

President of the Council, will have the following constitution:—Chairman: Sir Richard Redmayne, representing the United Kingdom; and the following members: Dr. Willet G. Miller, representing Canada; Mr. W. S. Robinson, Australia; Mr. T. Hutchinson Hamer, New Zealand; The Rt. Hon. W. P. Schreiner, the Union of South Africa; The Rt. Hon. Lord Morris, Newfoundland; Mr. R. D. Oldham, India; Dr. J. W. Evans, Crown Colonies; Mr. W. Forster Brown (Mineral Advisor to H.M. Woods and Forests); Professor H. C. H. Carpenter (President of the Institute of Metals); Dr. F. H. Hatch (Member of the Mineral Resources Advisory Committee of the Imperial Institute and Past President of the Institution of Mining and Metallurgy); Sir Lionel Phillips (late Director of the Mineral Resources Development Department, Ministry of Munitions); Mr. Edgar Taylor (of John Taylor & Son, and late President of the Institution of Mining and Metallurgy); Mr. Wallace Thorneycroft (President of the Institution of Mining Engineers). Mr. Arnold D. McNair is Secretary, and the offices of the Bureau are for the present at the Holborn Viaduct Hotel, E.C.

Some department such as this has long been needed, and it is to be hoped that the new body will fulfil the expectations that have been aroused by its appointment, and that its functions will not be restricted to the collection and dissemination of information, but that it will also institute such researches as may appear desirable as to the occurrence of important but little-known minerals, both in this country and in the Colonies. The exigencies of the War have shown how important for the welfare of the State the discovery of new sources of such minerals may become; examples will occur to everyone. In the present war the cutting off of overseas supplies has necessitated the search for and development of home resources of manganese, wolfram, iron pyrites, phosphates, petroleum, etc. This country has been well served in the past by its purely scientific institutions, but the economic side has been unduly neglected. We wish the Bureau a successful career in the important work assigned to it.

ORIGINAL ARTICLES.

I. — ON THE DISTRIBUTION OF THE BRITISH CARBONIFEROUS GONIATICES, WITH A DESCRIPTION OF ONE NEW GENUS AND SOME NEW SPECIES.

By WHEELTON HIND, M.D., B.S., F.R.C.S., F.G.S.

(PLATE XVI.)

PART III of the Catalogue of the Fossil Cephalopoda in the British Museum (Nat. Hist.), by A. H. Foord and G. C. Crick, was published in 1897. Since then much fresh material has come into my hands and it is now possible to give much more accurate and fuller details of the horizons and localities at which the various species occur. This is of special importance, in view of the fact that the Goniatices can be used as zone indices of the Carboniferous Series from the upper part of the *Dibunophyllum* beds (D_2 of Dr. Vaughan)

up to the Middle Coal-measures. This I showed to be the case in my Presidential address to the Yorkshire Naturalists' Union, and published in the *Naturalist*, April to July, 1909, and elsewhere. Many details have, however, been added since then, and an elaborated and emended table will be published in a forthcoming paper by myself and Dr. Wilmore, F.G.S., on the Carboniferous succession of some Midland areas.

The zones published in the *Yorkshire Naturalist*, op. supra cit., p. 154, were as follows:—

MILLSTONE GRITS	.	.	<i>Gastrioceras listeri</i> .
PENDLESLIDE SERIES	.	.	<i>Glyphioceras bilingue</i> .
			<i>G. spirale</i> .
			<i>G. reticulatum</i> .
			<i>Posidonomya becheri</i> .
			<i>Cyathaxonina</i> .
CARBONIFEROUS LIMESTONE.			Upper <i>Dibunophyllum</i> .

It may be briefly stated that the Goniatices mentioned above occur with the utmost regularity wherever these horizons are exposed. Of the zones in the above list the *G. reticulatum* zone is the least satisfactory, on account of the persistence of the species from Pendleside to Middle Coal-measure times. Several other Goniatices zones will be indicated in the forthcoming paper, with greater detail as to their extent. Many of the localities given in the Museum Catalogue (op. supra cit.) are unsatisfactory, partly because, at the time when it was published, the zones of the Carboniferous rocks had not been made out, and partly because the real history of many of the specimens in the Natural History Museum was not known. Collections were largely referred to the town where the collectors lived, e.g. Halifax, Todmorden. Halifax is given as a locality for a large number of species which could not have come from the Lower Coal-measures. I suspect that many of these, if not all, came from the collection of the late J. W. Davis, of Halifax. I see this fact was mentioned by Mr. Crick, Q.J.G.S., vol. lxxvii, pp. 400-4. Long lists of fossils are given by J. W. Davis in his portion of the volume, *West Yorkshire*, part i, Geology, 1878 (Davis and Lees), but none are referred to Halifax as a locality. The "Hardbed Coal" occurs there with the marine fossils of the Mountain Mine or Bullion Coal, and the locality is correct for *Gastrioceras listeri*, *G. carbonarium*, *Dimorphoceras gilbertsoni*, *D. looneyi*, and *D. discrepans*. The locality Halifax must therefore be called in question for all Goniatices other than the above. Todmorden is also unsatisfactory, for, though the Goniatices beds occur at that town, the majority of the collections have been made from Horsebridge Clough, Crimsworth Dean, and High Green Wood, north of Hebden Bridge, from the valley of Hebden Water and its tributary. The two former localities are in the same little valley.

