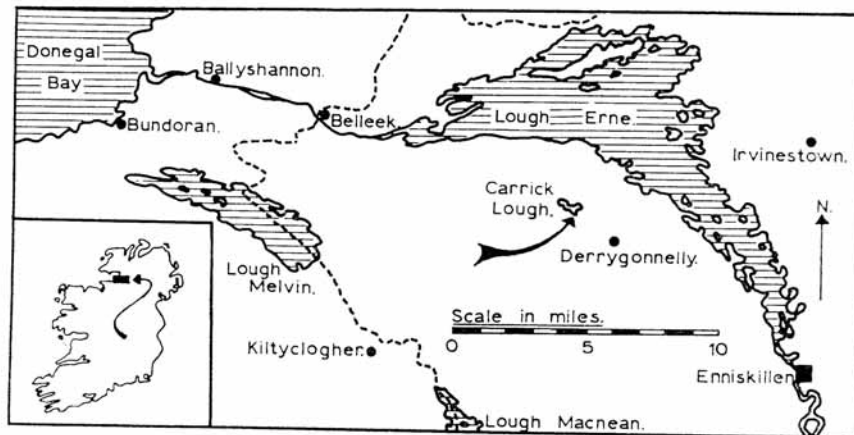


A NEW FENESTRATE BRYOZOAN FROM THE LOWER CARBONIFEROUS OF COUNTY FERMANAGH

by R. TAVENER-SMITH

ABSTRACT. Collections of bryozoa made recently in south Fermanagh include numbers of small but complete *Fenestella*-like colonies. These show considerable morphological variation, but careful examination indicates that they all belong to a single homogeneous population. The sample is described, and it is considered that the distinctive pattern of branching shown by the colonies and the presence in each of a strongly developed proximal spine places them in a new genus, for which the name *Ptilofenestella* is proposed.

A COLLECTION of bryozoa has been made from thin beds of muddy limestone on the south side of Carrick Lough (text-fig. 1), County Fermanagh, Northern Ireland. The



TEXT-FIG. 1. The geographical situation of Carrick Lough.

strata occur not far below the local top of the Carboniferous Limestone and are probably of D_1 age, corresponding stratigraphically with the lower part of the Dartry Limestone (Oswald 1955) of the Leitrim-Sligo area. They are highly fossiliferous, and because the original fossil material has been to some extent replaced by silica, treatment of blocks with dilute hydrochloric acid has yielded a considerable fauna. This is characterized by the presence of large numbers of finely preserved bryozoan fragments of varying size and shape. Brachiopods, lamellibranchs, gastropods, trilobites, and sponges are also present but constitute only minor elements of the fauna. Representatives of the first three groups are usually of small size, serving still further to emphasize the predominantly bryozoan nature of the assemblage. Among the bryozoa,

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fenestrate cryptostomes are most numerous and a preliminary examination of these showed the common presence of a distinctively shaped form that is the subject of this paper.

The colonies in question are quite small. Though varying considerably in size, they do not exceed a centimetre in length or 6 mm. in diameter. The zoarial shape is very characteristic, being hemispherical proximally but cylindrical distally, at which extremity it is open. The reticulate meshwork of branches and dissepiments forming the colonial skeleton thus presents the appearance of an elongate basket open at one end. The framework is strong, and this, coupled with its small size, probably accounts for the preservation of a large number of specimens.

Zoaria of this sort are associated in the collections with fenestellid fragments of many kinds, and it was at first thought that they represent the broken-off proximal extremities of larger funnel-shaped colonies of *Fenestella*. Closer examination showed that this is not so, because the ends of branches forming the zoarial baskets are usually not fractured, but are quite undamaged (Pl. 66, fig. 11). The specimens are therefore complete colonies, but the possibility remains that they are immature forms that were killed off at an early stage in development and segregated by current action. This is unlikely for several reasons. First, fossil material from the locality concerned is in general poorly sorted and shows no sign of having been carried far. Delicate structures like long, spiny outgrowths are commonly preserved without damage, for example. Again, if the basket-shaped colonies are all young forms the associated fauna would be expected to yield fragments with a comparable meshwork and appearance representing broken parts of larger, adult expansions. None satisfying this requirement was found in the course of examining more than 5,000 fenestellid fragments from the same locality and horizon. Finally, the arrangement of branches in the distal part of some of the longer zoaria suggests that these are in a late stage of development. A branch thus situated may in some cases be seen to terminate abruptly while the pair on either side of it grow more closely together beyond, so that the normal dissepimental length is soon re-established. When two or three branches fail in this way at several points round the periphery of the cylinder the diameter is reduced so that it begins to close in distally (Pl. 66, fig. 4). Branch failure of this kind, though by no means universal, is not uncommon among the larger specimens and similar occurrences in other stocks have been attributed by Elias and Condra (1957, p. 56) to a decline in the vigour of growth during the later, or gerontastic phase of colonial development. For these reasons it seems likely that the specimens are complete, fully developed zoaria which, by reason of their compact shape and structure, have been preserved without damage in considerable numbers.

