



A Monograph of the British Ordovician and Silurian Bellerophontacea. Part II. Pages 49–92, i–viii; Plates IX–XIII. (Including Title-page and Index)

F. R. Cowper Reed

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A MONOGRAPH

OF THE

BRITISH ORDOVICIAN AND SILURIAN

BELLEROPHONTACEA.

BY

F. R. COWPER REED, M.A., Sc.D., F.G.S.

PART II.

PAGES 49—92, i—viii; PLATES IX—XIII. (Including Title-page and Index.)

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backwards obliquely to meet carina at 75° — 60° , with their edges rising into small nodules where crossed by the strong regular contiguous revolving ridges of equal size and strength; lamellæ frequently alternate on opposite sides of whorl.

Dimensions [G. 80486].—Height of shell 10 mm.; height of mouth 6 mm.; width of mouth 4 mm.

Horizon.—Wenlock Limestone.

Locality.—Dudley.

Remarks.—The single specimen in the British Museum [G. 80486], on which the foregoing description is based, has much of the proximal part of the shell hidden by the matrix and by an attached specimen of *Orbiculoidea*. The presence of a slit-band is only visible near the mouth, and proximally its edges draw together so that it seems to be closed. The shell, however, must be referred to the genus *Temnodiscus* rather than *Cyrtolites*, and is allied to *T. lamellifer* (Lindstr.)¹ and *T. pharetra* (Lindstr.)²

3. *Temnodiscus purchisoni* (D'Orbigny). Plate IX, figs. 8, 9.

1839. *Bellerophon striatus*, Sowerby (*non* Bronn, 1835), in Murchison's Silurian System, p. 604, pl. iii, fig. 12 e.

1848. *Bellerophon purchisoni*, Férussac and D'Orbigny, Hist. Nat. Ceph., vol. i, p. 210, pl. vii, figs. 1–3.

1852. *Bellerophon purchisoni*, D'Orbigny, M'Coy, Syn. Brit. Palæoz. Foss. Woodw. Mus., fasc. ii, p. 310.

non 1842. *Bellerophon purchisoni*, D'Orbigny, D'Archiac and de Verneuil, Trans. Geol. Soc. [2], vol. vi, p. 353, pl. xxviii, figs. 7, 8.

Specific Characters.—Shell somewhat compressed, carinated, increasing very rapidly in size towards the mouth, especially in height; composed of few (1–2) whorls. Outer whorl higher than wide, subcordate, with dorsum acutely angular, becoming subangular towards mouth and finally almost rounded, the sides of the whorl becoming at the same time more convex and swollen and the whole whorl broader; carina slightly raised, with flattened top bearing slit-band [with widely separated strongly arched lunulæ]. Umbilicus situated considerably below centre of shell, small, open, perforated (?). Surface of shell ornamented with numerous closely placed, sharp, thin transverse lines or lamellæ [having finely fimbriated edges], bending back rather suddenly to meet the carina at about 30° — 45° .

Dimensions.—Height about 12 mm. [6669.]

Horizon.—Upper Ludlow.

Localities.—Felindre; Horeb Chapel, Llandoverly; Malvern.

Remarks.—There has been considerable confusion about this species, but the above description has been drawn up from the type-specimen in the Jermyn

¹ Lindström, *op. cit.*, p. 82, pl. vi, figs. 31–38.

² *Ibid.*, p. 83, pl. vi, figs. 39–51.

Street Museum [6669] from Horeb Chapel, but the details of the ornament of the slit-band and transverse lines from the specimen [28090] from Malvern.

The description of the species *B. striatus* from the Upper Ludlow Tilestones of Felindre which Sowerby gave is as follows: "Carinated, covered with sharp striæ parallel to the edge of the aperture; apex (spire?) very small, convoluted; aperture cordate (with a narrow deep sinus in the front?); keel flattened at the edge and transversely striated." McCoy described the Ludlow examples from the Tilestones of Horeb Chapel, Llandoverly, as follows: "Involute, sub-compressed, of about one and a-half very rapidly enlarging, completely exposed whorls; section of whorls obtusely cordate, the width slightly exceeding the length; sides tumid, very convex; circumference with an obtusely-defined, broad, prominent flattened keel; umbilicus small; surface with fine sharp striæ, transverse on the sides and keel; average diameter five lines; in proportion to diameter length of mouth $\frac{80}{100}$, width of umbilicus $\frac{15}{100}$. The greater width and tumidity of the sides, fewer and more rapidly expanding whorls, and consequently greater size of the last volution and wide obtusely flattened keel separate this species from *B. carinatus* (Sow.)."

The specimen [6669 $\frac{28}{91a}$] in the Jermyn Street Museum (formerly in the Geological Society's Museum), which is recognised as Sowerby's type, and is marked "Upper Ludlow, Horeb Chapel," consists of a well-preserved internal cast of a small shell measuring 12 mm. in height. It is composed of $1\frac{1}{2}$ or 2 whorls. The umbilicus is perforated, possibly as the result of the inner whorl being broken away. The outer whorl very rapidly increases in size, especially in height, and is somewhat compressed, being higher than wide, with a subangular dorsum and slightly raised flattened carina. The height of the outer whorl at the mouth is just over three-fourths the total height of the shell, being 8.5 mm., and its width is about 7 mm. The umbilicus is therefore far below the centre of the shell. The acuteness of the carination of the dorsum decreases somewhat towards the mouth, and the sides of the whorl become more swollen and convex. The slight flattening of the carina probably indicates the presence of a slit-band. The ornament shown on a fragment of the external impression of the shell seems to consist of fine, sharp transverse striæ bending back rather suddenly to meet the carinal edge at 30° — 45° . In another specimen [28090] from Malvern in the Jermyn Street Museum labelled *B. purchisoni*, the ornamentation, which is well preserved, consists of thin transverse lamellæ with fimbriated edges as in *T. pharetra* (Lindström),¹ but the lamellæ are closer and more regular than in that species. The slit-band is well seen, and shows strongly arched, widely separated lunulæ, as in that species.

¹ Lindström, *op. cit.*, p. 83, pl. vi, figs. 39—51.

It is undoubtedly the case that this shell should be referred to the genus *Temnodiscus*, and it is allied to the Swedish species *T. pharetra* and *T. arrosus* (Lindstr.).¹

Férussac and D'Orbigny² gave the following specific diagnosis of *B. murchisoni*, which was proposed by them for the pre-occupied name *striatus*: "Coquille ovale, comprimée, finement striée en travers avec quelques lignes d'accroissement sur les cotés, formant des stries en sautoir sur la partie dorsale, qui est un peu carénée. Spire croissant très rapidement, visible en entier dans l'ombilic. Bouche triangulaire, un peu cordiforme. La moule est presque lisse." Both the Devonian of Wissenbach and the Silurian localities in England quoted by Murchison are given for its occurrence, for D'Archiac and de Verneuil³ recorded it from the Devonian of Wissenbach. The form from the Devonian of Argentina which Kayser⁴ considered to be allied to *B. murchisoni* is placed by Knod⁵ in his new species *B. globosus* which typically occurs in the Devonian of Bolivia. Holzapfel⁶ points out that Sowerby's specific name *B. striatus* was pre-occupied by an Upper Devonian species named by Bronn in 1835, and restricts it to the latter.

4. *Temnodiscus salopiensis*, sp. nov. Plate IX, fig. 10.

Specific Characters.—Shell high, narrow, compressed, cornuate, composed of 1—1¼ whorls not in contact; umbilicus open, perforated, the proximal end of shell nearly touching the distal portion near mouth. Whorl lanceolate in cross-section, higher than wide, rapidly increasing in size; sides rounded, slightly inflated; dorsum narrow, with high, narrow, suddenly elevated and compressed keel bearing slit-band. Mouth simple (?), not expanded. Surface of whorls with sides crossed by strong narrow transverse ribs, nearly straight, mostly equidistant, sloping a little back to meet keel nearly at right angles, then bending back more strongly to cross it obliquely as thick, distant lunulæ swelling out into small nodes so as to give a serrated aspect to the keel. Interspaces between ribs smooth.

Dimensions [G. 17506].—Height of shell, 12·0 mm.; width of whorl near mouth, 4·5 mm.; height of whorl near mouth, 6·5 mm.

Horizon.—Wenlock Limestone.

Locality.—Shropshire.

¹ *Ibid.*, p. 83, pl. vi, figs. 52, 53.

² Férussac and D'Orbigny, 'Hist. Nat. Ceph.' (1835—1848), vol. i, p. 210, pl. vii, figs. 1—3.

³ D'Archiac and De Verneuil, 'Trans. Geol. Soc. Lond.' [2], vol. vi (1842), p. 210, pl. xxviii, figs. 7, 8.

⁴ Kayser, 'Zeitschr. deutsch. geol. Gesell.', Bd. xlix (1897), p. 287, t. x, fig. 9.

⁵ Knod, 'Neues Jahrb. f. Miner. Geol.,' Beil. Bd. xxv (1908), p. 503, pl. xxii, figs. 1, 2.

⁶ Holzapfel, 'Abh. k. preuss. geol. Landesanst.,' n.f. Heft xvi (1895), p. 208.

Remarks.—Only the single specimen [G. 17506] of this species in the British Museum is known to me. It is allied to *T. lamellifer* (Lindstr.),¹ but differs in the transverse ribs not being lamellose or fimbriated and by their inclination to the keel being more at right angles, as well as by the interspaces being smooth and by the whorl increasing less rapidly in size.

5. **Temnodiscus solitarius**, sp. nov. Plate IX, fig. 11.

Specific Characters.—Shell high, narrow, compressed, cornuate, composed of $1\frac{1}{2}$ whorls in contact, but not overlapping; inner whorls absent, leaving umbilicus perforated. Whorls lanceolate in cross-section, rapidly increasing in height, more than twice as high as wide, with gently convex sides, and high compressed carina bearing narrow slit-band on summit. Mouth simple. Umbilicus small, open, perforated, situated at about one-fourth the height of shell. Surface of whorls ornamented with regular equidistant thick transverse lines, closely placed, fimbriated minutely and set with transverse granules connected with fine lines across interspaces, arched gently back on sides, but more strongly near carina, where they become finer and closer and meet slit-band at about 30° . Slit-band narrow, not clearly defined, crossed by strong lunulæ.

Dimensions.—Height of shell about 11.5 mm.

Horizon.—Upper Ludlow (Whitecliffe Group, *Sp. elevatus* Beds).

Locality.—Ludford Lane.

Remarks.—This shell, which was recorded as *Bellerophon purchisoni* by Misses Elles and Slater,² resembles *T. lamellifer* (Lindstr.), the type of the genus, in shape and perforated umbilicus, but in ornament is more like *T. arrosus* (Lindstr.)³ and *T. pharetra* (Lindstr.).⁴ There is no described British species like it.

Genus **BELLEROPHON**, Montfort (sens. str.).

Generic Characters.—Symmetrically involute, subglobose shells, with or without an umbilicus, the latter never very large in the typical section; whorls more or less rounded on the back; aperture generally expanded, usually with a callosity on the inner lip; dorsal lip with a more or less deep central emargination behind which there is a well-developed slit-band; surface sculpture consisting of more or less strongly-developed transverse striæ of growth. Type, *B. vasulites*, Montfort.⁵

¹ Lindström, *op. cit.*, p. 82, pl. vi, figs. 31—38.

² Elles and Slater, 'Quart. Journ. Geol. Soc.,' vol. lxii (1906), p. 219.

³ Lindström, *op. cit.*, p. 83, pl. vi, figs. 52—53.

⁴ *Ibid.*, p. 83, pl. vi, figs. 39—51.

⁵ Montfort, 'Conchyl. System.,' vol. i (1808), p. 51.

Perner¹ quoted the definition of the genus given by Ulrich and Scofield,² which restricts its scope to a considerable extent. But not only Ordovician and Silurian, but Devonian, Carboniferous and Permo-Carboniferous species are included by these American authors in this genus, though it seems capable of further subdivision. Perner divides the Bohemian Ordovician and Silurian representatives into three sections or subgeneric groups, their criteria being the length of the dorsal fissure behind the emargination, the size and depth of the umbilicus, the shape and direction of the lateral lips (apertural lobes) of the mouth and the character of the sculpture of the surface. These three divisions are named *Sphærocyclus*, *Cœlocyclus* and *Prosoptychus*, and are characterised as follows :

(1) *Sphærocyclus*.—Traces of spiral sculpture on surface; dorsal slit relatively long (about one-third the length of the whorl); mouth not enlarged; slit-band broad; umbilicus deep without callosity. Type *B. bohemicus*, Barr.

(2) *Cœlocyclus*.—Shell spherical; umbilicus very deep, wide, open, exposing inner whorls; slit-band broad, elevated; umbilical edge (sides of whorl) subangular to angular. Type *B. rarissimus*, Barr.

(3) *Prosoptychus*.—Last half of outer whorl ridged, more or less straightened, laterally enlarged; apertural lobes surround or conceal umbilicus.

The spiral sculpture on *Sphærocyclus* recalls *Bucaniopsis*, which seems to have a greater warrant for generic rank than *Sphærocyclus*. The genus separated off as *Cymbularia*, Koken, owing to the infolding of the apertural margins, which is not mentioned by its founder as characteristic, may otherwise be only a subgeneric group of *Bellerophon*.

It is not possible to refer all the British species to one or other of these subgeneric divisions, principally on account of our imperfect knowledge of their characters; moreover, it is possible that other new groups should be formed to receive some of them.

1. **Bellerophon globulus**, Lindström. Plate IX, figs. 12, 13.

1873. *Bellerophon dilatatus*, Sowerby, Salter, Catal. Camb. Silur. Foss. Woodw. Mus., p. 157 (a/877) (*non B. dilatatus*, Sowerby, 1839, in Murchison's Silur. Syst.).

1884. *Bellerophon globulus*, Lindström, Silur. Gastrop. Pterop. Gotland, p. 75, pl. v, figs. 25-34.

Specific Characters.—"Shell of somewhat variable form, globular, ovate or elliptical in outline; surface of a dark glossy hue, almost smooth, with extremely fine, densely-packed transverse striæ, which join the slit-band at an angle of 38°, bend outwards towards the sides and again converge towards the umbilicus.

¹ Perner, *op. cit.*, pp. 130, 131.

² Ulrich and Scofield, *op. cit.*, p. 853.

The slit-band forms an elevated keel with a flat top, on each side bordered by a fine line and wavy with the minute and delicate lines of growth. Whorls four and a-half, regularly increasing in width, twice as large as high and consequently not so narrow as in *B. sphæra*. Shell thick and as common in the genus [at] thickest around the umbilicus and at the inferior corners of the aperture. The last whorl, when seen from the side, is straight or only faintly curved, and its apertural and dorsal contours are nearly parallel. . . . The inferior corners of the aperture near the umbilicus where the shell is [at] thickest, are rounded or cylindrical, and completely hide the umbilicus, which in young specimens is open" (Lindström).

There are several shells in the Sedgwick Museum labelled by Salter *Bellerophon dilatatus* which completely agree in all essentials with Lindström's *B. globulus*. The subquadrate semi-elliptical shape of the whorls, the straightening of the last whorl, the high expanded mouth, the narrow raised slit-band flattened at the top, are just as Lindström describes and figures. The transverse striæ on the shell, though they meet the slit-band at an angle between 35° and 45° as in the Swedish form, are not always extremely fine and densely packed, for they may be rather irregular in strength, though fine on the whole. One specimen (*a/877*) from the Wenlock Limestone, Dudley, in the Sedgwick Museum, has the slit-band, shell and surface ornament well preserved, and they agree precisely with Lindström's figures and descriptions. Internal casts of the species are, however, as a rule only preserved, and these have frequently been labelled *B. wenlockensis*. But *B. globulus* is less globose in shape, the whorls are relatively higher, the cross-section is semi-elliptical and not so transverse. The sides tend to be somewhat flattened, and the dorsum is only distinctly angulated towards the mouth. The shape of the whorls, degree of convexity of the dorsum and expansion of the mouth vary somewhat in this species, as Lindström himself has pointed out.

Dimensions.—Height of shell, c. 43 mm.; width of mouth, c. 50 mm.

Horizons.—(1) Wenlock Limestone; (2) Lower Ludlow; (3) Upper Ludlow?

Localities.—(1) Dudley; Dormington Wood, Woolhope; (2) Ledbury; Dudley; (3) Kendal [28102, 28103] (Jermyn Street Museum).

2. *Bellerophon ledburiensis*, sp. nov. Plate IX, fig. 14.