The Natural History Museum is fortunate in possessing nearly all the types of Phillips's Goniatices, but the localities given by him are practically valueless. Bolland is a large district, partly in Lancashire, partly in Yorkshire, and practically the whole of the Lower Carboniferous rocks occur therein. Black Hall, near Chipping, and

some of the Devonshire Culm localities are, however, sufficiently detailed to determine the exact horizon. "River Ribble" is, of course, too vague. The Scottish localities are copied from the Handbook, Brit. Assoc., Glasgow, 1901, p. 503, where there is a list of Carboniferous Cephalopoda from the Clyde area, drawn up by J. Neilson. Many Devonshire localities are quoted from Mr. Crick's paper, Q.J.G.S., vol. lxvii, pp. 309-408.

Several Irish localities are quoted from Foord's Carb. Ceph., Ireland, part v, Pal. Soc., vol. lvii, 1903. Several Irish specimens which are known only from a single locality are not dealt with, because I have no knowledge of the exact horizon at which they occur. Unfortunately, it will be noted that all known British Goniatites occur in the upper beds of the Carboniferous Limestone and the succeeding series, and except in Ireland no Goniatites are noted from beds below the Upper *Dibunophyllum* zone. I suspect that Kniveton, however, will be eventually found to be of a much lower horizon, and there I have obtained species which I refer to *G. corpulentum*, M'Coy, and a variety of *G. truncatum*, and I possess a large specimen of this variety from Clitheroe. The presence at Kniveton of *Pericyclus fasciculatus* is interesting. De Koninck has described the following species: From Tournai—*Brancoceras rotatorius*, *Glyphioceras complanatus*, *G. rotella*, *G. ryckholtii*, *G. crenulatus*, *G. perspectivus*, *G. belvalianus*, *Pericyclus divisus*, *P. funatus (princeps)*. From Pauquys—*Glyphioceras inconstans*, *G. spheroidale*, M'Coy, *P. fasciculatus*. From Vève—*P. impressus*. At least four of the above species occur in Ireland.

TABLE OF DISTRIBUTION OF BRITISH GLYPHIOCERATIDÆ.

COAL-MEASURES	<i>Glyphioceras reticulatum</i> , Phillips.
	<i>G. micronotum</i> , Phillips.
	<i>Dimorphoceras gilbertsoni</i> , Phillips.
	<i>D. looneyi</i> , Phillips.
	<i>Gastrioceras listeri</i> , Martin.
	<i>G. carbonarius</i> , V. Buch.
	<i>G. coronatum</i> , Foord & Crick.
	<i>Nomismoceras ornatum</i> , Foord & Crick.
	<i>Pericyclus impressus</i> , de Koninck.
	<i>P. divaricatum</i> , Hind.
MILLSTONE GRIT	<i>Glyphioceras reticulatum</i> , Phillips.
	<i>G. beyrichianum</i> , de Koninck.
	<i>G. bilingue</i> , Salter.
	<i>G. calyx</i> , Phillips.
	<i>G. phillipsii</i> , Foord & Crick.
	<i>G. davisii</i> , Foord & Crick.
	<i>G. platylobum</i> , Phillips.
	<i>G. spirale</i> (var.), Phillips.
	<i>Dimorphoceras gilbertsoni</i> , Phillips.
	<i>D. looneyi</i> , Phillips.
PENDLESIDE SERIES	<i>D. discrepans</i> , Brown.
	<i>Gastrioceras listeri</i> , Martin.
	<i>Glyphioceras reticulatum</i> , Phillips.
	<i>G. bilingue</i> , Salter.
	<i>G. davisii</i> , Foord & Crick.
	<i>G. phillipsii</i> , Foord & Crick.
	<i>G. spirale</i> , Phillips.

G. beyrichianum, de Koninck.
G. striolatum, Phillips.
G. bidorsale, Phillips.
G. calyx, Phillips.
G. vesica, Phillips.
G. nitidum, Phillips.
G. platylobum, Phillips.
Dimorphoceras gibsoni, Phillips.
D. looneyi, Phillips.
D. discrepans, Brown.
Nomismoceras rotiforme, Phillips.
N. spirorbis, Phillips.
N. vittiger, Phillips.
Prolecanites serpentinus, Phillips.
P. compressus, Sowerby.

CARBONIFEROUS LIMESTONE
 (D₂ beds)

Pericyclus fumatus, Sowerby.
P. fasciculatus, M'Coy.
P. doohylensis, Crick.
Brancoceras enniskilleni, Foord.
Glyphioceras crenistria, Phillips.
G. striatum, Sowerby.
G. sphaericum, Martin.
G. fimbriatum, Foord & Crick.
G. obtusum, Phillips.
G. implicatum, Phillips.
G. truncatum, Phillips.
G. micronotum, Phillips.
G. vesica, Phillips.
G. mutabile, Phillips.
G. excavatum, Phillips.
C. vesiculifer, de Koninck.
G. complicatum, de Koninck.
Nomismoceras vittiger, Phillips (very rare).
Dimorphoceras gilbertsoni, Phillips.
Prolecanites cyclolobus, Phillips.
P. discoides, Foord & Crick.
P. mixolobus, Phillips.
Pronorites cyclolobus, Phillips.

NOTES ON EACH SPECIES OF CARBONIFEROUS GONIAITITES, WITH
 DISTRIBUTION AND LOCALITIES.

Genus **Brancoceras**.

BRANCOCERAS ENNISKILLENI, Foord. *Dibunophyllum* zone, D₂.
 Derbyshire: Carsington.
 Ireland: Blacklion, near Enniskillen.

Genus **Pericyclus**.

PERICYCLUS FASCICULATUS, M'Coy. ? *Dibunophyllum* zone, D₁.
 Derbyshire: Kniveton.
 Ireland: Little Island, co. Cork; Clane, co. Kildare.
 PERICYCLUS DOOHYLENSIS, Foord & Crick. *Dibunophyllum* zone, D₁.
 Derbyshire: Kniveton.
 Ireland: Doohyle, near Rathkeale, co. Limerick.