EXAMINATION OF SPECIMENS

External features. Although all the colonies are basically alike in that they have a basket-like shape, they are quite variable in several respects, as even a cursory examination shows. The most obvious differences relate to the length of the basket (from 3 to 10 mm.), its diameter ($1\frac{1}{2}$ to 6 mm.), and the number of branches composing it (13–34). There is also considerable variation in the texture of the meshwork of branches and dissepiments forming the basket. Some colonies, not always the smallest, have a fine mesh in which the usual fenestrule size is about 0.22×0.57 mm., while in others, not always the largest,

the mesh is much coarser and fenestrules may be up to 0.44×0.88 mm. Less noticeable differences affect the spacing of zooecial apertures and carinal nodes, the size of apertures, and width of branches. In view of these differences an examination was carried out to determine the limits of morphological variation in the assemblage, and to ascertain whether more than one taxonomic group was represented.

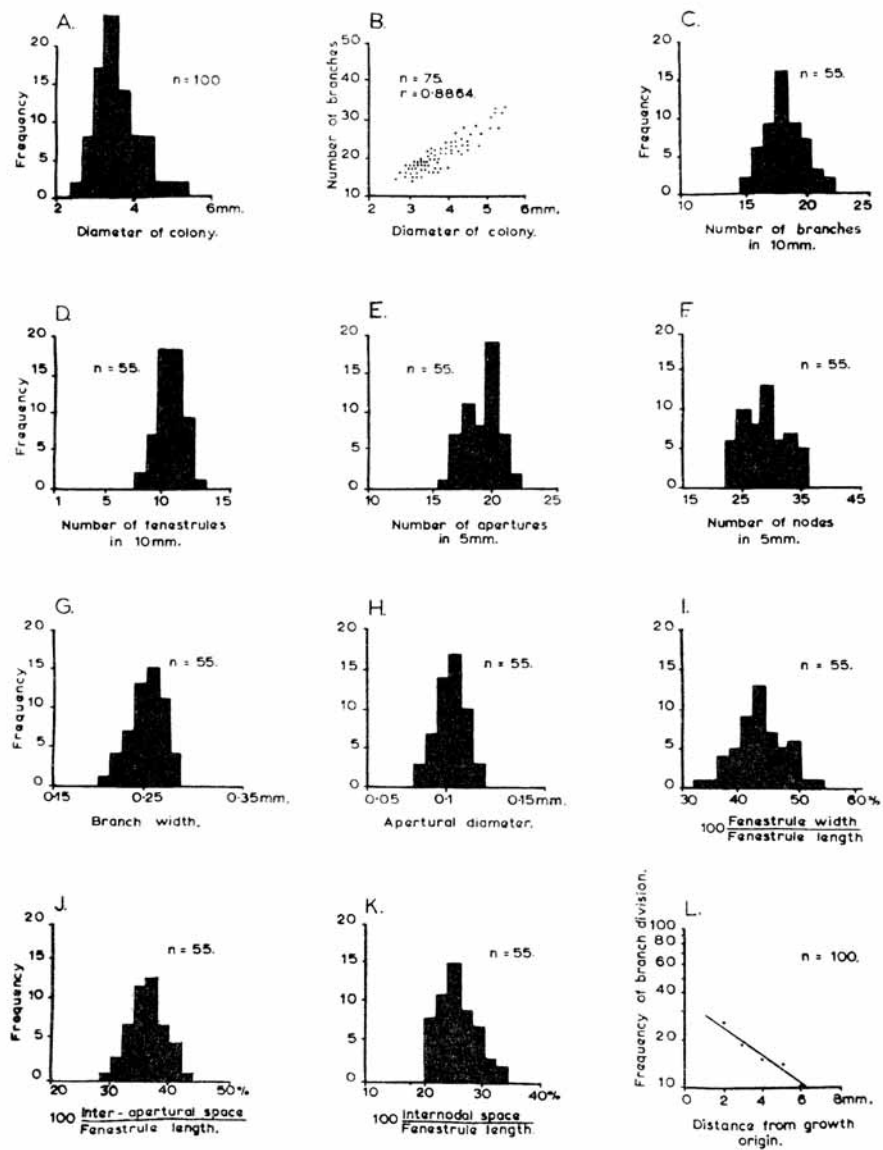
It seemed reasonable to examine at the outset the grosser differences of zoarial size and structure, with the exception of the length of colonies which is a function of age and therefore of no immediate interest. The range of zoarial diameter was determined by measuring this feature at a standard distance of 3 mm. from the growth origin (to eliminate possible effects due to age differences) in a hundred colonies chosen to be fairly representative of the collection. The resultant data were used to construct the histogram of text-fig. 2A. Next the diameter of seventy-five colonies was plotted against the number of branches composing them (text-fig. 2B), all readings being taken at the same distance from the proximal end as before. The two graphs demonstrate the existence of a continuous series in each case, and it is evident that differences in these respects noticed in the collection are those between end members of the series which, when viewed together, may differ considerably from one another. The second graph also shows that a fairly constant proportional relationship exists between the number of branches in a colony and its diameter. This explains why the meshwork of large and small colonies is often (though not always) of similar texture.

