and these *must* be useful. As this applies also to every species in the direct line of descent, the characters which are sectional or generic must also, at the time of their origin, have been useful.

In the second place, although non-utilitarian characters do undoubtedly appear in the normal course of variation, no agency has yet been detected adequate to the extension of these useless peculiarities to all the individuals which constitute a species, and, further, to prevent their extension to any of the varieties which are destined to become new species. Unless the power in question can have this twofold effect it cannot lead, except by accident, to the production of useless specific characters.

Under conceivable conditions, however, it is possible that certain useless characteristics may become limited to the individuals of a single species. But what we know of the modes of variation and the distribution of varieties indicates that, if at any time so produced, they must be altogether exceptional and of the nature of chance products; and that they cannot possibly constitute such a general characteristic of species as has been suggested.

Our final conclusion is that, whether we can discover their use or no, there is an overwhelming probability in favour of the statement that every truly *specific* character is or has been useful, or, if not itself useful, is strictly correlated with such a character.

On the Fistulose *Polymorphinæ*, and on the Genus *Ramulina*.

By T. Rupert Jones, F.R.S., and F. Chapman, A.L.S., F.R.M.S.

[Read 16th January, 1896.]

Part I.

The Fistulose Polymorphinæ.

It having been suggested that the several specimens referred to the genus *Ramulina*, Rupert Jones, may possibly belong to fistulose *Polymorphinæ*,* this memoir has been undertaken to show what evidence there is for or against the suggestion.

With this object in view, it is necessary for us to define the special *Polymorphinæ* which bear extraneous growths of fistulose form. Therefore, in the first place, we propose to take a survey of the known fistulose, tubulose, and racemose *Polymorphinæ*.

* F. B. Balkwill and F. W. Millett.—"The Foraminifera of Galway. Journ. Microsc. Nat. Sci., vol. iii. 1884, p. 33.

These admit of being grouped as follow:—

I. *Apical.*—Those which have the exogenous shell-growth confined to the apical or oral extremity of the shell (apical): and of this kind there are five recognizable varieties, namely,—

1. *Single crest.* A simple comb or crest with marginal tubes.
2. *Circular and flat.* A flat circular top with marginal tubes.
3. *Radiate cushion.* Tubes radiating from a cushion-like mass.
4. *Radiate cluster.* Radiate or subradiate cluster of tubes.
5. *Racemose.* An irregular fistulose mass.

II. *Subapical.*—Those in which the fistulose outgrowths are confined to the region just below the apertural apex.

III. *On the general surface.*—Those which have either tubes or irregular fistulose patches scattered on the general surface.

IV. *Marginal.*—Those in which the extra shell-matter is arranged as a thin outstanding flange or wing on the margin.—Most of these last were perhaps parasitic, attached to some object.

V. *Mixed.*—There are many specimens which combine more or less of the foregoing kinds of outgrowths,—thus apical, subapical, on the general surface, and on the sides or the margin; and therefore they cannot stand as specially separate varieties.

I, 1–5.—The first four groups of the *apical* growths seem to keep tolerably separate from the others in being confined to the apical region, and do not occur in the *mixed* forms; but the *racemose* style of outgrowth is variously modified in the general-surface, marginal, and mixed groups.

II. *Subapical growths.*—The examples of the subapical or cervical arrangement of tubules or fistulæ are not common as a distinct group. They consist in one case (39*) of coarse tubes

* These numbers refer to the detailed catalogue at pp. 508–516.

(broken) far apart and irregular. In another (40) two circles of small holes and one broken tube remain in evidence.

Amongst examples in which the style of outgrowth is mixed, one (62) has a single circle of subapical holes (equivalent to lost tubules), but these are associated with scattered and exogenous patches, and sinuous rows of holes disposed over the general surface. The bases of some strong cervical tubes exist in another (60), together with an apical growth. These specimens indicate the existence of the *subapical* kind of growth; but show also that it becomes mixed with other conditions.

III. *Fistulose growths on the general surface; variable in extent.*—The outgrowth in some examples (42) is very redundant and somewhat obscures the form of the initial Polymorphine series. The specimen 43 is a good example of tubular fistulose outgrowths disposed over the general surface and with some apical tubes more limited in extent. In another form (46) the outgrowths have a tendency to become lateral and are more or less flattened. Short thick tubules, not at all confluent at their bases, scattered over all the surface, in 47, characterize apparently a distinct variety.

IV. *Marginal outgrowths.*—The simplest example of marginal growth is 48, showing a double series of perforations along one edge and the base of the shell, whence doubtlessly outgrowth had, as it were, taken root, the sarcode having been extruded through the shell to form calcified processes. The exact condition of this fistulose growth is indeterminable.

A good marginal growth, chiefly at the oral end, on one side, and at the base, in 49, has a somewhat racemose edge; and 58 has a more continuous and more racemose marginal expansion. Still more freely branching is the marginal investment of 53.

A simple marginal wing, nearly flat or merely undulose, belongs to the *attached* form, *Polymorphina concava*, Williamson, 54. A similar form is 56, but the flange shows indications of the septation of the shell being continued in it; and the edge in this instance is more or less dentate.

In the coarsely tubulated marginal outgrowth of 57 (unfortunately broken), we have a somewhat different condition of this kind of growth, less confluent than in others.

In 5 the marginal growth, being only at the oral end of the shell, presents, though it is strongly dentate, an analogy to the crest-like apical growth ("*damæcornis*") of 4, and is here grouped with it.

V. *Mixed growths.*— A flatly racemose marginal outgrowth is associated with the *apical* in 67; also with the *apical* (broken) in 68; and with both *apical* and *subapical* growths in 69: therefore it cannot be regarded as a peculiar or special condition.

So also the mixed conditions of apical with subapical, or with scattered patches and tubules, cannot be set apart; for the *racemose-apical* falls in with some of the other modifications, as 61, 62, 63, 66—see the list of forms.