PERICYCLUS DIVARICATUS, Hind. Base of Pendleside Series to 3rd Grit.
Yorkshire: Cracoe Knolls, Flasby, Horsebridge Clough, near Hebden Bridge.

Lancashire: River Ribble at Dinckley Hall, 3rd Grit Shales, Eccup.

Cheshire: In the *G. spirale* beds, Congleton Edge.

Isle of Man: *P. becheri* beds, Poolvash.

Genus *Glyphioceras*.

GLYPHIOCERAS SPHÆRICUM, Phillips. Carboniferous Limestone, upper beds of Upper *Dibunophyllum* zone, D₂.

Lancashire: Black Hall.

Yorkshire: Keal Hill, Craven.

Derbyshire: Crowdecote, Castleton, Chrome Hill.

Devon: Fremington, Bonhay Road, Exeter.

Isle of Man: Poolvash.

Scotland: Upper Limestone Series: Gare. Lower Limestone Series: Corrieburn.

Ireland: Loughshinny, co. Dublin; Bantry, co. Cork.

GLYPHIOCERAS CRENISTRIA, Phillips. The upper beds of Upper *Dibunophyllum* zone, D₂.

This is an important zone fossil. It occasionally passes up into the *Prolecanites* zone just above it.

Lancashire: River Ribble at Dinckley Hall, Black Hall, and Cold Coats, near Chipping.

Yorkshire: Keal Hill, El Bolton, Rilstone. The Knotts, Bolland and Brockthornes, both 5 or 6 miles S.E. of Long Preston. Salterforth Railway Cutting.

Derbyshire: Castleton, Gluttondale, Chrome Hill.

Staffordshire: Wetton, Narrowdale.

Devonshire: Venn, Swimbridge, Bampton, and Bonhay Road, Exeter; Burlescombe.

Isle of Man: Poolvash.

Ireland: Foord quotes Queen's County and co. Fermanagh.

GLYPHIOCERAS FIMBRIATUM, Foord & Crick.

The validity of this species is doubtful, and its locality is not recorded.

GLYPHIOCERAS STRIATUM, Sowerby.

An important zone fossil which is common to the *G. crenistria* and *Prolecanites compressus* beds, and also in the *Posidonomya becheri* shales. Often crushed flat in shales, but easily recognized by its spiral ornament.

Lancashire: River Ribble Dinckley Hall, Cold Coats.

Yorkshire: El Bolton, Keal Hill, Flasby, Eastby. Beck half-mile N. of Ashnot inlier, Upper Hodder at Dalehead, between Hammerton Hall and Birch Hill.

Derbyshire: Chrome Hill.

Devonshire: Fremington.

Isle of Man: Poolvash.

North Wales: Teilia.

Ireland: Courtlough, Garristown, and Newton, co. Dublin; Drumsra, co. Tyrone.

Scotland: Upper Limestone Series: Gare. Lower Limestone Series: shale above Hosie Limestone, Campsie. Main Limestone: Carluke.

GLYPHIOCERAS OBTUSUM, Phillips. The *G. crenistria* beds.

Not at all a common species.

Lancashire: Black Hall, near Chipping.

Ireland: Co. Cork: Blackrock, Little Island, and Middleton. Co. Waterford: Ballyduff. Co. Limerick: Ballynacarriga.

GLYPHIOCERAS PHILLIPSII, Foord & Crick. Base of Pendleside Series to Millstone Grit.

Lancashire: River Ribble Dinckley Hall; Caton Green (Millstone Grit). Butler's Clough, Billington.

Yorkshire: Horsebridge Clough and Crimsworth Dean, Hebden Bridge (*G. reticulatum* zone); stream below Weets Head; stream north-west of Ashnot, Rilstone.

Staffordshire: Waterhouses (*G. reticulatum* beds).

Devonshire: Pinhoe Brickfield, Exeter.

North Wales: Holywell.

GLYPHIOCERAS MICRONOTUM, Phillips. Upper *Dibunophyllum* zone to Middle Coal-measures.

Lancashire: River Ribble Dinckley Hall; Rough Lee (Sabden Shales); River Hodder above the great falls.

Yorkshire: Rilstone and Lothersdale, 704 feet above Barnsley Coal, Brodsworth.

Staffordshire: Narrowdale, Wetton; above the Gin Mine Coal, North Staffs Coalfield.

Derbyshire: Castleton, Park and Chrome Hills, Thorpe Cloud.

Isle of Man: Poolvash.

Scotland: Upper Limestone Series: Orchard and Garngad Road. Lower Limestone Series: Shale over Hosie Limestone, Campsie, and Thornton.

GLYPHIOCERAS TRUNCATUM, Phillips. *Seminula* beds to Upper *Dibunophyllum*.

Lancashire: River Ribble Dinckley Hall, Black Hall, Cold Coats; ? Salt Hill, Clitheroe (*S.* beds).

Yorkshire: Keal Hill and El Bolton.

Derbyshire: Chrome Hill, Park Hill, Castleton, Thorpe Cloud, and Kniveton.

Staffordshire: Wetton, Narrowdale.

Isle of Man: Poolvash.

Scotland: Upper Limestone Series: Thornliebank.

Ireland: Drumsra, co. Tyrone; St. Donlaghs, co. Dublin; Clane, co. Kildare; Little Island, Tankardstown, Middleton, co. Cork; Lisnakeny, Nantenan, Ballyeahane, and Kilmacot, co. Limerick.

N.B.—The specimens quoted from Redesdale, Northumberland, in the Catalogue probably belong to a new species of *Pericyclus*, but

I have a specimen, a fragment of the body-chamber, which I think should be referred to *G. truncatum*.

GLYPHIOCERAS VESICA, Phillips. From the *G. crenistria* zone to the *G. spirale* zone, D₂, and Pendleside Series.