In order to examine the nature and extent of structural variability in greater detail a sample of fifty-five of the best preserved colonies was chosen so as to present as far as possible an adequate cross-section of the collection. Each of these was then measured for twelve variables, between ten and twenty readings being taken in every case, depending on the size and state of preservation of the specimen. Nearly 9,000 measurements were made, all being taken from the mature, cylindrical parts of zoaria, the short proximal ends being avoided because of the difficulty of making accurate measurements there due to the strong curvature of the meshwork. The dimensions recorded were as follows:

(a) Those regarded as standard in systematic work on fenestrate bryozoans, namely the number of branches in 10 mm. measured transversely to the branch axes; the number of fenestrules in the same distance measured parallel to the branch axes; the number of zooecial apertures in one row per 5 mm., and the number of carinal nodes, also in 5 mm. The procedure used in recording these data was that recommended by Condra and Elias (1944, pp. 54-57).

(b) In some circumstances continuous variables are more useful than discontinuous ones, and measurements were therefore made of fenestrule length, fenestrule width (each measured between the mid-points of opposite sides), inter-apertural distance, and internodal distance (the distance between adjacent centres in both cases—see text-fig. 3). These were the continuous variables most nearly equivalent to the discontinuous ones mentioned above.

(c) Branch width and apertural diameter. Measurements of the first were made at right angles to the branch axis midway along the length of a fenestrule, so as to obtain the normal width, unaffected by branch-dissepiment junctions or branch division. In these colonies there are no notable differences in branch width immediately before and after branch division, and so such measurements were not taken. In recording branch

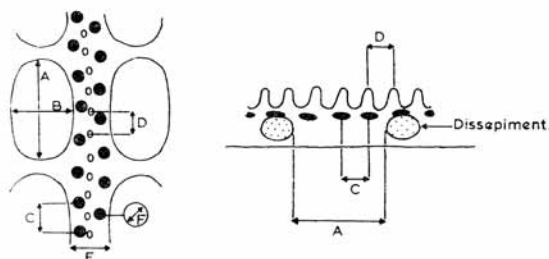


TEXT-FIG. 2. Graphs of structural data from the sample. A, distribution of the diameters of 100 colonies. B, a bivariate plot showing the relationship between zoarial diameter and number of branches in each of 75 colonies. C-F, distributions of the modal values of 55 colonies for each of the characters named. G-H, other distributions utilizing the mean values of the same number of colonies. I-K, percentage ratios between mean values of the features named in 55 zoaria. L, incidence of branch division in relation to distance from growth origin in 100 colonies.

width and apertural diameter care was taken to avoid parts of zoaria showing excessive secondary skeletal material, so that the effects of this complication should, as far as possible, be excluded from the data.

(d) The number of zooecial apertures per fenestrule was considered by Elias and Condra (1957, p. 63) to be of great taxonomic importance. This dimension was therefore recorded, and measurements were also made of the number of carinal nodes per fenestrule.

From these measurements histograms were constructed to illustrate the pattern of morphological variation. They were based on the central values (mean or mode, depending on whether a variable was continuous or not) of each of the zoaria in the sample.



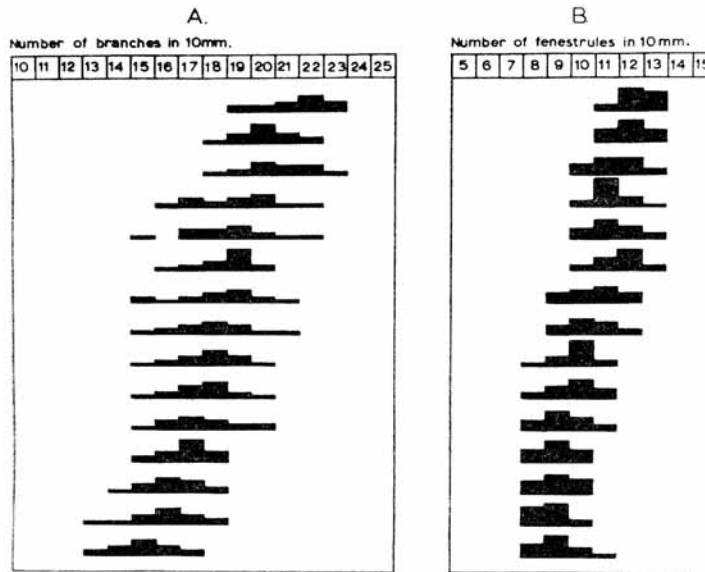
TEXT-FIG. 3. Method of making measurements. A, fenestrule length. B, fenestrule width. C, inter-apertural space. D, internodal space. E, branch width. F, apertural diameter.

These graphs (text-figs. 2C–H) show that for every feature considered the distribution of data is unimodal, with no marked bi- or polymodality such as would be expected if the sample was inhomogeneous in any respect. It is therefore clear that morphological differences between zoaria in these respects relate not to the presence of more than one taxon in the sample, but to the existence of a continuum of forms, the end members of which when seen together show distinct structural dissimilarities.

The histograms utilize only one value for each zoarium, however, and give no indication of the degree of intra-colonial variation that is present. In order to remedy this, and also to provide an idea of the amount of overlap between colonies, text-figs. 4A and B show the distribution of counts of the number of branches and fenestrules per 10 mm. in fifteen zoaria (listed in the same order in both diagrams) covering the range of variation observed in the sample. It is seen that there is substantial overlap between the ranges of different colonies, and the impression of continuous variation given by text-figs. 2C and D is reinforced. A similar pattern exists for each of the other variables examined.

