18. *On* SOME *of the* PROTEROZOIC GASTEROPODA *which have been referred to* *MURCHISONIA and PLEUROTOMARIA*, *with* DESCRIPTIONS *of* NEW SUBGENERA *and* SPECIES. By Miss JANE DONALD. (Communicated by J. G. GOODCHILD, Esq., F.G.S. Read March 12th, 1902.)

[PLATES VII–IX.]

INTRODUCTION.

AFTER the creation of the genus *Murchisonia* by A. d'Archiac & E. de Verneuil in 1841,[1] most of the Palæozoic, *Turritella*-like, banded gasteropoda were referred to that genus by later writers. Recently attention has been drawn to the fact that these shells do not all agree with the type, and that there are at least two separate groups, each distinguished by a different form of the outer lip. The typical group is characterized by a slit of greater or less depth in the outer lip, with parallel edges, which is represented by a band on all the whorls. The other group is characterized by having merely a sinus in the outer lip, which in some cases gives rise to a band more or less distinctly limited, while in others it is not defined in any way.

Some of the oldest-known gasteropoda, both elongated and short, have an opening in the outer lip; and as, owing to age and the manner of fossilization, very few have the outer lip well preserved, it is difficult to arrive at a correct conclusion as to its structure, more especially as the form of the lines of growth on the whorls rarely shows the actual depth of the sinus in the outer lip when mature. In the adult the outer lip frequently advances, thus rendering the mature sinus much deeper than the indications of it in the earlier stages of growth. The existence of a true slit in the outer lip, with a break in the continuity of the lines of growth, is still more difficult to ascertain where the outer lip is not visible; for the lines of growth often do not give evidence of the break, but sometimes even appear continuous, as if forming a shallow sinus, from the manner in which the shell is preserved. Again, there are cases, even where the outer lip is fairly well seen, in which it is difficult to decide whether the opening should be considered a slit or a sinus. Where the lines of growth sweep back very obliquely, as in *Hormotoma*, *Ectomaria*, and allied genera, the sinus can be followed with tolerable ease. But where the lines of growth run less obliquely, as in the true *Murchisonia* and *Lophospira*, it is much more difficult to ascertain with accuracy (in the absence of the outer lip) whether there was a slit or not.

With regard to these shells, two important questions require to be answered. Firstly: are forms possessing a slit, or those possessing a sinus, the more primitive; and does the presence of a slit indicate a different line of development from that of the sinus, or is the one

[1] Bull. Soc. Géol. France, vol. xii, p. 154.

evolved from the other? Secondly: are the elongated *Murchisonia* and the shorter *Pleurotomaria* both derived from the same stock, and which appears earlier? We need also to know the full value of the presence or absence of a sinus or slit in classification, and what special characteristics are associated with each respectively.

Before considering the British evidence on these points, it may be well to review the results of the investigations of some foreign palæontologists. Messrs. Ulrich & Scofield and Prof. Koken have devoted considerable attention to the study of the origin of these shells, and the former also to these differences in structure.

The researches of Ulrich & Scofield lead them to the conclusion that the sinus is older than the slit, and they regard *Raphistomina*, Ulr.,[2] as the most primitive genus of this group, it being represented by *Pleurotomaria laurentina*, Billings, in the Calciferous Series. They place this genus in the family Raphistomidæ, and unite it with the Pleurotomariidæ, Euomphalidæ, and Trochidæ in a new suborder, which they name Eotomacea. They consider that this suborder should moreover include the Fissurellidæ, Haliotidæ, Turbinidæ; and provisionally also the Maclureidæ, because of their evident relations to the Euomphalidæ. The Raphistomidæ are characterized by a short form, and have in the outer lip a sinus only, which does not give rise to a band on the whorls. The family contains shells which these authors regard as 'the best known representatives of the original stock from which' the other families 'were almost simultaneously evolved.' They are acquainted with only two Lower Silurian (Ordovician) species possessing a deep parallel-edged slit, namely: *Schizolopha textilis*, Ulr., from the upper part of the Trenton Group, and *Sch. Moorei*, Ulr., from the Lorraine and Richmond Groups, both of which are short forms. The depth of the slit in the former is about two-ninths of the circumference of the last whorl; in the latter it is about one-fifth. *Schizolopha*, Ulr., is referred to the Pleurotomariidæ, in which family Ulrich & Scofield include all genera, whether elongated or short, that possess either a sinus or a slit in the outer lip, giving rise to a band on all the whorls. Thus they place here such elongated forms as *Hormotoma*, *Cœlocaulus*, *Turritoma*, and *Solenospira*, Ulr. (*Ectomaria*, Koken), which other writers have regarded as closely allied to *Murchisonia*, though they have not a slit, but a sinus. They state[3] that none of these genera can be properly united with *Murchisonia*, and they are doubtful whether *M. coronata*, Goldf., the type-form of *Murchisonia*, is a true member of the Pleurotomariidæ.

Prof. Koken diverges somewhat from Ulrich & Scofield in his grouping of the genera. In 1896,[4] previous to the publication of the work on Minnesota, he proposed a new suborder, which he called Sinuata; in this he placed the Raphistomidæ, Euomphalidæ, Euomphalopteridæ, Pleurotomariidæ, Haliotidæ, Fissurellidæ,

[1] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 948.
[2] *Ibid.* p. 930. [3] *Ibid.* pp. 959–60.
[4] Jahrb. d. k.-k. geol. Reichsanst. vol. xlvi, p. 61.

Bellerophontidæ, and Murchisoniidæ. Since then,[1] he has removed the Murchisoniidæ and the Bellerophontidæ from it. He differs from Ulrich & Scofield in separating the elongated forms referred to *Murchisonia* from the Pleurotomariidæ, causing them to constitute a distinct family. He considers that the Euomphalopteridæ also constitute a separate family, instead of regarding them as a genus of the Raphistomidæ; and he excludes moreover the Trocho-Turbinidæ from this suborder, placing them in a different suborder, which he calls Trochomorphi. Prof. Koken, however, agrees with Ulrich & Scofield in regarding the sinus as the earlier structure, and he considers that the slit has gradually developed from it.

It is not quite clear whether Ulrich & Scofield believe the slit to have developed from the sinus or not. On p. 948 (*op. jam cit.*) they state that the slit

'seems to be a later phase in the evolution of the majority of the lines of development that can be traced from the Lower Silurian into subsequent periods.'

On p. 949 they write that in

'*Hormotoma* we have good evidence showing a gradual development of the slit. In all the Lower and Upper Silurian species of this genus a deep V-shaped apertural notch is present, but no slit. In, however, what we consider to be Devonian representatives of the same type of shell (e. g. *Murchisonia desiderata* and *Maia*, Hall) we observe that the bottom of the notch is prolonged into a short slit, but the backward sweep of the edges of the outer lip forming the notch is quite as pronounced as in the earlier species which have no slit. From this and the preceding case, therefore, it is evident that the slit did not take the place of a deep notch, but that it is really an additional and distinct feature.'

Lower down on the same page they say,

'It is interesting to note that, as far as we now know, the slit, which furthermore seems to have been developed almost suddenly, is longer in the earliest species known to possess one than in any of the later Palæozoic forms.'

Though Ulrich & Scofield trace the earliest appearance of representatives of the family Pleurotomariidæ (as constituted by them) in America, they do not throw any light on the first appearance of true *Murchisonia*, for they state[2] that strictly speaking they do not consider that the genus is represented in America. Unfortunately Prof. Koken does not distinguish clearly between the elongated forms having a slit and those with merely a sinus, but he refers all to his family Murchisoniidæ. He considers it probable that the Murchisoniidæ and Loxonematidæ have originated from the same stock,[3] and also that the *Turritellæ*[4] may have developed from them later on. If this were correct with regard to the *Turritellæ*, we should expect them to yield some decided evidence of a very primitive origin, but this is not the case, as the recent researches of W. B. Randles clearly show. It remains to be proved whether the recent forms with a sinus, hitherto referred to *Turritella* and *Murchisonia*

[1] Neues Jahrb. 1898, vol. i, p. 12.
[2] Final Rep. Geol. & Nat. Hist. Surv. Minn. vol. iii, pt. ii (1897) p. 960.
[3] Jahrb. d. k.-k. geol. Reichsanst. vol. xlvi (1896) p. 62.
[4] 'Die Gastrop. des Balt. Untersilurs' Bull. Acad. Imp. Sci. St. Petersb. ser. 5, vol. vii (1897) p. 201.

(*in lit.*), really agree with the former genus in the structure of the animal; or whether they possess distinctive and more primitive characters allying them with these ancient gasteropods. In stating this opinion with regard to the common origin of *Murchisonia* and *Loxonema*, Koken evidently refers more especially to *M. insignis*, Eichw. and allied species having a deep sinus in the outer lip, which I have shown [1] to be distinct from the typical *Murchisonia* and members of the genus *Hormotoma*. It is, however, doubtful whether the true *Murchisoniæ* are derived from this stock. The type-species is of Devonian age, and varies greatly in its spiral angle, size, and ornamentation. I have examined the specimen of *M. coronata*, Goldf. (*turbinata*, Schloth.) in the collection of E. de Verneuil, and it gives distinct evidence (as described by him) of a slit with parallel edges in the outer lip, the filling-up of which forms a band on all the whorls, bordered on each side by a keel. The peristome does not slope back so obliquely above the band, nor advance so prominently below, as in *Hormotoma* and *Ectomaria*, and there is a break in its continuity at the slit, so that there must have been three distinct areas of deposition of the shell, as in *Pleurotomaria*. The slit is not deep, being probably about two-fifths of the width of the body-whorl, and is therefore much shorter than that of the recent species of *Pleurotomaria*. Thus, in the structure of the outer lip and of the band, the *Murchisoniæ* come nearest to the *Pleurotomariæ*; but they are distinguished by being more elongated in form, and by having the aperture longer and slightly channelled below; also they do not appear to have developed an inner pearly layer. The existing species of *Pleurotomaria*, contrary to the *Turritellæ*, are proved by recent investigations to be really primitive in structure.

At present, I know of only one British Ordovician species of the Pleurotomariidæ which has the outer lip sufficiently well preserved to show the slit. It is in the collection of Mrs. Robert Gray, and is not only a new species, but is also probably referable to a new genus, for which I suggest the name *Palæoschisma*. The slit is short and narrow, being rather more than one-fifth of the circumference of the last whorl in depth; it gives rise to a band bordered on each side by a keel, with a slighter submedian keel. Another shell has an opening in the outer lip preserved, but it has more the character of a deep sinus than a short slit; it would also be about one-fifth of the circumference of the body-whorl in depth if intact, although it is much wider in proportion than that of *Palæoschisma*. This shell most probably belongs to the genus *Lophospira*, Whitfield, and both it and the species of *Palæoschisma* are of Llandeilo age.