The frequent occurrence of apical extrusions, and the probability of the marginal and other superficial exogenous growths having started from the aperture of the apex and stretched downwards (backwards), shows at least that only adult individuals produced them; and probably the perforations left after excrescences have been removed were due to absorption of the intervening shell-wall (as suggested by T. Alcock), so as to allow of direct communication of the inner and outer sarcode *.

We cannot entertain the notion formerly advanced by M. O. Terquem, that any of these outer growths may be due to parasitical Polyzoa allied to *Cellepora* †; for we regard them as a permanent calcareous tubing of the chief pseudopodia.

In none of the foregoing Fistulose *Polymorphinæ* do we find tubes and tubules exactly corresponding with the tubular structures that have been referred to *Ramulina*.

A Polymorphine form figured by Beissel, and much like our "*diffusa*," shows a peculiar structure, such as we find in *Ramulina*‡. Hence we think it best to take this internal structure,

* T. Alcock.—"On *Polymorphina tubulosa*." Proc. Lit. Phil. Soc. Manchester, vol. vi. 1867, pp. 85–90.

† O. Terquem.—"Les Foraminifères du Pliocène supérieur de l'Isle de Rhodes." Mém. Soc. Géol. France, sér. 3, vol. i. 1878, no. 3, pp. 1–133.

‡ T. Beissel and E. Holzapfel.—"Die Foraminiferen der Aachener Kreide." Abhandl. Königl. Preuss. geol. Landesanstalt, neue Folge, Heft 3, 1891, p. 59, pl. xii. figs. 9–16.

instead of the outer aspect, as a guide in determining the systematic relationship of this form.

The aulostomate or exogenous growth in the Foraminifera is not confined to the genus *Polymorphina*, as will be seen on referring to the figures of the interesting examples of *Cristellaria crepidula* and *C. calcar* [var.], given by Dr. Goës in his work on the Foraminifera of the Caribbean Sea*. Here we see the terminal growth and stag-horn condition of the aperture well marked; the last chamber having given off tubular sheaths for a few large pseudopodia.

The following is, so far as we are aware, a complete list of the known forms of fistulose *Polymorphinæ*. They are grouped according to their mutual relationships, with reference to their zoological type-forms, and accompanied with concise notes on the characters of the outgrowths. Thus adding to our knowledge of the genus, this (first) part of our paper may be regarded as supplemental to the Monograph of *Polymorphina* by Messrs. Brady, Parker, and Jones, in the Transactions of the Linnean Society, vol. xxvii. 1870 †.

* A. Goës.—"On the Reticularian Rhizopoda of the Caribbean Sea." Kongl. Svenska Vetenskaps-Akad. Handlingar, vol. xix. 1882, no. 4, pp. 43 and 49, pl. iii. figs. 40, 52.

† The history and affinities of this genus are fully treated of in the Monograph referred to; but the critical examination of the Foraminifera depicted in Ehrenberg's 'Mikrogeologie' not having been completed when that Monograph was published in 1870, several inaccuracies were introduced; and certain errors should be corrected according to Parker and Jones's critical determinations given in the 'Annals and Magazine of Natural History,' ser. 4, vol. ix. 1872, pp. 211–230, 280–303; vol. x. 1872, pp. 184–200, 253–271, 453–457.

Thus at page 213 delete *Strophoconus ovum*, *spicula*, and [*Grammostomum*] *laxus*; at p. 219, *Strophoconus stiliger* and *acanthopus*; at p. 220, *Grammostomum turio*; at p. 223, *Strophoconus Hemprichii*; at p. 224, *Sphæroidina Parisiensis*; at p. 227, the 1st, 2nd, 3rd, 5th, 6th, 8th to the 16th, and the 19th of Ehrenberg's species; and add *Loxostomum vorax*, pl. xxviii. fig. 24; at p. 232 delete *Polymorphina asparagus* and *turio*, *Sagrina longirostris*, and *Vaginulina obscura*; at p. 233, *Vaginulina paradoxa*; at p. 234, *Polymorphina nucleus*; at p. 238, *Grammostomum costulatum*; at p. 242 add, under *Globulina tuberculata*, *Proroporus verrucosus*, pl. xxix. fig. 19.

Classification of the Fistulose Polymorphinæ.

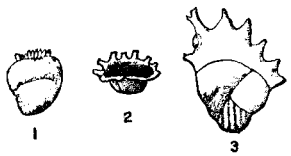
SERIES I.—APICAL OUTGROWTHS.

Figs. 1–23.

Group No. 1.—Apical Crests.

[N.B.—*Surface of outgrowth is smooth unless otherwise stated.*]

Proposed varietal *names* *.	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
1. Var. *damæcornis*, Reuss. Figs. 1–3.	*a.* Simple crest over apical (oral) part of test.	1, *2*, and 3.
	[Those marked thus *2* are figured here.]	
	b. Crest or comb on the apex, with marginal tubules (unequal); and with inferior flange-like series in one instance.	*4* and *5*.
	c. An irregular crest, terminating in somewhat lengthened tubules.	6.

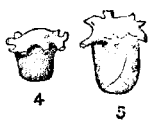


Var. DAMÆCORNIS, *Reuss*.

Fig. 1. *Polymorphina gibba* (d'Orb.). [*Globulina transversa*, Terquem, 1882.]
„ 2. *P. trigonula* (Reuss). [*Polymorphina* (*Guttulina*) *damæcornis*, Reuss, 1845.]
„ 3. *P. regina*, Brady, Parker, and Jones. [*Polymorphina regina*, fistulose form, Wright, 1886.]

Group No. 2.—Apical Crowns.

2. Var. *coronula*, nov. Figs. 4, 5.	*a.* Flat circular top, with marginal tubules, horizontal and equal.	*7* and *8*.



Var. CORONULA, nov.