A further suggestion implicit in text-fig. 4 is that a zoarium with many branches per 10 mm. also tends to have a high fenestrule count in that distance, and vice versa. In other words, there appears to be a correlation between these two variables that would seem likely to determine the texture of the meshwork, and hence the size of fenestrules. This possibility can be tested by plotting the mean width of fenestrules against their mean length in a number of zoaria. When this was done for the fifty-five colonies of the

sample it was found that the coefficient of correlation (r) was 0.6886, showing that a significant positive correlation does exist. This means that in spite of variation in the size of fenestrules from one colony to another (according to the texture of the meshwork) there is a definite tendency for their shape (i.e. the ratio between length and breadth in this case) to remain fairly constant. Nevertheless the correlation is not a particularly strong one, and room is left for a certain amount of fluctuation, as specimens in

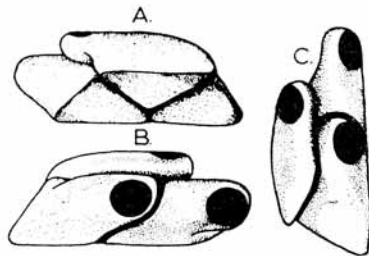


TEXT-FIG. 4. Graphs of the number of branches per 10 mm. (A), and of fenestrules per 10 mm. (B) in colonies chosen to illustrate the range of variation observed in the sample. Fifteen counts were made of each feature in every colony, and the order of arrangement is the same in both diagrams.

the collection show. This aspect of variation was explored by expressing the mean fenestrule width of each colony as a percentage of mean fenestrule length (thus giving a statistic for fenestrule shape) and arranging the resulting data in histogram form (text-fig. 2i). The distribution is seen to be a normal one with a well-developed mode reflecting the correlation between the two dimensions involved. In more than half the colonies average fenestrule width is between 40 and 45 per cent. of the length, while in only about one case in ten is it less than 35 per cent. or more than 50 per cent. It is again apparent that the observed differences do not indicate the existence of separate distinctive groups within the sample, but only of a continuous series, of which those colonies showing the greatest differences are the end members. The ratios inter-apertural space to fenestrule length (text-fig. 2j), and internodal space to fenestrule length (text-fig. 2k) were treated in the same way and the resultant graphs, which reflect the number of

zooeical apertures and carinal nodes per fenestrule, once more demonstrate the homogeneity of the data.

Internal structure. Following the work of Nekhoroshev (1932, pp. 35–41) and his colleagues in Russia it has been generally realized that internal features, particularly the shape of the zooeical chamber, are of taxonomic importance. Examination of these in colonies of the present assemblage is not easy, however, for the internal structure has in many cases been extensively destroyed during silicification. Another difficulty is due to the basket shape of the zoaria which makes it almost impossible to cut more than two branches lengthways in the same section. The branches are, in any case, quite short, so that even in the most favourable circumstances only a small number of chambers are seen. Twenty colonies were mounted in resin blocks and serially sectioned at intervals of 0.05 mm. Six showed well-preserved internal structures, a further eight showed vestigial structures on which some measurements could be made, and the rest were unproductive.



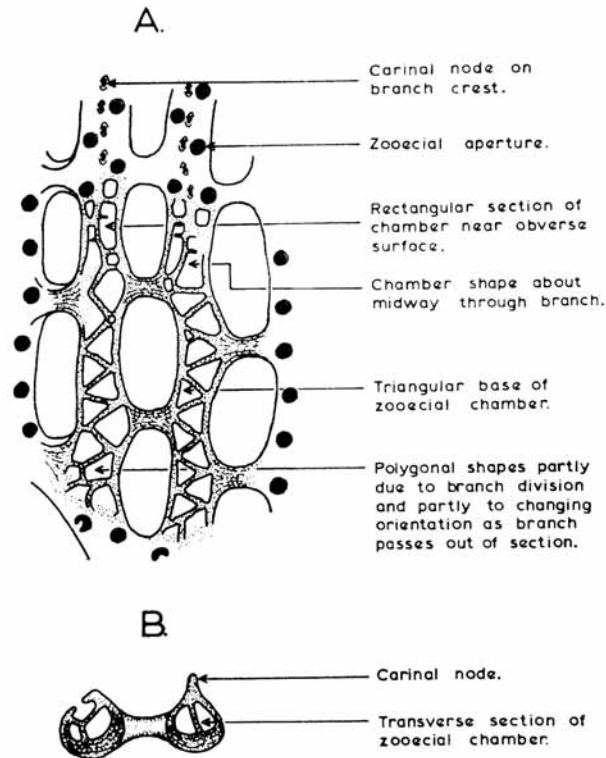
TEXT-FIG. 5. The shape of the zooeical chamber: drawings of a model based on serial sections. A, dorso-lateral view showing the triangular base-shape. B, ventro-lateral view. C, ventral view to illustrate the arrangement of chambers within a branch.

As is commonly the case in fenestellids, the plan of the zooeical chamber was found to differ according to the level at which the section was taken. This is because the chambers are not simple, box-like structures but have rather more complex shapes often bounded by curved surfaces (text-fig. 5). For this reason the plan of a chamber near the obverse surface of a branch approaches a rectangle, though in its lower part it is triangular (text-fig. 6A). The latter is the zooeical base shape that is often referred to in systematic descriptions and it is to this feature that the following discussion relates.

