Endogenous resting spore**: mature resting spore completely enclosed in parent cell. *Chaetoceros compressus* Laud. (Fig. 9).

II. The silica elements of the diatom cell wall; these constitute the **frustule** (Fig. 10), which comprises:

- a. Two valves (see A below), the epivalve and the hypovalve, and
- b. The girdle (See B below), consisting of epicingulum and hypocingulum. The girdle is apparently lacking in some fossil species.
- c. The **epivalve** + **epicingulum** together constitute the **epitheca** (Fig. 11), that part of the frustule derived from the parent cell.
- d. The **hypovalve** + **hypocingulum** together constitute the **hypotheca**, that part of the frustule laid down by the daughter cell after cytokinesis. The hypocingulum is sometimes not laid down until a further cell division is about to take place.

- A. **Valve:** one of two opposing distal plates, more or less flattened or convex, of a diatom frustule. (Note: we discourage the use of "calyptra" for the specialized valve of *Rhizosolenia*).
1. For descriptive terms for valve outline see: Systematics Association Committee for Descriptive Biological Terminology 1962, of which a part is copied in Stearn (1973, fig. 19). Terms not covered there may be found in Hendey (1964, text-fig. 2).
 2. **Valve mantle:** the marginal part of the valve differentiated by slope, sometimes also by structure (Fig. 12).
 3. **Valve face:** the part of the valve surrounded by the mantle (Fig. 12).
 4. **Elevation:** raised portion of the valve wall, not projecting laterally beyond the valve margin, that may bear on it some special structure but otherwise has much the same structure as the valve. *Biddulphia biddulphiana* (Smith) Boyer (Fig. 13). Special case: **horn:** elevation that is long and narrow. *Hemiaulus polycystinorum* (Ehrenb. (Fig. 14).
 5. **Seta:** hollow outgrowth of valve projecting outside the valve margin, with different structure from the valve. **Terminal setae:** setae of the end cells of a colony. The space between valves of adjacent cells in colonies is called the **aperture*** or window. *Chaetoceros* Ehrenb. (Fig. 15).
 6. **Hyaline areas*:** areas where the basal siliceous layer is not penetrated by areolae. The following types occur in Pennales:
 - a. **Axial area:** a hyaline field along the apical axis. The use of "pseudoraphe" for this structure in araphid diatoms is discouraged.
 - b. **Central area:** an expanded or otherwise distinct portion of the axial area midway along its length. In diatoms with a thickened central nodule (see 14 below), an unthickened hyaline area around the central nodule is the central area. A central area that forms a hyaline band extending across the valve, i.e. transapically, is termed a **fascia** (see 14 below for stauros, which is a different structure).

- c. **Lateral area:** apical extension of an expanded central area that divides the striae (*Naviculae lyratae*).
- d. **Terminal area*:** an expansion of the axial area at the apex of the valve, or a hyaline area around the terminal nodule (see 14.f. below).
7. **Keel:** the summit of the ridge bearing the raphe in those members of the Pennales whose valve is sharply angled at the raphe. *Entomoneis* Ehrenb., *Nitzschia* Hassall, *Surirella* Turpin, *Plagiotropis* Pfitz. (Fig. 38).
- a. **Wing*:** a keel in which fenestrae (sing. **fenestra***), areas where the valve surface and the mantle are fused, alternate with **alar canals***, passages between the interior of the frustule and the raphe canal (see 14.f. below). *Surirella robusta* Ehrenb. (see Paddock & Sims 1977, figs 53-56). In many cases the fenestra is an open or partially occluded hole surrounded by a rim where the valve surface and mantle fuse, the occlusions usually being parallel **fenestral bars***.
8. **Costa:** an elongated solid thickening of the valve. *Triceratium pentacrinus* (Ehrenb.) G.C. Wall. Special cases:
- a. **Pseudoseptum:** a membranous costa on the inner side of the valve, especially used for one projecting in the valvar plane from the apex of the valve. *Biddulphiana biddulphiana* (Smith) Boyer (Fig. 13), *Stauroneis acuta* W. Smith (Fig. 18a), *Eunotogramma weissei* Ehrenb. (Fig. 18b).
- b. **Axial costa*:** an internal costa lying alongside the raphe (see 14 below). *Frustulia rhomboides* (Ehrenb.) De Toni (see Cox 1975, figs 21, 23), *Gyrosigma attentuatum* (Kütz.) Rabenh. (see Cox 1977, figs 29, 33, 35). The structures that have been called "horns of the central nodule" are axial costae, sometimes only slightly developed, bordered by a narrow strip of axial area (see Sims & Paddock 1979, figs 2, 4, 8, 13).
- c. **Marginal ridge:** a ridge between the valve face and the valve mantle, continuous or interrupted, perforated or