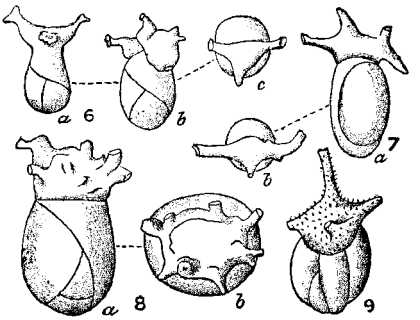
Fig. 4. *P. gibba*, d'Orb. [*Polymorphina damæcornis*, Wright, 1875.]
5. *P. gibba*, d'Orb. Chapman Coll.

* For the application of these varietal names, see further on, p. 516.

GROUP No. 3.

APICAL CUSHIONED OUTGROWTHS.

Proposed varietal *names.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
3. Var. *acuplacenta*, nov. Figs. 6–9.	*a.* A more or less distinctly cushioned and sessile mass, giving off radial tubules.	9, 10, 11, *12*, and *13*.
	b. Similar, with the test and outgrowth prickly.	*14*.
	c. Similar, with the surface of only the outgrowth prickly.	15.



VAR. ACUPLACENTA, NOV.

Figs. 6 *a*, *b*, *c*. *P. gibba*, d'Orb. *a* and *b*, lateral aspects; *c*, oral aspect. [*Globulina gibba*, Terquem, 1878.]

„ 7 *a*, *b*. *P. gibba*, d'Orb. *a*, lateral aspect; *b*, oral aspect. [*Guttulina gravida*, Terquem, 1878.]

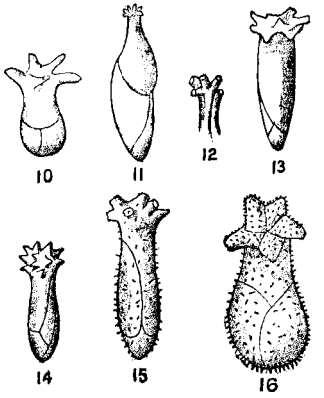
„ 8 *a*, *b*. *P. gutta*, d'Orb. *a*, lateral aspect; *b*, oral aspect. [*Polymorphina Roemeri*, Reuss (*P. diluta*, Bornemann), 1870.]

„ 9. *P. communis*, d'Orb. [*Polymorphina lactea* (fistulose form), Brady, 1884.]

GROUP No. 4.

APICAL CLUSTER OF TUBES.

4. Var. *horrida*, Reuss. Figs. 10–16.	*a.* Low radiate cluster of tubules.	16, *17*, 18, *19*, 20, *21*, 22, and 23.
	b. Irregular subradiate cluster of tubules.	*24*.
	c. Similar, with surfaces of test and outgrowth prickly.	*25* and *26*.

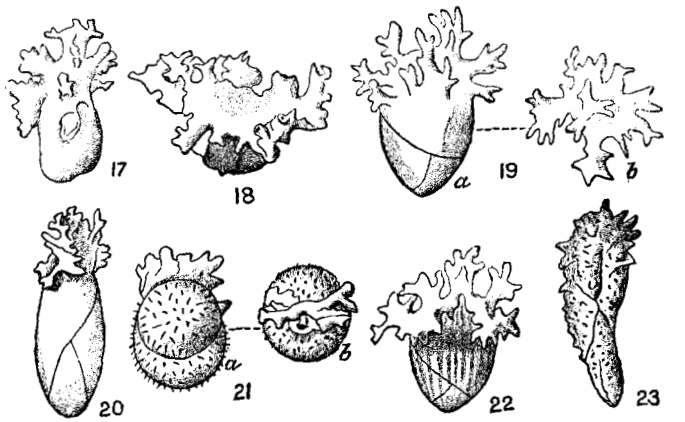


Var. HORRIDA, *Reuss.*

Fig. 10. *P. gutta*, d'Orbigny. [*Globulina horrida*, Reuss, 1845.]
,, 11, 12. *P. fusiformis*, Roemer. Fig. 12=fistulose extremity more highly magnified. [*Polymorphina lanceolata*, Reuss, 1870.]
,, 13. *P. fusiformis*, Roemer. [*Polymorphina prisca*, Berthelin, 1880.]
,, 14. *P. fusiformis*, Roemer. [*Polymorphina horrida*, Wright, 1875.]
,, 15. *P. fusiformis*, Roemer. (A hirsute subvariety.) [*Polymorphina fusiformis*, fistulose var., Chapman, 1896.]
,, 16. *P. hirsuta*, d'Orbigny. [*Globulina horrida*, Reuss, 1850.]

GROUP No. 5.—APICAL RACEMES.

Proposed varietal *name.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
5. Var. *racemosa*, nov. Figs. 17–23.	*a.* Group of separate tubules slightly branching (broken) around apex.	27.
	b. Branching (racemose) group, sessile; not cushioned.	*28*, *29*, 30, *31*.
	c. Rough mass with short irregular tubules,—low racemose.	*32*.
	d. Low racemose tubules, smooth, but with prickly initial series.	*33*.
	Regularly racemose outgrowth, with initial test finely striate.	*34*.
	Fistulæ scattered over apical region ...	*35*.



Var. RACEMOSA, nov.

Fig. 17. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

„ 18. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

„ 19 *a*, *b*. Near *P. lactea* (Walker and Jacob). *a*, lateral aspect; *b*, oral aspect. [*Globulina oviformis*, Searles Wood, MS., about 1846.]

„ 20. *P. lactea* (Walker and Jacob). [*Polymorphina prælonga*, Terquem, 1878.]

„ 21 *a*, *b*. *P. hirsuta*, Reuss. *a*, lateral aspect; *b*, oral aspect. [*Polymorphina hirsuta*, Reuss, 1870.]

„ 22. *P. virgata* (Searles Wood, MS.) [*Globulina virgata*, Searles Wood, MS., about 1846.]

„ 23. *P. fusiformis*, Roemer.