Although a triangular base shape is the commonest, colonies that were sectioned showed that there is some variation in this feature. Minor differences are apparent between neighbouring triangles along the same branch, certain of which may be slightly broader, narrower, higher, or lower than others (text-fig. 6A). Variation of this kind is ubiquitous, and appears to be random not systematic, no doubt reflecting the differing growth potential of individual zooids. More marked irregularities of chamber plan are commonly found where branch division takes place, probably due to the more complex budding pattern in such situations. Here chambers may have three, four, or five-sided base shapes, the decisive factor in the matter perhaps being the availability of space. A remark by Larwood (1962, p. 24) in connexion with the variation of zooeical shape in a group of Cretaceous cheilostomes seems relevant here. He says that '... if only a limited amount of space is available for development, a zooeicum tends to fill that space, and its shape is to some extent controlled by it'.

Measurements of zooeical base shapes showed the average length (i.e. the side parallel with the branch axis) to be 0.18 mm., and width (perpendicular to the branch axis) to be 0.17 mm. The extremes of variation recorded were represented by chambers that measured 0.26 mm. \times 0.15 mm., and 0.15 \times 0.19 mm., the last figure being the

width in each case. It is noteworthy that Larwood (though admittedly working on an entirely different group of bryozoa) does not consider the size of the chamber to be as important taxonomically as its shape. He states (1962, p. 24) that: 'For a given species there may be considerable differences in size between the zooecia of different zoaria.



TEXT-FIG. 6. Internal structure. A, tangential section of branches showing the plan of the zooecial chamber at different levels. B, transverse section of branches with a dissepiment.

Zooecial size, therefore, should seldom be used as a basis for differentiating species.' Perhaps similar views are held by the Russian workers, for although they have used zooecial shape for systematic purposes for many years, they rarely give the dimensions of these structures and as far as the author is aware, do not use zooecial size for discriminatory purposes.

The results of the morphological examination may be summarized as follows. Samples of 55-100 zoaria from a single locality and horizon in the Carboniferous Limestone have been measured for all features that are normally considered to be of taxonomic

importance. With respect to each it has been found that continuous variation exists in the sample. Homogeneous distributions of this kind are customarily taken to indicate the presence of a single species, and it is therefore concluded that the collection represents one stock in which, to judge by the dispersion of the data, there was a considerable degree of morphological variation.

An idea of the relative variability of the data for each of the main features measured may be gained by comparing their coefficients of variation $\left(\frac{100\sqrt{\text{variance}}}{\text{mean}}\right)$. These are given below, each figure being based directly on the mean or modal values of 55 colonies, and indirectly on between 550 and 775 measurements.

Branches per 10 mm.	9.57	Apertures per 5 mm.	7.13
Fenestrules per 100 mm.	8.87	Nodes per 5 mm.	12.08
Branch width	6.40	Apertural diameter	9.41

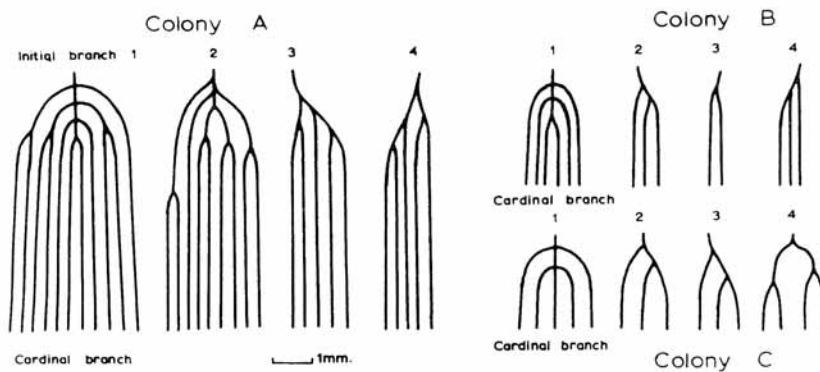
Variation is least marked in branch width and the spacing of zooecial apertures, and since these features bear a direct relationship to the shape and size of the chamber, it follows that these also will be relatively stable. On the other hand, the distribution of branches and fenestrules (the characters governing meshwork texture) and of carinal nodes is notably more variable, and it is possible for two colonies to differ considerably in these respects and yet belong to the same species. The figures therefore suggest that, because they show less fluctuation, data relating to the dimensions and spacing of zooecia might be more useful taxonomically than those concerned with the meshwork texture in the strict sense. With regard to the latter they also show that the number of fenestrules per 10 mm. is rather less variable than that of branches in the same distance, thus supporting the contention of Elias and Condra (1957, p. 63) on this point. The high coefficient of variation for the spacing of carinal nodes is noteworthy: this feature was consistently the least regularly distributed of all those measured on the sample.

MORPHOLOGICAL DESCRIPTION

The following description is based on an examination of more than two hundred colonies, each of which has the characteristic conico-cylindrical, basket-like shape. The dimensions of the baskets vary appreciably, some being long, narrow cylinders whereas others are shorter and relatively broader. While differences in length are largely a function of age, and therefore of only incidental interest, those of diameter are more important and are illustrated in text-fig. 2A. Although the number of branches in the cylindrical part of a colony is generally correlated quite highly with the diameter (text-fig. 2B), there is enough variation to permit observable differences of meshwork texture and fenestrule shape from one colony to another.