1878. *Bellerophon wenlockensis*, Sowerby, Salter, Cat. Camb. Silur. Foss., Mus. Pract. Geol., p. 113.

Specific Characters.—Shell globose, involute, outer whorl completely enveloping inner whorls and slowly increasing in size to mouth. Umbilicus closed, with stout rod-like callosity projecting from it. Whorl transverse, more than twice as wide as high; dorsum broad, rounded, gently convex; sides rounded, inflated. Slit-

band narrow, slightly raised, with fine median line along it; lunulæ very delicate and numerous. Mouth with basal inner angle of lip reflected across umbilicus and recumbent on whorl. Surface of shell crossed by strongly arched fine transverse striæ meeting slit-band at about 20°, with traces of low rounded similarly arched transverse ridges; transverse lines crossed by fine somewhat broken oblique revolving lines set at rather wide equal distances apart and inclined to slit-band at about 60°.

Dimensions [28080].—Height of shell, 30 mm.; width of dorsum, 32 mm.; height of outer whorl, 15 mm.

Horizon.—Wenlock Limestone.

Locality.—Near Ledbury.

Remarks.—This shell is undoubtedly distinct from *B. wenlockensis*, and in shape and ornament more resembles *B. bohemicus*, Barr.,¹ from Stage Ff2. From the nature of the ornamentation it might seem that this species should be placed in the genus *Bucania*, but the closed umbilicus, reflected basal lip and umbilical callosity are more important, and it is preferable to place it in *Bellerophon*. Only the one specimen [28080, Mus. Pract. Geol.] is known to me.

3. *Bellerophon ruthveni* (Salter MS).

1873. *Bellerophon ruthveni*, Salter, Cat. Camb. Silur. Foss. Woodw. Mus., p. 186.

1891. *Bellerophon ruthveni*, Salter, Woods, Cat. Type Foss. Woodw. Mus., p. 96.

1901. *Bellerophon ruthveni*, Salter, Reed, Geol. Mag. [4], vol. viii, p. 358, pl. xv, figs. 5, 6.

No further details can be added to the description of this species given by me in 1901, for no better specimens are available. The species is imperfectly known and cannot be defined precisely. Salter's definition was as follows: "Smaller than *B. dilatatus* and with the band angular, and the whorls angular where the band becomes so. Very common, 1¼ inches wide." The aperture is transverse and widely expanded with rounded lateral lobes; there is a wide, sharply V-shaped sinus in the outer lip; the slit-band is very narrow and sunk in a groove between slightly elevated margins. The dorsum of the outer whorl near the mouth seems to be more strongly arched and carinated, but this may be due to the crushing of the specimens. There seem to be traces of one or two spiral thread-like lines running parallel and close to the slit-band and slightly diverging towards the mouth, and there are faint transverse simply arched growth-lines on the lateral lobes.

Horizon.—Kirkby Moor Flags (Up. Ludlow).

Locality.—Benson Knot, Kendal.

¹ Perner, *op. cit.*, p. 132, text-fig. 94 e.

4. **Bellerophon sphaera**, Lindström, var. nov. **judex**. Plate IX, fig. 15.

Varietal Characters.—Shell globose, involute, outer whorl completely enveloping inner whorls; umbilicus closed, central. Whorls rounded, wider than high; dorsum and sides convex, more or less inflated. Slit-band narrow, slightly elevated. Mouth slightly expanded, transversely semi-elliptical, with the lower lip slightly reflected and adherent. Surface of shell crossed by gently arched fine striæ of rather irregular size meeting slit-band at acute angle (30° – 45°).

Dimensions.—Height of shell, 35 mm.; thickness at umbilicus c. 22 mm.; width of mouth, c. 40 mm.

Horizons.—(1) Mulloch Hill Group, Lower Llandovery. (2) Saugh Hill Group, Upper Llandovery.

Localities.—(1) Mulloch Hill, Girvan; (2) Woodland Point, Girvan.

Remarks.—The general characters of this shell seem to show that it is specifically inseparable from *B. sphaera*, Lindstr.,¹ but the less coarse and less regular ornamentation may be regarded as sufficient to put it as a variety. The absence of carination of the dorsum and the different ornamentation show that we cannot refer it to *B. wenlockensis*. As in the case of the Gotland shells there seems to be some variation in the globosity of our specimens, but the Woodland Point examples are too much crushed to determine their original shape.

5. **Bellerophon wenlockensis**, Sowerby. Plate IX, fig. 16.

1839. *Bellerophon wenlockensis*, Sowerby, in Murchison's Silurian System, p. 633, pl. xiii, fig. 21.

(Non 1841. *Bellerophon wenlockensis*, Sowerby? Phillips, Palæoz. Foss. Cornw. Dev., p. 108, pl. xl, fig. 203.)

1848. *Bellerophon wenlockensis*, Sowerby, Férussac and d'Orbigny, Hist. Nat. Ceph., vol. i, p. 189, pl. viii, fig. 7.

1852. *Bellerophon wenlockensis*, Sowerby, McCoy, Syn. Brit. Pal. Foss. Woodw. Mus., p. 311.

1875. *Bellerophon wenlockensis*, Sowerby, Baily, Charact. Brit. Foss., vol. i, Palæoz., p. 65, pl. xxii, fig. 2.

1884. *Bellerophon wenlockensis*, Sowerby, J. D. La Touche, Handbook to the Geology of Shropshire, p. 73, pl. xiv, fig. 492.

Specific Characters.—Shell subglobose to globose, involute, outer whorl nearly completely embracing inner whorls. Umbilicus small, deep, nearly concealed by downward extension of lateral angles of mouth. Outer whorl slowly increasing in size, very transverse, more than twice as wide as high, sides rounded, inflated; dorsum convex, rounded, except near mouth, where a low sharp narrow keel is developed. Slit-band narrow, raised, with sharp elevated edges and numerous

¹ Lindström, *op. cit.*, p. 74, pl. iii, figs. 35–38; pl. v, fig. 1–16.

strong lunulæ. Mouth slightly expanded towards base; dorsal sinus forming very obtuse **V** (about 100°—110°), followed by narrow, straight, open slit which extends fully one-third the length of the whorl; lateral lobes rounded, arched forward. Surface of shell ornamented by transverse arched, strong, sublamellose squamous lines, rather closely-set, but not always equidistant or equal, somewhat undulated in places, curving back gently to meet the slit-band at about 60°, becoming coarser and less regular near the margins of mouth (with short, closely-placed fine cross lines in interspaces of some specimens).

Dimensions :

	I	II (G. 15775)
Height of shell	55 mm.	50 mm.
Thickness at umbilicus	c. 37 „	c. 31 „
Height of outer whorl near mouth	c. 20 „	c. 18 „
Width of „ „ „	c. 50 „	c. 46 „

Horizon.—(1) Wenlock Limestone; (2) † Llandovery Beds.

Localities.—(1) Ledbury; Wenlock; Croft, Malvern; Woolhope; Dudley. (2) The Frolic, Haverfordwest; Blaen-y-cwm.

Remarks.—Of this species Sowerby gave no specific diagnosis, but merely said: “This species differs a little from the species [*B. tenuifascia*] of the Carboniferous Limestone (‘M. C.’ vol. v, p. 109, pl. cccclxx, figs. 2, 3) figured in ‘M. C.’ but it is difficult to indicate a real difference owing to the calcareous spar having taken the place of the shell. We assign it provisionally the name *B. wenlockensis*. Loc. Wenlock; Croft, Malvern.”

Sowerby’s figured type-specimen [6708], in the Jermyn Street Museum, is from Ledbury, and is an internal cast covered with crystalline calcite. There is a more perfect example (G. 15775) in the British Museum from the same locality; but neither of them shows any ornament or has the shell preserved. Better specimens from Dudley and Woolhope are in the Sedgwick Museum. McCoy gave the following definition: “Globose, periphery and sides obtusely rounded; umbilicus very small, mouth transversely lunate, rounded at the sides, forming a deep, obtuse **V**-shaped sinus in the middle, the sides of which meet at an angle of 105°, which is also the angle at which the coarse, very irregular, close, subimbricating ridges of the surface meet the keel; keel about half a line wide, strongly defined, prominent (traces in parts of very minute spiral striæ roughening the transversely arched ones). Width at mouth $2\frac{1}{2}$ inches, proportional diameter $\frac{8}{100}$, diameter of mouth $\frac{47}{100}$, diameter of umbilicus $\frac{13}{100}$. Rare in the Wenlock Limestone of Woolhope.”

The specimen a/627 on which McCoy based this specific description is in the Sedgwick Museum, and it is from this one that I have drawn up the diagnosis of the species.

The other specimens in the same Museum are from Dudley (*b*/823, Salter's Catalogue) and are merely internal casts. The characters therefore of the slit-band and ornamentation of the surface are ascertained from the Woolhope specimen.

The species appears to be allied to *B. squamosus*, Lindstr.,¹ especially in the matter of its ornamentation, but the mouth is less expanded, and the shell is relatively broader and more globose, the dorsum also being more broadly rounded. Perner would place it in his group *Sphærocyclus*.

There are many poorly preserved specimens from the Llandovery Series of the Frolic, Haverfordwest, and one [28044] in Jermyn Street from Blaen-y-cwm, which seem inseparable specifically from *B. wenlockensis*. In the shape of the shell, characters of slit-band, partial carination of the distal portion of the outer whorl and course of striæ on the surface, they completely agree; but the striæ seem less regular in size and distribution than in typical Wenlock examples, and therein more resemble *B. squamosus*, Lindstr.

The Devonian shell from Newton referred by Phillips² to *B. wenlockensis*, Sow., with a query, seems to have been a very poor specimen and its specific reference quite indeterminable.

6. *Bellerophon* ? *solvensis*, Hicks.

1873. *Bellerophon solvensis*, Hicks, Quart. Journ. Geol. Soc., vol. xxix, p. 50, pl. iii, fig. 33.

Specific Characters.—"A small species, of three very gradually increasing whorls, about one-eighth of an inch in diameter. Surface smooth, sides inflated."

The small specimen on which Hicks founded this species is an internal cast which does not admit of precise determination, and its generic position in modern classification is doubtful. It should be added to Hicks' diagnosis that the umbilicus is open and rather deep, exposing the 2 or 3 inner whorls; and that the section of the whorls is transversely elliptical or subcircular. It may belong to the group *Cælocyclus* of *Bellerophon* or to *Bucania*.

Horizon.—Arenig Series.

Locality.—Tremanhire, near Solva, and St. David's.

Genus **BUCANIOPSIS**, Ulrich.

Generic Characters.—Shell agreeing in all respects with *Bellerophon* except that the surface is cancellated by regular revolving and transverse striæ. Whorls enlarge rapidly, giving a broadly expanded aperture. Umbilicus of moderate size

¹ Lindström, *op. cit.*, p. 75, pl. v, figs. 25—34.

² Phillips, 'Palæoz. Foss.' (1841), p. 108, pl. xl, figs. 203 *a, b*; Whidborne, 'Mon. Brit. Devon. Fauna' (Palæont. Soc.), vol. i (1892), p. 329.

or entirely closed. Inner lip somewhat thickened. Revolving lines never oblique or wrinkled.

The type-species is *Bucaniopsis carinifera*, Ulrich,¹ of the Trenton Formation, and the definition of the genus was first given by Ulrich and Scofield in 1897 (*op. cit.*, p. 853).

Perner (*op. cit.*, p. 156) adopts this name and recognises it as a distinct genus, but I am not convinced that the presence of spiral lines is sufficient to warrant its generic separation from *Bellerophon*, for as Perner points out it agrees in all other respects with *Bellerophon*, and spiral lines (though subordinate to the transverse ones) are found in the subgenus *Sphærocyclus* belonging to the latter. However, in the present state of our knowledge it would cause unnecessary confusion to alter the customary usage of the name; but its relegation to a lower rank as a subgenus instead of a genus appears to be desirable. The name was spelt *Bucaniopsis* by its author, but *Bucaniopsis* is undoubtedly the correct orthography.

1. *Bucaniopsis expansus* (Sowerby). Plate X, figs. 1—4.

1839. *Bellerophon expansus*, Sowerby in Murchison's Silurian System, p. 613, pl. v, fig. 32.

(?) 1839. *Bellerophon globatus*, Sowerby, *ibid.*, p. 604, pl. iii, fig. 15; p. 613, pl. iv, fig. 50.

1848. *Bellerophon expansus*, Férussac and D'Orbigny, Hist. Nat. Cephal., vol. i, p. 185, pl. viii, fig. 1.

1852. *Bellerophon expansus*, Sowerby, McCoy (*pars*), Syn. Brit. Pal. Foss. Woodw. Mus., fasc. ii, p. 309.

1884. *Bellerophon expansus*, Sowerby, J. D. La Touche (*pars*), Handbook to the Geology of Shropshire, p. 81, pl. xix, figs. 643, 644?

1909. *Bellerophon expansus*, Sowerby, Moberg and Grönwall, Om Fyledalens Gotlandium (Lunds), Univ. Arsskr., n.f. afd. 2, bd. 5, nr. 1, p. 41, pl. iii, figs. 5, 6, 7.

Specific Characters.—Shell involute, composed of a few transverse, rounded, convex whorls; outer whorl nearly completely enveloping inner ones, somewhat straightened and very rapidly expanding in width and height to mouth where it becomes obtusely carinate; dorsum strongly arched, convex, sides swollen. Umbilicus small, deep, with rounded edges, situated at less than one-third the height of shell. Mouth very large and high, transversely expanded, with wide rounded subcircular lateral lobes, broad reflected lower lip, and open bluntly V-shaped dorsal sinus. Slit-band of moderate width, not raised, but bordered on each side by a narrow thread-like line, and crossed by fine indistinct lunulæ and marked with 5—6 delicate revolving lines similar to but finer than those on rest of shell. Surface of shell ornamented with regular continuous rounded revolving lines, closely placed, of equal or subequal size and rarely interrupted by a few fine simply arched transverse striæ curving back to meet slit-band at about 45°.

Dimensions [28079].—Height of shell, 15.0 mm.; height of mouth, 11.5 mm.; width of mouth, 16.5 mm.

¹ Ulrich and Scofield, *op. cit.*, pp. 853, 922, 925, pl. lxii, figs. 56—61.

Horizon.—Upper Ludlow.

Localities.—Ludlow [28079]; Trewerne Hills; Castel Dinas Bran, Llangollen; Brigsteer, Kendal; Frith Farm, Malvern [28078].

Remarks.—Good specimens from Ludlow showing the ornamentation and slit-band, such as were described and figured by Moberg and Grönwall (*op. cit.*), occur in the Jermyn Street Museum [28078, 28079], and others in the Sedgwick Museum show the slit-band, but not the revolving lines on the surface. The latter are not seen in internal casts, and the type [6700] does not show them, being merely a poor impression of the apertural part of the shell.

Sowerby's description of the species was very brief: "Spire small, rounded; aperture very large, two-lobed, twice as long as broad; sinus broad and short. Length of aperture $7\frac{1}{2}$ lines; width of ditto 11 lines." Though he does not mention the slit-band, yet there is clear evidence of its presence in his figured specimen.

McCoy's definition of the species is valueless, for he combined shells of more than one type and from more than one stratigraphical horizon.

It has been believed that Sowerby's *B. globatus*¹ from the Tilestones of Felindre and Upper Ludlow Bone-bed is identical,² but the type-specimen cannot be found and the question must therefore be left unsettled.

2. *Bucaniopsis forbesi*, sp. nov. Plate X, figs. 5, 6.

Specific Characters.—Shell high, of few whorls, nearly involute; umbilicus very small, about one-fifth diameter of shell, deep, with centre situated at about one-fourth (?) the height of shell. Outer whorl large, rapidly expanding in height to mouth and less rapidly in width; dorsum rounded, becoming slightly carinate towards mouth. Mouth large, higher than wide, from half to two-thirds the height of shell. Slit-band rather broad, slightly depressed, inconspicuous (? bearing several closely placed revolving lines), with edges defined and raised. Surface of shell covered with fine cancellation produced by numerous fine sub-equidistant revolving lines parallel to slit-band closely decussated by equally strong gently arched transverse lines meeting slit-band at about 60°.

Dimensions.—Height of shell (distorted), c. 20 mm.; height of mouth (distorted), c. 12 mm.

Horizon.—Whitehouse Group, Middle Ordovician.

Locality.—Shalloch Mill, near Girvan.