FRAGMENTS OF APICAL OUTGROWTHS.

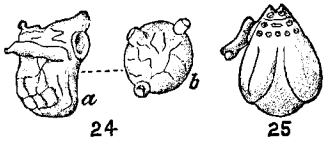
	Salient characters of Outgrowths.	*Nos. in detailed list*, pp. 508–516.
*a**.	Fragment of smooth bifid tubule, branching at the ends.	36.
*b**.	Fragment of smooth bifid tubule	37.

SERIES II.

GROUP No. 6.—SUBAPICAL OUTGROWTHS.

Figs. 24, 25.

Proposed varietal *names.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
Var. *circularis*, nov. Figs. 24, 25.	*a.* Tubules apart	38 and *39*.
	b. Tubules in two circles	*40*.



Var. CIRCULARIS, nov.

Fig. 24 *a*, *b*. Near *P. gibba*, d'Orbigny. With wrinked surface. ["Testa incertæ sedis," Terquem, 1878.] *a*, lateral aspect; *b*, oral aspect.

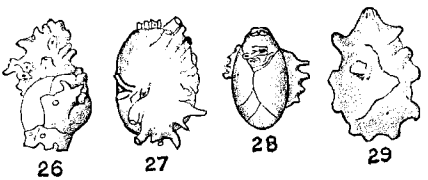
,, 25. *P. problema*, d'Orbigny. [*Guttulina racemosa*, Terquem, 1878.]

SERIES III.

GROUP No. 7.—OUTGROWTHS ON THE GENERAL SURFACE.

Figs. 26–29.

Var. *diffusa*, nov. Figs. 26–29.	*a.* Irregular tubules, lumpy and short.	41 and *42*.
	b. Short irregular tubules, of various sizes, some broken.	*43*.
	c. Irregular patches.....	44, 45, and *46*.
	d. Short fistulæ, regularly scattered	*47*.



Var. DIFFUSA, nov.

Fig. 26. *P. gibba*, d'Orbigny. [*Polymorphina tubulosa*, Jones, Parker, and Brady, 1866.]

,, 27. *P. rotundata* (Bornemann). [*Globulina oviformis*, Terquem, 1878.]

,, 28. *P. lactea* (Walker and Jacob). [*Polymorphina solidula*, Terquem, 1878.]

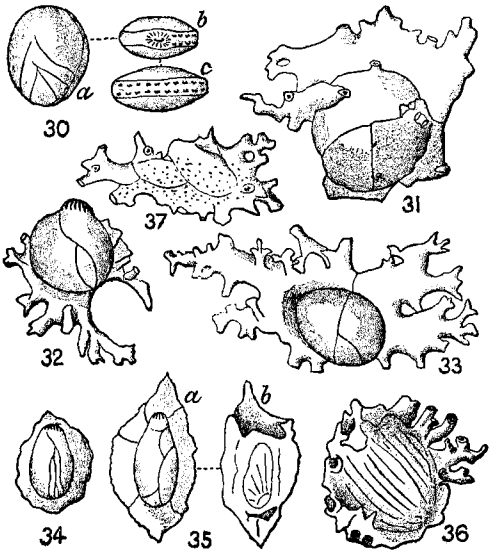
,, 29. *P. gutta*, d'Orbigny. [*Polymorphina gutta*, fistulose var., Chapman, 1896.]

SERIES IV.

Group No. 8.—Marginal Outgrowths.

Figs. 30–37.

Proposed varietal *name.*	*Salient characters of Outgrowths.*	*Nos. in detailed list,* pp. 508–516.
Var. *marginalis*, nov. Figs. 30–37.	*a.* Marginal (broken); no apical outgrowth.	*48.*
	b. Marginal, modified, racemose, chiefly at the oral end.	*49.*
	c. Marginal, chiefly at the aboral end ...	*50.*
	d. Marginal, lateral, and at the aboral end.	51.
	e. Marginal, more or less complete	52 and *53.*
	f. Marginal, attached, plate non-septate.	*54* and 55.
	g. Marginal, attached, plate septate	*56.*
	h. Marginal, striate surface to initial test and outgrowth smooth (? attached).	*57.*
	i. Marginal, racemose edges, aculeate (? attached).	*58.*



Var. MARGINALIS, nov.

Fig. 30 *a*, *b*, *c*. *P. Humboldtii*, Bornemann. *a*, lateral aspect; *b*, oral aspect; *c*, latero-peripheral aspect. [*Polymorphina communis* (part), Parker and Jones, 1857; *P. lactea*, var. *tubulosa*, Parker and Jones, 1865.]

„ 31. *P. gibba*, d'Orbigny. [*Polymorphina gibba* (fistulose form), Brady, 1884.]

„ 32. *P. gibba*, d'Orbigny. [*Polymorphina gibba*, Goës, 1894.]

„ 33. *P. gibba*, d'Orbigny. [*Polymorphina gibba* (fistulose form), Wright, 1885.]

„ 34. *P. lactea* (Walker and Jacob). [*Polymorphina concava*, Williamson, 1858.]

„ 35 *a*, *b*. *P. lactea* (Walker and Jacob). *a*, lateral aspect of free surface: *b*, surface formerly attached. [*Polymorphina concava*, var. *denti-marginata*, Chapman, 1894.]

„ 36. *P. regina*, Brady, Parker, and Jones. [*Polymorphina Orbignii* (striate-fistulose specimen), Brady, Parker, and Jones, 1870.]

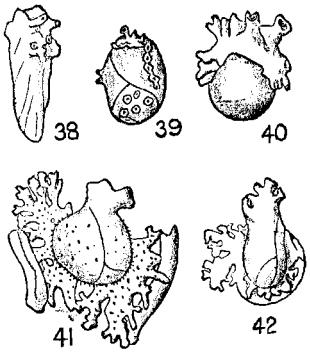
„ 37. *P. compressa*, d'Orbigny. [*Polymorphina compressa* (fistulose form), Brady, 1884.]