solid. *Lithodesmium undulatum* Ehrenb., *Ditylum brightwellii* (T. West) Grun. (Fig. 17), *Eunotogramma weissei* Ehrenb., *Rattrayella oamaruensis* (Grun.) De Toni, *Biddulphia tuomeyi* J.W. Bailey (Fig. 16).

- d. **Collar**: a circular membranous costa on the outer side of the valve. *Melosira nummuloides* (Dillwyn) Agardh (Fig. 19).
 - e. **Crest***: a tall thin costa, often toothed or fimbriate along its free margin, on the outer side of the valve. *Odontropis cristata* Grun. (see Hustedt 1930, fig. 511).
 - f. **Otarium***: one of the pair of short membranous costae that occur opposite each other at or near the base of the labiate process in some species of *Rhizosolenia* Brightw., previously termed a wing. *Rhizosolenia styliformis* Brightw. (see Hasle 1975, figs 3, 9).
9. **Canopy***: a flap of silica attached to, or near to, the axial area and extending over the valve towards the margin, *Navicula hyalinula* De Toni (see Sims & Paddock 1979, figs 27, 28, 30, 31).
10. **Fold**: an inward fold of the valve wall. *Hemiaulus capitatus* Grev. (Fig. 20). The specialized fold in some *Melosira* spp. is called a **sulcus**. *Melosira ambigua* (Grun.) O. Müller (Fig. 21).
11. **Stigma**: a perforation of the basal siliceous layer in the central area of raphe-bearing Pennales, with an unoccluded outer opening and an inner opening that can be variously occluded, e.g. by a membrane of cracked appearance [*Cymbella cistula* (Ehrenb.) Kirchner, see Cox 1976, figs 28, 31], or unoccluded but with a collar-like margin (*Navicula mutica* Kütz., see Cox 1977, figs 2, 4). Stigmata may be near the central nodule or at the proximal ends of central striae.
- If the inner openings of a pore or pores in the central area terminate the central raphe endings, these pores are not stigmata but cuniculi (see 14.c. below).
12. **Apical and marginal fields**: areas set off from the pattern of the rest of the valve. There are the following types:

- a. **Pseudocellus:** field of areolae decreasing in size from those on the main part of the valve. *Biddulphia* Gray, *Trigonium* Cleve (Fig. 23).
 - b. **Ocellus:** plate of silica, normally with a thickened structureless rim, pierced by closely packed holes, the porelli (sing. **porellus**). *Odontella edwardsii* (Febiger) Grun. (Fig. 24), *Auliscus caelatus* Bailey (Fig. 25), *Synedra tabulata* (Ag.) Kütz. (Fig. 26), *Striatella unipunctata* (Lyngbye) Agardh. (Note: in pennate diatoms the porelli are usually arranged in longitudinal rows; in centric diatoms they are radial, concentric or irregular).
 - c. **Pseudonodulus:** a marginal to submarginal structure, always single, i.e. one per valve, sometimes **areolate** [*Actinocyclus normanii* (Greg.) Hust., Fig. 27], sometimes **operculate** (*A. octonarius* Ehrenb., Fig. 28), and sometimes **luminant** [*Roperia tessellata* (Roper) Grun., Fig. 29].
13. **Processes:** projections with homogeneously silicified walls. There are the following types:
- a. **Labiate process:** a tube or an opening through the valve wall with an internal flattened tube or longitudinal slit often surrounded by two lips. *Lauderia* Cleve, *Actinocyclus* Ehrenb. (Figs 30, 31).