Remarks.—Only two somewhat distorted examples of this shell in Mrs. Gray's collection have come under my notice, but they have the ornamentation well preserved in places, and in general characters they resemble *Bucaniopsis carinifera*,

¹ Sowerby in Murchison's 'Silur. Syst.', p. 604, pl. iii, fig. 15; *ibid.*, p. 613, pl. iv, fig. 50.

² McCoy, 'Syn. Pal. Foss. Woodw. Mus.', fasc. ii, p. 309; Salter, 'Cat. Camb. Silur. Foss. Woodw. Mus.', pp. 68, 192.

Ulrich,¹ and to a less extent *B. calypso*, Perner,² while *B. eiseni* (Lindström)³ may also be compared.

3. **Bucaniopsis nicoli**, sp. nov. Plate X, figs. 7—9.

Specific Characters.—Shell high, of few whorls rapidly increasing in size, much expanded at mouth. Umbilicus small, deep, about one-fifth or one-sixth the height of shell. Outer whorl wider than high, rapidly increasing in size near mouth; dorsum rounded, convex in early part of whorl, but becoming decidedly carinate towards mouth, bearing narrow slightly elevated slit-band with a narrow groove along each side of it; umbilical edges subangular; umbilical slope short, steep. Mouth very large with broad open V-shaped sinus in outer lip; large rounded prominent apertural lobes expanded at right angles to plane of shell, and large strongly deflected inner lip reaching nearly to base of shell. Surface of shell finely cancellated by numerous regular closely-placed thread-like revolving lines of subequal size parallel to slit-band, becoming slightly sinuous and divergent on apertural lobes, crossed by much more delicate transverse arched striæ meeting slit-band at 60°—75°. Strong growth-line and ridges concentric to margin in peristome.

Dimensions.—Height of shell, 18 mm.; height of mouth, 13 mm.; width of mouth, 19 mm.

Horizons.—(1) Drummuck Group (Starfish Bed) (Upper Ordovician); (2) Bala Series.

Localities.—(1) Thraive Glen; Drummuck, Girvan; (2) Onny River, Shropshire.

Remarks.—This shell is much like the imperfectly known *B. forbesi* from Shalloch Mill, but the mouth seems larger and the whole shell broader, and it more resembles the Silurian *B. expansus*.

There is one specimen [28042] in the Jermyn Street Museum from the Bala beds of the Onny River, Shropshire, which seems inseparable from the Girvan form above described. It shows the dorsal aspect and the outline of the mouth and has the ornamentation beautifully preserved. The revolving lines show a tendency to be alternately thick and fine, but perhaps this feature may be sufficient to regard the shell as marking a variety. The dimensions of the specimen are as follows: Height of shell, 13 mm.; width of mouth, 17 mm.

4. **Bucaniopsis ? cf. latevittatus** (Lindström).

Some internal casts of a *Bellerophon* in the Sedgwick Museum from the Wenlock Limestone of Dudley belong to a very broad low globose shell with

¹ Ulrich and Scofield, *op. cit.*, p. 925, pl. lxii, figs. 56—61.

² Perner, *op. cit.*, p. 157, text-fig. 110 a—c.

³ Lindström, *op. cit.*, p. 78, pl. vi, figs. 19—21.

unusually low transverse whorls, the width being four or five times the height, which is very small. The dorsum is broadly rounded and there is no trace of angulation. Unfortunately the shell itself is not preserved, but in *B. laterittatus*, Lindstr.,¹ and *B. pilula*, Lindstr.,² it is stated to possess revolving as well as transverse striae. In shape and external characters, so far as preserved, our shell may be compared with these species. Lindström (*op. cit.*, p. 74), on the strength of the ornamentation, refers these Swedish shells to the genus *Bucania* of Waagen and De Koninck, but Ulrich and Scofield³ refer *B. laterittatus* to the genus *Bucaniopsis*.

<i>Dimensions</i> :	I	II
Height of shell	20 mm.	23 mm.
Width of shell at umbilicus	16 „	18 „

Horizon.—Wenlock Limestone.

Locality.—Dudley.

5. *Bucaniopsis* ? sp.

Specific Characters.—Shell of few whorls, outer whorl very rapidly expanding in size, especially in width; dorsum broadly rounded; umbilicus deep, open; umbilical edge subangular, umbilical slope steep. Whorls transverse, wider than high. Mouth very large and broad, transversely subcordate, with lateral and lower lips suddenly expanded at right angles to plane of spiral; lower lip impressed by early part of outer whorl but descending below it and somewhat reflexed; outer lip not reflexed, with large open V-shaped sinus and rounded apertural lobes.

Dimensions.—Height of mouth including lips, c. 32 mm.; width of mouth including lips, c. 50 mm.; height of shell without lips, c. 17 mm.; width of distal end of outer whorl, c. 15 mm.; height of distal end of outer whorl, c. 9 mm.

Horizon.—Llandovery Beds D.

Locality.—The Frolic, Haverfordwest.

Remarks.—There is one fair internal cast and one imperfect apertural view of another specimen in the Sedgwick Museum referable to a species which is undoubtedly distinct from other British forms. It is not possible to make out the characters of the surface or slit, but the broadly expanded mouth, the rapidly increasing size of the outer whorl and the deep open umbilicus with subangular edges resemble *B. mohri*, Miller,⁴ from the Richmond Beds of Indiana and

¹ Lindström, *op. cit.*, p. 79, pl. vi, figs. 26—28.

² *Ibid.*, p. 80, pl. vi, figs. 29, 30.

³ Ulrich and Scofield, *op. cit.*, p. 853.

⁴ Miller, 'Cincinnati Quart. Journ. Sci.', vol. i (1874), p. 306, fig. 30; Ulrich and Scofield, *op. cit.*, p. 920, pl. lxiv, figs. 44, 45.

Kentucky, rather than any European species. The generic reference of this Welsh form is doubtful, but probably it belongs to *Bucaniopsis*.

Genus **CYMBULARIA**, Koken.

Generic Characters.—Shell involute, more or less laterally compressed; umbilicus closed on one or both sides. Outer whorl with distal portion angulated and carinated, but rest of whorl rounded. Aperture with long narrow dorsal slit and lateral lips infolded. Otherwise like *Bellerophon*.

This genus was established by Koken¹ in 1896 with *Bellerophon cultrijugatus*, Roemer,² from a boulder of Orthoceras Limestone, as its type. This species has apparently a closed umbilicus, though Koken says the genus has an open one, but he included *B. globulus*, Lindstr., which has it closed, and Perner has pointed out that the umbilicus may be closed only on one side by a callosity. The outer half of the last whorl is said to be characterised by a prominent keel and to be compressed, with a narrow dorsal slit reaching some distance back; but the rest of the dorsum is rounded. There is an occasional want of symmetry in the shell to which Perner calls attention. But Koken makes no mention of the infolding of the lateral edges of the mouth as shown in his figure of *C. galeata*, Koken,³ the first member of his genus which he illustrates. This feature is also well seen in the so-called *Bellerophon* (*Oxydiscus*?) *incola*, Barrande, as figured by Perner.⁴ It is a character of some importance and is found also in the genus *Euphemus* as understood by Waagen.⁵ The expanded mouth of *Bellerophon* with frequently outwardly bent margins is strikingly different. Neither in Zittel-Eastman's Textbook (2nd ed., 1913) nor in Bassler's Index (Bull. 92, U.S. Nat. Mus., 1915) is the genus mentioned. The angulation or carination of the distal part of the last whorl near the mouth is found also in Perner's *Prosoptychus*, a section of *Bellerophon*; but the umbilicus is always closed, and the lips are reflected in that section.

1. **Cymbularia alata** (Portlock). Plate X, figs. 10, 11.

1843. *Bellerophon alatus*, Portlock, Geol. Rep. Londond., p. 471, pl. xxxiii, fig. 9.

Specific Characters.—Shell involute, lenticular, thickest at umbilicus; whorls triangular, as high or rather higher than wide; outer whorl completely enveloping inner whorls, with acutely angulated dorsum; sides slightly convex or flattened

¹ Koken, 'Leitfossilien' (1896), p. 392.

² Roemer, 'Leth. Geogn.', vol. i, Palæoz. (1876), Atlas, pl. v, figs. 10 a, b.

³ Koken, 'Gastrop. Balt. Untersilur.', Bull. Acad. Imp. Sci. St. Pétersb., ser. v, vol. vii, no. 2, 1897, p. 115, fig. 2.

⁴ Perner, *op. cit.*, p. 160, pl. lxxxvii, figs. 9—11.

⁵ Waagen, 'Salt Range Fossils' ('Palæont. Ind.', ser. xiii), vol. i (1887), p. 163, pl. xiv, figs. 9a—d.

and meeting at 60° — 70° . Slit-band narrow, slightly elevated on carina. Umbilicus completely closed, subcentral, with callosities projecting laterally and supporting expanded basal angles of mouth. Mouth triangular, widest at base, with shallow broad open V-shaped sinus in upper lip and infolded (?) lateral lips. Surface of shell ornamented by strong widely-spaced equidistant lamellose lines arched back gently but bending back suddenly close to slit-band to meet it at about 30° .

Dimensions.—Height c. 30 mm.; thickness at base of mouth c. 35 mm.

Horizon.—Bala Beds.

Locality.—Desertcreat, Tyrone.

Remarks.—The want of symmetry noticed by Portlock may be due to the distortion of the specimen, or it may be natural, for *Cymbularia* is frequently asymmetrical, as Perner has noticed and as Lindström¹ has mentioned to be the case in his *Bellerophon* [*Cymbularia*] *fastigiatus*. The species is imperfectly known, and there are only three crushed examples for examination. The type-specimen [27998] and the paratypes [27999 and 28000] are all in the Jermyn Street Museum.

The original description is meagre and runs as follows: "Back sharply angular; aperture expanded, with flattened wing-like sides, triangular from the angularity of the back, and without a sinus; spire suddenly involute, not umbilicated. The striæ proceeding from the wings to the back are curved, and the wings have also a twisted appearance and are not quite symmetrical."

The relations of this species to *C. drummuckensis* from the Drummuck Beds (Up. Bala) of Girvan (see below) are close, but the ornamentation of the surface is different.

2. *Cymbularia carinata* (Sowerby). Plate X, fig. 12.

1839. *Bellerophon carinatus*, Sowerby, in Murchison's Silurian System, p. 604, pl. iii, fig. 4, and 1 d.

? 1839. *Bellerophon carinatus*, Sowerby, *ibid.*, p. 613.

1848. *Bellerophon carinatus*, Sowerby, Férussac & D'Orbigny, Hist. Nat. Cephal., vol. i, p. 209, pl. ix, fig. 12.

1852. *Bellerophon carinatus*, Sowerby, McCoy (pars), Syn. Brit. Pal. Foss. Woodw. Mus., fasc. ii, p. 309.

Specific Characters.—Shell sublenticular, of few whorls, somewhat compressed. Umbilicus open, rather deep, with a diameter of less than one-third the height of the shell, with subrectangular umbilical edge and very short steep umbilical slope. Whorls subtriangular, but rounded in cross-section; inner whorls partly exposed in umbilicus; outer whorl rather rapidly expanding in height and width, with gently convex sides and subangular dorsum bearing carina. Mouth transversely

¹ Lindström, *op. cit.* p. 77.

expanded, broadly triangular, with basal angles projecting laterally. Slit-band situated on slightly elevated compressed keel. Surface of shell smooth?

Dimensions.—Height of shell [6655] c. 8 mm.

Horizon.—Upper Ludlow (Passage Beds).

Localities.—Horeb Chapel [6655]; Bradnor Hill; S. of Trichrug, Llangadock [28097—28999]?

Remarks.—The type-specimen [6655] from Horeb Chapel in the Jermyn Street Museum is an imperfect internal cast partly embedded in matrix, but showing the umbilicus on one side. Only internal casts of the species are known. Sowerby's original description is brief and runs as follows: "Convolute, compressed, keeled, smooth; inner whorls several, small, partly visible; aperture an equilateral triangle." He also recorded the species from the Upper Ludlow of Bradnor Hill (*op. cit.*, p. 613), but gave no figure.

It has been often recorded from the Llandovery beds, but its occurrence in them is highly doubtful, the specimens thus labelled in the Jermyn Street and British Museums from Bog Mine, Shelve, Eastnor Park and Llandovery apparently belonging to a variety or even another species (see next page).

In spite of the opinion of many palæontologists that *B. carinatus* is identical with *B. acutus*, Sowerby, Salter¹ as far back as 1854 recognised that they were distinct, saying: "*B. acutus* appears to be quite a distinct species from *B. carinatus*, [the former] having a very acute keel and flat almost excavated sides strongly striated; the umbilicus is very large and sharp-edged." We may also add that the inflation of *B. carinatus* is marked, and the mouth is transverse and broad, overhanging the umbilicus, instead of high and narrow. It is not improbable that two species from the Upper Ludlow rocks have also been associated under the name *B. carinatus*, the narrow lenticular much compressed form with the very acute angular dorsum, very small umbilicus and large outer whorl, such as Nos. 28098 and 28099 in the Jermyn Street Museum, being distinct from the type and perhaps belonging to *Zonidiscus* or another genus.

McCoy (*op. cit.*) united *B. carinatus* and *B. acutus* "with no doubt of their identity," and consequently his definition of the former applies strictly to neither species; the only localities and horizons which he mentions are the Tilestone (Ludlow) of Storm Hill, Llandeilo, and the "calcareous Upper Bala schists of Dolydd Ceiriog Waterfall, S.E. of Moel Ferna, E. of the Berwyn Mountains," the latter locality furnishing *B. acutus*.

Moberg and Grönwall² remark that *B. lenticularis*, Grönwall, from the Wenlock rocks of Gotland, is allied to *B. carinatus*, Sow., and to *B. acutus*, Sow. Koken³ described a shell of Ordovician age as *Cymbularia lenticularis* which is distinct

¹ Salter, 'Quart. Journ. Geol. Soc.,' vol. x (1854), p. 74.

² Moberg and Grönwall, *op. cit.*, p. 43, pl. iii, figs. 12 a, b.

³ Koken, 'Gastrop. balt. Untersilurs,' p. 116, fig. 3.

from Moberg and Grönwall's species; the shell is asymmetrical, which is often the case in *Cymbularia*, as Perner points out. But the distinguishing feature of *Cymbularia* when compared with *Bellerophon* seems to be in the mouth, the lateral edges of which are infolded instead of expanded outwards and simple, as I have already pointed out. This oral character is not determinable in *C. carinata*, hence the doubt as to its generic position.

3. ***Cymbularia carinata*** (Sow.), var. Plate X, figs. 13, 14.

1878. *Bellerophon carinatus*, Sowerby, Salter, Cat. Camb. Silur. Foss. Mus. Pract. Geol., p. 78.

Varietal Characters.—Shell involute, composed of 3—4 whorls, somewhat compressed, as high as wide or rather higher than wide, subtriangular in section, with gently convex sides, subangular dorsum and traces of slight keel. Umbilicus open, rather deep, about one fourth the height of the shell in diameter, partly exposing inner whorls; umbilical slopes steep. Outer whorl increasing rather rapidly in height to mouth, with long narrow dorsal median slit extending about half the length of the whorl. Slit-band and surface ornamentation unknown.

Dimensions.—Height of shell, 19 mm.; height of mouth, 10 mm.

Horizon — Upper Llandovery.

Localities.—Bogmine, Shelve, Shropshire; Eastnor Park, W. Malvern; Cwm Dwr, Llandovery [G. 21038].

Remarks.—Only internal casts of this shell are preserved, and no external impressions show the surface characters. There are five specimens [28062, 28064—67] from Bogmine and one from Eastnor Park in the Jermyn Street Museum in this condition, and one in the British Museum [G. 21038], and it is from these that the above description has been drawn up. The shell is certainly referable to the genus *Cymbularia*, but it is not identical with Sowerby's *B. carinatus*, as it has been labelled, being more swollen and less compressed, but probably it may be regarded as a variety of it.

4. ***Cymbularia drummuckensis***, sp. nov. Plate X, figs. 15—19.

Specific Characters.—Shell lenticular, somewhat inflated centrally, thickest at umbilicus, composed of few whorls, completely involute. Whorls tectiform, carinate, subtriangular in cross-section, with dorsum more or less sharply angulated and occasionally weakly trilobed towards mouth; sides gently convex, but somewhat flattened towards mouth; outer whorl completely enveloping inner whorls and very slowly increasing in height. Umbilicus subcentral, completely closed by callosities. Mouth subtriangular, not suddenly expanded,

without reflexed lateral lips, but with basal corners supported laterally by prominent thickened callosities projecting horizontally and completely filling umbilicus; outer lip with short, acutely V-shaped sinus followed by long narrow slit extending about one-third the length of whorl; lateral lips forming large gently rounded subparallel lobes with upper edges slightly folded inwards and basal portions thickened to join umbilical callosities. Slit-band narrow, slightly raised, concave between sharp margins. Surface of shell marked with fine regular transverse thread-like lines, closely placed, often minutely fimbriated, curving back rather suddenly at about two-thirds their length to meet slit-band at very acute angles (20° — 30°).