SERIES V.

Group No. 9.—Mixed Outgrowths.

Figs. 38–42.

Proposed varietal *name.*	*Salient characters of Outgrowths.*	*Nos. in detailed list*, pp. 508–516.
Var. *complicata*, nov. Figs. 38–42.	*a*. Examples, figured by Soldani, of apical and marginal outgrowths.	59.
	b. Apical and sub-apical (broken, probably racemose).	60.
	c. Apical (broken), and limited patch of sub-apical.	*61*.
	d. Apical, sub-apical, and general surface (near racemose).	*62*.
	e. Apical and sub-apical (broken)	63.
	e. Apical and sub-apical	64 and *65*.
	f. Apical cluster, and lateral (obscure)...	66.
	g. Apical and marginal, attached; surface aculeate.	*67*.
	h. Apical (broken) and marginal (? attached).	68.
	i. Apical, sub-apical, and marginal, attached.	*69*.



Var. COMPLICATA, nov.

Fig. 38. *P. angusta*, Egger. [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]
„ 39. *P. rotundata* (Bornemann). [*Globulina oviformis*, Terquem, 1878.]
„ 40. *P. gibba*, d'Orbigny. [*Globulina gibba*, Terquem, 1882.]
„ 41. *P. hirsuta*, Reuss. [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]
„ 42. *P. rotundata* (Bornemann). [*Polymorphina Orbignii*, Brady, Parker, and Jones, 1870.]

FISTULOSE POLYMORPHINÆ.

SERIES I.—APICAL OUTGROWTHS (page 501).

Group No. 1.—*Apical Crests.* Figs. 1-3.

1. 'Polymorpha corcula spinosa,' Soldani, 1791, Testaceograph. ac Zoophytograph. vol. i. part 2, p. 114, pl. 110. fig. p. Zoological type: *Polymorphina communis*, d'Orb. Recent; Mediterranean.
2. *Globulina transversa*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. 3, p. 129, pl. xiii. fig. 17. Zool. type: *Polymorphina gibba*, d'Orb. Eocene; Paris Basin.—Fig. 1.
3. *Guttulina problema*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. 3, p. 134, pl. xiii. fig. 44. Zool. type: *P. problema*, d'Orb. Eocene; Paris Basin.
4. *Polymorphina* (*Guttulina*) *damæcornis*, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 40, pl. xiii. fig. 85. Zool. type: *P. trigonula* (Reuss). Pläner-Mergel; Bohemia.—Fig. 2.

5. *Polymorphina regina*, var. fistulose form, Wright, 1886, Proceed. Belfast Nat. F. Club, Appendix IX, p. 331, pl. xxvii. fig. 13. Zool. type: *P. regina*, Brady, Parker, and Jones. Chalk; Keady Hill, North Ireland.—Fig. 3.
6. *Polymorphina compressa*, Goës, 1894, Kgl. Vet.-Akad. Handlingar, vol. xxv. no. 9, p. 58, pl. x. fig. 549. Zool. type: *P. compressa*, d'Orb. Recent; Coast of Norway.

Group No. 2.—*Apical Crowns.* Figs. 4 and 5.

7. *Polymorphina damæcornis*, Wright, 1875, Rep. and Proc. Belf. Nat. F. Club, vol. for 1873–74, Appendix III, p. 88, pl. iii. figs. 16 *a*, *b*. Zool. type: *P. gibba*, d'Orb. Chalk; North-East Ireland.—Fig. 4.
8. Chapman Collection. Zool. type: *Polymorphine gibba*, d'Orb. Gault; Folkestone. Outgrowth consisting of numerous tube-like extensions, breaking out peripherically from a flattened apical crown.—Fig. 5.

Group No. 3.—*Apical cushioned Outgrowths.* Figs. 6–9.

9. 'Polymorpha subovalia,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 114. figs. D, E. Zool. type: *P. communis*, d'Orb. Recent; Mediterranean.
10. *Globulina tubulosa*, d'Orbigny, 1846, Foram. Foss. Vienne, p. 228, pl. xiii. fig. 16. Zool. type: *P. gibba*, d'Orb. Miocene Tertiary; Vienna.
11. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 71. [Also a reproduction by Brady, Parker, and Jones, 1870, in Trans. Linn. Soc. vol. xxvii. pl. xlii. fig. 38 *g*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.
12. *Globulina gibba*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 43, pl. iv. (ix.) figs. 2 and 3 *a*, *b*. Also *Guttulina gravida*, Terquem, 1878, ibid. p. 47, pl. iv. (ix.) figs. 30 *a*, *b*. Zool. type: *P. gibba*, d'Orb. Pliocene; Island of Rhodes.—Figs. 6 *a*, *b*, *c* ("*gibba*"); figs. 7 *a*, *b* ("*gravida*").
13. *Polymorphina Roemeri*, Reuss (*P. diluta*, Born.), 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 485; Schlicht, 1870, Foram. Pietzpuhl, pl. xxxiv. figs. 4–12. Zool. type: *P. gutta*, d'Orb. Oligocene; Pietzpuhl, North Germany.—Fig. 8.

14. *Polymorphina lactea* (fistulose form), Brady, 1884, Chall. Rep. vol. ix. p. 560, pl. lxxiii. fig. 14. Zool. type: *P. communis*, d'Orb. Recent.—Fig. 9.
15. *Polymorphina sororia* (fistulose form), Brady, 1884, ibid. p. 562, pl. lxxiii. fig. 15. Zool. type: *P. sororia*, Reuss. Recent.

Group No. 4.—*Apical Cluster of Tubules.* Figs. 10–16.