Lancashire: Black Hall, River Ribble W. of Dinckley Hall.

Yorkshire: Crimsworth Dean.

Scotland: Upper Limestone Series: Bowertrapping, Gare, Robroyston, Auchenberg. Lower Limestone Series: East Kilbride, Thornton.

GLYPHIOCERAS IMPLICATUM, Phillips. The *G. crenistria* zone, D₂.

I have not met with this species in any of the collections from the Hebden Bridge area that I have examined.

Lancashire: Black Hall, River Ribble at Dinckley Hall.

Derbyshire: Chrome Hall.

Isle of Man: Poolvash.

Scotland: Upper Limestone Series: Gare, Robroyston.

GLYPHIOCERAS MUTABILE, Phillips. From the *G. crenistria* zone to *G. spirale* zone.

Lancashire: River Ribble, W. of Dinckley Hall.

Yorkshire: Quarry 1 mile S. of Rilstone.

Derbyshire: Castleton, Storrs quarry, Bradbourne.

Staffordshire: Narrowdale.

Scotland: Upper Limestone Series: Gare, Robroyston.

GLYPHIOCERAS PLATYLOBUM, Phillips. Pendleside Series to Millstone Grit.

Yorkshire: valley of the Nidd. Sabden Shales, Rough Lee; Gillbeck, S.E. of Lothersdale. Foord & Crick quote the species from Wetton, Staffordshire, and Todmorden.

GLYPHIOCERAS STENOLOBUM, Phillips.

This must be a rare or doubtful species. It must be noted that the suture-lines figured by Phillips and by Foord & Crick are quite different. Neither Phillips's or their figures show that the shell has a wide peripheral sinus as stated in the text. Unfortunately the "type" has been lost, and the original locality, "Bolland," gives no information as to the horizon whence the type-specimen was obtained.

GLYPHIOCERAS NITIDUM, Phillips. *G. crenistria* beds to Millstone Grit.

Lancashire: River Ribble Dinckley Hall, Black Hall, near Chipping; Millstone Grit beds, stream N. of Haws House, 6 miles E. of Lancaster.

GLYPHIOCERAS BILINGUE, Salter.

An important zone fossil. At Pendle Hill it characterizes 300 feet of Black Shale below the Upper Pendle or Farey's Grit. It occurs in the Sabden Shales, W. of Sales Wheel, M.G.

Lancashire: Pendle Hill, Butlers Clough, Billington, and near Lango; River Ribble E. of Sales Wheel, Longridge Fell; streams N. of Chipping, Marsden Tunnel, Pule Hill.

Yorkshire: east bank of Winterburn Reservoir, stream half-mile N.E. of Thorlby, shales S. of El Bolton, stream half-mile S., and Clough, 1 mile S. of Ashnot; Hareshaw, S. of Lothersdale, below Weets Head and Eastby beck. Above Weston Grit, Clifton Bank, 1 mile N. of Otley. Millstone Grit Shales, Moreton Bank.

Derbyshire: River Dove, Glutton Bridge, Mam Tor, River Noe, Bradwell and stream W. of Bradbourne.

Cheshire: River Dane half-mile E. of railway viaduct; Wild Moor, Bank Hollow, E. of Macclesfield.

South Wales: Bishopton, near Swansea.

Ireland: Caher Lane and Rathcahill, near Abbeyfield, co. Limerick.

GLYPHIOCERAS RETICULATUM, Phillips. Pendleside Series to Middle Coal-measures.

An important species which when very young is strongly ribbed and has a wide and deep umbilicus and a deep groove on the periphery. As it grows the ornament becomes more delicately reticulate and in the old stage the shell may be almost smooth. Like *G. spirale* and *G. bilingue* the aperture is curved at the sides like a reversed S, and there is a deep sinus at the periphery. It is quite open to doubt whether the horizon at Hebden Bridge may not be Millstone Grit rather than Pendleside Series.

Lancashire: River Ribble W. of Dinckley Hall above the *G. spirale* beds, Pendle Hill above Hook Cliff; Sabden Shale, Rough Lee.

Yorkshire: Holden Clough, Bolland; High Green Wood, Crimsworth Dean, and Horsebridge Cough, Hebden Bridge; Millstone Grit Shales at Eccup and Wadsworth Moor, 705 feet above Barnsley. Coal, Brodsworth.

Derbyshire: River Noe and Mam Tor.

Staffordshire: River Dane, Dane Valley; Morridge. Shales below 3rd Grit, Shirley Brook, near Froghall.

Cheshire: River Dane, N. side of Dane Valley; Bosley Minn.

Devonshire: Doddiscombeleigh; Pinhoe, near Exeter; Dunsford Road above Pocomb Bridge, bottom of Ashlake Road, Mincing Lake, Newton St. Cyres, under Slope Wood and Willhayes Copse; near Barnstaple.

South Wales, Pembrokeshire: Penally, near Tenby.

Scotland: Upper Limestone Series: Gare.

Ireland: Pendleside Series: Lisdoonvarna Doon, Mt. Phelim, and cliffs of Moher and Kilkee, co. Clare; Foynes Island and Rathcahill, co. Limerick; Mullaghtumy (Clogher), co. Tyrone; 5 miles N. of Maynooth, co. Meath; marine bands, Castlecomer Coalfield.

GLYPHIOCERAS DAVISI, Foord & Crick. *G. reticulatum* beds, Hebden Bridge to Sabden Shales.

Hitherto this fossil has only been found associated with *G. reticulatum*, and the study of a series of specimens in my collection has led me to suspect that it may be an old-age form of

that species. Haug, Mém. Soc. Géol. France, Pal., tom. vii, p. 90, has expressed the same view. Hind & Howe, on the strength of the locality quoted in the Cat. Foss. Ceph. Brit. Mus., p. iii, erroneously recorded this species as passing up into the Coal-measures (Q J.G.S., vol. lvii, app. B).