Dimensions.—Height of shell, 21 mm.; thickness at umbilicus, 13 mm.

Horizon.—Drummuck Group (Upper Ordovician).

Locality.—Thraive Glen, Drummuck, Girvan.

Remarks.—The closed umbilicus and umbilical callosities projecting laterally resemble members of Perner's group *Prosoptychus*, but the last portion of the outer whorl is not straightened. The narrow sunken slit-band with raised edges is like *Cymbularia* as illustrated by Perner, and the general shape of the shell resembles *C. galeata*, Koken, and *B. fastigiatus*, Lindstr.,¹ which Koken refers to *Cymbularia*. In the latter species, judging from Lindström's figures, the ornament is closely similar, and so is also the general shape of the shell, but the umbilicus is not closed. However, *B. globulus*, Lindstr.,² which Koken himself placed in his genus *Cymbularia*, has a closed umbilicus, and the basal angles of the mouth are supported on umbilical callosities as in *C. drummuckensis*. The American species *B. subangularis*, Ulrich,³ may perhaps be compared with our shell, and the imperfectly known *B. obtectus*, Phillips,⁴ from Marloes Bay, of which the type-specimens [28005, 28004] are in the Jermyn Street Museum, undoubtedly bears a great resemblance to it.

Some specimens of *C. drummuckensis* from the typical locality and horizon which have a rather more subglobose shape and broader dorsum, with a tendency to trilobation of its surface, may represent a variety.

It is probable that *C. drummuckensis* is the Girvan species referred by Salter⁵ to Sowerby's *B. acutus*, which is undoubtedly quite distinct.

The type-specimens of *C. drummuckensis* are in Mrs. Gray's Collection and come from Thraive Glen.

¹ Lindström, *op. cit.*, p. 76, pl. vi, figs. 1—10.

² Lindström, *op. cit.*, p. 75, pl. v, figs. 25—34.

³ Ulrich and Scofield, *op. cit.*, p. 920, pl. lxiv, figs. 14—16.

⁴ Phillips, 'Mem. Geol. Surv.', vol. ii, pt. i (1848), p. 356, pl. xiv, fig. 12.

⁵ Salter, 'Quart. Journ. Geol. Soc.', vol. vii (1851), p. 172, pl. ix, figs. 18, 18 a.

5. *Cymbularia merita*, sp. nov. Plate X, fig. 20.

Specific Characters.—Shell involute, subglobose; whorls rounded, slowly expanding to mouth, with high, strongly-arched dorsum, slightly excavated on each side of narrow slightly-raised keel bearing flattened slit-band so as to form parallel shallow revolving depressions. Umbilicus small or closed. Mouth subtriangular, large, about one and a-half times as wide as high, rather suddenly expanded at base, the lower thickened margins being nearly at right angles to vertical plane of shell; lateral margins making a dorsal angle of about 90° ; dorsal sinus V-shaped, large, wide, deep; lateral lobes prominent, angulated at corners of sinus at about 60° . Surface of whorls marked by regular fine gently-arched transverse lines, equidistant, rather closely placed, bending back sharply close to keel to meet slit-band at about 30° , with traces of very delicate and closely-placed faint revolving striæ crossing them.

Dimensions [G. 73904 a].—Height of shell to base of mouth, 12 mm.; height of shell including mouth, 20 mm.; width of mouth at base, 20 mm.; diameter of shell at umbilicus, 10 mm.

Horizon.—Wenlock Shale.

Locality.—Dudley.

Remarks.—This species is based on one specimen [G. 73904 a], in the British Museum, which was labelled *Bellerophon expansus*, Sow. Only the apertural view is seen, as the rest of the shell is imbedded in matrix, but the last whorl and the mouth are well preserved and the ornament on the surface is clearly shown. In the shape of the whorl, the narrow slightly-raised keel with a shallow revolving depression on each side of it, and the course of the transverse lines on the shell, it resembles *B. fastigiatus*, Lindström,¹ though the two species can scarcely be considered identical.

6. *Cymbularia turnbulli*, sp. nov. Plate XI, figs. 1—4.

? 1878. *Bellerophon ventriculatus*, Edgell MS., Catal. Camb. Silur. Foss. Mus. Pract. Geol., p. 67.

Specific Characters.—Shell involute, subglobose, somewhat compressed, the whorls subangular and higher than wide. Umbilicus small, deep, situated at less than half height of shell. Outer whorl nearly completely enveloping inner whorls, increasing in height rather rapidly, tectiform, subcarinate towards mouth; dorsum high, strongly-arched, subangular and weakly trilobed in outer third of whorl by broad, faint, revolving depressions, the median portion being more elevated and angulated towards mouth. Mouth widest at base with basal angles projecting; inner lip somewhat reflexed; lateral lips forming gently rounded lobes

¹ Lindström, *op. cit.*, p. 76, pl. vi, figs. 1—10.

not reflexed; upper lip with wide open V-shaped sinus followed by short narrow slit. Slit-band narrow, strongly margined. Surface of shell ornamented with fine regular equal closely-placed thread-like lines arching back suddenly near slit-band to meet it at about 20° — 30° . A few low narrow rounded equidistant transverse folds are usually present on the sides near the mouth.

Dimensions.—Height of shell, c. 16 mm.; width of outer whorl behind mouth, c. 11 mm.

Horizon.—Llandovery Group.

Locality.—(1) Gas Works, Haverfordwest; The Frolic, Haverfordwest; (2) ? Blaen-y-cwm.

Remarks.—This shell resembles *B. fastigiatus*, Lindström,¹ except in the weak trilobation of the dorsum, which is also met with in some specimens of the variety of *C. drummuckensis* above mentioned. Such a feature is found in the Devonian trilobed genus *Plectonotus*, Clarke, which agrees in this respect with *Bucaniella*, but possesses a slit-band. It is possible that a callosity filled up the umbilicus. The specimens of *C. turnbulli* occur mostly as internal casts. The types are in the Sedgwick Museum.

It is probable that the poorly preserved and more or less crushed specimens [28053—56] from the Lower Llandovery of Blaen-y-Cwm, in the Jermyn Street Museum, to which the name "*Bellerophon ventriculatus*, Edgell MS.," is attached, are referable to this species, but no description or figures of specimens have ever been published under this name.

7. *Cymbularia youngi*, sp. nov. Plate XI, figs. 5—8.

Specific Characters.—Shell lenticular, more or less compressed, completely involute; whorls tectiform, carinate, subtriangular, higher than wide, few in number, with acutely angulated dorsum. Umbilicus closed, subcentral. Mouth high, triangular, much expanded, but not reflected at base, projecting laterally and supported by stout horizontal callosities arising from umbilicus; outer lip with large V-shaped sinus and broadly rounded apertural lobes. Slit-band narrow, elevated in slight carina, concave, with raised edges. Surface of shell crossed by fine closely-placed regular thread-like transverse lines of equal strength, arched back suddenly at about two-thirds the height of whorl to meet slit-band at about 45° — 60° .

Dimensions.—Height of shell, c. 22 mm.; thickness at umbilicus, c. 11 mm.

Horizon.—Whitehouse Group (Middle Ordovician).

Locality.—Shalloch Mill, Girvan.

Remarks.—This shell, though closely allied to *C. drummuckensis*, is rather more compressed than that species; the slit-band is also borne on a more definite keel and

¹ Lindström, *op. cit.*, p. 76, pl. vi, figs. 1—10.

not simply on the ridge of the dorsum; the ornamentation is finer and the transverse lines meet the slit-band at a larger angle. *C. alata* (Portl.) and *B. fasciatus*, Lindstr.,¹ are related more or less closely to it. Similar laterally projecting umbilical callosities which support the basal angles of the mouth are found in *B. (Prosoptychus) plateius*, Barr., which Perner² considers allied to *B. globulus*, Lindstr., a species referred by Koken to his genus *Cymbularia*. The types are in Mrs. Gray's Collection.

8. ***Cymbularia* ? *woodlandensis***, sp. nov. Plate XI, figs. 9, 10.

Specific Characters.—Shell lenticular, compressed, acutely carinate, with outer whorl almost completely enveloping inner whorls. Umbilicus very small, open, about one-sixth the diameter of the shell, and with centre situated at about two-fifths its height. Outer whorl large, rapidly increasing in height, but slowly in width, with gently convex sides and sharp acute dorsum without distinct carina, but bearing very narrow slit-band; umbilical edge abruptly rounded; umbilical slope short, steep. Mouth not expanded, nearly three times as high as wide with deep acute narrow V-shaped sinus in outer lip and large rounded apertural lobes. Surface of shell covered with rather coarse sublamellose transverse lines crossing umbilical edge obliquely and arching very strongly back on sides to meet dorsal edge at 30°.

Dimensions.—Height of shell, 30—34 mm.; thickness above umbilicus, 7—10 mm.

Horizon.—Saugh Hill Group, Llandovery Series.

Locality.—Woodland Point, Girvan.

Remarks.—The specimens of this shell are not usually in a good state of preservation, and the slit-band is only represented by occasional traces. The shell has the appearance of *Oxydiscus*, but has a slit-band. It is doubtful if it should be referred to *Zonidiscus* or *Cymbularia*, but its resemblance in general characters to *C. tarda* (Barr.),³ inclines me to refer it to the latter genus. The type-specimens are in Mrs. Gray's Collection.

9. ***Cymbularia* cf. *fastigiata*** (Lindström). Plate XI, figs. 11, 12.

1884. *Bellerophon fastigiatus*, Lindström, Silur. Gastrop. Pterop. Gotland, p. 76, pl. vi, figs. 1—10.

Specific Characters.—"Shell rather more discoid than globular, aperture transverse and triangular in outline, the base being only slightly arched. . . .

¹ Lindström, *op. cit.*, p. 75, pl. vi, figs. 13, 14.

² Perner, *op. cit.*, p. 141, text-fig. 101.

³ Perner, *op. cit.*, p. 77, pl. lxxxvii, figs. 32—34, 36, text-fig. 105 a—c.

Whorls five, transverse, carinated on the dorsal side. Umbilicus open and large with steep borders. The transversal striæ of the surface crowded; joining the slit-band in an acute angle of 32° , they are bent outwards and backwards to the umbilicus. In several specimens there is an indistinct carina on both sides of the slit-band and parallel to it, placed at the point where the transverse striæ are bending backwards. The slit-band is elevated, flat on its top, finely and transversely sculptured, somewhat concave along its median line and bordered on each side by two thin-edged lines" (Lindström).

Horizon.—Lower Ludlow.

Locality.—Vinnal Hill.

Remarks.—The poorly preserved examples of this species of *Cymbularia* which are in the Jermyn Street Museum [28095, 28096, 28093, 28094] and come from the Lower Ludlow of Vinnal Hill, may be compared with Lindström's species *B. fastigiatus*, the description of which as given by him is above quoted. The enrolment of the whorls, shape of the dorsum, carination, size of the umbilicus, dorsal sinus and ornamentation seem to agree most closely with that species.

Genus **ZONIDISCUS**, Spitz.

Generic Characters.—Shell compressed, sharply carinated; umbilicus open. Whorls higher than wide, more or less lanceolate in cross-section; dorsal lip with long narrow median slit followed by narrow slit-band; inner lip reflexed.

This genus was founded in 1907 by Spitz¹ for a group of compressed shells with sharp dorsal edge and slit-band and the habit of *Oxydiscus*. *Cyrtolites discus*, Lindström,² from the Silurian of Gotland, was chosen as the type, and a Lower Devonian species, *Oxydiscus geyeri*, Frech,³ was also given as an example of the genus. Spitz (*op. cit.*) moreover referred Ulrich and Scofield's *Oxydiscus cristatus*, Safford, and Lindström's *Cyrtolites euryomphalus* to it.

Koken's *Temnodiscus* (= *Cyrtolitina*, Ulrich and Scofield⁴) may probably be an allied genus, but it has a different surface-sculpture, a less compressed lenticular shape and a less carinate dorsum.

1. **Zonidiscus grayi**, sp. nov. Plate XI, figs. 13—15.

Specific Characters.—Shell compressed, lenticular, thickest at umbilical edge, dorsally acute, composed of 3—4 whorls. Whorls high, narrow, lanceolate in cross-section, bearing elevated compressed prominent carina; sides gently convex,

¹ Spitz, "Gastrop. Karnischen Unterdevon," 'Beitr. Pal. Geol. Oesterr. u. Orients,' vol. xx (1907), p. 124, pl. xi (i), fig. 7 a—c.

² Lindström, 'Silur. Gastrop. Pterop. Gotland,' p. 84, pl. vii, figs. 18—21.

³ Frech, 'Zeitschr. deutsch. geol. Gesell.,' vol. xlvi (1894), p. 463, pl. xxxiv, fig. 2.

⁴ Ulrich and Scofield, *op. cit.*, pp. 847, 866.

becoming slightly concave near keel, and swelling out towards base so as to form a narrowly rounded or subangular umbilical edge; umbilical slope short, steep or vertical. Umbilicus open, rather deep, about one-fourth the diameter of shell in width, and situated at rather less than half its height. Outer whorl increasing rather rapidly in height and embracing greater part of shell, with long, narrow median open slit in lip extending back from peristome for about one-third of the whorl; remainder of outer whorl provided with narrow slit-band raised on carina having sharp edges, and crossed by thick strong subequidistant lunulæ sometimes thickened and rising above carina so as to give it a crenulated appearance. Mouth higher than wide, with reflexed inner lip. Surface of shell ornamented with rather unequal transverse fine lines directed back rather obliquely from umbilical edge and running nearly straight to base of carina, where they bend back suddenly to meet slit-band at about 45° .

Dimensions.—Height of shell, 27.0 mm.; height of outer whorl near mouth, 14.0 mm.; width of base of mouth, 11.0 mm.

Horizons.—(1) Drummuck Group (Starfish Bed), Upper Ordovician; (2) ? Redhill Beds.

Localities.—(1) Thraive Glen, Girvan; (2) ? Prendergast Place, Haverfordwest.

Remarks.—The edges of the open slit in the anterior part of the outer whorl are usually crushed together, but its posterior end is generally well marked by the sudden appearance of the carina. The slit-band is well preserved in specimens which retain the shell. Probably this is the species from Drummuck described by Salter¹ as “like *Bellerophon acutus*, but with wide umbilicus.”

The reference of this species to Spitz's genus *Zonidiscus* cannot be doubted, for it combines the shape and general appearance of *Oxydiscus* with the slit-band and slit of *Cymbularia*, and it closely resembles the type of *Zonidiscus* (*Cyrtolites discus*, Lindstr.), though that species comes from a higher stratigraphical horizon.

Several specimens of this species in the Hunterian Museum are labelled *Bellerophon* (*Trematomotus*) *carinatus*, with a note stating that the specimens show “the row of close perforations on the keel.” This appearance of perforations seems due to the obliquity and prominence of the equidistant thick lunulæ, which rise up in a series of little projections along the keel so as to separate slightly depressed and concave elongated areas on the slit-band, thus giving a spurious resemblance to oval foramina. A side view of the shell makes the carina appear crenulated, but after examining many specimens in various states of preservation with and without the shell, it seems certain that there are no true perforations.

The best specimens of this species are in the Hunterian Museum, Glasgow, and come from the Drummuck Group. Several examples also occur in Mrs. Gray's Collection.

The Redhill specimens which are in the Sedgwick Museum are too poor for satisfactory identification.

¹ Salter, 'Quart. Journ. Geol. Soc.' vol. vii (1851), p. 172.

2. *Zonidiscus grayi*, var. *shallochensis*, nov. Plate XI, figs. 16, 17.

Varietal Characters.—Shell much compressed, lenticular, dorsally acute, composed of about 3 whorls, thickest on umbilical edge. Whorls high, narrow, triangular; dorsum carinated, narrow, acute; sides of whorls gently convex to flattened, somewhat swollen at base, with narrowly rounded or subangular umbilical edge; umbilical slope short, vertical. Umbilicus open, about one-fifth the diameter of the shell and with centre situated at about two-fifths its height. Mouth not expanded, with narrow median open slit in outer lip, followed by narrow slit-band (elevated on carina) with fine raised edges and strong distant lunulæ. Surface of shell ornamented by fine transverse regular sublamellose equidistant lines running obliquely back from umbilical edge to meet dorsal edge at about 75°, but scarcely curved.