The characteristic shape of each zoarium results from the mode of growth of its branches, which is as follows. From the proximal extremity a small number of initial branches diverge. These are almost always four or five in number (conforming to the 'initial circle' of eight or ten zooecia in *Fenestella* described by Cumings 1904, p. 61) though rarely there may be three or six. They branch and dichotomize at close intervals, and the proliferation of branches on a radial pattern, coupled with the necessity for them to remain interconnected by relatively short dissepiments, induces the initially

hemispherical or conical shape of the zoarium. Once this has been attained the incidence of branch division falls sharply (text-fig. 2L) and the number of branches is virtually stabilized. They continue to grow in length, lying approximately parallel to one another, so that the distal part of the zoarium is cylindrical. Failure of branches during the later stages of growth may cause the diameter of the cylinder to decrease distally, as already mentioned. The number of branches composing the cylindrical part of the zoarium may be from ten to thirty-six, depending on the diameter of the basket and texture of the meshwork. A distinctive feature shown by all specimens is that one of the initial branches



TEXT-FIG. 7. The pattern of branching in three representative zoaria. Dissepiments are omitted for greater clarity. Initial branches are numbered in order of occurrence clockwise from the cardinal branch in each case.

always divides more vigorously than the rest, and gives rise to a correspondingly larger part of the meshwork. This strongly developed branch system always has a pinnate growth pattern and is invariably easy to distinguish from the others. It is as if a colony of *Ptylopora* had been incorporated into the meshwork of an otherwise orthodox funnel-shaped *Fenestella*. For this structure it is proposed to introduce the name cardinal branch. Text-fig. 7 illustrates diagrammatically the branching pattern of three representative colonies from the collection, and in each of them the position and importance of the cardinal branch is apparent.

Another feature that characterizes the assemblage is the presence in all colonies of a spinose process extending back from the proximal extremity (Plate 66, fig. 9). Generally this is broken off near the base, but it is sometimes complete and may measure up to 8.5 mm. long and 0.2 mm. in diameter. Occasionally such spines are seen to divide into two at some point along their length, but this is uncommon. Where it happens the subsidiary spine usually branches off at a wide angle, as if the division was the result of new growth following breakage of the original. Other spines, of comparable length or shorter, may originate at random from the obverse surface of the curved initial part of a zoarium. There may be three or four of these. It is proposed to refer to the spine originating at the proximal extremity as the proximal spine and the others as lateral spines.

The writer is in agreement with Likharev (1924, pp. 1019-21) in regarding these

structures as means of attachment and support, though the proximal spine differs greatly from the relatively stout basal 'holdfast' often seen in *Fenestella*. It seems improbable that these spines fulfilled their function by growing downwards into loose sediment of the sea-bed and thereby stabilizing the zoarial basket as it extended in the opposite direction. Had this been the case, the earliest zooids of the colony would have faced directly downwards into the substratum, an unlikely situation. A more acceptable explanation may be that the habit was pendant, and that the proximal spine provided an attachment from which the zoarium was suspended. It is possible that the colonies grew within the interstices of an open framework of accumulating debris on the sea-bed, and that the spines served as rigid anchoring processes to maintain them in position. Such an environment might also help to account for the small size of these colonies, and for the fact that they are often perfectly preserved, though associated with large amounts of broken fossil material.

The branches of which the zoarium is composed have their obverse (or celluliferous) surfaces on the exterior of the basket. This face of each branch is divided longitudinally by a median crest, on either side of which (text-fig. 6B) the surface slopes rather sharply away to the branch margin. Along the crest there is a single row of closely spaced carinal nodes which, although presenting a superficial appearance of uniformity, are seen on closer inspection to differ to some extent in shape and development. Some of them are relatively tall (up to 0.2 mm.) and slender (being more suitably described as spines than nodes) while others are only half as high but are wider at the base, with a broadly conical

EXPLANATION OF PLATE 66

Ptilofenestella carrickensis from the Carboniferous Limestone at Carrick Lough, Co. Fermanagh, Ireland. Registration numbers refer to the collections of the British Museum (Natural History), London, where the specimens are kept.

- Fig. 1. A small colony with well-preserved proximal and lateral attachment spines. The proximal spine is broken and a curved subsidiary has developed from the stump. PD 4484. Paratype. $\times 5.2$.
- Fig. 2. A colony of intermediate size showing prominent carinal nodes which are long and slender proximally, but less well-developed distally. PD 4479. Paratype. $\times 7.0$.
- Fig. 3. Lateral view of a zoarium to show the growth pattern of the cardinal branch. PD 4478. Paratype. $\times 6.8$.
- Fig. 4. The termination of several branches has resulted in a progressive decrease in diameter towards the distal end of this colony. PD 4480. Paratype. $\times 7.3$.
- Figs. 5-7. Proximal views of three colonies of different size and shape. The cardinal branch is towards the top of the page in each case. PD 4485-PD 4487. Paratypes. $\times 6.7$, $\times 6.7$, and $\times 7.2$ respectively.
- Fig. 8. Part of a large, open-textured colony showing the structural features in greater detail. PD 4474. Paratype. $\times 15.8$.
- Fig. 9. A small colony with large fenestrules, relatively thin branches and a slender proximal spine. PD 4476. Paratype. $\times 7.5$.
- Fig. 10. The unbroken tips of some branches are visible in this small zoarium which also has unusually long and slender carinal nodes in the proximal region. PD 4477. Paratype. $\times 8.0$.
- Fig. 11. An oblique view of the distal end of a zoarial basket showing the unbroken ends of the branches. PD 4481. Paratype. $\times 8.0$.
- Fig. 12. A large, many-branched colony with close meshwork. The rows of carinal nodes are easily seen. PD 4475. Paratype. $\times 5.2$.
- Fig. 13. A typical example of the most commonly occurring form in the collection. PD 4473. Holotype. $\times 8.0$.
- Fig. 14. The interior of a zoarial basket broken lengthways to show the spines on the reverse side of branches. PD 4482. Paratype. $\times 8.0$.