Yorkshire: The *G. reticulatum* beds of Horsebridge Clough.

Lancashire: Sabden Shales of Rough Lee.

Staffordshire: River Dane, W. of salmon ladder.

Devonshire: Mincing Lane, near Exeter.

Ireland: Rathcahill and Foynes Island, co. Limerick; Puffing-hole, Kilkee, co. Clare; Coor Spa Well, near Ennis.

GLYPHIOCERAS EXCAVATUM, Phillips. *G. crenistria* zone.

Derbyshire: Castleton, Thorpe Cloud, Park Hill.

Staffordshire: Narrowdale.

Isle of Man: Poolvash.

Scotland: Upper Limestone Series: Orchard, Gare, Thornliebank. Lower Limestone Series: Thornton.

GLYPHIOCERAS BIDORSALE, Phillips.

A species of doubtful value. The late Mr. Crick referred a specimen in my collection from Horsebridge Clough to this species. Foord & Crick, op. supra cit., think it may be a form of *G. reticulatum*, and observe that the double median saddle on which Phillips founded the species does not exist in well-preserved examples.

GLYPHIOCERAS BEYRICHIANUM, de Koninck. Middle Pendleside Series to Millstone Grit.

This species has a most variable form. In the young stage the umbilicus, is wide and deep, inclusion small, the shell strongly marked with transverse ribs, the periphery broad and flattened, and like *G. reticulatum* has a central spiral sulcus.

In more mature shells the inclusion is more complete, the ribs more delicate, and the periphery more convex. Haug (op. supra cit., p. 92) describes and figures seven distinct varieties, all of which seem to come from Chokier. Similar varieties occur at Lisdoonvarna, co. Clare, and Rough Lee near Sabden.

My own observations lead me to suppose that the young stage of all the varieties are identical and occasionally persist, but the species was plastic and adopting new forms, or there may have been actually crossing going on between *G. reticulatum* and *G. beyrichianum*. Many specimens are very difficult to refer definitely to one or other of these species.

Gastrioceras circumplicatile, Foord, is probably a variety of the species. Haug points out that *G. diadema* is a synonym of *G. striolatum*, Phillips, and that as he adopts the latter as a distinct species the name *diadema* disappears and *G. beyrichianum*, de Kon., 1843, takes its place.

Lancashire: Sabden Shales, Rough Lee (Millstone Grit).

Yorkshire: Gillbeck, S.E. of Lothersdale (Millstone Grit); Horsebridge Clough, Hebden Bridge.

- Devonshire: Pinhoe Brickfield, near Exeter.
Derbyshire: Spoil-heaps, Edale Tunnel.
Cheshire: Silica quarry, Congleton Edge.
Denbighshire: Holywell Shales.
Pembrokeshire: Black limestones, seashore, Tenby.
Scotland: Upper Limestone Series: Orchard, Thornliebank.
Middle Limestone Series: Black Band Ironstone, Dalry.
Ireland: Lisdoonvarna, co. Clare.

GLYPHIOCERAS STRIOLATUM, Phillips.

Foord & Crick have included this species as a synonym of *G. diadema*. Haug (Trans. Geol. Soc. France) distinguishes *G. striolatum* from *G. beyrichianum*, and I follow him.

It occurs in the *G. reticulatum* beds of High Green Wood and Horsebridge Clough, near Hebden Bridge.

Devonshire: Pinhoe, Barley, and Dunsford Road, ? Ashlake Road, Mincing Lake, and Perridge Tunnel.

Scotland: Upper Limestone Series: Gare, Robroystone, Orchard, Auchenberg.

GLYPHIOCERAS CALYX, Phillips. Pendleside Series to Millstone Grit.

Yorkshire: Horsebridge and Crimsworth Dean; stream S.W. of Browsholm Hall; River Hodder; Sabden Shales, Gillbeck, S.W. of Lothersdale.

Ireland: Foynes Island.

GLYPHIOCERAS COMPLICATUM, de Koninck. Zone of *G. crenistria*.

Derbyshire: Castleton, Bradbourne.

This is the first note of the occurrence of this species in England.

GLYPHIOCERAS VESICULIFER, de Koninck. Zone of *G. crenistria*.

Yorkshire: El Bolton.

Lancashire: River Ribble, Dinckley Hall.

Isle of Man: Poolvash.

GLYPHIOCERAS PAUCILOBUM, Phillips.

Only one specimen known, possibly the type. Phillips recorded no locality.

GLYPHIOCERAS SPIRALE, Phillips.

An important Middle Pendleside zone fossil, occupying only a few feet of strata.

The species occurs at Clavier, Belgium, and in Ireland. Hitherto all British specimens have been found crushed. I have, however, been fortunate enough to extract a few uncrushed examples from nodules near Dinckley, one of which shows the suture-line to agree with the figure quoted by Foord & Crick after Roemer.

Lancashire: River Ribble, W. of Dinckley Hall; Pendle Hill, above Lower Pendle Grit; Sabden Shales, Rough Lee, a var. with fine ornament.

Yorkshire: Embsay Moor, black shales in beds N. of Eastby, beek three-quarters of a mile S. of Ashnot; Parkhead, Lothersdale.

Cheshire: Silica quarry, Congleton Edge.

444 *Dr. Wheelton Hind—British Carboniferous Goniatices.*

Derbyshire: Lower beds of Mam Tor.

Devonshire: Waddon Barton; Bampton; Hele, east of Venn; Popehouse Close, Christow.

Ireland: Foynes Island, co. Limerick; Loughshinny; Summerhill, and near Trim, co. Meath; Killorglin, co. Kerry.