Special types:

- i. **Bilabiate process***, in which there are two internal slit-like openings placed end to end. *Streptotheca tamesis* Shrebs. (see von Stosch 1977, tex-fig. 2).
 - ii. **Periplekton**, in which the external part is forked above, the two arms clasping the stem of the similar process on the adjacent valve. *Rutilaria radiata* Grove & Sturt (Fig. 32).
- It also appears that the raphe (see 14 below) is an evolutionary development of the labiate process.
- b. **Occluded process:** a hollow external tube occluded at one end. *Thalassiosira angstii* (Gran) Makarova (Fig. 33). (Note: a truly open tubulus has so far not been observed.)

- c. **Strutted process:** a tube through the valve surrounded by 2-5 chambers or pores (**satellite pores*** or **chambers**) through the valve wall separated internally by arched supports, often with threads of organic material extruded from the exterior part. *Thalassiosiraceae* (Fig. 34).
- d. **Spine:** a closed or solid structure projecting out from the surface of the frustule. *Thalassiosira eccentrica* (Ehrenb.) Cleve, *Corethron* Castr. (Figs 35, 36).
1. **Spinule:** very small spine.
 2. **Granule:** small rounded projection on the surface of the valve.
 3. **Linking spine:** interdigitating spine that connects frustules in chains. *Hemiaulus polycystinorum* Ehrenb. (Fig. 20).
14. **Raphe:** an elongated slit or pair of slits through the valve wall. When a pair of slits is present each individual slit is a **branch of the raphe***. In those diatoms where the raphe does not extend around the circumference of the valve, the structure between the two branches of the raphe is the **central nodule**; this is not always present, e.g. in Eunotiaceae. A central nodule that is expanded transapically and almost or quite reaches the margin of the valve is a **stauros**. Where this is deep and narrow, or where there is more than one deep and narrow extension of the central nodule reaching the valve margin, the stauros is **tigillate*** and each of the extensions is called a **tigillum*** [*Capartogramma crucicula* (Grun. ex Cleve) R. Ross; see Ross 1963 figs 8-11].
- a. **Central pore:** a pore-like expansion of the slit of a branch of the raphe adjacent to the central nodule.
 - b. **Central fissure***, **external*** or **internal***: continuations of the raphe slit onto or across the central nodule as fissures not penetrating through the valve.
 - c. **Cuniculus***: a structure consisting externally of a simple pore in the central area communicating with an elongate

raised area perforated by a slit that terminates the internal raphe fissure at the central area. *Navicula delognei* Van Heurck (see Cox 1978, figs 18-22).

- d. **Terminal fissure**: a continuation of the raphe slit at an apical end as a fissure not penetrating through the valve; normally there is only an external terminal fissure, which need not be designated as "external" except where there might be ambiguity.
- e. **Helictoglossa***: an inwardly projecting lipped structure terminating the raphe on the inner side of the valve. (This term replaces infundibulum, which is less appropriate and was earlier used for a quite different structure in *Surirella fastuosa* Ehrenb. and its allies.)
- f. **Terminal nodule**: a thickening of the basal siliceous layer at an end of a raphe, where it is a single slit, or at the apical end of a branch of the raphe. *Navicula bacillum* Ehrenb. (see Sims & Paddock 1979, fig. 43). (Note: a structure at the apical end of a raphe that is detectable as a thickening under the light microscope is often no more than a helictoglossa, but it should be called a terminal nodule unless there is positive evidence that it is a helictoglossa.)

The slit of the raphe can be **oblique***, but most frequently it is, for part or all of its length, **plicate***, i.e. in the shape of a V on its side (∧) in cross section. Where the slit, or the two fissures (see below), are only slightly oblique, the raphe is often termed "filiform" because of its appearance under the light microscope. In plicate raphes the two halves of the slit on either side of the bend are called the **inner fissure*** and the **outer fissure***. These terms are, however, also used for the course of the raphe slit along the inner and outer surface of the valve, and care needs to be taken to see that the context makes plain the sense in which they are used. The raphe in *Pinnularia* sect. *Complexae* is said to be complex. In *Pinnularia* each branch of the raphe is oblique close to the central and terminal nodules and plicate in its middle

part. In a complex raphe the outer fissure of the plicate part is distinctly oblique to the valve surface, whereas in those that are not regarded as complex the outer is approximately perpendicular to the valve surface.