I shall not now consider the earliest British representatives of the Raphistomidæ, as they do not possess a true sinual band, but shall proceed with the study of the more or less elongated forms having a band. Nor do I think it advisable at present to enter into the subject of the classification and the exact relationship of the

[1] Quart. Journ. Geol. Soc. vol. lv (1899) p. 257.

different families contained in the suborders Sinuata, Koken and Eotomacea, Ulr. respectively.

From what has been stated with reference to the investigations of Prof. Koken and Messrs. Ulrich & Scofield, it is evident that the earliest appearance of true *Murchisoniæ* still remains to be traced. In the lists of so-called *Murchisoniæ* several distinct genera are associated with them, and they consequently require revision. Mr. Etheridge[1] records twenty-four British species of Proterozoic *Murchisonia*. Four of these, as I have shown, probably belong to the genus *Hormotoma*: namely, *H. articulata*, *H. cingulata*, *H. (?) dubia* (referred to as *M. bellicincta*, Hall), and *H. (?) gracillima* (*M. gracilis*, Hall, var.). The specimen described as *M. angustata*, Hall, was placed by Salter in the genus *Hormotoma*, but I have pointed out[2] that it bears more resemblance to *Ectomaria*; it is, however, in too poor a state of preservation to admit of accurate determination. *M. scalaris*, Salt., too, is so bad a cast that it is impossible to discern its actual structure. Other species, again, must be excluded, as though they possess a band, and in some cases a slit, their characteristics agree more with those of *Lophospira* and some of the genera into which the original genus *Pleurotomaria* has been divided. Such fossils are—*M. angulata*, Sow., *M. balteata*, Phill., *M. cancellatula*, M'Coy, *M. corpulenta*, Sollas, *M. gyrogonia*, M'Coy, *M. inflata*, M'Coy, *M. Lloydii*, Sow., *M. pulchra*, M'Coy, *M. simplex*, M'Coy, *M. subrotundata*, Portl., *M. sulcata*, M'Coy (which is identical with *M. Lloydii*, Sow.), and *M. turrita*, Portl. The six species which remain are—*M. angulocincta*, Salt., *M. bicincta*, M'Coy, *M. corallii*, Sow., *M. elegans*, Sollas, *M. obscura*, Portl., and *M. torquata*, M'Coy. Although the general form of *M. angulocincta* somewhat resembles that of *Murchisonia*, I feel doubtful as to whether it really is a member of that genus; for the lines of growth, though not very distinct, seem merely to indicate a notch. It should probably be referred to the Cicelia subsection of the Perangulata section of the genus *Lophospira*, Whitfield. The other five species, and three new ones which I am about to describe, resemble *Murchisonia* in the band being grooved, and bounded on each side by a keel or raised thread, and also in the direction of the lines of growth. But none of the specimens of these species that I have seen have the outer lip intact, or the lines of growth sufficiently well preserved to show whether they possessed a slit or not. As a rule they are more slender than *Murchisonia*, and, with the exception of *M. elegans*, the whorls are more convex. In this latter characteristic they resemble *Hormotoma*, but the lines of growth are less oblique and the spiral ornamentation is more marked. *M. elegans* comes nearer to the description of *Goniostropha*, Œhl. than to that of any other section or subgenus of *Murchisonia*, and it seems advisable to place it there at present. The others, however, do not appear to agree with any previously described division of the

[1] 'Foss. Brit. Is.' vol. i (Palæozoic) 1888, p. 113.
[2] Quart. Journ. Geol. Soc. vol. lv (1899) p. 259.

Murchisoniidæ, and it would be convenient, at any rate provisionally, to regard them as a separate section or subgenus, for which I would suggest the name *Cyrtostropha*. At the same time, it is possible that further research may prove that these species are not all closely related one to the other, and further subdivision may be necessary.

Another new species which I am describing is from the Wenlock Formation of Dudley, and is more like the type of *Murchisonia* than any other Silurian or Ordovician species with which I am acquainted in its robust form, the direction of the lines of growth, and the structure and position of the band. The latter is not seen to be grooved as in *M. turbinata*, Schloth., but this may possibly be the result of the manner of preservation, since it only occurs as an external mould. No evidence, however, is given of a slit in the outer lip, so it cannot be referred to *Murchisonia* without a query.

From the material at present available, we find that, in the British Isles as well as in America, the elongated forms with a sinus or a notch precede those with a slit, and they also seem to do so in the Baltic Provinces. In the latter region the only shell recorded by Koken which may be a true *Murchisonia* is *M. Meyendorfi*, Kok. from Borkholm (Ordovician), but it is not clearly shown whether it possesses a slit. There are at least two, and possibly three, distinct groups of these sinuated shells with a band—the one containing *Hormotoma*, *Ectomaria*, etc., with the lines of growth sweeping back to and forward from the band very obliquely; a second, containing *Lophospira*, having the lines of growth less oblique, and agreeing more in direction with those of *Murchisonia*, only the band is prominent instead of being grooved; *Cyrtostropha* may perhaps form a third group, having the lines of growth but slightly oblique and the band grooved. In a former paper[1] I entered fully into the range of the genera *Hormotoma* and *Ectomaria*; but, for the sake of comparison, I will here repeat it briefly. In the British Isles they apparently commenced in the Durness Limestone (Upper Cambrian?), and do not appear, so far as I know, after the close of the Silurian Period; indeed, *Ectomaria* is not represented later than the Ordovician. In America, Ulrich & Scofield state that *Hormotoma* commences in the Calciferous Group and extends to the end of the Silurian. They consider that *Hormotoma* is represented in the Devonian by *M. desiderata* and *M. Maia*, Hall: species which agree with *Hormotoma* in possessing strongly retreating and advancing lines of growth; but they say that a slit is added to the bottom of the sinus. *Ectomaria* appears to be confined to the Ordovician, both in America and in the Baltic Provinces. *Hormotoma* ranges from the Ordovician and throughout the Silurian in the Baltic Provinces and Scandinavia. *Lophospira*, Whitfield, as emended by Ulrich, contains both elongated and short forms, and is said to range from the Calciferous Group upward to the middle

1 Quart. Journ. Geol. Soc. vol. lv (1899) p. 251.

of the Devonian. The British species are not fully worked out; but they begin, so far as known, in the Durness Limestone, and continue throughout the Ordovician and into the Silurian Period. The elongated forms probably have *L. (?) angulocincta* and the shorter *L. borealis*, from the Durness Limestone, as their earliest representatives. *Cyrtostropha* ranges from the Bala Formation (Ordovician) upward throughout the Silurian Period.

From what has been said, it is clear that we have no certain evidence of the appearance of typical *Murchisoniæ* in the British Proterozoic rocks, but the genus may have begun in the Wenlock Formation and be represented by *M. (?) dudleyensis* (p. 320). Possibly some of the forms from the Silurian of Gotland described by Lindström in his Ornatæ division may be true *Murchisoniæ*; but the existence of a slit is not indicated in any of the figures, and Ulrich refers them to *Lophospira*, with the exception of *M. deflexa* and *M. crispa*. The latter is represented with an opening in the outer lip, which has, however, more the appearance of a sinus than a slit. As before stated (p. 316), the earliest-known British species that exhibits a slit is a short form occurring in rocks of Llandeilo age. America possesses an older representative of *Pleurotomaria* showing the slit, in *Schizolopha textilis*, Ulr., which is from the upper part of the Trenton Group. So far, no light is thrown on the question as to whether *Murchisonia* and *Pleurotomaria* are derived from the same stock; nor have I yet met with any specimens showing a transition from the sinus to the slit.

Before proceeding to describe the species above mentioned, I would like to make two emendations in my last paper. I think that the species described as *Hormotoma antiqua*[1] should be transferred to the genus *Ectomaria*, the body-whorl being less produced, the whorls wider, and the lines of growth more oblique, than is usual in *Hormotoma*. I was previously much impressed by its resemblance to *E. Nieszkowskii*, Schmidt, the type of the genus *Ectomaria*, but the slight prominence of the keels caused me to place it in *Hormotoma*. A further examination of the specimen has led me, however, to conclude that this may be an accident in the manner of preservation, and that the weight of the evidence is in favour of its reference to *Ectomaria*.

The other correction that I wish to make concerns the locality of the specimen of *Hormotoma articulata* mentioned on p. 269 (*op. cit.*) as from the 'railway-tunnel shale' of Sedgley. Mr. Madeley informs me that the locality should be stated as Dudley. I may also mention here that I have seen another example of this species in the Nicholl Collection, in the Cardiff Museum, from the Wenlock Beds of Garcaed, Usk.

When I described *Ectomaria girvanensis*[2] from rocks of Llandeilo [Lapworth] age at Minuntion, I knew of only two specimens in the

[1] Quart. Journ. Geol. Soc. vol. lv (1899) p. 270 & pl. xxii, fig. 9.
[2] *Ibid.* p. 256.

collection of Mrs. Gray. She has now six others, one of which shows the lines of growth distinctly, and is figured in Pl. VII, fig. 11.

I am greatly indebted for the loan of specimens to Mrs. Robert Gray, Edinburgh; Prof. Hughes, Cambridge; Prof. Sollas, Oxford; the late Prof. Lindström, Stockholm; the Geological Survey of Scotland; and the respective committees of the Museums at Carlisle, Bristol, and Cardiff. I must also render thanks for assistance in studying collections to Mr. E. T. Newton, Dr. A. Smith Woodward, Mr. R. B. Newton, Mr. H. A. Allen, Mr. Madeley of Dudley, and Dr. Scharff of Dublin; and for help in looking up references to Mr. C. D. Sherborn. To Mr. Goodchild I am much obliged for revising this paper.

Family Murchisoniidæ, Koken.

Genus *Murchisonia*, d'Arch. & de Vern.

Murchisonia (?) dudleyensis, sp. nov. (Pl. VII, fig. 1.)

Diagnosis.—Shell somewhat robust, elongated, turreted, composed of more than nine whorls. Whorls increasing gradually, strongly angular below the middle of the earlier whorls and rather above the middle of the body-whorl, flattened or slightly concave above, convex below. Angle surmounted by a broad, flat band, which represents the slit or sinus in the outer lip. Lines of growth imperfectly seen, sloping forward below the band at a moderate angle. Aperture unknown. Surface apparently smooth.

Remarks and Resemblances.—This species, so far as I know, is represented only by two external moulds. In its robust form and broad prominent band it recalls the Carboniferous species *M. kendalensis*, M'Coy; also some of the smooth varieties of the type *M. turbinata*, Schloth., especially where the band of the latter is so worn as not to show its grooved form limited on each side by a strong keel. As the species under discussion is not very well preserved, it is possible that the band may also have been originally bounded by keels in the earlier stages of growth, as in *M. kendalensis*—if not in every stage, as in *M. turbinata*. Taking this into consideration, I refer it to *Murchisonia*, though the aperture and lines of growth are not sufficiently preserved to show whether it possessed a true slit in the outer lip. Among Silurian species it most nearly resembles *M. attenuata*, His., but differs in having the band situated lower on the whorl, the sutures not so oblique, and the lines of growth sloping less strongly forward below the band.