Probably *Goniatices granosus*, Portlock, from Tyrone, should be referred to this species.

Genus **Nomismoceras**, Hyatt, pars.

NOMISMOCERAS SPIROBIS. *G. crenistria* to *G. striatum* zones.

Lancashire: Above the great falls, River Hodder; Ribble at Dinckley Hall; Black Hall.

Yorkshire: Rilstone, Crimsworth Dean.

Derbyshire: Storrs Quarry, Bradbourne.

Devonshire: Waddon Barton.

Ireland: Foynes Island, co. Limerick.

NOMISMOCERAS ROTIFORME, Phillips. Generally confined to the *Posidonomya becheri* beds.

Lancashire: River Ribble Dinckley Hall. Pendleside Limestone: above great falls, River Hodder.

Yorkshire: River Hodder below Sandal Holm, and below bathing cots.

Staffordshire: Pepper Inn Wetton, and Narrowdale.

Isle of Man: Black marble quarry, Poolvash.

Ireland: Loughshinny.

NOMISMOCERAS VITTAGER, Phillips. Upper beds of *D*₂ to Pendleside Limestone.

Lancashire: Pendleside Limestone: above great falls, River Hodder.

Derbyshire: Storrs Quarry Bradbourne; Castleton.

Staffordshire: Narrowdale.

NOMISMOCERAS ORNATUM, Foord & Crick.

Roof of Bullion Coal, Sholvef.

Genus **Dimorphoceras**, Hyatt.

DIMORPHOCERAS GILBERTSONI, Phillips. Base of Pendleside Series to Middle Coal-measures.

A very widespread form.

Lancashire: River Ribble Dinckley Hall; Rough Lee (Sabden Shales).

Yorkshire: marine beds of Coal-measures and Pendleside Series: Crimsworth Dean and Horsebridge Clough; 705 feet above Barnsley Coal, Brodsworth.

Staffordshire: River Dane near Dane Bridge; marine bands of Coal-measures below Gin Mine Coal, 71 feet below 4th Coal, Cheadle; the coombes near Leek.

Derbyshire: Pendleside Series of Mam Tor.

Devonshire: *Gastrioceras* beds, Instow.

Ireland: Pendleside Series of Lisdoonvarna, Foynes Island; marine bands of Castlecomer Coal-measures.

Scotland: Lower Limestone Series: shale over Hosie Limestone, Thornton, Braidwood, and South Hill, Campsie.

DIMORPHOCERAS DISCREPANS, Brown. Pendleside Series to Coal-measures.

Yorkshire: Horsebridge Clough and Crimsworth Dean, Hebden Bridge; Sabden Shales, Rough Lee.

Lancashire: Lower Coal-measures, Sholver, near Oldham.

Ireland: Foynes Island and Lisdoonvarna.

DIMORPHOCERAS LOONEYI, Phillips. Pendleside Series to Coal-measures.

Lancashire: River Ribble, Dinckley Hall.

Yorkshire: Crimsworth Dean and Horsebridge Clough.

Devonshire: Pinhoe, Exeter.

Ireland: Lisdoonvarna and Foynes Island (Pendleside Series).

Scotland: Lower Limestone Series: Boghead; Raesgill, Carluke; Thornton, over Hosie Limestone.

Genus *Gastrioceras*, Hyatt.

GASTRIOCERAS CARBONARIUM, von Buch. Upper Millstone Grit to Middle Coal-measures.

Lancashire, Yorkshire, Cheshire, and Staffordshire: above the Upper Mountain Mine or Bullion Coal.

Staffordshire: below the Gin Mine Coal, above Stinking Coal, Cheadle.

Devonshire: Instow and Clovelly.

South Wales: Rosser veins, Glan Rymney.

GASTRIOCERAS LISTERI, Martin (?).

There is a great deal of doubt as to what was the original of Martin's figure, which resembles a Jurassic ammonoid. This, added to the fact that the species does not occur at the localities given, should, I think, cause us to utterly disregard Martin's figure, and to accept that drawn by J. de C. Sowerby, *Min. Conch.*, vol. v, pl. D 1, fig. 1, right- and left-hand figs.

Martin says of his shell: "a common species. It is found in most of our limestone tracts, particularly near Eyam and Middleton." Sowerby, speaking of the occurrence of the shell, states: "This stratum may be traced from Middleton to near Leeds, and perhaps further."

The maximum of *G. listeri* is in the roof of the Bullion, Upper Mountain, or Hard-bed Coal, and it has not been found higher up than the Lower Coal-measures, but it certainly occurs below the 1st Grit or Rough Rock.

Spencer states that he found the species with *G. reticulatum* at the Hebden Bridge localities. "*G. listeri* is very rarely found in the Millstone Grit rocks of this district (Halifax) . . . and it is only when we come to the Upper Millstone Grit shales that we find *G. listeri* occurring in great numbers" (*Trans. Manch. Geol. Soc.*, vol. xiii, p. 110).

Yorkshire and Lancashire: Everywhere over the Upper Mountain Mine or Bullion Coal.

446 *Dr. Wheelton Hind—British Carboniferous Goniatices.*

Staffordshire: Below the Rough Rock, Millstone Grit, near Ipstones.
Devonshire: Instow.

Ireland: marine bands, Castlecomer Coalfield.

GASTRIOCERAS CORONATUM, Foord & Crick. Lower Coal-measures.

Lancashire; above the Mountain Mine, Bacup.

Yorkshire: above the Mountain Mine, Shibden.

Genus **Prolecanites**, Mojsisovics.

PROLECANITES COMPRESSUS, J. Sowerby.