In those cases where the raphe extends completely around the circumference of the valve, the structures between its two branches are **nodules***. These may differ and their differences should be noted.

- g. **Raphe canal***: a space on the inner side of the raphe cut off to a greater or lesser extent from the rest of the interior of the frustule. A diatom in which a raphe canal is present has been said to have a canal raphe.
 - h. **Fibula**: a bridge of silica between portions of the valve on either side of the raphe. In some cases fibulae are prolongations of a single interstria (see III.B.4) or the fused prolongations of two or more interstriae. Adjacent fibulae may be partially fused, and this can give rise to a plate-like structure with more or less elliptic holes between the raphe canal and the interior of the frustule.
 - j. **Interspace**: the space between two fibulae.
 - k. **Portula***: the opening through a constricted part of an interspace, or the inner or outer opening of an alar canal (see 7.a. above).
15. **Longitudinal canal***: a tube-like space within the substance of the valve extending for most of the length of the valve but often interrupted at the centre. *Diploneis*, *Neidium* (see Sims & Paddock 1979, figs 3, 24).
16. **Horseshoe-shaped area***: the hyaline area to one side or occasionally both sides of the central area with a margin thickened on the inner side of the valve, sometimes to such an extent as to produce a hooded structure, that is found in some species of *Achnanthes*, e.g. *Achnanthes lanceolata* (Bréb.) Grun. (see Helmcke et al. 1977, pl. 946, 947).
- B. **Girdle**: part of the frustule between epivalve and hypovalve, composed of epicingulum + hypocingulum (Fig. 10).

1. **Cingulum:** portion of girdle associated with a single valve (Fig. 10).
2. **Band** or **segment:** a single element of the girdle (Fig. 39).
 - a. **Intercalary band (copula):** element of cingulum proximal to valve, different in structure or form from distal elements. Special case: **valvocopula***, an element adjacent to the valve.
 - i. **Septum:** a sheet or ridge of silica in the valvar plane projecting from a girdle band into the interior of the frustule. *Tabellaria flocculosa* (Roth) Kütz. (see Hustedt 1931, fig. 558). A septum may have perforations through it. *Grammatophora hamulifera* Kütz. (see Hustedt 1931, fig. 566).
 - b. **Connecting band (pleura):** element of cingulum distal to copula(e), or any element when no intercalary bands are present.
3. **Suture:** junction between valve and cingulum or between elements of the cingulum.
4. a. **Partectal ring*:** the specialized intercalary band of *Mastogloia* bearing two or more partecta.
 - b. **Partectum*:** a single compartment in the specialized intercalary band of *Mastogloia*. This structure has formerly been called "chamber" or "loculus", but these terms are used for different structures.
 - c. **Partectal duct*:** a canal leading from a partectum to the outside of the frustule.
- C. **Craticula:** a structure of robust siliceous bars sometimes formed within the valve of some species of Pennales. *Navicula cuspidata* Kütz. (Fig. 40).

III. Fine Structure of the siliceous cell wall.

- A. **Basal siliceous layer:** the layer that forms the basic structure of the various components of the frustule (Figs 41, 42).

B. **Stria**: a row of areolae or alveoli (see C below), or a single alveolus where this is not part of a row.

1. Striae in centric diatoms are:

- a. **Radial***: when they run from the centre of the valve towards the margin. *Coscinodiscus nitidus* Greg. (Fig. 47Aa), *Coscinodiscus oculus-iridis* Ehrenb. (Fig. 47Ab). [Note: radial and radiate (see 2.b. below) should not be confused].
- b. **Fasciculate***: when they are grouped in bundles and are parallel to a radial stria, each bundle being a **fascicle**. *Coscinodiscus rothii* (Ehrenb.) Grun. (Fig. 47Ac), *Coscinodiscus curvatulus* Grun. (Fig. 47Ad).
- c. **Tangential***: when they are straight or curved non-radial rows. *Thalassiosira leptopus* (Grun.) Hasle & Fryxell (= *Coscinodiscus lineatus* Ehrenb., Fig. 47Ba), *Thalassiosira eccentrica* (Ehrenb.) Cleve (Fig. 47Bb).