Localities and Horizon.—The largest specimen is in the Dudley Museum, and is from shale between two divisions of the Wenlock Limestone, Dudley. The apex is imperfect, and the nine existing whorls measure 56 millimetres in length and 19 mm. in width. The other and better preserved example is in the Museum of Practical Geology, London, and is figured in Pl. VII, fig. 1. It

is from the Wenlock Limestone of Dudley, and is broken so that only six whorls remain, which measure 38 millimetres in length and 14 mm. in width.

Section GONIOSTROPHA, Œhlert.[1]

GONIOSTROPHA (?) ELEGANS (Sollas). (Pl. VII, figs. 2–4.)

Murchisonia elegans, W. J. Sollas, 1879, Quart. Journ. Geol. Soc. vol. xxxv, p. 499 & pl. xxiv, fig. 8; R. Etheridge, 1888, 'Foss. of Brit. Is.' vol. i (Palæozoic) p. 418.

Diagnosis.—Shell slender, elongated, turreted, composed of about nine whorls. Whorls increasing gradually, angular generally below the middle, concave above the angle, flat below. Ornamentation consisting of a fine thread above, immediately beneath the suture, and another below which shows above the suture on some of the whorls of the spire. Sinual band composed of two strong threads placed rather near together, with a groove between them. Lines of growth not very distinct, sloping back to the band above and forward again below, with a moderate degree of obliquity; not seen on the band itself. Base produced. Aperture unknown.

Remarks and Resemblances.—All the members of this species that I have seen occur as external moulds, and the figures are drawn from wax-impressions. The type is in the Bristol Museum, and there are three other examples in the Cardiff Museum. Associated with the specimen called *M. elegans* are three individuals referred to *M. gracilis*, Hall, by Prof. Sollas, which appear identical with it, and only differ in the band being rather higher above the suture. In some specimens the sutures appear very oblique, and in others almost horizontal; the original shells have evidently been contorted obliquely, so that the degree of obliquity of the sutures differs on each side of an individual. In one case a representation of the whole contour of the shell has been obtained, and the differences in the obliquity of the suture, and in the degree of the spiral angle, may be observed according to the view taken on the single individual, instead of on different ones. The spiral angle may also appear either greater or less, according to the section of the mould made in breaking the rock. In the type (one of the individuals marked *M. gracilis*), and also in one of the specimens at the Cardiff Museum, the spiral angle appears wider than the normal; while in two other examples at the Cardiff Museum the spiral angle is less, and the whorls more exsert, which characters give the shells a very slender appearance. *Goniostropha elegans* differs from *Murchisonia gracilis*, Hall, in the whorls being more excavated above, and in the form of the band; it is quite distinct from this, and from any other species with which I am acquainted. As neither the outer lip nor the lines of growth on the band are preserved, it is impossible to decide whether the shell possessed a slit or a sinus. It is much less robust than the typical *Murchisonia*, and in general appearance agrees more nearly with the Section *Goniostropha*,

[1] Bull. Soc. Étud. Sci. Angers, 1887 (sep. cop.) p. 13.

Œhl. than any other: consequently I place it there provisionally. M. Œhlert does not state whether the forms grouped in this Section possess a slit or a sinus.

Dimensions.—The type (Pl. VII, fig. 2) has the apex broken; the six remaining whorls measure 13 millimetres in length and 5 mm. in width. The specimen marked *M. gracilis* (Pl. VII, fig. 3) has portions of six whorls preserved, in a length of 14 mm. An example (Pl. VII, fig. 4) with exsert whorls, in the Cardiff Museum, has about eight whorls in a length of 23 millimetres.

Localities and Horizon.—The specimens in the Bristol Museum are from the *Ctenodonta*-bed in the Rhymney Grit, Rhymney Hill, Cardiff, and are of Lower Wenlock age. Those in the Cardiff Museum are in the Storrie Collection, from Tymaur Lane, Rhymney, near Cardiff; and the rock in which they occur is similar to that just mentioned.

Subgenus Cyrtostropha, nov.

Diagnosis.—Shell elongated, conical, composed of numerous whorls. Whorls more or less convex, slightly flattened above, generally with a prominence or subangularity between the upper suture and the band. Band grooved, bordered on each side by a raised thread or keel, submedian, and situated on the widest part of the whorl. Lines of growth curving back to, and forward from, the band with a moderate degree of obliquity, more oblique below, and forming crescents on the band itself. Ornamentation consisting of spiral lines and a shallow groove immediately above the band. Aperture subovoid. Columella nearly straight.

Type, *Cyrtostropha corallii* (Sow.).

Remarks and Resemblances.—This subgenus differs from the typical *Murchisonia* in its more convex whorls and more oblique lines of growth, especially below the band, and probably in the presence of a sinus instead of a slit in the outer lip. None of the specimens with which I have met have the aperture well preserved, so it is impossible at present to determine this latter point. *Cyrtostropha* greatly resembles *Hormotoma* in the convexity of its whorls, but is distinguished by the less oblique lines of growth and the spiral and grooved ornamentation.

Dimensions.—The length varies from about 6 to 36 millimetres.

Range.—From the Bala Formation up to and throughout the Silurian Period.

Cyrtostropha corallii (Sow.). (Pl. VII, figs. 5 & 6.)

Pleurotoma corallii, J. de C. Sowerby, 1839, 'Sil. Syst.' p. 612 & pl. v, fig. 26.
Murchisonia corallii, A. d'Archiac & E. de Verneuil, 1841, Bull. Soc. Géol. France, vol. xii, p. 160; ? F. M'Coy, 1846, 'Syn. Silur. Foss. Irel.' p. 16; J. Phillips, 1848, Mem. Geol. Surv. vol. ii, pt. i, 'Malvern Hills' p. 258; H. G. Bronn, 1848, 'Index Palæont.' pt. i, p. 747; A. d'Orbigny, 1850, 'Prodr. de Paléont. Strat.' vol. i, p. 31; J. Morris, 1854, 'Catal. Brit. Foss.' 2nd ed. p. 259; J. Sowerby, 1867, 'Siluria' 4th ed. pl. xxiv, fig. 7 & p. 532; J. J. Bigsby, 1868, 'Thes. Silur.' p. 158; A. C. Ramsay, 1881, Mem. Geol. Surv. vol. iii, 'Geol. N. Wales' 2nd. ed. p. 468; J. D. La Touche, 1884, 'Geol. of Shropshire' p. 80 & pl. xviii, fig. 634; R. Etheridge, 1888, 'Foss. Brit. Is.' vol. i (Palæozoic) p. 113.

Diagnosis.—Shell conical, composed of more than six whorls. Whorls increasing gradually, somewhat convex, adpressed at the suture. Band situated on the widest part of the whorl, near the middle of the body-whorl, and slightly below the middle of the earlier whorls, broad, flat, and rather prominent, margined on each side by a fine raised thread. Above the band is a wide, shallow groove, of nearly the same width as the band itself; below the band is a strong keel which shows just above the suture. Lines of growth moderately oblique, curving back to the band above and forward again below, where they are strong and thread-like, and forming somewhat indistinct crescents on the band itself. Aperture longer than wide, columella nearly straight, inner lip spreading round its base. Umbilicus closed. Base convex.

Remarks.—This species was first described and figured by Sowerby, in Murchison's 'Silurian System,' as a member of the genus *Pleurotoma*; but his specimen was too imperfectly preserved to show much of its real character, merely traces of the band being visible. Its specific name evidently arises from its generally occurring embedded in coral. The broad, solid-looking band distinguishes it from all other species.

Localities and Horizon.—The best preserved specimen (Pl. VII, fig. 5) with which I have met is in the Grindrod Collection, University Museum, Oxford: it is from Upper Ludlow rocks, the exact locality of which is not given, but it is most probably from the neighbourhood of Malvern. The apex is wanting; the remaining five and a half whorls measure 19 millimetres in length and 7 mm. in width. The coral in which the shell is embedded is labelled *Stenopora fibrosa* var. *incrustans*. There are also portions of several other examples in this collection from the same strata. The type, which is in the possession of the Geological Society, is from the top bed of the Aymestry Limestone at Larden: it consists of four and a half whorls, the earlier ones also are broken off, and those left have a length of 12 mm. Other localities recorded in the 'Silurian System' are Ludlow Promontory; Fownhope, Botteville, north side of Caer Caradoc; Aran, near Newnham, north-east of Gaerfawe; and Bradnor Hill, Kington. In the Museum of Practical Geology, Jermyn Street, are specimens from Prior Court, Hales End, and Frith Farm, Malvern. There are also casts marked *Murchisonia corallii*, from Whitcliff, Ludlow, and Brook Wern, Llandeilo, but they are not well enough preserved for certain identification. The Piper Collection, in the Natural History Museum, South Kensington, contains an example from Frith, Ledbury. In the 'Geology of the Malvern Hills,' Phillips records this species from the following localities:—Malvern District: Overley, Hope End Pond, Coomb Hill. Abberley District: Ankerdine Hill. Woolhope District: Perton, Pride's Court, Hayle, Pilliard's Barn, Bodenham. Builth District: Henllwyn Hill, Cwm Craigddu. In all these cases the beds in which the fossil was found are of Upper Ludlow age. La Touche states that this species occurs in Ludlow rocks at Botville, Stoke Wood. M'Coy says that *Murchisonia corallii* is found at

Knockmahon, Tramore (Waterford). I have seen the fossil to which he refers in the Museum of Science & Art, Dublin; it is merely a cast, and admits of no precise comparison. The Rev. M. S. Donald has external casts from the Kirkby-Moor Flags, Lily Mere; and there are also several external casts in the Woodwardian Museum, Cambridge, from the same beds at Benson Knott, Kendal.

Cyrtostropha scitula, sp. nov. (Pl. VII, figs. 7, 7*a*, & 8.)

Diagnosis.—Shell elongated, turreted, composed of more than eleven whorls. Whorls increasing somewhat gradually, slightly angular below the middle, especially in the earlier stages of growth: contour convex both above and below the angle, convexity greater in the later whorls. Band situated on the angle, grooved and limited on each side by a keel. Lines of growth fine, curving back to the band above and forward below at a moderate angle, not seen on the band itself. Ornamentation consisting of several spiral raised threads, a strong one being situated about midway between the band and the suture below, and another above, bounding a slight depression between it and the band; there are also two or three finer threads between this and the upper suture. Sutures deep. Aperture unknown.

Remarks and Resemblances.—This species greatly resembles *C. corallii* in the contour of the whorls and in its occurrence embedded in coral, and it may possibly be a variety of that shell. It differs in having a greater spiral angle and more evenly convex whorls which are not adpressed at the suture, in the band being deeply grooved, rather narrower, and its limiting threads being stronger; also the thread below the band is not so strong, and occurs midway between the band and the suture, instead of immediately above the latter. It is distinguished from *Murchisonia bicincta*, M'Coy, by its greater robustness, and in the band being higher above the suture and bounded by stronger keels.