Dimensions.—Height of shell, 26—27 mm.

Horizon.—Whitehouse Group, Middle Ordovician.

Locality.—Shalloch Mill, Girvan.

Remarks.—The type-specimens of this variety are in Mrs. Gray's Collection. The difference between this form and *Z. grayi* lies in the more rapid increase in height of the outer whorl, the smaller umbilicus and the ornamentation, the lamellæ being thicker and coarser; but they are undoubtedly very much alike. Unfortunately the mouth and slit are not well preserved in any of the Shalloch Mill specimens. In Mrs. Gray's list (p. 696) in the 'Survey Memoir' this variety is entered with *Z. grayi* as *B. carinatus*, Sow.

3. *Zonidiscus? transiens*, sp. nov. Plate XI, figs. 18—21.

Specific Characters.—Shell lenticular, compressed, thickest at umbilicus, completely involute, composed of few whorls; outer whorl very slowly increasing in size, tectiform, subtriangular, as high as wide or rather higher than wide, completely embracing inner whorls; dorsum narrow, flattened, occupied by flat or slightly depressed slit-band; sides of whorl gently convex or somewhat flattened, rarely a little swollen at base. Umbilicus very small, deep, central, with subangular umbilical edges. Mouth high, subtriangular, not expanded; upper lip with deep long narrow V-shaped sinus followed by long slit; apertural lobes rounded, large. Surface of shell ornamented with very fine closely set, slightly wavy, and somewhat interrupted revolving lines parallel to slit-band, becoming faint or obsolete near umbilicus, and crossed by fainter gently-arched delicate transverse lines, distinct near umbilicus, but scarcely visible near periphery.

Dimensions.—Height of shell, 10—12 mm.; thickness at umbilicus, 5—6 mm.

Horizon.—Balclatchie Group, Lower Ordovician.

Localities.—Balclatchie; Ardmillan; Dow Hill, Girvan.

Remarks.—The non-expanded mouth, the long narrow dorsal slit succeeded by the slit-band, the small angular umbilicus, the complete occupation of the narrow dorsum by the slit-band and the general shape of the shell seem to necessitate its reference to the genus *Zonidiscus*. The revolving lines are unusual. There is also some resemblance to some species of *Conradella* and especially of *Temnodiscus*. In many of the specimens the edges of the dorsal slit are squeezed together, so that the slit is obliterated and the dorsum seems to be acutely carinated as in *Oxydiscus*, but the narrow seam between the edges can generally be detected.

All the examples of this species are in Mrs. Gray's Collection.

4. *Zonidiscus*, sp.

Specific Characters.—Shell discoidal, coiled in flat spiral, composed of 4—5 whorls, rather slowly increasing in size to mouth, very slightly overlapping, cordate in section, higher than wide, with acutely angular dorsum, convex sides, and short steep undefined umbilical slope. Umbilicus large, shallow, open, exposing inner whorls; no definite umbilical edge. [Slit-band present, very narrow?] Ornamentation unknown.

Dimensions.—Height of shell, 23·0 mm.; height of outer whorl near mouth, 8·5 mm.

Horizon.—Lower Llandovery.

Locality.—Canilo Hill, Builth; ? Blaen-y-cwm.

Remarks.—There are three specimens [28057—59] of this shell in the Jermyn Street Museum, but none are sufficiently well preserved to allow of a full specific diagnosis. The slit-band cannot be seen in the casts or impressions, and the ornamentation is not discernible. The shell labelled *B. discus*, Edgell MS. [28045], from the Lower Llandovery of Blaen-y-cwm, may be identical, but is itself too fragmentary for a satisfactory determination. The outer whorl does not increase in size so rapidly as in *Z. grayi* or *Z. grayi* var. *shallochensis*, and more resembles the species described by Lindström as *Cyrtolites discus*, Lindstr.,¹ which is the type of the genus *Zonidiscus*.

Genus **SALPINGOSTOMA**, Roemer.

Generic Characters.—Shell symmetrically coiled in one plane; whorls numerous, enlarging gradually, scarcely embracing; umbilicus large, open. Mouth abruptly expanded at maturity, forming a trumpet-like aperture, subcircular in shape;

¹ Lindström, *op. cit.*, p. 84, pl. vii, figs. 18—21.

peristome thin, the outer portion slightly sinuate. Inner whorls with a slit-band which is replaced in outer half of last whorl by a long narrow slit not extending to apertural expansion but closed some distance behind it. Surface marked with simple or sublamellose transverse growth-lines or rugæ and with more or less oblique irregular sometimes interrupted or wavy revolving lines.

The relations of this genus and the usage of the name *Salpingostoma* are discussed by Koken,¹ Ulrich and Scofield,² and Perner.³ The definition given by Ulrich and Scofield and the limitations assigned by them to the genus are here adopted. The type-species is *S. megalostoma*, Eichwald, of the Russian Ordovician. The true position of *Salpingostoma* in the scheme of classification adopted in this Memoir is somewhat doubtful, but it may be provisionally assigned to the group *Fissidorsata*.

1. **Salpingostoma asteroideum**, sp. nov. Plate XI, figs. 22, 23; Plate XII, figs. 1, 2.

Specific Characters.—Shell of 2—2½ whorls, loosely coiled, in contact but not overlapping, rapidly increasing in size (especially in height) to mouth, which is suddenly expanded at right angles to plane of shell to about three times the width of outer whorl. Outer whorl rounded, with weak dorsal carination developed especially near mouth, but elsewhere with subcircular cross-section, increasing rapidly in height near mouth. Umbilicus deep, open, exposing inner whorls, with centre at about one-fourth height of shell. Mouth immensely expanded, subcircular, rather higher than wide, with inner lip reflexed and extending below base of whorls; width of mouth about three times that of outer whorl; outer lip with small central emargination. Surface of shell covered with coarse strong, gently arched rounded rugæ regular and equidistant, meeting carina at 60°—75°, becoming weaker near mouth and dying out on expansions of peristome, with fine weak sinuous revolving spiral lines over the whole shell diverging slightly on each side from carina near aperture. Dorsal slit very narrow, usually concealed by carina.

Dimensions.—Width of mouth about 35 mm.; height of mouth about 40 mm.

Horizon.—(1) Drummuck Group (Starfish Bed), Upper Ordovician; (2) Upper Bala Beds.

Locality.—(1) Thraive Glen, Girvan; (2) ? Tyrone.

Remarks.—The types of this species come from Thraive Glen and are in Mrs. Gray's Collection. The immensely expanded mouth and the few whorls and ornamentation closely resemble *S. grande* (Barr.),⁴ from stage D in Bohemia, and

¹ Koken, 'Gastrop. Balt. Untersilur.', p. 131.

² Ulrich and Scofield, *op. cit.*, pp. 851, 897—900.

³ Perner, *op. cit.*, p. 96.

⁴ Perner, *op. cit.*, p. 97, pl. lxxxiv, figs. 12—14; pl. lxxxv, figs. 22—32; text-fig. 69a-f.

the species are undoubtedly closely allied. It is probable that the shell described by me as *Bellerophon? multirugatus*¹ from the Redhill Beds (Upper Bala) of the Haverfordwest area is also closely related, but it is not well enough known to make a complete comparison; the ornamentation seems almost identical. The crushed and distorted specimen said to be from Mulloch described and figured by McCoy² as *B. subdecussatus*, of which his figure was an inaccurate restoration, appears to present many points of similarity; the matrix is not that of the typical Mulloch Hill Sandstone, and the mode of preservation so much resembles that of *S. asteroideum* from the Starfish Bed that I am inclined to think this is its true horizon.

The dorsal slit is not well seen in any of our specimens, but its presence can here and there be detected, though near the mouth its place is always occupied by the weak carina. One fragment [20713] of a shell from Tyrone in the British Museum probably belongs to this species.

2. *Salpingostoma buccinoideum*, sp. nov. Plate XII, fig. 3.

Specific Characters.—Shell sublenticular, somewhat compressed; composed of 3—4 whorls in contact but not overlapping, rapidly increasing in height and less rapidly in width. Whorls sublanceolate in cross-section with gently convex sides, somewhat swollen near base and acutely carinated dorsum; terminal part of outer whorl free and suddenly expanding into large trumpet-shaped mouth of sub-circular shape; inner lip free. Umbilicus wide, shallow, open, exposing all the inner whorls; umbilical edge rounded. Traces of slit in dorsal carina. Surface of shell unknown.

Dimensions.—Height of shell, 27·0 mm.; height of outer whorl before becoming free, 12·0 mm.; width of ditto, 9·0 mm.; width of mouth, c. 30·0 mm.; height of mouth, c. 20·0 mm.

Horizons.—(1) Balclatchie Group (conglomerate), Lower Ordovician. (2) Stinchar Limestone Group, Lower Ordovician?

Localities.—(1) Balclatchie, Girvan; (2) Minuntion, near Girvan.

Remarks.—There is only one good specimen of this species from Balclatchie in Mrs. Gray's Collection, and this is chosen as the type; for the Minuntion specimen is poor and of doubtful reference. The large trumpet-shaped mouth and compressed carinate whorls are distinctive features. Perhaps *Salp. compressum* (Eichw.),³ is allied to it, and *Salp. megalostoma*, Eichw.⁴ also shows points of resemblance.

¹ Reed, 'Geol. Mag.' [5], vol. iii (1906), p. 365, pl. xx, figs. 11, 11 a.

² McCoy, 'Syn. Brit. Pal. Foss. Woodw. Mus.', p. 311, pl. 1, L, fig. 25 (non 25a).

³ Eichwald, 'Leth. Ross.', vol. i, pt. 2, p. 1068, pl. xli, fig. 9.

⁴ *Ibid.*, p. 1069, pl. xli, figs. 5 a—c.

3. *Salpingostoma etheridgei*, sp. nov. Plate XII, fig. 4.

Specific Characters.—Shell large, of 2—3 whorls in contact and slightly overlapping, rapidly increasing in height and more gradually in width, weakly carinate, subelliptical in section; sides convex, rounded, without umbilical edge. Umbilicus large, open; centre situated at less than one-third height of shell. Mouth rather suddenly expanded, more than three-fourths the height of shell; inner lip reflexed on to second whorl. Slit-band well marked, narrow, situated on low keel, with raised edges and distinct on inner portion of outer whorl, but becoming closed and represented only by sharp carination in outer three-fourths of whorl. Surface of shell smooth.

Dimensions.—Height of shell about 55.0 mm.; width of outer whorl near mouth about 28 mm.

Horizon.—Stinchar Limestone Group, Lower Ordovician.

Locality.—Craighead, Girvan.

Remarks.—The two species which most resemble it seem to be *Salp. megalostoma* (Eichw.)¹ from the Russian Orthoceras Limestone and *S. compressum* (Eichw.)² from Stage C. Our *Salp. buccinoideum* differs by having less regularly swollen sides, a sublanceolate instead of subcircular transverse section, a decided umbilical edge, a more acute dorsal carination and a free inner lip. The type of this species is in Mrs. Gray's Collection.

4. *Salpingostoma multirugatum* (Reed).

1906. *Bellerophon? multirugatus*, Reed, Geol. Mag. [5], vol. iii, p. 365, pl. xx, figs. 11, 11 a.

Specific Characters.—Shell with outer whorl rounded, rapidly enlarging towards mouth and embracing (?) inner whorls; dorsum broad, rounded, with low distinct narrow carina. Mouth transversely expanded with reflexed lip. Shell crossed by regularly arranged strong low rounded subequal broad transverse ribs, closely placed, separated by grooves of nearly equal width, curving back in a broad V of about 150° over the keel without interruption, but dying out on the margins of the mouth and becoming weaker on the umbilical slopes of the whorls; surface of ribs crossed by delicate fine revolving equidistant striæ parallel to the keel, but becoming sinuous, broken and irregular near the mouth.

Horizon.—Redhill Beds, Upper Ordovician.

Localities.—Prendergast Place; Mill Lane, Haverfordwest.

Remarks.—The original specimen on which this species was founded came

¹ Eichwald, 'Leth. Ross.', vol. i, pt. 2, p. 1069, pl. xli, figs. 5 a—c; Koken, 'Neues Jahrb. f. Miner.,' Beil. Bd. vi (1889), p. 384, pl. xiii, figs. 6, 9, 9 a; *idem.*, 'Gastrop. Balt. Untersilur.' (1897), p. 134.

² Eichwald, *ibid.*, p. 1068, pl. xli, fig. 9.

from the Redhill Beds of Haverfordwest and is in the Sedgwick Museum. The position and affinities of this species were regarded as doubtful by me when I described it, but now there can be no uncertainty as to its reference to the genus *Salpingostoma* and its close affinities to the Girvan species *S. asteroideum* and to *S. grande* (Barrande),¹ from Étage D in Bohemia. The specimens are crushed, distorted and imperfect, and the species is not capable of a completely satisfactory definition. It seems to have reached a large size, the mouth of some measuring 50—70 mm. across.

5. *Salpingostoma? infundibulum* (Salter MS.). Plate XII, fig. 5.

1878. *Bellerophon infundibulum*, MS. [? Salter], Cat. Camb. Silur. Foss. Mus. Pract. Geol., p. 123.

Specific Characters.—Mouth immensely expanded, forming a large free sub-circular flattened saucer; dorsal lip with small shallow open emargination followed by a narrow continuous groove on inner surface (occupied by open slit?) corresponding to keel on outer surface and continued on to dorsum of outer whorl. Ornamentation of inner surface of oral expansion composed of strong sinuous frequently broken and irregularly interrupted concentric rugæ, with fine regular concentric striæ between them. Outer whorl of shell just before expansion of mouth broadly transverse and deeply trilobed, consisting of median narrow strongly-elevated subangular portion and rounded lateral portions; lower portion of outer whorl free, not interrupting or indenting lower lip.

Dimensions.—Height of oral expansion, 43 mm.; width of ditto, 45 mm.; width of outer whorl before oral expansion, 18 mm.

Horizon.—Lower Ludlow.

Locality.—Vinnal Hill.

Remarks.—The peculiar trilobation of the outer whorl and the ornamentation of the oral expansion distinguish this imperfectly known shell, of which there is only the type specimen [28070] in Jermyn Street giving a full front view of the mouth. Its generic reference is doubtful.

6. *Salpingostoma*, sp.

In a specimen of a species of *Salpingostoma* from the Sholeshook Limestone in the Sedgwick Museum we get only a full front view of the mouth. This is sub-lanceolate in shape, higher than wide, pointed acutely above, but rounded below; it is widest across the middle. The lips are as usual suddenly reflected outwards at right angles to the plane of the shell, the lower lip being about one-fourth the height of the whole aperture and the upper lip about one-half the height; there

¹ Perner, *op. cit.*, p. 97, pl. lxxiv, figs. 12—14; pl. lxxxv, figs. 22—32; text-fig. 69.

is also a small V-shaped dorsal sinus. The presence of a sharp keel on the dorsum near the mouth is indicated in the cast. Perhaps this shell is allied to *S. richmondense*, Ulrich,¹ but it is too imperfectly known for an accurate comparison.

Dimensions.—Height of mouth, c. 55 mm.; width of mouth, c. 40 mm.

Horizon.—Shoeshook Limestone, Upper Ordovician.

Locality.—Shoeshook, Haverfordwest.

Sub-Group TEREPRODORSATA.

Genus **TREMATONOTUS**, Hall.

Generic Characters.—Shell enrolled like *Salpingostoma*. Mouth suddenly expanded, trumpet-shaped; border entire. Umbilicus wide, open, exposing inner whorls. Dorsum of each whorl with median row of closely-placed numerous rounded openings. Sculpture of shell consisting of revolving ridges and transverse undulating lamellæ. Shell composed of three layers with a fourth external one developed in old individuals.

Without discussing here the validity of the separation of *Phragmostoma* from *Trematonotus*, into which question Perner² has gone at some length, we use the generic name here in the same manner as he does, which is more restricted than that adopted by Ulrich and Scofield.³ The type is *T. alpheus*, Hall [? = *Bucania chicagoensis*, McChesney], from the Niagara Group, and the genus seems almost limited to the Upper Silurian.

Bellerophon dilatatus, Sowerby,⁴ is a well-known British example, and the specimens in the British Museum described by Mr. R. B. Newton as *Trematonotus britannicus*⁵ are now referred to this species (see below).