A most important zone form denoting the base of the Pendleside Series, and only occupying as a rule a few feet of beds, except on Pendle Hill, River Hodder, and Longridge Fell, where a great local expansion of the Pendleside Limestone occurs.

Lancashire: Warsaw End, Hook Cliff, Little Mearley Clough, Pendleton Clough, River Hodder below bathing cots, River Ribble at Dinckley Hall, at dip 2° in stream about one mile N. of Chipping.

Yorkshire: River Hodder below Sandal Holm, Salterforth railway cutting, Rilstone, Ingsbeck at base of Pendleside Limestone.

Cheshire: Old limestone quarry near Astbury, below Congleton Edge.

Devonshire: Coddon Hill, near Barnstaple.

Isle of Man: Scarlet Quarry.

Ireland: Co. Cork, Little Island and Black Rock, Middleton, Ballynabindra; Co. Galway, 4 miles east of Loughrea.

PROLECANITES MICLOBUS, Phillips.

Very rare. Phillips gave Bolland as the locality.

PROLECANITES DISCOIDES, Foord & Crick. Carboniferous Limestone, D₂.

Yorkshire: El Bolton, near Cracoe.

Derbyshire: Park Hill and Brassington.

PROLECANITES SERPENTINUS, Phillips.

A very small shell. Base of Pendleside Series.

Lancashire: River Hodder, River Ribble at Dinckley Hall, Black Hall.

Genus **Pronorites**, Mojsisovics.

PRONORITES CYCLOLOBUS, Phillips.

Very rare. Carboniferous Limestone, D₂.

Yorkshire: El Bolton, probably; Grassington is quoted in Phillips's list of errata.

Derbyshire: Thorpe Cloud.

NEW GENUS.

SAGITTOCERAS, Hind.

The genus is founded on a single specimen which consists of three-fourths of a complete individual. A large portion of the body-chamber is present, which on removal reveals the greater part of the penultimate whorl with the cameræ and suture-lines.

I obtained the specimen from Keal Hill, one of the well-known

Craven Knolls. It was in a block, on the south side of the hill, and from the accompanying fossils and nature of the rock came from the immediate vicinity. The beds on Keal Hill belong to the Upper *Dibunophyllum* horizon and are succeeded by the shales and black limestones of the Pendleside Series. *Glyphioceras crenistria*, *G. striatum*, and *G. truncatum* are common at the horizon at which the fossil was found.

I showed the specimen to the late Mr. G. C. Crick and left it with him for description, but his untimely death prevented him from publishing our views. He agreed with me that the suture-line denoted an ammonoid genus quite new to science.

Generic Characters.—Shell involute, discoidal, compressed with an acute periphery. Sides flattened. Umbilicus large and open. Camerae numerous. Suture: an acute median saddle, external lobe broadly rounded, external saddle acutely linguiform, lateral lobe deep, rounded, linguiform, lateral saddle raised, acutely pointed, second lateral lobe broad and obtusely rounded.

SAGITTOCERAS ACUTUM, sp. nov. (Pl. XVI, Figs. 1, 1a, 1b.)

Specific Characters.—Shell discoidal, much compressed, with an acute periphery. Whorl sagittate in section, much higher than broad, inclusion about three-fourths; whorls 3 or 4. Umbilicus large and open, sides smooth, very gently convex, sloping towards the umbilicus, the edge of which is subangular and its margin convex.

Body-chamber occupies about one complete whorl. Camerae many, about 20 to the whorl.

Suture as given under description of the genus above. Test thin, apparently smooth.

Dimensions.—Diameter, 83 mm. approximate; transversely, 30 mm. estimated.

Locality.—Upper *Dibunophyllum* zone of Keal Hill, Craven, Yorkshire.

Observations.—Dr. Foord¹ described under the name *Brancoceras enniskilleni* an acutely keeled Goniatite from the Carboniferous Limestone of Blacklion, near Enniskillen, in the Griffiths' Collection in the Science and Art Museum, Dublin, but the small umbilicus and general shape of the shell do not show any relation to that now under description, and Dr. Foord states that he saw the sutures and had "no doubt as to their being those of *Brancoceras*".

I obtained a fragment, two-thirds of a shell, which I refer to Foord's species, from the Carboniferous Limestone of Carsington, Derbyshire. The small umbilicus and greater thickness and less acutely angled periphery separate it at once from *Sagittoceras acutum*.

In external appearance *S. acutum* has a close resemblance to *Phacoceras oxystomum*, and may easily be mistaken for it if the suture-line is not seen.

The suture-line distinguishes the genus from all other Carboniferous forms by the rounding of the peripheral lobe, the acutely pointed external saddle, the presence of two lateral lobes, and a well-developed lateral saddle (Pl. XVI, Fig. 1a).

¹ *Carb. Ceph. Ireland*, p. 208, pl. xlvii, figs. 3a, b.

Pericyclus virgatus, de Koninck, has a lateral saddle and lateral lobe, but the shape of saddles and lobes are quite distinct from the genus under description. Pl. XVI, Fig. 1, shows the specimen after the body-chamber has been detached.

PERICYCLUS DIVARICATUM, Hind, 1905. (Pl. XVI, Figs. 2-6.)

Glyphioceras divaricatum, Hind, Proc. R. Irish Acad., vol. xxv, ser. B, No. 4, p. 144, pl. vi, fig. 6.

? *Pericyclus virgatus*, Foord & Crick, Cat. Foss. Ceph. Brit. Mus. Nat. Hist., pt. iii, p. 146.

Since the publication of this species much fresh material has accrued from many localities. The suture-line has also been seen and more perfect specimens examined. I now think it should be more correctly placed in the genus *Pericyclus*, Mojsisovics. I showed much of my material to the late Mr. Crick, and he expressed agreement with my conclusions. In many of the fossil lists I have published this species has been confused with *G. beyrichianum*. As the species was erected on fragmentary specimens I think it best to redescribe and refigure it in more detail. Its lowest known occurrence is in the *Posidonomya becheri* beds of the Pendleside Series, but it goes up as high as the 3rd Grit Shales of the Millstone Grit.