Dimensions and Localities.—None of the specimens of this species with which I have met have the aperture preserved, and they are all embedded in coral, with the exception of a small external cast from Spital, Kendal, in the Woodwardian Museum, Cambridge, which is probably this species, though not well enough preserved to admit of precise determination. The largest is in the Piper Collection, Natural History Museum, South Kensington: it has about seven and a half whorls preserved, with a length of 27 millimetres and a width of 9½ mm. It was found at Frith, Ledbury.

A specimen (Pl. VII, fig. 7), consisting of eleven whorls, is in the Grindrod Collection, University Museum, Oxford. It has a length of 20 millimetres and a width of 9 mm. The locality is not recorded, but the fossil is probably from the neighbourhood of Malvern.

In the Worcester Museum there is a very young individual, consisting of eight whorls, the length of which measures 6·5 millimetres, and the width 3 mm. It was found in the Upper Ludlow of Chance's Pitch, Malvern.

CYRTOSTROPHA BICINCTA (M'Coy). (Pl. VII, figs. 9, 9 *a*, & 10.)

Murchisonia bicincta, F. M'Coy, 1846, 'Syn. Silur. Foss. Irel.' p. 16 & pl. i, fig. 17; J. Morris, 1854, 'Catal. Brit. Foss.' 2nd ed. p. 258; J. Sowerby, 1867, 'Siluria,' 4th ed. p. 532; J. J. Bigsby, 1868, 'Thes. Silur.' p. 157; (?) J. Armstrong, J. Young, & D. Robertson, 1876, 'Catal. West. Scot. Foss.' p. 19; A. C. Ramsay, 1881, Mem. Geol. Surv. vol. iii, 'Geol. N. Wales' 2nd ed. p. 414; R. Etheridge, 1888, 'Foss. Brit. Is.' vol. i (Palæozoic) p. 113; (?) J. Horne & B. N. Peach, 1899, Mem. Geol. Surv. 'Silur. Rocks of Britain' vol. i, pp. 682, 695 & 699; *non* J. Hall, 1847, 'Pal. N. Y.' vol. i, p. 177 & pl. xxxviii, fig. 5.

Diagnosis.—Shell small, conical, composed of about ten whorls. Whorls slightly convex, increasing gradually. Band situated on the widest part of the whorl, low down and but a short distance above the suture, almost level with the surface, being but slightly grooved, bounded on each side by a strong raised thread. There is a slight groove above the band, limited by a faint thread, and indications of two other threads are perceptible immediately below the suture. Lines of growth not preserved. Aperture unknown.

Remarks and Resemblances.—The Museum of Science & Art, Dublin, contains but one specimen of this species, which is M'Coy's type (Pl. VII, fig. 9). As neither aperture nor lines of growth are preserved, its exact relationship cannot be ascertained. It bears considerable resemblance to *C. scitula* and *C. corallii*, therefore I refer it to *Cyrtostropha*. It is distinguished from both these species by its much smaller size, less prominent whorls, and the lower position of the band. Alhough it is entered in the list of Western Scottish fossils, I have not seen any shell identical with this in the Scottish collections. This species must not be confounded with *Murchisonia bicincta*, Hall, which is quite distinct, and has since been referred to *Lophospira* by Whitfield,[1] being considered by him as one of the types of that genus.

Dimensions.—The length=6·25 millimetres, and the width= about 3 mm.

In the Museum of Practical Geology, Jermyn Street, are three specimens which agree exactly with *C. bicincta* (M'Coy) in form and ornamentation, except that they are reversed. The varietal name *perversa* is inscribed on the tablet, but I have been unable to obtain any clue as to its origin. It has evidently been written there since the publication of the Catalogue in 1878, as it is not included therein. These shells are slightly larger than the type, and all are imperfect, none showing either apex or base. Two consist of seven whorls: the larger measures $8\frac{1}{2}$ millimetres in length; the other, which is figured in Pl. VII, fig. 10, measures 8 mm. in length. The smallest specimen has only four and a half whorls in a length of 5 millimetres.

Horizon and Locality.—The type, as well as these reversed specimens, occurs in limestone of Bala age, Chair of Kildare.

[1] Bull. Amer. Mus. Nat. Hist. vol. i (1886) p. 312.

CYRTOSTROPHA TORQUATA (M'Coy). (Pl. VIII, figs. 1, 1 *a*, & 1 *b*.)

Murchisonia torquata, F. M'Coy, 1852, 'Brit. Palæoz. Foss.' p. 294 & pl. xiv, figs. 19, 19 *a*; J. Morris, 1854, 'Catal. Brit. Foss.' 2nd ed. p. 259; J. Sowerby, 1867, 'Siluria' 4th ed. p. 533; J. J. Bigsby, 1868, 'Thes. Silur.' p. 159; J. W. Salter, 1873, 'Catal. Cambr. Foss.' p. 185, *non* p. 191; A. C. Ramsay, 1881, Mem. Geol. Surv. vol. iii, 'Geol. N. Wales' 2nd ed. p. 468; R. Etheridge, 1888, 'Foss. Brit. Is.' vol. i (Palæozoic) p. 114; H. Woods, 1891, 'Catal. Type Foss. Woodward. Mus.' p. 108.

Diagnosis.—Shell conical, composed of about eight whorls. Whorls increasing at a moderate rate, convex, with a swelling or thickening of the upper edge immediately below the suture. Band situated near the middle of the body-whorl and considerably below on the earlier whorls, slightly grooved, and bounded by a raised thread on each side. Lines of growth sharp, stronger above than below, curving back to the band above and rather more obliquely forward below, and forming crescents on the band itself. Aperture sub-ovoid.

Remarks and Resemblances.—This species is at present known only in the form of external moulds, which are more or less weathered and imperfect. The band and aperture are not very well preserved in any of the specimens. Salter, in his 'Catalogue of the Cambrian & Silurian Fossils' p. 191, refers *Murchisonia torquata* to *Hormotoma*. Though greatly resembling members of that genus in its convex whorls, it differs decidedly in having less oblique lines of growth. It is most like some of the species of *Cyrtostropha*, and I refer it to that subgenus for the present, because although the spiral lines with which the members are generally ornamented are not visible, there appear to be traces of a groove above the band on one or two specimens. This is a very characteristic feature in *Cyrtostropha*, in conjunction with the convex whorls and grooved band.

Dimensions.—The largest example that I have seen is in the Woodwardian Museum, Cambridge, from the Kirkby-Moor Flags of Spital. It is very badly preserved, the apex is absent, and only six whorls remain: these measure 18 millimetres in length and 7 mm. in width. Next to it, in the same piece of rock, is the specimen which was probably M'Coy's type: it consists of about eight whorls, measuring 11 mm. in length and 6 mm. in width. Fragments of other specimens from both Spital and Benson Knott show the surface better. Two of the examples figured (Pl. VIII, figs. 1 & 1 *a*) are in the Rev. M. S. Donald's collection; fig. 1 measures 13 millimetres in length and 5 mm. in width.

Localities and Horizon.—M'Coy states that this species is common in the Upper Ludlow of Spital and Benson Knott, Kendal; also in the tilestones of Storm Hill, Llandeilo (Caermarthenshire). There are specimens from all these localities in the Woodwardian Museum, Cambridge. Salter (*op. cit.* p. 191) also refers an external mould from Pontaryllechau to this species; but both it and that from Storm Hill are too poorly preserved to be referred to *C. torquata* with certainty, there being no trace of band or surface-ornamentation. Some external moulds, also from Kendal, are in the Carlisle Museum. The Rev. M. S. Donald has about six specimens in his collection, from the Kirkby-Moor Flags, Lily Mere.

CYRTOSTROPHA OBSCURA (Portl.). (Pl. VIII, figs. 2, 2 *a*, & 3.)

Loxonema obscura, J. E. Portlock, 1843, 'Geol. Rep. Londonderry' p. 415 & pl. xxxi, fig. 3; (?) H. G. Bronn, 1848, 'Index Palæont.' pt. i, p. 670.
Murchisonia obscura, J. Morris, 1854, 'Catal. Brit. Foss.' 2nd ed. p. 259; J. Sowerby, 1867, 'Siluria' 4th ed. p. 197, Foss. 40, fig. 3; J. J. Bigsby, 1868, 'Thes. Silur.' p. 158; (?) J. Armstrong, J. Young, & D. Robertson, 1876, 'Catal. West. Scot. Foss.' p. 19; *pars*, A. C. Ramsay, 1881, Mem. Geol. Surv. vol. iii, 'Geol. N. Wales' 2nd ed. p. 414; R. Etheridge, 1888, 'Foss. Brit. Is.' vol. i (Palæozoic) p. 113; (?) J. Horne & B. N. Peach, 1899, Mem. Geol. Surv. 'Silur. Rocks of Britain' vol. i, pp. 682 & 695; (?) B. N. Peach, J. Horne, & A. Macconochie, 1901, in 'Fauna, Flora, & Geol. of Clyde Area' publ. by Local Comm. for Meeting of Brit. Assoc. Glasgow, p. 438.

Diagnosis.—Shell elongated, turreted, composed of more than seven whorls. Whorls increasing at a moderate rate, convex, more or less smooth. Band situated near the middle of the body-whorl and below the middle of the whorls of the spire, slightly depressed, bounded by an indistinct ridge on each side. Lines of growth sloping back to the band above, and forward again below. Aperture imperfectly known, sub-ovoid. Base produced. No umbilicus.

Remarks.—The only known examples of this species are very imperfect, being fragmentary, compressed, and much weathered. It bears more resemblance to *Cyrtostropha* than to true *Murchisonia*, especially as on a wax-impression (taken from an external mould) there appear to be indications of the groove above the band bounded by a thread, so universal in this subgenus. It was originally regarded as *Loxonema* by Portlock, but the possession of a band distinguishes it from the members of that genus.

Localities and Horizon.—In the Museum of Practical Geology, Jermyn Street, are two specimens which are little better than internal moulds, and the external impression of one of these, from rocks of Bala age at Desertcreight (Tyrone). One of these (Pl. VIII, fig. 2) is Portlock's type; it has the apex broken, the seven remaining whorls measuring 27 millimetres in length and 13 mm. in width; as the specimen is flattened by pressure, the width appears greater than it must have been originally. Another fragment from Tyrone, consisting of about two whorls, is referred to this species, but I am uncertain as to its identity; it is embedded in the matrix, and the band appears to be higher than in the type. In the Harkness Collection, in the Carlisle Museum, are two examples: one from the Chair of Kildare, and the other from Pomeroy, referred to this species, but they are too badly preserved to admit of precise determination. I feel very doubtful whether the specimens in the Scottish lists which are called *Murchisonia obscura* are really referable to this species; those in Mrs. Gray's collection are certainly not identical.