16. 'Polymorpha subovalia,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 115. fig. o. Zool. type: *P. communis*, d'Orb. Recent; Mediterranean.
17. *Globulina horrida*, Reuss, 1845, Verstein. böhm. Kreideform. pt. ii. p. 110, pl. xliii. fig. 14. Zool. type: *P. gutta*, d'Orb. Pläner-Mergel; Bohemia.—Fig. 10.
18. *Polymorphina horrida*, Burrows, Sherborn, and Bailey, 1890, Journ. Roy. Micr. Soc. p. 561, pl. xi. fig. 14. Zool. type: *P. fusiformis*, Römer. Red Chalk; Speeton, Yorkshire.
19. *Polymorphina lanceolata*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 487, no. 12; Schlicht, 1870, Foram. Septarienthones von Pietzpuhl, pl. xxxi. figs. 25–28. Also *Polymorphina gracilis*, Reuss, 1870, *l. c.* p. 486, no. 7; Schlicht, 1870, *l. c.* pl. xxxi. figs. 36, 37. Zool. type: *P. fusiformis*, Römer. Oligocene; Pietzpuhl, North Germany. —Figs. 11 & 12.
20. *Polymorphina Roemeri*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 485; Schlicht, 1870, Foram. Pietzpuhl, pl. xxxiv. fig. 14. Zool. type: *P. gutta*, d'Orb. Oligocene; Pietzpuhl.
21. *Polymorphina prisca*, Berthelin, 1880, Mém. Soc. Géol. France, sér. 3, vol. i. Mém. no. 5, p. 57, pl. iv. (xxvii.) fig. 21. Zool. type: *P. fusiformis*, Römer. Gault; Montcley (Doubs), France.—Fig. 13.
22. *Globulina tubulosa*, d'Orbigny, 1846, Foram. Foss. Vienne, p. 228, pl. xiii. fig. 15. Zool. type: *P. gibba*, d'Orb. Miocene; Vienna.
23. *Aulostomella pediculus*, Alth, 1850, Haidinger Naturw. Abhandl. iii. p. 204, pl. xiii. fig. 17. Zool. type: *P. sororia*, Reuss. Cretaceous; Lemberg, East Galicia, Austria.
24. *Polymorphina horrida*, Wright, 1875, Rep. and Proc. Belfast Nat. F. Club, vol. for 1873–74, Appendix III, p. 85, pl. iii.

fig. 14. Zool. type; *P. fusiformis*, Römer. Chalk; North-East Ireland.—Fig. 14.

25. Chapman Collection. Zool. type: *P. fusiformis*, Römer. Gault; Folkestone.—The Polymorphine series of chambers agrees in form with *P. prisca* (Reuss), but the surface is rather thickly covered with fine prickles. Outgrowth apical, consisting of six or more limited tubes, which turn slightly outwards and downwards in a radial manner. The surface of the fistulose portion is also aculeate.—Fig. 15.
26. *Globulina horrida*, Reuss, 1850, Haid. Abhandl. iv. p. 43, pl. iv. fig. 8. Zool. type: *P. hirsuta*, Reuss. Chalk-marl; Lemberg.—Fig. 16.

Group No. 5.—*Apical and Racemose.* Figs. 17–23.

27. 'Polymorpha corcula spinosa,' Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 110. fig. T. Zool. type: *P. gibba*, d'Orb. (?). Recent; Mediterranean.
28. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. figs. 74, 75. [Reproduction of fig. 74 as *P. Orbignii*, by Brady, Parker, and Jones, 1870, in Trans. Linn. Soc. vol. xxvii. pl. xlii. fig. 38 *c*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.—Fig. 17.
29. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 72. Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.—Fig. 18.
30. *Polymorphina damæcornis*, Wright, 1875, Rep. and Proc. Belfast Nat. F. Club, vol. for 1873–74, Appendix III, p. 85, pl. iii. fig. 17. Zool. type: *P. gibba*, d'Orb. Chalk; North-East Ireland.
31. *Globulina oviformis*, Searles Wood, MS., about 1846. Zool. type: Near *P. lactea* (W. & J.). Pliocene; Suffolk. Apical outgrowth racemose, sessile, and regularly branched.—Figs. 19 *a*, *b*.
32. *Polymorphina prælonga*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 39, pl. iii. (viii.) fig. 21. *P. amygdaloides*, idem, ibid. p. 39, pl. iii. (viii.) fig. 28. Zool. type: *P. lactea* (W. & J.). Island of Rhodes.—Fig. 20.
33. *Polymorphina hirsuta*, Reuss, 1870, Sitzungsb. Ak. Wiss. Wien, vol. lxii. p. 486; Schlicht, 1870, Foram. Septarienthones von Pietzpuhl, p. 88, pl. xxxiv. figs. 1–3. Zool. type:

P. hirsuta, Reuss [*non* B., P., & J.]. Oligocene; Pietzpuhl, N. Germany.—Figs. 21 *a*, *b*.

34. *Globulina virgata*, Searles Wood, MS. (about 1846). Zool. type: *P. virgata* (Searles Wood, MS.). Pliocene; Suffolk.—The initial test differs from the costate form, *P. regina*, B., P., & J., in having a finely striate surface. The apical outgrowth is very regularly racemose, *i. e.* the branches are of nearly equal extent.—Fig. 22.

35. Chapman Collection, I. Zool. type: *P. fusiformis*, Römer. (An acerate subvariety.) Gault; Folkestone.—A Polymorphine series of chambers twisted in its growth, and bearing round the apical (oral) end numerous limited and irregular thorn-like outgrowths. The whole surface of the test is covered with fine prickles.—Fig. 23.

Fragments of Apical Outgrowths.

36. *Polymorphina communis* (part), Parker and Jones, 1857, Ann. Mag. Nat. Hist. ser. 2, vol. xix. p. 283, pl. xi. fig. 34; and *P. lactea* var. *tubulosa*, Parker and Jones, 1865, Phil. Trans. vol. 155, p. 362, pl. xiii. fig. 52 *d*. Zool. type: *P. lactea* (W. & J.). Recent; Norwegian coast.