1. **Trematonotus aymestriensis** (Sowerby). Plate XII, figs. 7, 8.

1839. *Bellerophon aymestriensis*, Sowerby, in Murchison's Silurian System, p. 616, pl. vi, fig. 12.

1848. *Bellerophon aymestriensis*, Sowerby, Férussac and D'Orbigny, Hist. Nat. Ceph., vol. i, p. 216, pl. viii, fig. 15.

? 1860. *Bellerophon aymestriensis*, Sowerby, Eichwald, Leth. Ross., vol. i, Anc. Per., p. 1084.

1885. *Bellerophon dilatatus*, Sowerby, Etheridge (*pars*), Brit. Pal. Foss., p. 119.

? 1884. *Trematonotus compressus*, Lindström, Silur. Gastrop. Pterop. Gotland, p. 87, pl. iv, figs. 8—12.

Specific Characters.—Shell discoidal, of 4—5 whorls in contact but scarcely

¹ Ulrich and Scofield, *op. cit.*, p. 903, pl. lxxvii, figs. 39, 40.

² Perner, *op. cit.*, pp. 104, 121.

³ Ulrich and Scofield, *op. cit.*, p. 851.

⁴ Murchison, 'Silur. Syst.', p. 627, pl. xii, figs. 23, 24.

⁵ Newton, 'Geol. Mag.' [3], vol. ix (1892), p. 337, pl. ix.

overlapping. Umbilicus large, shallow, open, exposing all the inner whorls. Whorls transversely elliptical, about twice as wide as high, increasing very slowly in size to near mouth where the height increases rather more rapidly; dorsum gently convex or flattened, except near mouth; umbilical edges subangular, becoming more rounded near mouth. Median line of oval foramina on narrow band on dorsum, gradually increasing in size and in distance apart towards mouth. Regular revolving thick lines on dorsum, 12—14 on each side of the row of foramina, becoming coarser and less regular on oral expansion. Mouth large, trumpet-shaped, rather suddenly expanded, subcircular, with lower lip reflected but not descending as low as centre of umbilicus.

Dimensions:

	I.	II.
Height	c. 80 mm.	c. 70 mm.
Thickness	c. 30 „	c. 35 „

Horizon.—(1) Aymestry Limestone; (2) Lower Ludlow.

Localities.—(1) Aymestry; Leintwardine; (2) Mary Knoll, Ludlow.

Remarks.—The type specimen [6709] in the Jermyn Street Museum is an imperfect internal cast, but it shows some of the foramina on the dorsum, though Sowerby did not mention them. The other specimen [28003] from Leintwardine is a more complete internal cast, and was labelled by someone *Trematonotus compressus*, Lindström, with a query, to which species it is undoubtedly closely allied. It differs from *Tr. dilatatus* in the more discoidal form of the shell, the larger and more open umbilicus, the more flattened dorsum, the sharper and more marked umbilical edges, and the oval shape of the foramina and more complete chain of them on the dorsum. The mouth also seems to have been relatively smaller, but this is doubtful.

Sowerby's description of his Aymestry form is as follows: "Thick, discoid, with a broad, rather flat margin; whorls few, their section transversely oblong and but slightly indented by the preceding whorl; aperture expanded. The greater part of the mouth is, in this specimen, broken away, but enough is left to show that it expands; is it not possible that if it were perfect it would prove to be like *B. dilatatus* (pl. xii, f. 23 and 24)? Diameter $3\frac{1}{4}$ inches, thickness 2 inches 10 lines. Loc. Aymestry."

Lindström (*op. cit.*, p. 88) mentions this species as apparently nearly related to his *Tr. compressus*. Of the specimens in the Jermyn Street Museum [28071, 28072] from the Lower Ludlow of Mary Knoll belonging to *T. aymestriensis* one of them [28071] shows the external ornamentation and the line of foramina.

2. *Trematonotus dilatatus* (Sowerby). Plate XIII, fig. 1.

1839. *Bellerophon dilatatus*, Sowerby, in Murchison's Silurian System, pp. 622, 627, pl. xii, figs. 23, 24.

1875. *Bellerophon dilatatus*, Sowerby, Baily (*pars*), Charact. Brit. Fossils, p. 65, pl. xxii, figs. 1 a, 1 b.

1884. *Bellerophon dilatatus*, Sowerby, J. D. La Touche, Handbook to the Geology of Shropshire, p. 73, pl. xiv, figs. 489—491.
- ? 1884. *Trematonus longitudinalis*, Lindström, Silur. Gastrop. Pterop. Gotland, p. 86, pl. iv, figs. 1—7.
1892. *Trematonus britannicus*, R. B. Newton, Geol. Mag. [3], vol. ix, p. 337, pl. ix.
- Non 1843. *Bellerophon dilatatus*, Sowerby, var., Portlock, Geol. Rep. Londond., p. 398, pl. xxix, fig. 1.
- Non 1852. *Bellerophon dilatatus*, McCoy, Syn. Brit. Palæoz. Foss. Woodw. Mus., fasc. ii, p. 309.
- Non 1860. *Bellerophon dilatatus*, Sowerby, Eichwald, Leth. Ross., vol. i, Anc. Per., p. 1067.

Specific Characters.—Shell discoidal; whorls few, transverse, about twice as wide as high, slightly overlapping, slowly increasing in size to mouth. Umbilicus open, rather deep, more than half the diameter of the shell; umbilical edges rounded. Outer whorl with gently convex dorsum becoming more convex and even subangular towards mouth, with a narrow median ridge developed in the distal two-thirds showing along it a few large oval foramina set at subequal distances apart. Mouth large, subtriangular or cordate, higher than wide, with rather abruptly reflexed, much expanded flattened margins, having the upper lip vertical and about twice as wide as the lower lip, and the lateral lips gradually decreasing in width to the lower lip, which descends owing to its reflection as low as centre of umbilicus and is interrupted medially by the inner part of the outer whorl. Small dorsal emargination in upper lip. Exterior of shell ornamented with rather closely-set thick revolving slightly sinuous lines parallel to central ridge but diverging slightly on expanded margins of mouth, and with a few transverse growth-lines. Interior of mouth with expanded margins showing similar thick revolving lines concentrically striated and diverging outwards in a pinnate fashion on each side of the median line of the upper lip.

Dimensions :

	I (6712)	II (4597)
Height of shell with oral expansion	c. 95 mm.	c. 105 mm.
Height of shell to base of mouth	c. 38 „	c. 40 „
Width of mouth	c. 65 „	c. 75 „
Width of outer whorl at base of mouth	c. 20 „	c. 23 „

Horizons.—(1) Wenlock Limestone; (1 a) Wenlock Shale; (2) Lower Ludlow?; (2 a) Woolhope Beds.

Localities.—(1) Burrington, near Ludlow; (1 a) Dudley; (2) Kingsland; ? Mary Knoll, Ludlow; (2 a) Worcester Railway, Malvern [28075].

Remarks.—There are two excellent specimens in the Jermyn Street Museum, of which Sowerby's original type from Burrington [6712] (Sowerby, *op. cit.*, pl. xii, fig. 23) is rather less perfect than the other [4597], the locality of which is doubtful. Sowerby's description is as follows: "Discoid, smooth; sides largely umbilicated; margin broad, slightly convex, with a central ridge; whorls few; aperture suddenly dilated to a much greater diameter than the spire and enclosing

it, orbicular. Diameter of the spire 1 inch 8 lines, thickness 1 inch, longest diameter of the aperture 3 inches, rather longer than wide. The last whorl before it expands to form the large aperture, is twice as wide as long. The edge of the aperture embraces two-thirds of the discoid spire; the front of it has no fissure, although there is a ridge upon the whorl which indicates the existence of such a fissure at an earlier period of growth. Two of our specimens show furrows inside the mouth; the one from the Lower Ludlow Rock is nearly smooth, but has slight indications of them; may not the former be impressions of the outer surface? Loc. Burrington, near Ludlow."

It will be noticed that he does not mention the foramina, but there are distinct traces of their presence in his type-specimen, though it is not as well preserved in this region as could be wished. The presence of external revolving ridges is also doubtful, as the shell is missing on the dorsum.

Lindström¹ was doubtful if his *T. longitudinalis* was identical with Sowerby's species, and remarked that neither Sowerby nor McCoy make mention of the presence of foramina in the dorsal line. McCoy's² description of the species was based on the Girvan specimens from Mulloch Hill, which show the revolving lines distinctly and are here regarded as a separate species referable to *Phragmostoma* (see *Phr. decipiens*).

R. B. Newton (*op. cit.*) has given a full description of certain specimens in the British Museum, from the Wenlock Beds of Dudley, which he describes as *Trematodontus britannicus*, but it does not seem possible to separate them from Sowerby's *B. dilatatus*, though they are very much better preserved than the latter's types, and show the foramina on the dorsum with great clearness as well as the ornamentation of thick sinuous revolving lines. Newton states that there is no sign of an apertural sinus and that the margin is entire, but the broad shallow open notch figured by Lindström in his *Tr. longitudinalis* appears to exist.

The specimen [27997] from the Wenlock Shale of Dudley in the Jermyn Street Museum, though distorted, may be referred to this species; it shows well the spiral lines and foramina as in Newton's figured specimens of *Tr. britannicus*, but concentric striæ seem more developed round the reflected margins of the mouth where the spiral lines have completely died out.

The difference in the appearance of the exterior of these shells seems largely due to the fact that the shell itself consists of more than one layer, the inner one bearing the revolving lines, as Perner³ has pointed out. The Bohemian species *Tr. beraunensis*, Perner,⁴ from Stage Ee2, which shows the structure distinctly, is allied to our *Tr. dilatatus*.

¹ Lindström, *op. cit.*, p. 86, pl. iii, figs. 39, 40; pl. iv, figs. 1—7.

² McCoy, *op. cit.*, p. 309.

³ Perner, *op. cit.*, pp. 104, 105.

⁴ *Ibid.*, p. 114, pl. lxxxii, figs. 26—29; pl. lxxxvi, figs. 45, 46; text-figs. 80—82.

It is possible that several varieties are included under the specific name *Tr. dilatatus*; but the evidence is hardly sufficient to separate them satisfactorily, except in the case of the form from Woodland Point described below. The specimen [28060] from the Upper Llandovery of Bog Mine, Shelve, may belong to a distinct variety, but is too poor for description.

3. ***Trematonotus dilatatus*, var. nov. *girvanensis*.** Plate XIII, figs. 2, 3.

Varietal Characters.—This shell, of which the types occur in Mrs. Gray's Collection, agrees with the type-form in general characters, but the umbilical edges seem to be subangular, and the oval aperture subcircular or transversely elliptical in shape, the upper lip being less high and the lower lip especially narrower, for it only descends about one-fourth the distance from the base of the mouth to the base of the shell, and therefore does not reach the centre of the umbilicus. The foramina along the middle line of the dorsum also are smaller, but in no case are they well preserved. The whole shell seems more globose and the whorls relatively broader than in the type; but owing to crushing and distortion of the specimens this may be more apparent than real.

Dimensions.—Height of shell (with oral expansion), 67 mm.; height of ditto to base of mouth, 27 mm.; width of mouth, 64 mm.; width of outer whorl at base of mouth, 21 mm.

Horizon.—Saugh Hill Group, Llandovery Series.

Locality.—Woodland Point, Girvan.

4. ***Trematonotus portlocki*, sp. nov.** Plate XIII, fig. 4.

1843. *Bellerophon dilatatus*, Sowerby, var., Portlock, Geol. Rep. Londond., p. 398, pl. xxix, fig. 1.

1875. *Bellerophon dilatatus*, Sowerby, Baily (*pars*), Charact. Brit. Fossils, vol. i, Palæoz., p. 65 (*non* pl. xxii, figs. 1 a, 1 b).

Specific Characters.—Shell of few volutions; whorls low, transverse, wider than high, with broad gently convex dorsum; umbilicus large, open, exposing inner whorls (?); umbilical edges angular or subangular. Median band narrow, flattened, slightly raised, continuous, bearing small oval contiguous foramina (?). External surface of dorsum ornamented with closely-placed thick revolving lines, 20–24 on each side of slit-band, decussated by fine closely-placed transverse lines. Mouth abruptly expanded to a great size, being in height more than twice the diameter of the shell, subcircular in shape, rather higher than wide, with slight dorsal emargination and with whole margin reflexed and flattened, but not covering last whorl in front, wider dorsally than laterally, and marked with concentric striæ; whole interior of mouth ornamented with closely-placed thick revolving lines

similar to those on dorsum, curving outwards slightly on each side of a median impressed groove running up to marginal dorsal sinus.

Dimensions.—Height of shell (without oral expansion), c. 20 mm.; height of mouth, c. 47 mm.; width of mouth, c. 44 mm.

Horizon.—Upper Bala Beds.

Locality.—Desertcreat, Tyrone.

Remarks.—There is only one specimen, the type [27996] of this species, and it is in the Jermyn Street Museum; the apertural side which Portlock correctly figured is complete, but the umbilicus and dorsal parts are obscured by matrix. The raised continuous median band and the ornamentation mark it off at once from the typical *Tr. dilatatus* (Sow.), though Portlock says that Sowerby's description "exactly suits" it. The foramina on the slit-band are very indistinct, but seem to be small and contiguous. The raised band and general aspect somewhat resemble *Tr. longitudinalis*, Lindstr.,¹ but the finer and more regular ornament and the greater sharpness of the umbilical edges are distinctive features. The band, as in that species, seems to become narrower and sharper and to lose its foramina on the oral expansion.

Genus **PHRAGMOSTOMA**, Hall (*emend.* Koken).

Generic Characters.—Shell of same general shape and structure as *Trematonotus*, but with dorsum possessing only one opening or a small number of orifices. These orifices only occur on the outer whorl towards the mouth and are borne on a median ridge bordered on each side by a groove; the rest of the dorsum of the outer whorl is smooth.

The generic name is here employed in the manner followed by Perner (*op. cit.*, p. 121), who adopted Koken's² definition. The single species described below is doubtfully referred to this genus.

1. **Phragmostoma decipiens**, sp. nov. Plate XIII, figs. 5—7.

1852. *Bellerophon dilatatus*, Sowerby, McCoy, Syn. Brit. Pal. Foss. Woodw. Mus., fasc. ii, p. 309 (*non* Sowerby).

Specific Characters.—Shell subglobose, subdiscoidal, of 4—5 broad transverse whorls, slightly overlapping to about one-fourth or one-fifth their height; umbilicus conical, deep, rather large, being rather more than one-third the diameter of the shell, exposing all the inner whorls; umbilical edge subangular to rounded;

¹ Lindström, *op. cit.*, p. 86, pl. iv, figs. 1—7.

² Koken, 'Die Leitfossilien' (1896), p. 99.

umbilical slope very steep. Whorls transverse, low, about twice as wide as high, with distal third of outer whorl nearly straight, increasing slowly in height to mouth but more rapidly in height in distal third; dorsum gently rounded or slightly flattened except in distal third where it becomes carinated with a sharp median angulation. Mouth transverse, slightly expanded at sides (but not abruptly), with lower lip reflected and thickened; upper lip not reflected or thickened, but with broad open very shallow V-shaped emargination followed by long narrow median slit and then by slightly depressed band showing obscure traces of small oval foramina. Surface of shell ornamented with (1) closely-placed fine transverse striæ, becoming stronger and squamose near margins of aperture and curving back to meet median line at about 60°; and with (2) weak low rounded regular equal revolving ridges parallel to median line and becoming stronger and more distinct on umbilical slopes where they are slightly oblique to the suture-lines, and are finely cancellated by the transverse striæ.

Dimensions.—Height, c. 60 mm.; thickness, c. 20 mm.; diameter of umbilicus, c. 24 mm.

Horizon.—Mulloch Hill Group, Llandoverly Series.

Locality.—Mulloch Hill, Girvan.

Remarks.—This large shell, of which the types are in Mrs. Gray's Collection, was referred by McCoy to *Tr. dilatatus* (Sow.), and in fact he only mentioned this Girvan locality for the occurrence of the species. The specimens which he thus labelled in the Sedgwick Museum and the more abundant and more illustrative material in Mrs. Gray's Collection show that it cannot be considered identical with Sowerby's form. The non-reflection of the upper lip of the mouth, the narrow median dorsal slit, the much smaller expansion of the mouth and depressed median band are sufficient to separate it, though the general shape of the shell and character of the ornamentation are on the whole closely similar. Indeed there was at first some doubt in my mind whether it was separable from the form from Woodland Point described above as *Trem. dilatatus* var. *girvanensis*, but the reduced sharpness of the umbilical edge, the presence of the median slit on the dorsum, the simple non-reflected and unthickened upper lip, the straightening of the last part of the outer whorl, the strong transverse striæ and the depressed median band are distinguishing features. The ornament of longitudinal revolving lines is almost identical. As to the genus to which this Mulloch Hill shell should be referred, *Phragmostoma* seems more suited to receive it than *Trematonotus*, and we may compare *Phr. civis* (Barr.)¹ from Stage Ee 2 for the double ridge or slit-band on the last whorl and for the ornament, and *Phr. nobile* (Barr.)² for the carination and foramina near the mouth.