CYRTOSTROPHA ROBUSTA, sp. nov. (Pl. VIII, fig. 4.)

Diagnosis.—Shell elongated, conical, composed of more than ten whorls. Whorls increasing gradually, convex, slightly flattened above. Band situated on the widest part of the whorl, rather below the middle, almost level with the surface, bounded on each side by a strong raised thread. Lines of growth sloping back to it above and advancing with greater obliquity below, not seen on the band

itself. There is a shallow groove immediately above the band, and several fine threads ornament the surface. A short distance beneath the band is a subangularity, below which the base appears rather flattened; between this angularity and the band there is also a slight thread. Aperture imperfectly known.

Remarks and Resemblances.—There is but one specimen of this species at present known, and it is in Mrs. Gray's collection. It resembles somewhat *C. obscura*, Portl., but the whorls appear to be broader and the lines of growth more oblique than in that species, of which the only examples are so badly preserved that it is difficult to make a just comparison.

Dimensions.—Length=36 millimetres; width=14 mm.

Locality and Horizon.—Thraive Glen, in beds of Upper Bala age [Lapworth].

CYRTOSTROPHA ORDOVIX, sp. nov. (Pl. VIII, figs. 5 & 5 *a*.)

Diagnosis.—Shell elongated, turreted, composed of more than nine whorls. Whorls increasing gradually, more or less convex, but slightly flattened above. Band submedian on the body-whorl, but below the middle of the earlier whorls, concave, and bounded on each side by a strong raised thread. Ornamentation consisting of a ridge or swelling just below the suture, and several fine spiral lines, the strongest of which is a short distance above the band, bounding a space less than the width of the band. Lines of growth sloping back to the band above, with but slight obliquity, and advancing below with greater obliquity, not seen on the band itself. Aperture imperfectly known.

Remarks and Resemblances.—This species, so far as I know, is at present represented by only three specimens in Mrs. Gray's collection, and they are all more or less imperfect and crushed. The ornamentation is indistinct at the best, and is not seen on the earlier whorls. *C. Ordovix* somewhat resembles *Hormotoma Grayiana*, but is distinguished from it by being more slender, by the spiral ornamentation, and by the lesser obliquity of the lines of growth.

Dimensions.—The largest specimen is figured in Pl. VIII, figs. 5 & 5 *a*, and consists of seven whorls, both apex and base being broken; it measures 25 millimetres in length, and the penultimate whorl measures about 7·25 mm. in width. Another example has eight and a half whorls in a length of 22 millimetres.

Locality and Horizon.—Shalloch Mill (Ayrshire), in beds of Middle Bala age [Lapworth].

Genus *Hormotoma*, Salt.

Subgenus GONIOSPIRA, nov.

Diagnosis.—Shell elongated, composed of numerous gradually increasing whorls. Whorls angular near the middle, surface smooth. A narrow, prominent, more or less convex and indistinctly limited band on the angle. Lines of growth sloping back to the band

above and very obliquely forward below, curved on the band itself, indicating the existence of a deep V-shaped sinus in the outer lip. Aperture imperfectly known, inner lip slightly thickened. Base produced. Umbilicus closed. Sutures very oblique.

Type, *G. filosa*, sp. nov.

Remarks and Resemblances.—In a former paper[1] I referred to this group of shells as greatly resembling *Hormotoma*, regarding it as a subgenus, but I had not then met with any British specimens, and therefore abstained from naming it. *Goniospira* is like *Hormotoma* in its elongated smooth form, and in the character of the sinus and the lines of growth. It differs in possessing more angular whorls, and in the band being prominent and slightly convex. From *Lophospira* it is distinguished by the band being less distinctly limited, and by the greater obliquity of the lines of growth.

Dimensions.—The length varies from 23 up to possibly 75 millimetres.

Range.—This subgenus most probably ranges from the Ordovician up to the end of the Silurian System. The only known British representative is from the Middle Bala [Lapworth] of the Girvan district. *Murchisonia Artemesia*, Billings,[2] from the Calciferous Group of Canada, which has a convex band, possibly belongs here, but the whorls appear less angular. Also *M. attenuata*, His.,[3] from the Silurian of Gotland, has the essential characteristics of this subgenus, although the angularity on the base is not so marked.

GONIOSPIRA FILOSA, sp. nov. (Pl. VIII, figs. 6 & 6*a*.)

Diagnosis.—Shell elongated, turreted, composed of more than eight whorls. Whorls increasing gradually, angular near the middle, slightly excavated above, flat below, with a strong angle on the base, which is hidden by the suture in the earlier whorls. The only ornamentation is a raised thread immediately below the suture. Band prominent, narrow, convex, situated on the angle. Lines of growth sharply defined, curving back to the band above, and very obliquely forward below, continuing across the band, and forming a V-shaped sinus. Sutures very oblique. Aperture longer than wide; columella-lip slightly thickened. Base produced. Umbilicus closed.

Remarks and Resemblances.—This species is represented at present by only one specimen in Mrs. Gray's collection, which is remarkably well-preserved, and shows the lines of growth distinctly. As I observed in describing the subgenus, it bears most resemblance to *Hormotoma*: especially the earlier part of the spire, when the outer shell-layer is removed, obliterating the prominence of the band, which here appears level with the surface, having the lines of growth continuous across it from suture to suture. The smooth

[1] Quart. Journ. Geol. Soc. vol. lv (1899) p. 260.
[2] Geol. Surv. Canad. 'Palæoz. Foss.' vol. i (1865) p. 345 & fig. 332.
[3] Lindström, 'Silur. Gastrop. & Pterop. Gotl.' Kongl. Svensk. Vet.-Akad. Handl. vol. xix, No. 6 (1884) p. 130 & pl. xii, figs. 20–24.

form, combined with the angular whorls, distinguishes it from all other species.

Dimensions.—There are five whorls, with the impression of three more in the matrix. The length = 23 millimetres, and the width = 8 millimetres.

Locality and Horizon.—Shalloch Mill (Ayrshire), in rocks of Middle Bala age [Lapworth].

Genus *Turritoma*, Ulrich.[1]

Diagnosis.—Shell elongated, consisting of numerous whorls. Whorls somewhat flattened, convex above, slightly concave in the middle, and most prominent in the lower part where the band is situated; other features apparently as in *Hormotoma*.

Type, *T. acrea* (Billings).

Ulrich states that

'this is a well-marked group of species, readily distinguished from *Hormotoma* (to which the group is related) by the flattened instead of uniformly rounded volutions, and by the lower position of the band.'

Besides the type, he considers that it includes *T. Ada* (Billings), *T. Boylei* (Nicholson), *T. constricta* (Whiteaves), *T. cava* (Lindström), and *T. Laphami* (Hall). The type, judging from the figure, apparently has the whorls slightly convexo-concave, but this does not appear to be the case with *Murchisonia Boylei* and *M. Laphami*; indeed, Nicholson states that the whorls of the former are flat.[2]

Remarks.—In Mrs. Gray's collection I have met with two species which correspond more nearly to the diagnosis of *Turritoma* than that of any other genus, except that the whorls are not convexo-concave, but flat or very slightly convex. I therefore refer them here provisionally. They differ from *Hormotoma* in this flatness of the whorls, in the less produced base, and also in the band being lower than is usually the case in that genus. The form of the band and the direction of the lines of growth are similar to those of *Hormotoma*. They have most in common with *H. cingulata* (His.),[3] the flattened whorls and low-lying band of which caused me to regard it as a doubtful member of the genus; and if the convexo-concavity of the whorls be not an essential character of *Turritoma*, that species should perhaps be removed hither.

TURRITOMA (?) POLITA, sp. nov. (Pl. VIII, figs. 7 & 8.)

Diagnosis.—Shell conical, of moderate size. Whorls about ten, somewhat flattened, and but slightly convex, smooth. Sinual band near the middle of the body-whorl, but very low down on the earlier whorls, appearing just above the suture, broad, flat, level with the surface, limited on each side either by a groove or by a slight, raised thread. Lines of growth curving obliquely back to the band above, much more obliquely forward below, and curved

[1] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 959.
[2] Quart. Journ. Geol. Soc. vol. xxxi (1875) p. 547.
[3] *Ibid.* vol. lv (1899) p. 265.

on the band itself, indicating a fairly deep sinus. Sutures deep. Aperture imperfectly known, apparently sub-ovoid.

Remarks and Resemblances.—So far, only two specimens of this species are known to me, and these are in Mrs. Gray's collection. They are both more or less crushed and flattened by pressure. The spiral angle of the higher whorls of the largest individual is smaller than that of the rest of the spire; whether this is a natural condition, or caused by pressure, it is impossible to say: it may perhaps be the result of both. This shell (Pl. VIII, fig. 8) measures 16 millimetres in length and 7·5 mm. in width; it is partly embedded in the matrix. The other (Pl. VIII, fig. 7) has six whorls in a length of 13 mm., the width measuring 6 mm. in one direction, and 4·5 mm. in the other; it is disengaged from the matrix. The lines of growth are strong and well marked on part of the body-whorl. This is quite distinct from all previously described British species.

Locality and Horizon.—Shalloch Mill (Ayrshire), in rocks of Middle Bala age [Lapworth].

TURRITOMA (?) PINGUIS, sp. nov. (Pl. IX, figs. 1–3.)

Diagnosis.—Shell conical, or somewhat pyramidal. Whorls about nine, increasing rather rapidly, smooth, flat above, angular at the periphery. Band generally flat, but sometimes slightly raised and convex on the last whorl, limited by a groove on each side, situated on the periphery, near the middle of the body-whorl, just visible above the suture on the penultimate whorl, wholly or partly hidden on the earlier whorls. Lines of growth strong, sweeping obliquely back to the band above and still more obliquely forward below, forming crescents on the band, and indicating the existence of a deep sinus in the outer lip. Sutures deep. Base flattened and very slightly convex. Umbilicus closed. Aperture imperfectly known.

Remarks and Resemblances.—This shell much resembles *T. (?) polita*, but differs in being of greater size, and in the whorls increasing more rapidly, thus rendering the shell shorter in comparison to the width. Also the body-whorl appears more angular, and the base flatter and less produced. In the conical spire and flatness of the whorls it is like *Euconia Etna* (Billings)[1] and *E. Ramsayi* (Billings)[2]; but it is distinguished from both by being more elongated, having the base less flattened, the band on the periphery, the lines of growth forming a deeper sinus, and the absence of an umbilicus.

Dimensions.—There are eight specimens in Mrs. Gray's collection. The largest has five whorls preserved in a length of 23 millimetres, the width measuring 13 mm. The specimen figured in Pl. IX, fig. 1, also has five whorls, and measures 22 millimetres in length and 13 mm. in width. Another individual, if entire, would consist of about nine whorls in a length of 13 millimetres.