profile. These differences do not appear to follow a regular pattern and it is not uncommon to find taller and shorter nodes in juxtaposition. Nevertheless the taller kind are commoner in the proximal region while lower, wider ones predominate distally.

Zooecial apertures are situated in two longitudinal rows alternating with one another on either side of the median crest. They are circular and when well preserved are surrounded by low, thin, unornamented peristomes. The apertures do not overlap the branch margin and the latter, bordering the fenestrule, is therefore straight.

Zooecial chambers are located in two longitudinal rows within branches, corresponding to the arrangement of the apertures (each of which is at the distal end of its cell). Chambers are rather irregularly shaped (text-fig. 5), and appear rectangular in longitudinal sections near the obverse surface of a branch, but triangular in those near the base.

The reverse side of branches is invariably smooth and well-rounded, and a curious feature shown by some colonies (fifteen out of twenty-seven examined) is the sporadic presence of small nodes or spines on this surface. These are irregularly developed even in a single zoarium, being more numerous on some branches than others. They often occur singly in the middle of a branch opposite the junction with a dissepiment, but may also be present between such positions. These protruberances vary in size and shape: they may approximate in these respects to carinal nodes, or be so small as to be hardly visible. They are usually confined to the proximal part of a colony and are rarely seen in the cylindrical region.

Branch division occurs most commonly in the proximal part of a zoarium (text-fig. 2L), and is not attended by any notable preliminary increase in branch width or by the appearance of an incipient third row of zooecia, as has been reported in some species of *Fenestella*. Dissepiments vary in length from one colony to another according to the spacing of branches. Fenestrules are rectangular or oblong-oval in shape, depending on the amount of flare at each end of a dissepiment. The spacing of apertures does not bear a simple relationship to that of the dissepiments (i.e. they are not 'stabilized' in the sense of Elias and Condra, 1957), and the dissepiments are depressed below the branch surface on both sides, though to a slightly greater extent on the obverse (text-fig. 6B).

The micrometric formula of this species, constructed in the orthodox manner (Miller 1961, p. 222) is 13-23/8-13//17-24/21-38. The additional figures given below relate to the distribution of the modal values of fifty-five zoaria for the named variables. They could be used as a basis for biometrical comparisons utilizing the χ^2 test or a comparable technique. Each mode is based on fifteen measurements.

1. Number of branches in 10 mm.	15	16	17	18	19	20	21	22
Frequency in sample	2	6	9	16	9	7	3	2
2. Number of fenestrules in 10 mm.	8	9	10	11	12		13	
Frequency in sample	2	7	18	18	9		1	
3. Number of apertures in 5 mm.	16	17	18	19	20		21	22
Frequency in sample	1	7	11	8	19		7	2
4. Number of carinal nodes in 5 mm.	22-23	24-25	26-27	28-29	30-31		32-33	34-35
Frequency in sample	6	10	8	13	6		7	5
5. Number of apertures per fenestrule	2	3						
Frequency in sample	31	24						

Further quantitative data are as follows (in every case the mean value for fifty-five specimens is followed by the variance in parenthesis):

<i>Fenestrule length</i>	0.072 (0.223) mm.	<i>Internodal space</i>	0.18 (0.020) mm.
<i>Fenestrule width</i>	0.030 (0.065) mm.	<i>Branch width</i>	0.24 (0.009) mm.
<i>Inter-apertural space</i>	0.025 (0.011) mm.	<i>Apertural diameter</i>	0.10 (0.004) mm.

DISCUSSION

Colonies of the Fermanagh sample exhibit most of the characters of *Fenestella*, to which genus they were at first thought to belong. They also have other features which render their inclusion in that genus difficult. The first of these is the universal presence of the cardinal branch, a structure without parallel in *Fenestella*. A somewhat similar branch arrangement occurs in *Ptiloporella* Hall, but in that genus the pinnate pattern of growth recurs many times in a zoarium, whereas in colonies of the present assemblage it is restricted to one of the initial branches only, the others showing the usual pattern seen in *Fenestella*. Furthermore, except near the growth origin, the cardinal branch is no thicker than the subsidiaries to which it gives rise; traced into the cylindrical part of a zoarium it soon loses its identity and cannot be distinguished from any other branch (text-fig. 7). This is not so in *Ptiloporella*, where the thicker primary and thinner secondary branches remain quite distinct throughout their length (Hall 1885, p. 36).