¹ Perner, *op. cit.*, p. 125, pl. cciv, figs. 20—30; text-figs. 89, 90.

² *Ibid.*, p. 122, pl. lxxxii, figs. 6, 7; pl. lxxxvi, figs. 43, 44; text-figs. 87 a—d.

Genus **CARINAROPSIS**, Hall.

Generic Characters.—Shell composed of little more than two whorls, the inner one very small, scarcely embraced by the outer, and more or less free; outer whorl very large, rapidly expanded; dorsum sharply carinated, becoming less angular towards aperture; [slit-band occasionally distinguishable?]. Mouth very large, with everted margins; dorsal lip thin, sinuate and centrally notched; inner lip entire, reflexed [with broad thick inner plate bearing median ridge]; inner aperture to whorls covered [always?] by triangular flat operculum.

Ulrich and Scofield¹ believe that this genus should include the genus *Pterotheca*, Salter, the Girvan representatives of which have been described by the present author² amongst the Pteropoda. Perner,³ however, puts *Carinaropsis* (which he spells *Carinariopsis*) in his group Bucanioidea. In Zittel-Eastman's 'Text-book of Palæontology' (2nd edit., 1913, p. 523) the genus is put in a family by itself after the family Bellerophontidæ, but *Pterotheca* is included with the Pteropoda and placed in the family Hyolithidæ. A discussion of the characters of *Carinaropsis* and of the diverse usage of the name by various authors is given by Perner. Our British specimens do not help to clear up the difficulties connected with it. I have not seen any trace of a slit-band in any examples, and I much doubt if forms possessing this structure should be included in this genus, of which the type-species is *C. carinata*, Hall,⁴ of the Trenton Group.

1. **Carinaropsis gracilis**, sp. nov. Plate XIII, figs. 8, 9.

Specific Characters.—Shell of 1—1½ whorls, scarcely embracing, acutely carinate, triangular in section; umbilicus small, situated at about one-fourth the height of shell. Outer whorl very rapidly increasing in size to about three or four times the height and width at peristome. Mouth large, much expanded laterally, transversely elliptical in shape, with broad acute shallow V-shaped sinus in outer lip; apertural lobes rounded, very large, laterally extended and flattened, inner lip somewhat deflected. Surface of shell with fine transverse striæ and growth-lines concentric to margin near peristome.

Dimensions :

	I	II
Height of shell	c. 16·5 mm.	21 mm.
Width of mouth	c. 18·5 „	27 „

Horizon.—Balclatchie Group, Lower Ordovician.

Localities.—Ardmillan; Balclatchie; Dow Hill, Girvan.

¹ Ulrich and Scofield, *op. cit.*, pp. 857, 926.

² Reed, 'Trans. Roy. Soc. Edinburgh,' vol. xlvii, pt. ii, no. 9 (1909), p. 215.

³ Perner, *op. cit.*, p. 90.

⁴ Hall, 'Palæont. New York,' vol. i (1847), p. 183, pl. xl, figs. 1 a—c.

Remarks.—This shell is allied to *C. acuta*, Ulr. & Scof.,¹ and *C. explanata*, Ulr.,² but the internal septum is not visible in any of our specimens from Girvan. The species from the Corona Beds of Roman Fell near Appleby described below bears much resemblance to this Scottish one, the type-specimens of which are in Mrs. Gray's Collection.

2. *Carinaropsis maccoyi*, sp. nov. Plate XIII, fig. 10.

1852. *Bellerophon carinatus*, Sowerby, McCoy (*pars*), Syn. Brit. Pal. Foss. Woodw. Mus., fasc. ii, p. 309.

Specific Characters.—Shell of few whorls, carinated; outer whorl acutely angular, wedge-shaped, rapidly increasing in height, with sharp dorsum and suddenly expanded mouth. Umbilicus small, open, partly exposing 1—2 inner whorls; umbilical edge subangular; umbilical slope very steep. Mouth transverse, wider than high, with everted margins and inner lip descending nearly to base of shell; large deep V-shaped sinus in outer lip.

Dimensions.—Height of shell, 3.50 mm.; width of mouth, 4.75 mm.

Horizons.—(1) Middle Bala; (2) Corona Beds, Bala Series.

Localities.—(1) Dolydd Ceiriog Waterfall, E. of Berwyn Mts.; (2) Roman Fell, near Appleby.

Remarks.—The two small specimens in the Sedgwick Museum from Dolydd Ceiriog which McCoy and Salter labelled respectively *Bellerophon acutus* and *B. carinatus*, are quite distinct from typical examples of these species. The very large transversely expanded and reflexed mouth, the very rapid increase in the height of the outer whorl, the small number of whorls, the small umbilicus and whole appearance of the shell at once distinguish it. But it bears a considerable resemblance to *Carinaropsis acuta*, Ulr. & Scof.,³ from the Black River Group of Minnesota. The specimens from Roman Fell are mostly larger than those from Dolydd Ceiriog, but seem referable to the same species. The Dolydd Ceiriog shell is chosen as the type of our species.

Species of Bellerophontacea of uncertain value.—The four very fragmentary specimens [28046—49], from the Lower Llandovery of Blaen-y-cwm, which Salter⁴ named *Bellerophon ionicus*, but did not describe or figure, are in the Jermyn Street Museum. They are too imperfect and broken to allow of any specific description.

The same poor state of preservation likewise prevents any satisfactory determination of the solitary specimen [28045] from the same horizon and locality and

¹ Ulrich and Scofield, *op. cit.*, p. 928, pl. lxii, figs. 6—9.

² *Ibid.*, p. 929, pl. lxii, fig. 5.

³ Ulrich and Scofield, *op. cit.*, p. 928, pl. lxii, figs. 6—9.

⁴ 'Catal. Camb. Silur. Foss. Mus. Pract. Geol.' (1878), p. 67.

in the same Museum to which Wyatt Edgell¹ attached the MS. name of *Bellerophon discus*, but it probably is referable to the genus *Zonidiscus* rather than to *Oxydiscus* (see p. 74). It seems to resemble in general characters the shell called *Oxydiscus annularis*, Perner,² from Stage Ee 2 in Bohemia.

ADDENDUM.

Salpingostoma shallochense, sp. nov. Plate XII, fig. 6.

Specific Characters.—Shell composed of few whorls in contact but not overlapping, slowly increasing in size to mouth, circular or subcircular in section, but with dorsum of last whorl weakly carinated towards mouth. Outer whorl ornamented with transverse rugæ set some distance apart and slightly arched back in middle so as to form a wide angle on the dorsum, which shows distinct traces of a median slit with compressed, somewhat sinuous (?) edges. Mouth suddenly and immensely expanded nearly at right angles to plane of shell, forming a trumpet-shaped subcircular peristome with flattened lips about five times the diameter of outer whorl; inner lip reflexed and descending below base of whorls; outer lip entire, without median emargination, but with faint median ridge on its outer surface in continuation of dorsal slit on last whorl. Surface of peristomal expansion marked with low concentric growth-ridges and ornamented with numerous radiating thick rounded raised lines, mostly equidistant and regularly disposed, minutely wavy on the inner and lateral portions, with the broader interspaces occupied by 4–7 much finer similarly wavy thread-like radial lines. Inner surface of peristome showing numerous fine straight radiating striæ and a few concentric growth-ridges.

Dimensions.—Height of shell before oral expansion, c. 25 mm.; width of mouth, 60–65 mm.; height of mouth, 50–55 mm.

Horizon.—Whitehouse Group.

Locality.—Shalloch Mill, Girvan.

Remarks.—The cast and impression of the huge mouth of this shell, with a portion of the coiled whorls attached, has been lately sent me by Mrs. Gray. Unfortunately there is not sufficient of this imperfectly preserved specimen to give as full a description of the specific characters as could be desired, but the species is certainly distinct from any previously described, although it is obviously allied to *S. grande* (Barr.)³ from Stage D 5 in Bohemia, agreeing with it in the ornamentation of the peristome, the transverse ribs on the whorls, and the dorsal slit.

¹ *Ibid.*, p. 67.

² Perner, *op. cit.*, p. 74, pl. lxxxvi, figs. 1–3.

³ *Ibid.*, p. 97, pl. lxxxiv, figs. 12–14; pl. lxxxv, figs. 22–32; text-fig. 69 a–f.

STRATIGRAPHICAL DISTRIBUTION OF THE BELLEROPHONTACEA IN ENGLAND AND WALES.

ARENIG.

- Sinuities*? *ramseyensis* (Hicks).
 „ *discoides*, sp. nov.?
Oxydiscus? *llanvirnensis* (Hicks).
 „ ? *perturbatus* (Sow.).
Tetranota hippopus (Salt.).
Bellerophon? *solvensis*, Hicks.
 Budleigh { *Cyrtolites budleighensis*, sp. nov.
 Salterton { *Bellerophon*, sp.

BALA (including LLANDEILO).

- Sinuities anceps* (Salt. MS.).
 „ *bilobatus* (Sow.).
 „ *crypticus*, Reed.
 „ *pseudocompressus*, sp. nov.
 „ *pusgillensis*, sp. nov.
 „ *semirugosus* (Salter MS.).
 „ *soudleyensis*, sp. nov.
 „ sp.
Oxydiscus acutus (Sow.).
 „ ? *llanvirnensis* (Hicks).
 „ ? *perturbatus* (Sow.).
Cyrtolites nodosus (Salt.).
 „ sp.
Bucania, sp.
Kokenospira lingualis (Salt.).
 „ *latidorsata*, sp. nov.
 „ *secunda* (Reed).
Bucaniopsis nicoli, sp. nov.
Conradella sladensis, Reed.
Salpingostoma multirugatum (Reed).
 „ sp.
Carinaropsis maccoyi, sp. nov.

LLANDOVERY.

- Cyrtolites nodosus* (Salt.), var. nov. *llan-doveriana*.

- Bucaniella quadrisulcata*, sp. nov.
 „ *trilobata* (Sow.).
Kokenospira credibilis, sp. nov.
Bellerophon wenlockensis, Sow., var.
Bucaniopsis?, sp.
Cymbularia carinata (Sow.), var.
 „ *turnbulli*, sp. nov.
Zonidiscus, sp.
Trematonotus dilatatus (Sow.), var.

WENLOCK.

- Bucaniella trilobata* (Sow.),
Kokenospira subdecussata (McCoy).
Temnodiscus fletcheri, sp. nov.
 „ *monilifer*, sp. nov.
 „ *salopiensis*, sp. nov.
Bellerophon globulus, Lindstr.
 „ *ledburiensis*, sp. nov.
 „ *wenlockensis*, Sow.
Bucaniopsis? cf. *latevittatus*, Lindstr.
Cymbularia merita, sp. nov.
Trematonotus dilatatus (Sow.).

LUDLOW.

- Bucaniella trilobata* (Sow.).
Bellerophon globulus, Lindstr.
 „ *ruthveni*, Salt. MS.
Temnodiscus murchisoni (D'Orb.).
 „ *solitarius*, sp. nov.
Bucaniopsis expansus (Sow.).
Cymbularia carinata (Sow.).
 „ cf. *fastigiata* (Lindstr.).
Salpingostoma? *infundibulum*, Salt. MS.
Trematonotus aymestriensis (Sow.).
 „ *dilatatus* (Sow.).

ORDOVICIAN SPECIES OF BELLEROPHONTACEA FROM TYRONE, IRELAND.

BALA.

- Sinuities bilobatus* (Sow.)?
 „ *elongatus* (Portlock).
 „ *subrectangularis*, sp. nov.?

- Kokenospira lingualis* (Salt.).
Cymbularia alata (Portlock).
Salpingostoma asteroideum, sp. nov.?
Trematonotus portlocki, sp. nov.

[Note.—The Silurian species of Bellerophontacea occurring in Ireland are not sufficiently known to give a satisfactory list.]

STRATIGRAPHICAL DISTRIBUTION OF THE BELLEROPHONTACEA IN THE
GIRVAN DISTRICT, SCOTLAND.

ORDOVICIAN.

STINCHAR LIMESTONE GROUP.

- Oxydiscus bougangensis*, sp. nov.
 „ *hunteri*, sp. nov.
Cyrtolites craigensis, sp. nov.
Bucania gravida, sp. nov.
 „ cf. *punctifrons* (Emmons).
Kokenospira nicholsoni, sp. nov.
Tetranota carrickensis, sp. nov., var. *craigensis*.
Salpingostoma buccinoideum, sp. nov. ?
 „ *etheridgei*, sp. nov.

BALCLATCHIE GROUP.

- Sinuities balclatchiensis*, sp. nov.
 „ *discoides*, sp. nov.
 „ *maccallumi*, sp. nov.
 „ ? *sphaeroidalis*, sp. nov.
 „ ? *separatus*, sp. nov.
Sinuities congruens, sp. nov.
Oxydiscus hunteri, sp. nov.
Bucania evoluta, sp. nov.
 „ *gravida*, sp. nov.
Kokenospira maccullochi, sp. nov.
Tetranota carrickensis, sp. nov.

MULLOCH HILL GROUP.

- Kokenospira mullochensis*, sp. nov.
Bellerophon sphaera, Lindstr., var. nov. *judex*.
Phragmostoma decipiens, sp. nov.

SAUGH HILL GROUP.

- Bellerophon sphaera*, Lindstr., var. nov. *judex*.
Cymbularia ? *woodlandensis*, sp. nov.

- Zonidiscus transiens*, sp. nov.
Salpingostoma buccinoideum, sp. nov.
Carinaropsis gracilis, sp. nov.

WHITEHOUSE GROUP.

- Isospira huttoni*, sp. nov.
Bucania Playfairi, sp. nov.
Conradella girvanensis, sp. nov.
 „ ? *multilineata*, sp. nov.
Bucaniopsis forbesi, sp. nov.
Cymbularia youngi, sp. nov.
Zonidiscus shallochensis, sp. nov.
Salpingostoma shallochense, sp. nov.

DRUMMUCK GROUP.

- Sinuities subrectangularis*, sp. nov.
Cyrtolites thraivensis, sp. nov.
Kokenospira lingualis (Salt.), var. nov. *girvanensis*.
Tetranota carrickensis, sp. nov. var. *etheridgei*.
Conradella aff. *fimbriata*, Ulr. & Scof.
Bucaniopsis nicoli, sp. nov.
Cymbularia drummuckensis, sp. nov.
Zonidiscus grayi, sp. nov.
Salpingostoma asteroideum, sp. nov.

SILURIAN.

- Trematonotus dilatatus* (Sow.), var. nov. *girvanensis*.

CAMBEGAN GROUP.

- Kokenospira euphemoides*, sp. nov.

PENKILL GROUP.

- Bellerophon*, sp. ind.

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NOTE.—The roman and arabic numerals following a semicolon refer to the plates and figures illustrating those species which are figured.