Locality and Horizon.—Thraive Glen, in rocks of Upper Bala age [Lapworth].

[1] Geol. Surv. Canad. 'Palæoz. Foss.' vol. i (1865) p. 226 & fig. 210.
[2] 'Canad. Nat. & Geol.' vol. iv (1859) p. 351 & figs. 3 & 4.

Genus *Lophospira*, Whitfield.[1]

This genus is thus described by R. P. Whitfield (*loc. cit.*),

'Shells univalve, with elevated spires and strongly carinated or keeled volutions; whorls closely coiled in the upper part, but often becoming disconnected below from a too rapid descent of the coil. Central keel marking the position of a sinus or notch in the outer lip of the aperture. Axis usually minutely perforate when the whorls are not disconnected. Types: *Murchisonia bicincta*=*M. Milleri*, Hall, and *M. helicteres*, Salter.'

It has since been emended and divided into sections and subsections by Ulrich.[2] I hope, in a future paper, to discuss this genus fully, and describe all the known British species. At present I am only describing two of the probably earliest representatives, and also the only one with which I have met showing the sinus in the outer lip.

Lophospira (?) angulocincta (Salt.). (Pl. IX, figs. 4 & 4 *a*.)

Murchisonia angulocincta, J. W. Salter, 1859, Quart. Journ. Geol. Soc. vol. xv, p. 380 & pl. xiii, figs. 9, 10; J. Sowerby, 1867, 'Siluria' 4th ed. p. 532; J. J. Bigsby, 1868, 'Thes. Silur.' p. 157; R. Etheridge, 1888, 'Foss. Brit. Is.' vol. i (Palæozoic) p. 113.

Diagnosis.—Shell very elongated, slender, turreted, composed of about thirteen whorls. Whorls increasing gradually, strongly angular below the middle, slightly concave both above and below. There is a swelling immediately below the suture, and an angle or keel below the band on the body-whorl. Band situated on the strong angle below the middle of the whorl, prominent, rather convex. Lines of growth indistinct, apparently curving back to the band above, and forming a shallow sinus on the band itself, not seen below. Aperture subquadrangular.

Remarks.—All the specimens of this species hitherto seen are much weathered. A small example in the Museum of Practical Geology, Jermyn Street, shows the surface best, but it is more or less indistinct. A portion of one of its whorls is figured (Pl. IX, fig. 4 *a*), showing what appear to be the lines of growth, which give the band a somewhat crenulated appearance. If this be really the correct sculpture, this species can only have possessed a sinus in the outer lip, and not a slit. For this reason, and also because no well-authenticated species of *Murchisonia* have appeared so early, I refer it to *Lophospira*, Whitfield.

Resemblances.—This species is quite distinct from all known British ones. It bears some resemblance to *M. Catharina*, Billings,[3] from the Quebec Group in Canada, in form, the great angularity of the whorls, and in the position of the angle below the middle of the whorls.

Dimensions.—There are three specimens in the Museum of

[1] Bull. Amer. Mus. Nat. Hist. vol. i (1886) p. 312.
[2] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) pp. 960 & 962.
[3] Geol. Surv. Canad. 'Palæoz. Foss.' vol. i (1865) p. 231 & fig. 215.

Practical Geology, Jermyn Street, one of which is merely part of a section. The largest, which is the type (Pl. IX, fig. 4), consists of about thirteen whorls, and measures 22 millimetres in length, and 7 mm. in width. The Natural History Museum, South Kensington, and the Geological Survey Collection, Edinburgh Museum, each contain two small, badly-preserved examples.

Locality and Horizon.—Durness Limestone, Sutherland, which is regarded as probably homotaxial with the Tremadoc Beds.

LOPHOSPIRA BOREALIS, sp. nov. (Pl. IX, figs. 5 & 6.)

Diagnosis.—Shell turreted, of medium height, composed of more than five angular whorls, which increase rather rapidly. There is a strong angle, near the middle of the whorls of the spire and somewhat above the middle of the body-whorl, which represents the sinus; a slighter angle below is situated at the suture. Outline nearly flat above the submedian angle, slightly concave between it and the lower one. Lines of growth very indistinct, apparently curving forward below the angle. Aperture subquadrate; inner lip thickened. Umbilicus open.

Remarks.—There is but one undoubted specimen of this species in the Geological Survey Collection, Edinburgh Museum; and it is merely an internal mould, consisting of four distinct whorls and a much worn apex, the actual number of whorls in which cannot be made out. On the upper part of the body-whorl are traces of a fine line just below the suture. The submedian keel is much weathered, but was probably trilineate. A shell (Pl. IX, fig. 6), of which only two whorls are preserved, may perhaps belong to this species; it differs in there being two finer keels below instead of a single strong one, and it also gives the impression of being more depressed.

Resemblances.—This species differs from *L. bicincta* (Hall)[1] in not possessing so strong a keel on the upper part of the whorl below the suture, and in the lines of growth being more oblique; the former characteristic also distinguishes it from *L. obliqua*, Ulrich[2] (*Murchisonia bicincta*, Salt.). I have compared it with specimens of the latter species and the variety *perangulata* from Allumette Island in the Natural History Museum, South Kensington; and find that it differs from all also in the sinual angle being more nearly central, and thus the upper flattened part of the whorl is almost equal to the lower concave part, and the whorls are wider. It is most like *L. centralis*, Ulrich,[3] but it is likewise distinguished from it by the nearly central position of the sinual angle, and the lower keel being apparently stronger. It belongs probably to the Perangulata subsection of the Perangulata section of Ulrich.[4]

Dimensions.—Length = about 19 millimetres; width = 12 mm.

Locality and Horizon.—Durness Limestone, Sutherland.

[1] 'Pal. N. Y.' vol. i (1847) p. 177 & pl. xxxviii, figs. 5 *a–h*.

[2] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 965 & pl. lxxii, figs. 6–8.

[3] *Ibid.* p. 979 & pl. lxxiii, fig. 9.

[4] *Ibid.* p. 962.

LOPHOSPIRA VARIABILIS, sp. nov. (Pl. IX, figs. 7–10.)

Murchisonia gyrogonia, pars, J. Horne & B. N. Peach, 1899, Mem. Geol. Surv. 'Silur. Rocks of Britain' vol. i, p. 682; (?) J. Horne, B. N. Peach, & A. Macconochie, 1901, in 'Fauna, Flora, & Geol. of Clyde Area' publ. by Local Com. for Meeting of Brit. Assoc. Glasgow, pp. 428 & 438; *non* F. M'Coy, 1855, 'Brit. Palæoz. Foss.' p. 293 & pl. 1 K, fig. 43.

Diagnosis.—Shell turreted, composed of about nine whorls. Whorls increasing somewhat rapidly, the two apical ones apparently convex, the rest possessing a strong angle below the middle, where the band is situated; body-whorl convexo-concave above, the earlier whorls not so convex above, but having a raised thread immediately below the suture, slightly concave below the band. Base very convex, with a subangularity a short distance below the band, which is represented by a strong raised thread on the earlier whorls, appearing just above, or else hidden by, the suture. Band prominent, composed of three keels, the central one becoming very strong and convex on the body-whorl. Sinus deep and wide, the end pointed and almost triangular. Lines of growth sharp, numerous, fine lines being intercalated between stronger ones, retreating slightly above the band, almost vertical below. Ornamentation consisting of very fine and faint spiral lines. Aperture subquadrangular; inner lip reflected. Umbilicus apparently closed.

Remarks and Resemblances.—There are eight specimens of this species in Mrs. Gray's collection, and also two casts which probably belong to it. One of these has the outer lip well preserved, showing the sinus, which has the end and the greater portion of the sides intact. The sinus is remarkably broad, especially when compared with the width of the band on the earlier whorls, where it is much narrower than on the body-whorl. An example in the Geological Survey Collection, Edinburgh Museum, has part of the sinus intact, and it is similar in form, but not so well preserved. The specimens vary considerably in the height of the body-whorl: in some cases this may be partly the result of the manner of preservation, some being slightly compressed downward, while others are pressed upward. Members of the genus *Lophospira* are frequently characterized by irregularity in the coiling of the spire. This appears to be the species wholly, or in part, referred to as *Murchisonia gyrogonia*, M'Coy,[1] in the list of species published in the Scottish Survey Memoir, 'Silur. Rocks of Britain' vol. i (1899) p. 682. The specimen just mentioned from Balclatchie is thus named in the Museum. It differs, however, from *M. gyrogonia* in the whorls being less flat above and below the band, in the band not being flange-like; also the angle on the body-whorl is not so pronounced in the adult. *L. variabilis* resembles *Pleurotomaria Sybillina*, Billings,[2] from the Island of Anticosti, but is distinguished by its greater height and more numerous whorls. It is also somewhat like *L. tenuistriata*, Ulrich,[3] from the Utica Group, but differs in the greater convexity

[1] 'Brit. Palæoz. Foss.' 1855, p. 293 & pl. 1 K, fig. 43.

[2] Geol. Surv. Canada 'Catal. Sil. Foss. Anticosti' 1866, p. 54 & fig. 19.

[3] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 983 & pl. lxxii, figs. 48–50.

of the upper part of the body-whorl; moreover, the angularity below the band on the body-whorl is less pronounced, and the lines of growth, though varying in strength, are not lamellar and they do not recede and advance so strongly as represented in the figures of *L. tenuistriata*. This species evidently belongs to the Perangulata subsection of the Perangulata section of Ulrich.

Dimensions.—The crushed specimen figured in Pl. IX, fig. 9 consists of eight whorls in a length of 15·5 millimetres. That figured in Pl. IX, fig. 7, has about six whorls, measuring 13·5 mm. in length, and 8 mm. in width; the length of the sinus in its outer lip, if entire, would be about 4·5 mm., and would thus equal about one-fifth of the circumference of the last whorl.

Locality and Horizon.—Balclatchie (Ayrshire), in rocks of Llandeilo age [Lapworth].

Family PLEUROTOMARIIDÆ, d'Orbigny.

Genus *Pleurotomaria*, Defrance.

Subgenus PALÆOSCHISMA, nov.

Diagnosis.—Shell depressed-conical. Whorls few in number, flattened or slightly concave above, base convex. Band situated on the widest part of the whorl, near the middle of the body-whorl, low down on the earlier whorls, appearing just above the suture; lower margin coinciding with the periphery, concave, bounded on each side by a strong raised thread. Outer lip retreating with a moderate degree of obliquity above, oblique immediately below the band, and then forming a convex curve. Slit short, with parallel edges, about one-fifth the circumference of the body-whorl in length. Aperture probably subquadrate, but imperfectly known.

Type, *Palæoschisma girvanense*, sp. nov.