2. Striae in pennate diatoms are:

- a. **Parallel***: when they are perpendicular to the median line of the valve or to the raphe. *Navicula plicata* Donkin (Fig. 48d), *Pleurosigma distinguendum* Hust. (Fig. 48h).
 - b. **Radiate***: when they are inclined from the valve margin towards the centre of the valve. *Pinnularia major* (Kütz.) Rabenh. - median part (Fig. 48e).
 - c. **Convergent***: when they are inclined from the valve margin towards the apex. *Pinnularia major* (Kütz.) Rabenh. - near apex (Fig. 48e).
3. **Voigt fault***: an irregularity in the arrangement of the striae on one side of and adjacent to the axial area, normally occurring in both halves of the valve on the same side of the axial area and at about the same distance from the centre (see Voigt 1956).
4. **Interstria***: the non-perforate strip of basal siliceous layer between two striae. In many pennate diatoms the striae are depressed into the basal siliceous layer on the inner

side of the valve, and occasionally on the outer side of the valve, and in such cases the interstriae have often been called costae (see II.A.8. above), but only those interstriae where the basal siliceous layer is thickened should be termed costae.

C. **Areola:** the regularly repeated perforation through the basal siliceous layer normally occluded by a velum (see D below) or a rica (see E below), or both. Small areolae are often termed puncta.

1. **Poroid areola** or **poroid:** an areola not markedly constricted at one surface of the valve. *Triceratium antediluvianum* (Ehrenb.) Grun. (Fig. 42).
2. **Loculate areola** or **loculus:** an areola markedly constricted at one surface of the valve and occluded by a velum or rica or both at the other; the passage through the constriction at the surface opposite the velum or rica is the **foramen**. *Coscinodiscus oculus-iridis* Ehrenb. (Fig. 43).

Two structures have the general form of loculi but are probably not homologous. These are:

3. **Pseudoloculus:** a chamber formed on the outer side of the basal siliceous layer by expansion of the distal parts of anastomosing or reticulate costae. *Triceratium favus* Ehrenb. (see Ross & Sims 1971, pl. 5, figs 4, 7), *Biddulphia reticulata* Roper (see Ross & Sims 1972, fig. 7).
4. **Alveolus:** an elongated chamber or one of a series of elongated chambers running from the axial or central part of the valve to the margin, opening to the inside of the frustule by a large opening and with an areolate outer layer. *Pinnularia viridis* (Nitzsch) Ehrenb. (see Schrader 1973, pl. 6, figs 5-7, 10), *Cyclotella* Kütz. (see Round 1970, figs 8E-H).

D. **Velum:** a thin perforate layer of silica across an areola, the perforations normally not less than 30 nm across and often not circular.

There are the following types:

1. **Cribrum:** a reticulate velum or one perforated by regularly arranged pores. *Triceratium antediluvianum* (Ehrenb.) Grun. (Fig. 44a).
 2. **Rota:** a velum consisting of a bar across an areola or a number of radial bars, in both cases with or without a widened area in the centre. *Triceratium shadboltianum* Grev. (Fig. 44b).
 3. **Vola:** one of the elements of a velum that consists of a number of separate elements projecting from the wall of an areola. *Arachnoidiscus ehrenbergii* Bail. (Fig. 44c).
- E. **Rica*:** a very thin perforate layer of silica, the perforations usually circular and not more than 15 nm in diameter, often decussately arranged. *Navicula delognei* Van Heurck (see Cox 1978, fig. 5), *Frustulia rhomboides* (Ehrenb.) De Toni (see Cox 1975, fig. 13), *Nitzschia palea* (Kütz.) W. Smith (see Lange-Bertalot & Simonsen 1978, fig. 297). [Note: as far as we are aware a rica has not been reported in any centric diatom, and we are uncertain whether or not the vela in these are homologous with ricae or with the coarser reticulate structures that occlude the areolae of, e.g., *Cocconeis scutellum* Ehrenb. (see Helmcke & Krieger 1953, pl. 48) and *Nitzschia amphibia* Grun. (see Lange-Bertalot & Simonsen 1978, fig. 295); these latter conform to our definition of velum and the perforations within them are occluded by ricae.]
- F. **Passage pore:** an opening connecting one loculate areola with another.
- G. **Bullula:** a bubble-like void in the basal siliceous layer amongst well separated areolae. *Aulacodiscus reticulatus* Pant. (Fig. 45).
- H. **Hypocaust:** a continuous space within the basal siliceous layer amongst well separated areolae with thin walls. *Actinocyclus octonarius* Ehrenb. (see Ross & Sims 1972, fig. 13).