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 „ *var. craigensis*, *Tetranota*, 42; VIII,
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 „ *var. etheridgei*, *Tetranota*, 42; VIII,
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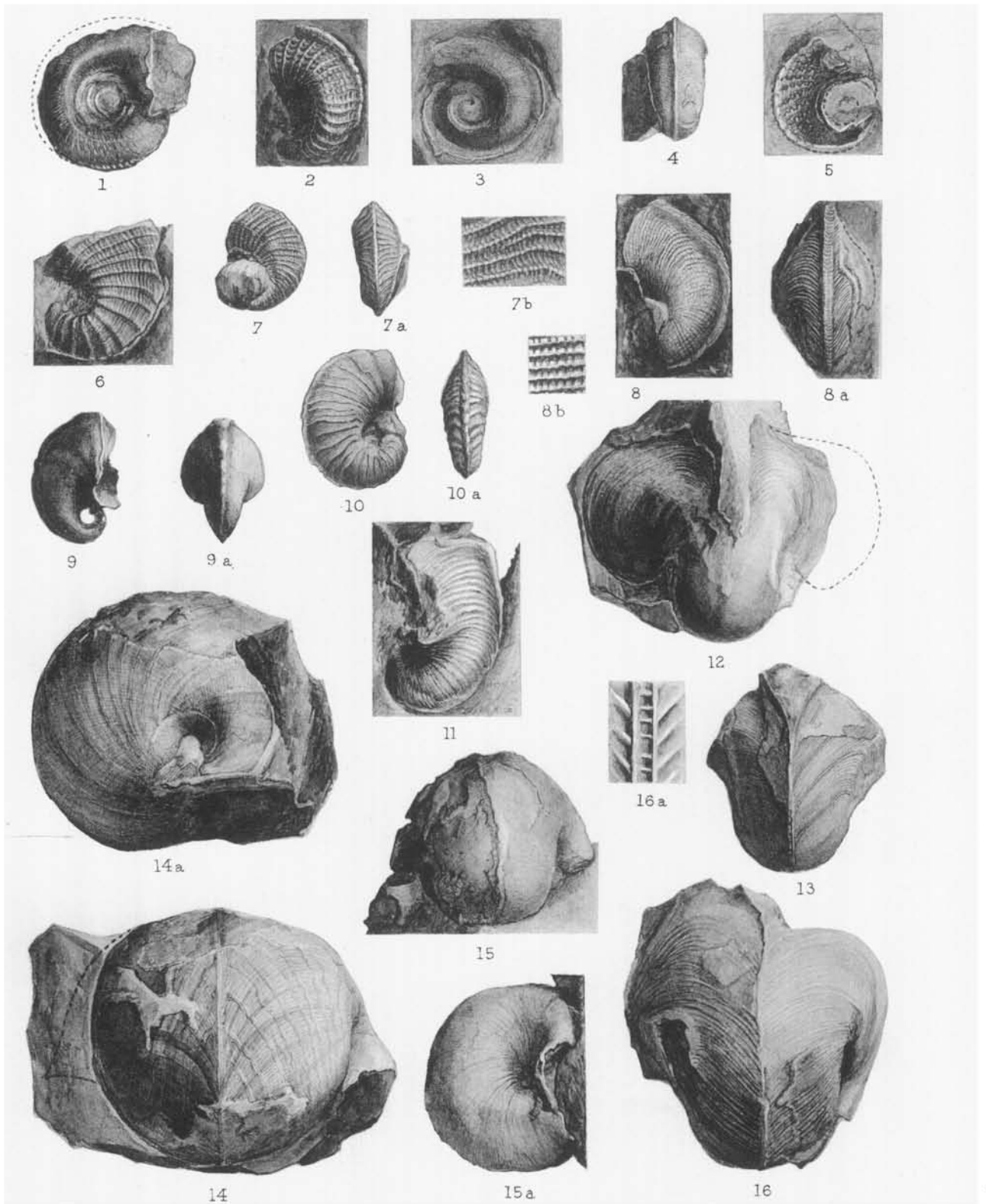
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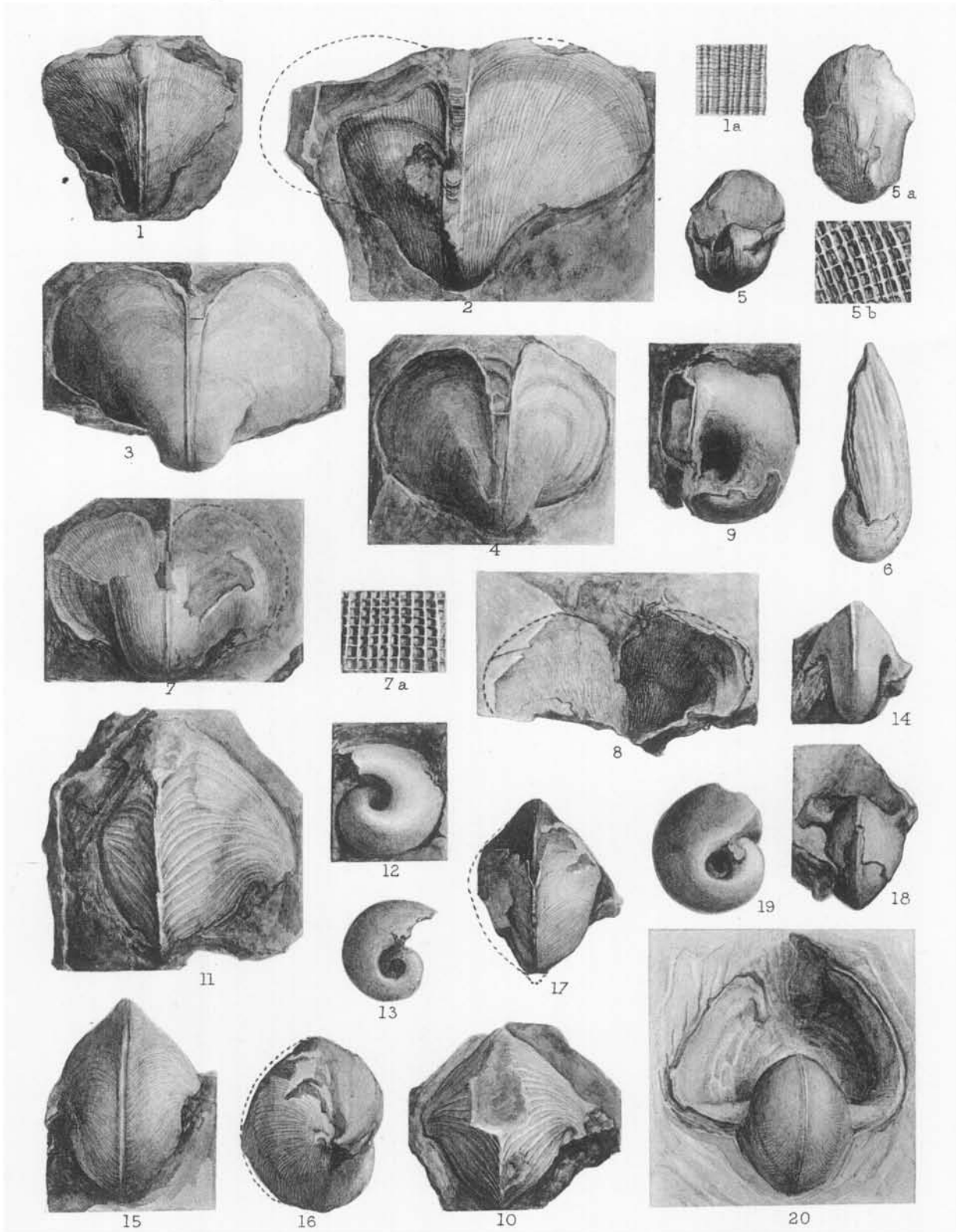
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1-5. CONRADELLA. 6-11. TEMNODISCUS.

12-16. BELLEROPHON.

PLATE X.

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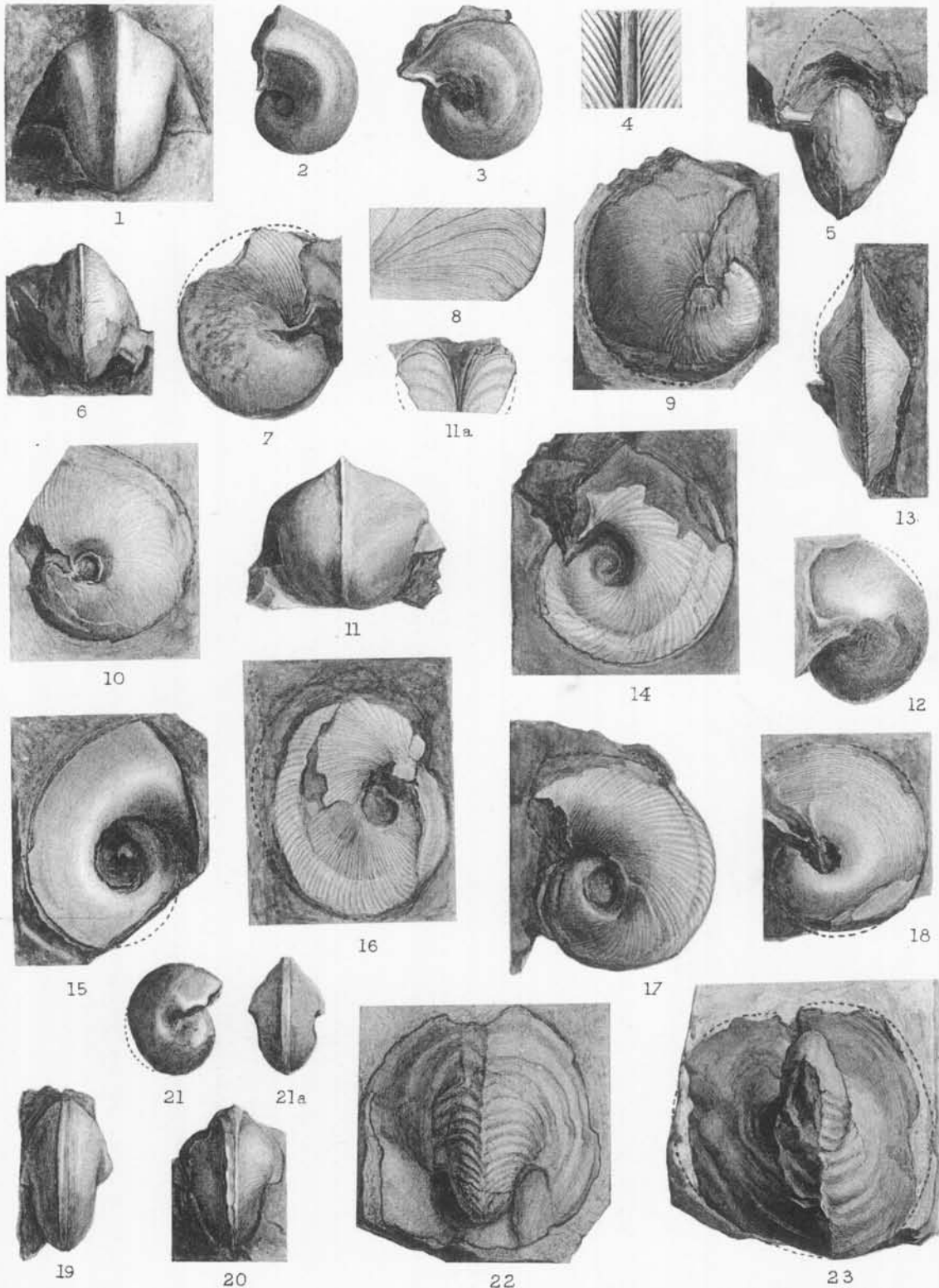
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1-9. BUCANIOPSIS. 10-20. CYMBULARIA.

PLATE XI.

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23.	Ditto. Ditto. Nat. size. Same horizon, locality and collection.	75.



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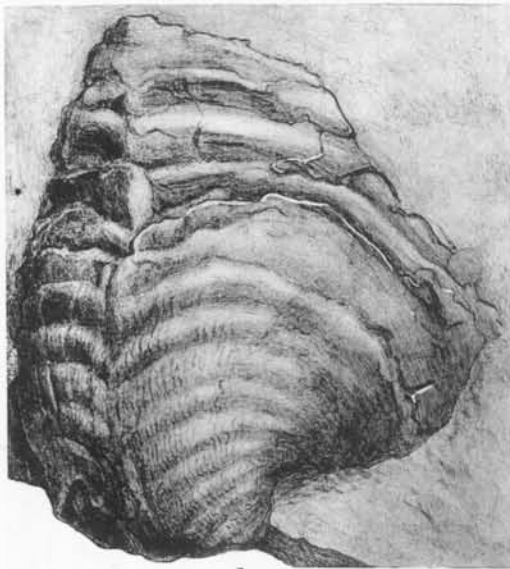
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1-12. CYMBULARIA. 13-21. ZONIDISCUS.

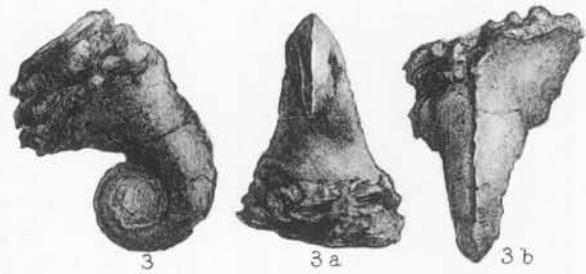
22 - 23. SALPINGOSTOMA.

PLATE XII.

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1



3

3 a

3 b



2



4 a



4



1 a



7



6



6 a



5



8 a



8

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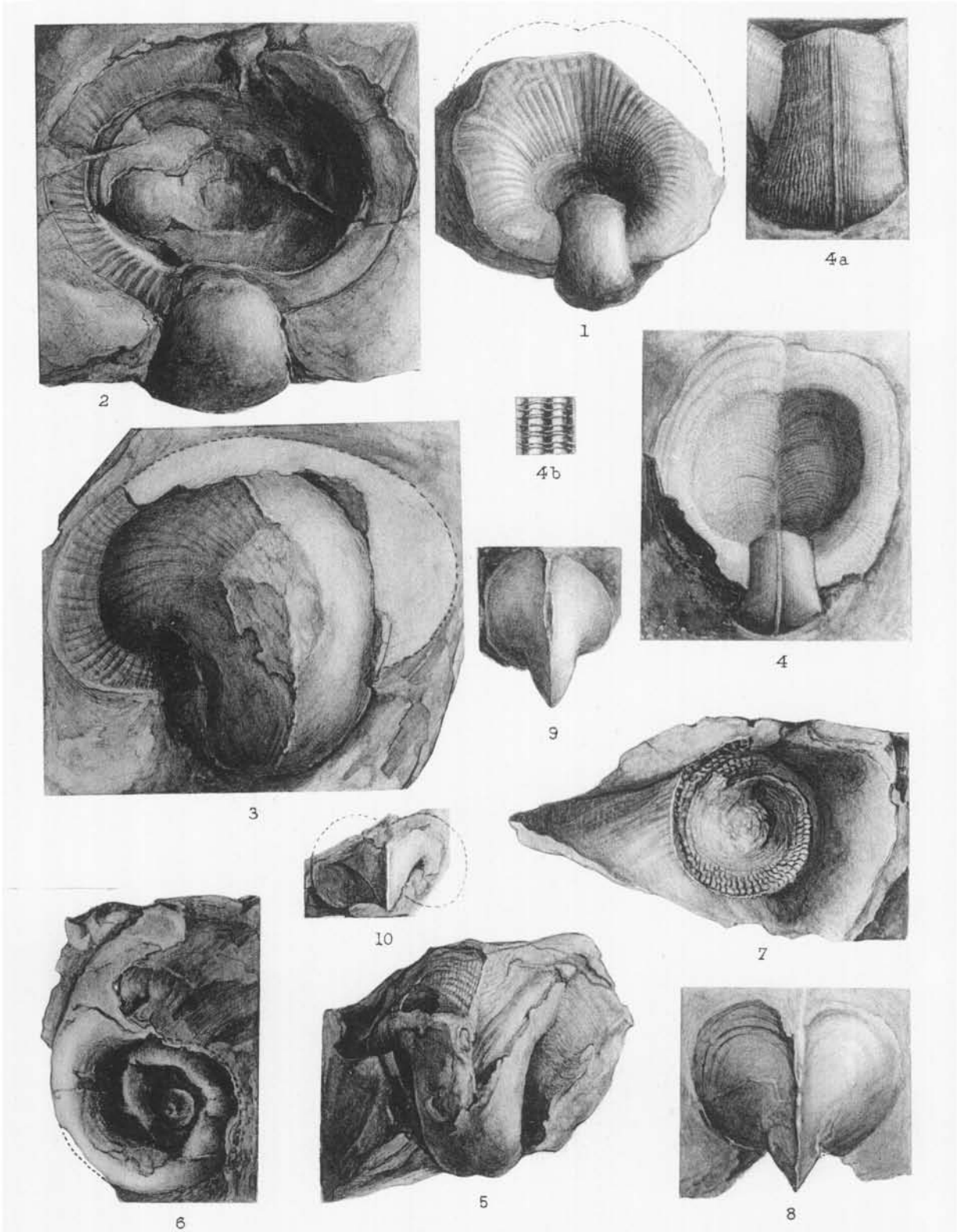
1-6. SALPINGOSTOMA. 7-8. TREMATONOTUS.

PLATE XIII.

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Reed, Bellerophontacea.

PLATE XIII



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1-4. TREMATONOTUS 5-7. PHRAGMOSTOMA.

8-10. CARINAROPSIS.