Remarks and Resemblances.—The characteristics of this subgenus do not exactly agree with those of any previously described genera or subgenera of the Pleurotomariidæ. It comes nearest to *Eotomaria*, Ulrich[1] in general form, and in possessing a concave band, bounded on each side by a strong thread situated on the apical side of the whorl; but it differs in having a distinct though short slit, instead of a sinus in the outer lip. The form of the slit greatly resembles that of *Trepospira sphærulata*[2] (Conrad), which species is figured by Ulrich as the type of his genus *Trepospira*. *Palæoschisma* is, however, distinguished in the band being visible above, instead of hidden by the suture on the earlier whorls, and in the absence of ornamenting nodes. It differs from *Schizolopha*,[3] the only Ordovician genus described by Ulrich with a slit in the outer lip, in the form of the shell and in the character and position of the band, this latter in *Schizolopha* being prominent

[1] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 954.
[2] *Ibid.* pp. 957 & 1081.
[3] *Ibid.* p. 952.

and situated on the periphery. From *Ptychomphalina*, Bayle[1] it is separated by having less convex whorls, and in the slit probably being shorter. In *Bembexia*, Œhl.[2] the form is more turriculated, the band higher above the suture and situated on the periphery; also the lines of growth sweep backward to and forward from the band less obliquely. Though the umbilical region is imperfectly known, it does not appear to have the wide umbilicus of *Mourlonia*, de Kon.[3]

Dimensions.—The length of the type = 11 millimetres.

Range.—The only species at present known is from the Llandeilo Formation.

PALÆOSCHISMA GIRVANENSE, sp. nov. (Pl. IX, figs. 11 & 11 *a*.)

Diagnosis.—Shell depressed-conical, composed of more than four whorls. Whorls increasing rapidly, smooth, slightly angular at the periphery, flat or rather concave above, convex below. A fine thread immediately below the suture constitutes the only ornamentation. Band a little above the middle of the body-whorl, but very low down on the penultimate whorl, being about half its width above the suture, flat or slightly concave, bounded by a strong thread on each side, with another thread between, somewhat nearer the upper than the lower limit, and becoming much fainter on the latter half of the body-whorl, the lower margin coinciding with the periphery. Lines of growth sloping rather obliquely back above, forming crescents on the band, and advancing with a moderately convex curve below. Slit in the outer lip short. Base convex. Aperture imperfectly known. Umbilicus probably closed.

Remarks.—At present there is but one specimen known of this species, which is in the collection of Mrs. Gray. It is remarkable for being the earliest British representative of the Pleurotomariidæ with which I have met possessing the slit in the outer lip preserved, the end and greater part of the sides being intact.

Resemblances.—This species greatly resembles *Eotomaria labiosa*, Ulrich,[4] in form, but is distinctly separated from that species, and from all other members of the genus, by possessing a slit in the outer lip, and a thread near the middle of the band. It bears also a certain general likeness to figures of *Pleurotomaria elliptica*, His.[5] Prof. Lindström kindly lent me a specimen of that species from the

[1] P. Fischer, 'Man. de Conchyliologie' 1885, p. 850. After a vain search for the original description of this genus by Bayle, I wrote to ask Dr. H. Fischer whether he could throw any light on the subject. As far as he can tell, his father was the first to publish the description of the genus, the name of which was written in manuscript by Bayle on the labels of the following species in the École des Mines, Paris—*Pt. carinata*, Sow. (Visé), *Pt. conica*, Phill. (Visé), and *Pt. striata*, Sow. (Visé). The date of the genus given by Fischer is 1885, and that was the year in which p. 850 was published.

[2] Bull. Soc. Études Sci. Angers, 1887 (sep. cop.) p. 24.

[3] Ann. Mus. Roy. Hist. Nat. Belg. vol. viii, pt. iv (1883) p. 75.

[4] Final Rep. Geol. & Nat. Hist. Surv. Minnesota, vol. iii, pt. ii (1897) p. 1003 & pl. lxix, figs. 15–17.

[5] 'Lethæa Suecica' 1837, p. 35 & pl. xi, fig. 1.

Upper Orthoceratite-Limestone of Lerkaka (Öland) for comparison. I find that *P. girvanense* differs in being much smaller, being about one third the size; the upper surface of the whorl is flatter and almost concave, while *Pleurotomaria elliptica* is slightly convex; below the band the base is more convex, while *Pl. elliptica* is flattened: the upper part of the body-whorl also appears longer in proportion; but the only known specimen is slightly flattened by pressure, so it cannot be accurately compared in this particular. The whorls are less angular at the periphery, the three keels forming the band on the penultimate whorl are nearly equal in strength, and the lower one coincides with the periphery; while in *Pl. elliptica* the central one appears the strongest and most prominent. They agree, however, in having the central thread of the band less developed on the latter part of the body-whorl. Both species are quite distinct from *Trochus ellipticus* of Portlock,[1] which latter is so much crushed that it would be difficult to compare other specimens with it accurately.

Dimensions.—The length = 11 millimetres, the width = 11 mm., and the length of the slit = about 5 mm.: if the lip were entire, it might possibly be longer. It equals about one-fifth of the circumference of the body-whorl.

Locality and Horizon.—Ardmillan Braes (Ayrshire), in rocks of Llandeilo age [Lapworth].

Family TURRITELLIDÆ, Lam.

Genus *Aclisina*, de Kon.[2]

ACLISINA (?) OBSCURA, sp. nov. (Pl. IX. fig. 12.)

Diagnosis.—Shell small, very elongated, turreted, composed of about thirteen whorls. Whorls increasing gradually, flat above, slightly convex below. There is a strong keel near the middle of the whorl, with two similar keels at equal distances apart below, and traces of a fine thread above them, and another thread immediately below the suture. Base convex, moderately produced. Apertures and lines of growth unknown.

Remarks and Resemblances.—There are but two examples of this species known, which are in Mrs. Gray's collection. As the aperture and lines of growth are not preserved on either of them, it is difficult to ascertain to which genus they should be referred. There does not appear to be any trace of a true sinual band, therefore they cannot be placed in *Murchisonia*. The elongated form and ornamenting keels resemble those of both *Ectomaria* and *Aclisina*, and more especially the latter, the keels being finer than is usually the case in *Ectomaria*. It reminds one forcibly of certain Carboniferous species of *Aclisina*; and should it prove really to

[1] 'Geol. Rep. Londonderry' 1843, p. 414 & pl. xxxi, fig. 1.

[2] This genus is fully described in Quart. Journ. Geol. Soc. vol. liv (1898) p. 45.

belong to this genus, it is the earliest known representative, for none older than the Devonian have been recorded previously.

Dimensions.—The length of the largest example = 14 millimetres, and the width = 5 mm. Its five upper whorls are merely represented by their impression left in the matrix. The smaller shell = about 9 mm. in length.

Locality and Horizon.—Woodland Point (Ayrshire), in beds of Middle Llandovery age [Lapworth].

EXPLANATION OF PLATES VII–IX.

Plate VII.

Fig. 1. *Murchisonia (?) dudleyensis*, sp. nov. Wax-impression, × 1½. Dudley. Museum of Practical Geology, London.

Figs. 2–4. *Goniostropha (?) elegans* (Sollas). Wax-impressions. Fig. 2. Type, partly embedded, × 4; fig. 2*a*. Outline of whorl, × 6; Fig. 3. Specimen with band more nearly central, × 4. Rhymney Quarry, Cardiff. Bristol Museum. Fig. 4. Specimen with whorls more exsert, × 3. Tymaur Lane, Rhymney, Cardiff. Cardiff Museum.

5 & 6. *Cyrtostropha corallii* (Sow.). Fig. 5. Front view, embedded in coral (*Stenopora fibrosa* var. *incrustans*), × 2; fig. 5*a*. Portion of whorl, × 4. Grindrod Collection, University Museum, Oxford. Fig. 6. Wax-impression, back view, × 4. Lily Mere. Collection of the Rev. M. S. Donald.

7 & 8. *C. scitula*, subgen. et sp. nov. Fig. 7. Back view, partly embedded, × 2; fig. 7*a*. Portion of eighth whorl, × 6. Locality unknown. Grindrod Collection, University Museum, Oxford. Fig. 8. Young specimen, × 6. Chance's Pitch, Malvern. Worcester Museum.

9 & 10. *C. bicincta* (M'Coy). Fig. 9. Type, partly embedded in matrix, × 4. Fig. 9*a*. Portion of second whorl from base, × 12. Chair of Kildare. Museum of Science & Art, Dublin. Fig. 10. Sinistral variety, partly embedded, × 4. Chair of Kildare. Museum of Practical Geology, London.

Fig. 11. *Ectomaria girvanensis*, Don. Portion of body-whorl showing lines of growth, × 2. Minuntion (Ayrshire). Gray Collection.

Plate VIII.

Fig. 1. *Cyrtostropha torquata* (M'Coy). Front view from wax-impression, × 4. Fig. 1*a*. Single whorl of another specimen, × 5. Lily Mere. Collection of the Rev. M. S. Donald. Fig. 1*b*, × 5. Kendal. Carlisle Museum.

Figs. 2 & 3. *C. obscura* (Portl.). Fig. 2. Front view of type, greatly compressed, × 2; fig. 2*a*. Portion of a wax-impression of a whorl, taken from the cavity in the matrix made by part of fig 2, × 3. Fig. 3. Back view of another specimen, slightly compressed, × 2. Desertcreight. Museum of Practical Geology, London.

Fig. 4. *C. robusta*, subgen. et sp. nov. Front view of specimen, × 1½. Thraive Glen, Gray Collection. Drawn from a photograph.

5. *C. Ordovix*, subgen. et sp. nov., × 2. Fig. 5*a*. Portion of whorl, × 4. Shalloch Mill. Gray Collection.

6. *Goniospira filosa*, sp. nov., × 2. Fig. 6*a*. Body-whorl, × 3. Shalloch Mill. Gray Collection. Drawn from a photograph.

Figs. 7 & 8. *Turritoma (?) polita*, sp. nov. Fig. 7. Back view, slightly crushed, making the spiral angle appear rather wider, × 3. Fig. 8. Specimen embedded in matrix, × 3. Shalloch Mill. Gray Collection. Drawn from a photograph.

PLATE IX.

Figs. 1-3. *Turritoma (?) pinguis*, sp. nov. Fig. 1. Front view, × 2. Fig. 2. Single whorl showing lines of growth, × 3. Fig. 3. Young specimen, × 5. Thraive Glen. Gray Collection. Drawn from a photograph.

Fig. 4. *Lophospira (?) angulocincta* (Salt.), × 2. Fig. 4*a*. Portion of a whorl of another specimen, × 6. Durness. Museum of Practical Geology, London.