37. 'Tubuli læves, lucido-candidi, ramulosi,' etc., Soldani, 1780, Saggio Orittografico, p. 112, pl. ix. fig. 56 *c*. Zool. type: ? Recent; Mediterranean.

SERIES II.—SUBAPICAL OUTGROWTHS (page 505).

Group No. 6.—*Tubules apart or in circles.* Figs. 24 & 25.

38. 'Polymorpha oviformia, pyriformia, oliviformia,' etc., Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 116, pl. 121. figs. *ii*, *kk*, *mm*, *nn*, *oo*, and *pp*. Zool. type: *P. gibba*, d'Orb. Recent; Mediterranean.

39. 'Testæ incertæ sedis,' Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 47, pl. iv. (ix.) figs. 41 *a*, *b*. Zool. type: Near *P. gibba*, d'Orb., but having the surface wrinkled. Pliocene; Island of Rhodes.—Figs. 24 *a*, *b*.

40. *Guttulina racemosa*, Terquem, 1878, ibid. p. 46, pl. iv. (ix.) fig. 24. Zool. type: *P. problema*, d'Orb. Pliocene; Island of Rhodes.—Fig. 25.

SERIES III. OUTGROWTHS ON THE GENERAL SURFACE (page 505)

Group No. 7.—*Regular or irregular.* Figs. 26–29.

41. 'Polymorpha subovalia,' etc., Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 114, pl. 115. fig. P; pl. 127. figs. L, M; p. 118, pl. 128. fig. N; pl. 129. figs. *ee*, *gg*, *hh*. Zool. type: *P. communis*, d'Orb. Recent; Mediterranean.
42. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1863, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 73. Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.—Fig. 26.
43. *Globulina oviformis*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 44, pl. iv. (ix.) fig. 11. Zool. type: *P. rotundata* (Born.). Pliocene; Island of Rhodes.—Fig. 27.
44. 'Polymorpha corcula spinosa,' Soldani, 1791, Testaceographia. vol. i. pt. 2, p. 114, pl. 109. figs. H, I. Zool. typ.: *P. lactea* (W. & J.). Recent; Mediterranean.
45. *Raphanulina Humboldtii*, Zborzewski, 1834, Nouv. Mém. Soc. Imp. Nat. Moscou, vol. iii. p. 311, pl. xxviii. fig. 1 *a*. Zool. type: *P. communis*, d'Orb. Tertiary; S.W. Russia
46. *Polymorphina solidula*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 40, pl. iii. (viii.) fig. 33. Zool. type: *P. lactea* (W. & J.). Pliocene; Island of Rhodes.—Fig. 28.
47. Chapman Collection, K. Zool. type: *P. gutta*, d'Orb. Gault; Folkestone. Several short, rounded tubercles disposed over the general surface.—Fig. 29.

SERIES IV. MARGINAL OR PERIPHERAL OUTGROWTHS (page 506).

Group No. 8.—*Regular or irregular; shell free or attached.* Figs. 30–37.

48. *Polymorphina communis*, in part, Parker and Jones, 1857, Ann. Mag. Nat. Hist. ser. 2, vol. xix. p. 283, pl. x. figs. 25–27; and as *P. lactea*, var. *tubulosa*, Parker and Jones, 1865, Phil. Trans. vol. 155, p. 362, pl. xiii. figs. 52 *a–c*. Zool. type: *P. Humboldtii*, Bornemann. Recent; coast of Finmark.—Figs. 30 *a*, *b*, *c*.
49. *Polymorphina gibba* (fistulose form), Brady, 1884, Chall. Reports, vol. ix. p. 562, pl. lxiii. fig. 16. Zool. type: *P. gibba*, d'Orb. Recent.—Fig. 31.

50. *Polymorphina gibba*, Goës, 1894, Kgl. Vet.-Akad. Handl. vol. xxv. no. 9, p. 55, pl. ix. fig. 522. Zool. type: *P. gibba*, d'Orb. Recent; Coast of Norway.—Fig. 32.
51. *Misilus aquatifer*, Montfort, 1808, Conch. Syst. vol. i. p. 294, 74e genre. See Ann. Mag. Nat. Hist. ser. 3, vol. vi. 1860, p. 345. Zool. type: *P. lactea* (W. & J.). Recent; Mediterranean.
52. 'Polymorpha corcula spinosa,' etc., Soldani, 1791, Testaceographia, vol. i. part 2, p. 114, pl. 109. figs. G, M, L; pl. 110. figs. N, S; pl. 111. figs. X, *a a*, *c c*, *d d*. Zool. type: *P. gibba*, d'Orb. Recent; Mediterranean.
53. *Polymorphina gibba* (fistulose form), Wright, 1886, Proceed. Belfast. Nat. F. Club, 1884–85, Appendix, 1886, p. 324, pl. xxvi. fig. 11. Zool. type: *P. gibba*, d'Orb. Recent; Belfast Lough.—Fig. 33.
54. *Polymorphina concava*, Williamson, 1858, Recent. Foram. Gt. Britain, p. 72, pl. vi. figs. 151, 152; refigured by Brady, Parker, & Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 236, pl. xl. figs. 32, *a*, *b*. Zool. type: *P. lactea* (W. & J.). Recent; British coast.—Fig. 34.
55. *Polymorphina concava*, R. Jones, Monogr. Crag Foram. Part II. 1895, pl. v. fig. 22 (Millett's Collection). Zool. type: *P. lactea* (W. & J.). Pliocene; Suffolk.
56. *Polymorphina concava*, var. *dentimarginata*, Chapman, 1894, Quart. Journ. Geol. Soc. vol. l. p. 717, pl. xxxiv. figs. 14 *a*, *b*. Zool. type: *P. lactea* (W. & J.). Lower Greensand; Surrey.—Outgrowth a shelly capsule surrounding the initial test, lengthened and acuminate at the oral and aboral extremities, the edge finely acerate. The whole of the capsule is septate, divided into about five chambers. The surface of attachment, together with the initial test, is perfectly flat and smooth.—Figs. 35 *a*, *b*.
57. *Polymorphina Orbignii* (striate-fistulose specimen), Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *m*. Zool. type: *P. regina*, B., P., & J. Pliocene; Suffolk.—Fig. 36.
58. *Polymorphina compressa* (fistulose form), Brady, 1884, Chall. Reports, vol. ix. p. 566, pl. lxxiii. fig. 17. Zool. type: *P. compressa*, d'Orb. Recent.—Fig. 37.