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Additions to the Glossary

Terms included here are marked with asterisk in the text. All other terms may be found in the "Proposals for a Standardization of Diatom Terminology and Diagnoses" (Nova Hedwigia, Beiheft 53, 350-354, 1975). The Latin terms are given with endings for the nominative plural in parentheses and with their gender (m = masculine, f = feminine, n = neuter). The French terms were contributed by P. Compère, Meise.

<u>English</u>	<u>French</u>	<u>German</u>	<u>Latin</u>
alar canal	canal alaire	Flügelkanal	canalis (-es) alaris (-es) m
aperture	ouverture	Öffnung	apertura (-ae) f
axial costa	côte axiale	Axialrippe	costa (-ae) axialis (-es) f
bilabiate process	processus bilabié	bilabiater Fortsatz	rimoportula (-ae) bilabiata (-ae) f
branch of the raphe	branch du raphé	Raphenast	ramus (-i) raphis m
canopy	conopeum	Conopeum	conopeum (-ea) n
cell wall	paroi cellulaire	Zellwand	paries (-ietes) cellulæe m
central fissure	fissure centrale	Zentralspalte	fissura (-ae) centralis (-es) f
coating membrane	membrane enveloppante	Hüllmembran	membrana (-ae) tegens (-entes) f
convergent	convergent	konvergent	convergens
crest	crête	Kamm	crista (-ae) f
cuniculus	cuniculus	Cuniculus	cuniculus (-i) m
external	externe	Außen-	externus
fasciculate	fasciculé	gebündelt	fasciculatus
fenestra	fenêtre	Fenster	fenestra (-ae) f
fenestral bar	barre fenestrale	Fensterstrebe	barra (-ae) fenestralis (-es) f
helicloglossa	hélictoglosse	Heliktoglossa	helicloglossa (-ae) f
horseshoe-shaped area	aire en fer à cheval	hufeisenförmiger Fleck	area (-ae) hippocrepica (-ae) f
hyaline area	aire hyaline	hyaline Area	area (-ae) hyalina (-ae) f
inner fissure	fissure interne	Innenspalte	fissura (-ae) interior (-es) f

EnglishFrenchGermanLatin

internal	interne	Innen-	internus
interstria	interstrie	Interstria	interstria (-ae) f
longitudinal canal	canal longitudinal	Längskanal	canalis (-es) longitudinalis (-es) m
nodule	nodule	Knoten	nodulus (-i) m
oblique	oblique	schräg	obliquus
otarium	otarium	Otarium	otarium (-ia) n
outer fissure	fissure externe	Außenspalte	fissura (-ae) exterior (-es) f
parallel	parallèle	parallel	parallelus
partectal duct	canal partectal	Partektaldukt	ductus (-us) partectalis (-es) m
partectal ring	anneau partectal	Partektalring	annulus (-i) partectalis (-es) m
partectum	partectum	Partektum	partectum (-a) n
plicate	plissé	gefalzt	plicatus
portula	portule	Portula	portula (-ae) f
radial	radial	radial	radialis
radiate	radiant	radiat	radiatus
raphe canal	canal raphéen	Raphenkanal	canalis (-es) raphis m
resting spore	kyste	Dauerspore	cysta (-ae) f
rica	rica	Rica	rica (-ae) f
satellite pore	pore satellite	Satellitenpore	porus (-i) satelliticus (-i) m
tangential	tangential	tangential	tangentialis

<u>English</u>	<u>French</u>	<u>German</u>	<u>Latin</u>
terminal area	aire terminale	terminale Area	area (-ae) terminalis (-es) f
tigillate stauros	stauros tigillé	tigillater Stauros	stauros (-i) tigillatus (-i) m
tigillum	tigillum	Tigillum	tigillum (-a) n
valvocopula	valvocopula	Valvocopula	valvocopula (-ae) f
Voigt fault	défaut de Voigt	Voigtsche Diskordanz	inordinatio (-iones) Voigtii
wing	aile	Flügel	ala (-ae) f