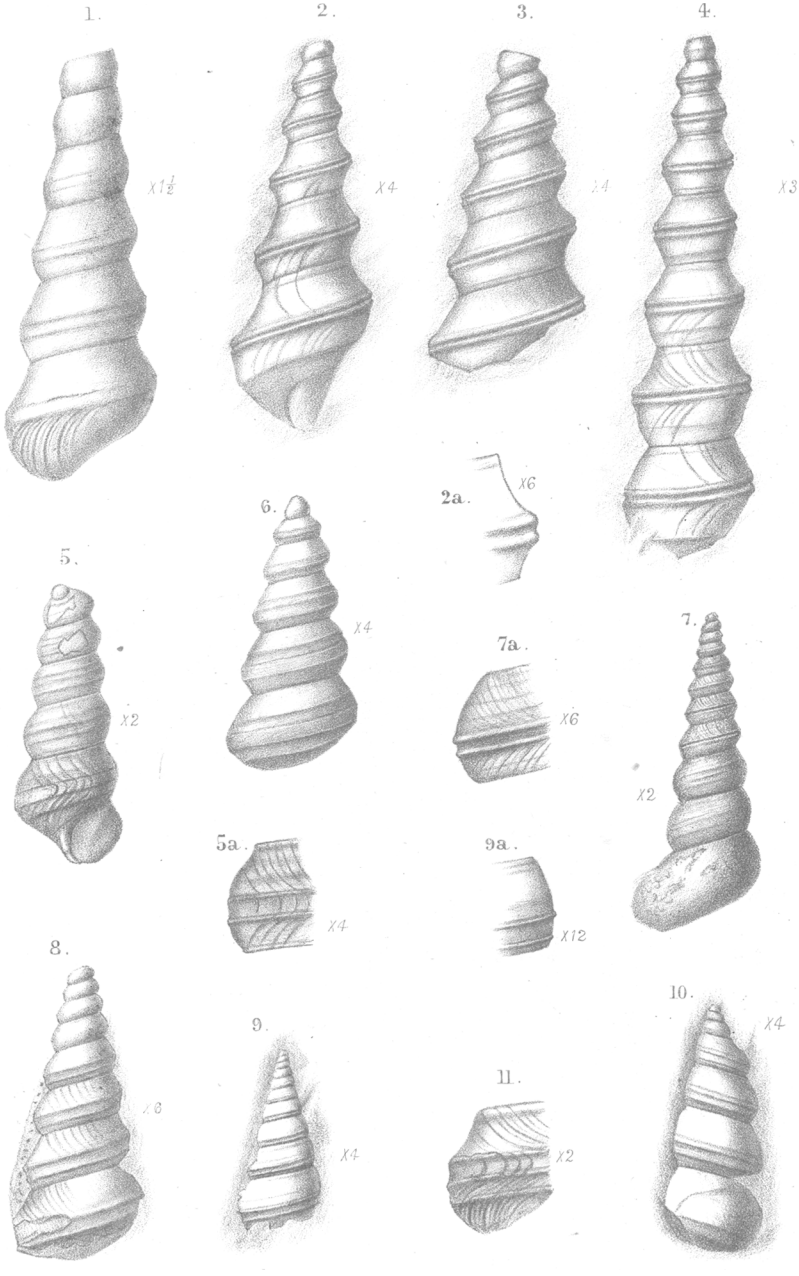
5. *L. borealis*, sp. nov. Front view, × 2. Durness. Geological Survey Collection, Edinburgh Museum.

6. *L. borealis*, var. (?), × 2. Durness. Geological Survey Collection, Edinburgh Museum.

Figs. 7-10. *L. variabilis*, sp. nov. Fig. 7. Side view showing sinus, × 3. Fig. 8. Front view, × 3. Fig. 9. Specimen crushed and embedded, but showing the apical whorls fairly well, × 3. Fig 10. Back view, × 3. Balclatchie. Gray Collection. All drawn from photographs.

Fig. 11. *Palæoschisma girvanense*, subgen. et sp. nov. Side view, showing slit in outer lip, ×3. Fig. 11*a*. Outline of portions of two whorls, ×3. Ardmillan Braes. Gray Collection. Drawn from a photograph.

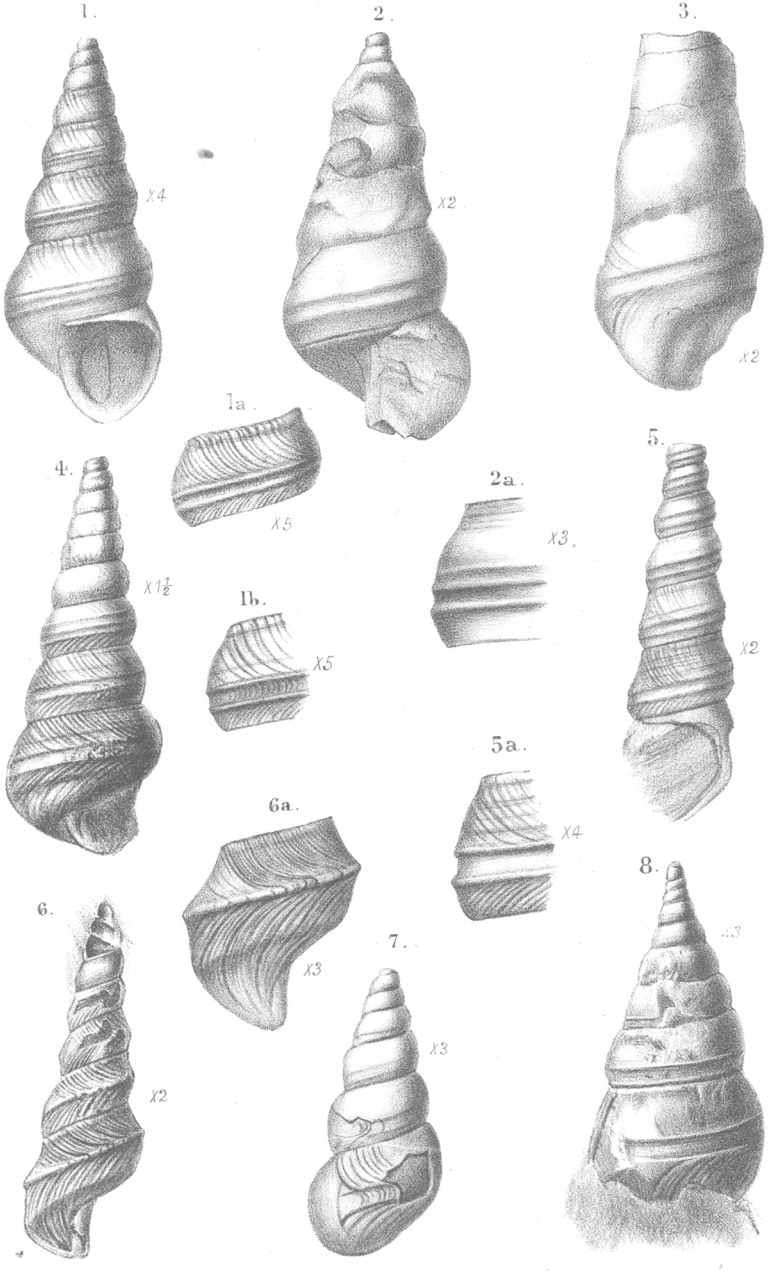
12. *Aclisina (?) obscura*, sp. nov. × 3. Woodland Point. Gray Collection.



J. Donald del.
A. H. Searle lith.

Mintern Bros. imp.

PROTEROZOIC MURCHISONIIDÆ.



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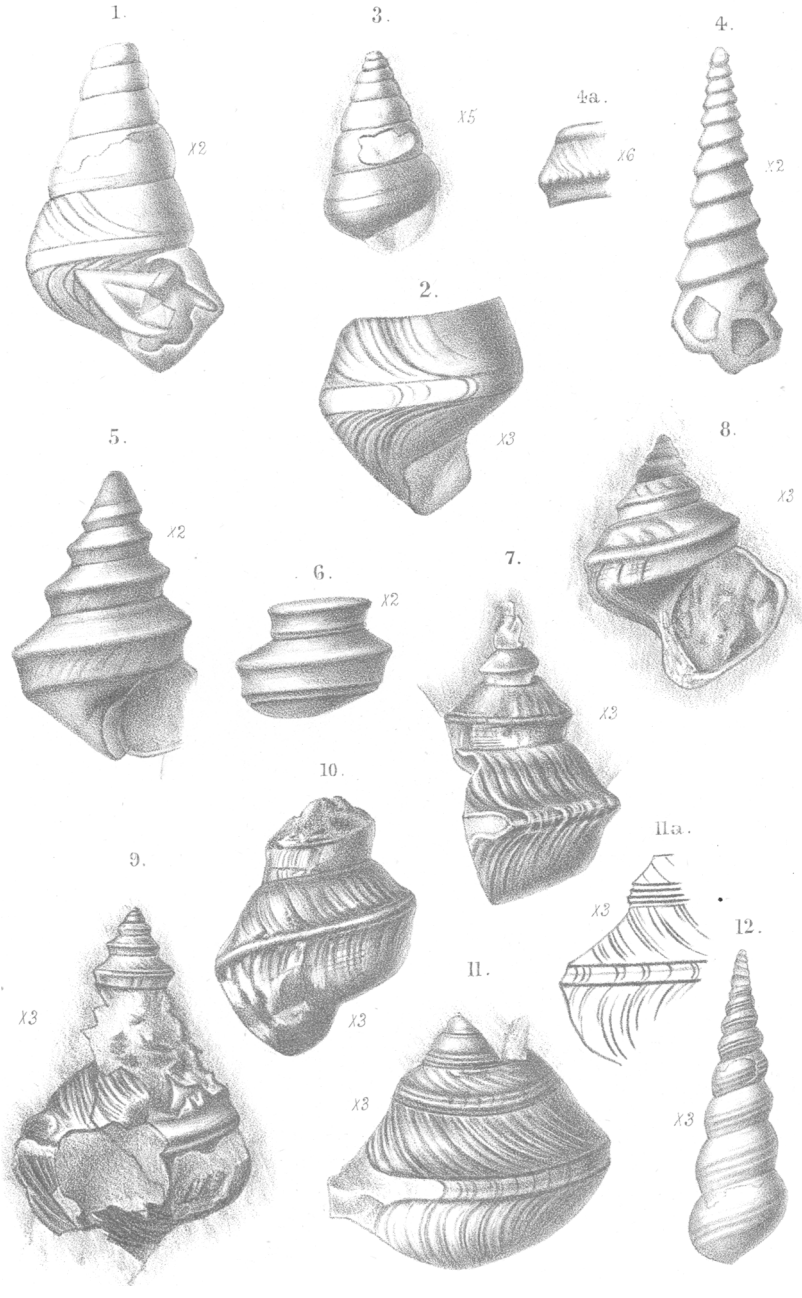
PROTEROZOIC MURCHISONIIDÆ.



J. Donald del. et phot.
A. H. Searle lith.

Minterne Bros. imp.

PROTEROZOIC MURCHISONIIDÆ, PLEUROTOMARIIDÆ, & TURRITELLIDÆ.