SERIES V.—MIXED OUTGROWTHS (page 507).

Group No. 9.—*Apical, Subapical, Marginal, &c.*
Figs. 38–42.

59. 'Polymorpha corcula, spinosa,' etc., Soldani, 1791, Testaceographia, vol. i. part 2, p. 114, pl. 109. fig. K; p. 114, pl. 110. figs. O, Q, R, V; p. 114, pl. 111. figs. Y, Z, *b b*; p. 116, pl. 121. figs. *h h*, *l l*. Zool. type: *P. gibba*, d'Orb., etc. Recent; Mediterranean.

60. *Polymorphina tubulosa*, Jones, Parker, and Brady, 1866, Monogr. Crag Foram. (Pal. Soc.), pl. i. fig. 70. [See also reproduction = *P. Orbignii*, Brady, Parker, & Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *f*.] Zool. type: *P. gibba*, d'Orb. Pliocene; Suffolk.

61. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc.. vol. xxvii. p. 244, pl. xlii. fig 38 *e*. Zool. type: *P. angusta*, Egger. Recent.—Fig. 38.

62. *Globulina oviformis*, Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. i. no. 3, p. 44, pl. iv. (ix.) fig. 12. Zool. type: *P. rotundata* (Born.). Pliocene; Island of Rhodes.—Fig. 39.

63. *Aulostomella dorsigera*, Costa, 1856, Atti Acad. Pontaniana, vol. vii. fasc. 2, p. 281, pl. xviii. figs. 20 *a*, A, B. Zool. type; *P. sororia*, Reuss. Tertiary; Cannitella, Calabria.

64. *Apiopterina Orbignii*, Zborzewski, 1834, Nouv. Mém. Soc. Imp. Nat. Moscou, vol. iii. p. 311, pl. 28. fig. 2 *b*. Zool. type: *P. lactea* (W. & J.). Tertiary; South-West Russia.

65. *Globulina gibba*, Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. iii. Mém. 3, p. 130, pl. xiii. fig. 22. Zool. type: *P. gibba*, d'Orb. Eocene; Septeuil, near Paris.—Fig. 40.

66. *Polymorphina horrida*, Wright, 1875, Rep. & Proc. Belf. Nat. F. Club, vol. for 1873–74, Appendix III, 1875, p. 85, pl. iii. fig. 15. Zool. type: *P. lactea* (W. & J.). Upper Cretaceous; North Ireland.

67. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *i*. Zool. type: *P. hirsuta*, Reuss. Recent; English Channel.—Fig. 41.

68. *Polymorphina lactea*, var. *fistulosa*, Williamson, 1858, Rec. Foram. Gt. Brit. p. 72, pl. vi. fig. 150. Also figured as *P. Orbignii* by Brady, Parker, and Jones, 1870, Trans. Linn.

Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *d*. Zool. type: *P. compressa*, d'Orb. Recent; Coast of Britain.

69. *Polymorphina Orbignii*, Brady, Parker, and Jones, 1870, Trans. Linn. Soc. vol. xxvii. p. 244, pl. xlii. fig. 38 *j*. Zool. type: *P. rotundata* (Born.). Pliocene; Suffolk.—Fig. 42.

TABULAR SYNOPSIS of the Fistulose *Polymorphinæ*, showing the relative proportion of the several Species to the Groups or Varieties described above; and arranged on the basis of the foregoing catalogue.

Varieties.....	1.	2.	3.	4.	5.	6.	7.	8.	9.
Polymorphina									
communis ...	*	.....	**	*	.....	.....	*		
gibba	*	*	**	*	***	*	*	***	**
problema ...	*	.....	.....	.....	.....	*			
trigonula ...	*								
sororia	.....	.....	*	*	.....	.....	.....	.....	*
gutta	.....	.....	.....	*	.....	.....	*		
hirsuta	.....	.....	.....	*	*	.....	.....	.....	*
fusiformis ...	.....	.....	.....	***	*				
virgata	.....	.....	.....	.....	*				
lactea	.....	.....	.....	.....	**	.....	.....	***	
rotundata ...	.....	.....	.....	.....	.....	.....	*	.....	*
Humboldtii	.....	.....	.....	.....	.....	.....	.....	*	
regina.....	.....	.....	.....	.....	.....	.....	.....	*	
compressa ...	.....	.....	.....	.....	.....	.....	.....	*	*
angusta	.....	.....	.....	.....	.....	.....	.....	.....	*

Note.—The asterisks indicate occurrence and relative abundance.

Varieties:—1. *damæcornis*, Reuss; 2. *coronula*, nov.; 3. *acuplacenta*, nov.; 4. *horrida*, Reuss; 5. *racemosa*, nov. (1–5; Series I, apical growths): 6. *circularis*, nov. (Series II, subapical): 7. *diffusa*, nov. (Series III, diffuse): 8. *marginalis*, nov. (Series IV, marginal): 9. *complicata*, nov. (Series V, mixed).

It will of course be obvious that, in many cases, these varietal names will have to be applied to more than one species of the genus, since the latter, as a whole, shows a strong tendency to take on one or more of these redundant fistulose outgrowths.

From this Table it is evident that *Polymorphina gibba* supplies by far the greatest number and the greatest variety of exogenous growths in this genus; in fact, showing examples of each kind.