Another unusual feature of the present collection is the development of a strong, backwardly directed proximal spine in each colony. This is often accompanied by others of a similar nature arising from the obverse surface of the curved part of the zoarium. The latter have counterparts in *Fenestella*, but the proximal spine has none, and is in marked contrast to the stout, encrusting 'holdfast' that is generally seen when the basal part of a colony of that genus is preserved.

In view of these distinctive structures it is considered better to erect a new genus for the reception of the Fermanagh specimens, than to include them in one of the existing genera. Because the distinctive branch arrangement shown by the sample has features in common with that of *Ptylopora* M'Coy, *Ptiloporella* Hall, and *Fenestella* Lonsdale, the name *Ptilofenestella* seems appropriate for the new genus.

Order CRYPTOSTOMATA Shrubsole and Vine 1882

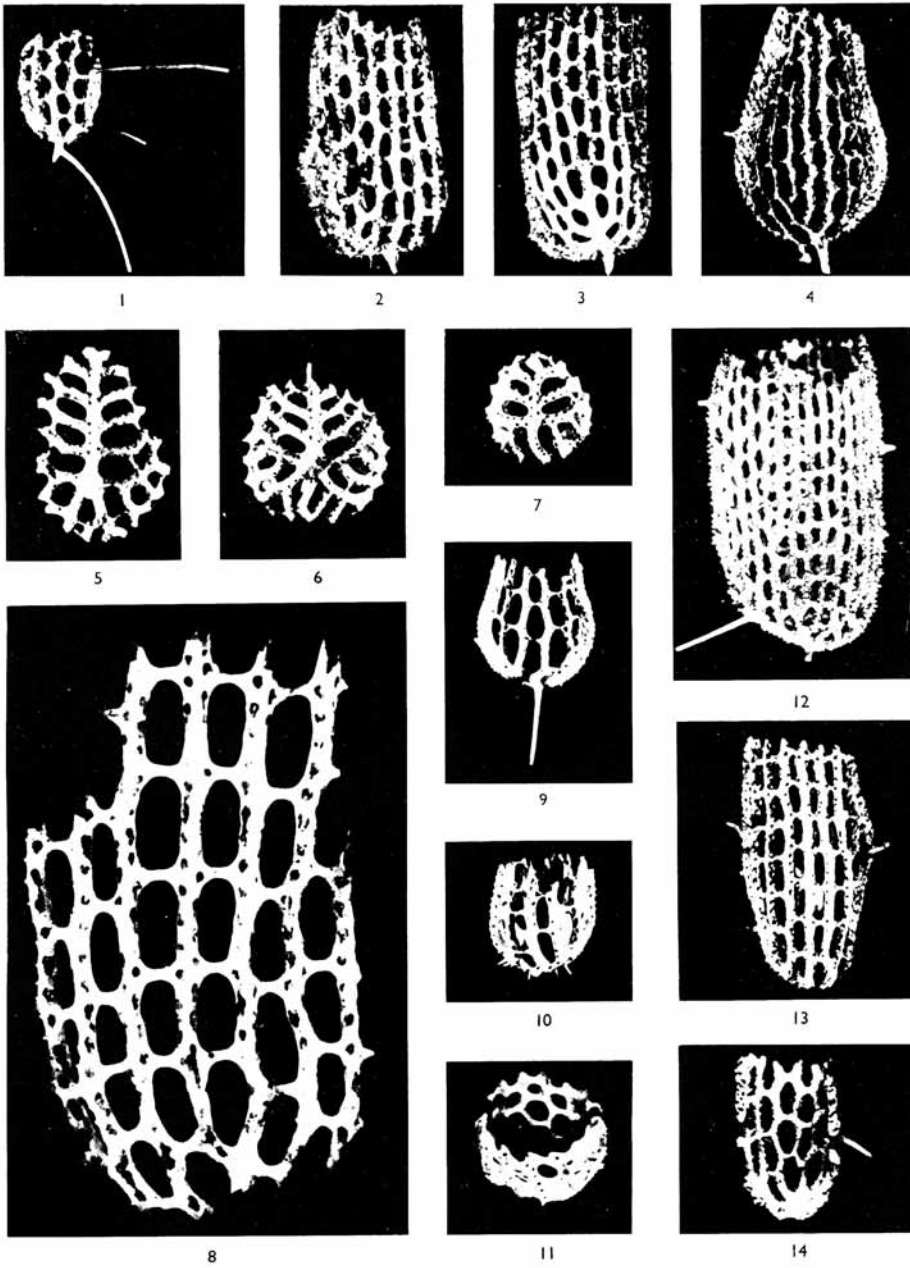
Family FENESTELLIDAE King 1850

Genus PTILOFENESTELLA gen. nov.

Diagnosis. Funnel or basket-shaped zoarium consisting of a meshwork structurally similar to that of *Fenestella* but with a cardinal branch. This has a pinnate growth pattern and gives rise to a considerably larger part of the zoarial expanse than any of the other initial branches. There is also a well-developed proximal spine that appears to have served as an attachment structure for the colony.

Type species. *Ptilofenestella carrickensis* sp. nov.

Horizon and locality. Viséan limestone, probably of D₁ age, south side of Carrick Lough near Derrygonnelly, Fermanagh, Ireland.



TAVENER-SMITH, *Ptilofenestella*