Specific Characters.—Shell discoidal, compressed, umbilicated, attaining a diameter of 70 mm. Greatest thickness at umbilical margin. Height of outer whorl, four-sevenths of the diameter of the shell. Whorls seven or eight, inclusion in the inner whorls almost nil but becoming in the outer three or four more and more complete. Umbilicus deep, open in the young, becoming relatively more narrow with the growth of the shell, its margin rounded, the under surface bevelled. Whorl elliptical in section, deeply impressed by the preceding one. Periphery narrow, convex, becoming obscurely keeled centrally in fully grown shells. Very feebly convex at the sides. Body-chamber occupies two-thirds of the last whorl. Suture-line as shown in Fig. 6.

Test ornamented with many flattened ribs which bifurcate about half-way between the umbilicus and the periphery. The grooves between the ribs, linear at first, become broader and equal, about half the measurement of the ribs in breadth. The ribs arch forward on the side, but on the periphery form a fairly deep sinus with concavity towards the younger part of the shell. A specimen from Cracoe Fells shows also spiral marking on the ribs.

Dimensions.—Greatest diameter, 70 mm.; width at umbilicus, 25 mm.

Localities.—Pendleside Series: silica quarry, Congleton Edge, Dinckley Hall River Ribble, Flashy, in watercourse between Butterhaw and Shelterton, and S. of Shelterton, Horsebridge Clough, near Hebden Bridge. *Posidonomya becheri* beds: Poolvash, Isle of Man. Millstone Grit Shales: Eccup, near Leeds. Ireland: Foynes and Foynes Island; Lisdoonvarna, in the Pendleside Series.

Observations.—The flat dichotomous ribs distinguish this species from all other described forms of the genus. *P. virgatus*, de Koninck, sp., has more rounded ribs, and these are not dichotomous.

Foord & Crick, Cat. op. supra cit., refer doubtfully some specimens, said to be from Halifax, to *P. virgatus*; they remark, "De Koninck says the ribs are not dichotomous, but they certainly are in these specimens up to a diameter of 16 mm." These shells most probably belong to the species under description. The species alters its habit with age. In the young the shell is much more globose and the ribs more transverse than in the adult, when the shell is more discoidal and compressed and the ribs sinuously curved on the side with a deep peripheral sinus.

The young stage may be confused with some forms of *G. beyrichianum*, but the umbilicus in the latter is much wider and inclusion less. The transverse ribs less close and more acute.

Pericyclus impressus, de Koninck, 1880. (Pl. XVI, Figs. 8–10, 12.) Ann. Mus. Roy. d'hist. Nat. Belgique, tom. v, pt. ii, p. 118, pl. xlix, fig. 3.

Specific Characters.—Shell subglobose, involute, umbilicated. Whorls six, inclusion extensive, somewhat obtusely lunate in sections not very high. Umbilicus large and open in the young stages, becoming narrow with age; its border rounded, sides convex; the periphery convex.

Body-chamber occupies the last whorl. Camerae four to a quarter of an inch. Suture as drawn below (Pl. XVI, Fig. 12b).

Test thin, with many simple transverse subangular ribs, the sulci between which have numerous fine spiral lines. On the periphery the ribs have only a suspicion of a hyponomic sinus.

Dimensions.—Fig. 9, Pl. XVI, measures, diameter 18 mm., transversely 10 mm.

Locality.—Millstone Grit Shales (Sabden Shales). Gill beck, near Cowling, Yorkshire.

Observations.—De Koninck's types were obtained from Vève, assise iii^e. The umbilicus at once distinguishes the species from others of the genus.

In the young the ribs are much less numerous, and the umbilicus wide, inclusion very small (Pl. XVI, Fig. 10).

All the specimens obtained were from one bullion in shale, a quarter of a mile above Stonehead Farm.

PERICYCLUS VIRGATUS, de Koninck, 1880. (Pl. XVI, Fig. 7, 7a.) Ann. Mus. d'hist. Nat. Belgique, tom. v, pt. ii, p. 118, pl. xlix, fig. 4.

I have two fragments of the body-chamber and one crushed example of this species from the Redesdale ironstone.

In his description de Koninck says, "Umbilie assez étroit à bords anguleux et infundibuliform," but his figure shows a moderately sized umbilicus with a convex border. The ribs are more numerous and flatter than in *P. funatus*, Sow., and less flat and less regularly dichotomous than in *P. divaricatus*, Hind. De Koninck's specimen was obtained at Visé.

PERICYCLUS REDESDALENSIS, sp. nov. (Pl. XVI, Figs. 13, 13a, 13b.)

Specific Characters.—Shell moderately inflated, sides flattened. Evolute, umbilicus about $\frac{1}{4}$ in. in diameter, greatest thickness half-way between the periphery and umbilicus. Inclusion extensive.

Height of last whorl about half the diameter. Whorls ? 4, oval in section, broader than high, indented by preceding whorl. Umbilicus with somewhat raised and rounded margin and convex inner area, infundibuliform. Periphery very convex, marked off, in casts, from the lateral area by a spiral groove. Body-chamber occupies almost a complete whorl. Test unknown except on inner area of umbilicus, where there are many distinct, close ribs. The cast shows indications of numerous strong curved ribs, with a deep sinus backwards on the periphery. Suture-line as figured (Pl. XVI, Fig. 13*b*).

Dimensions.—Diameter, 43 mm.; transversely, 17 mm.

Locality.—Redesdale Ironstone, Northumberland.

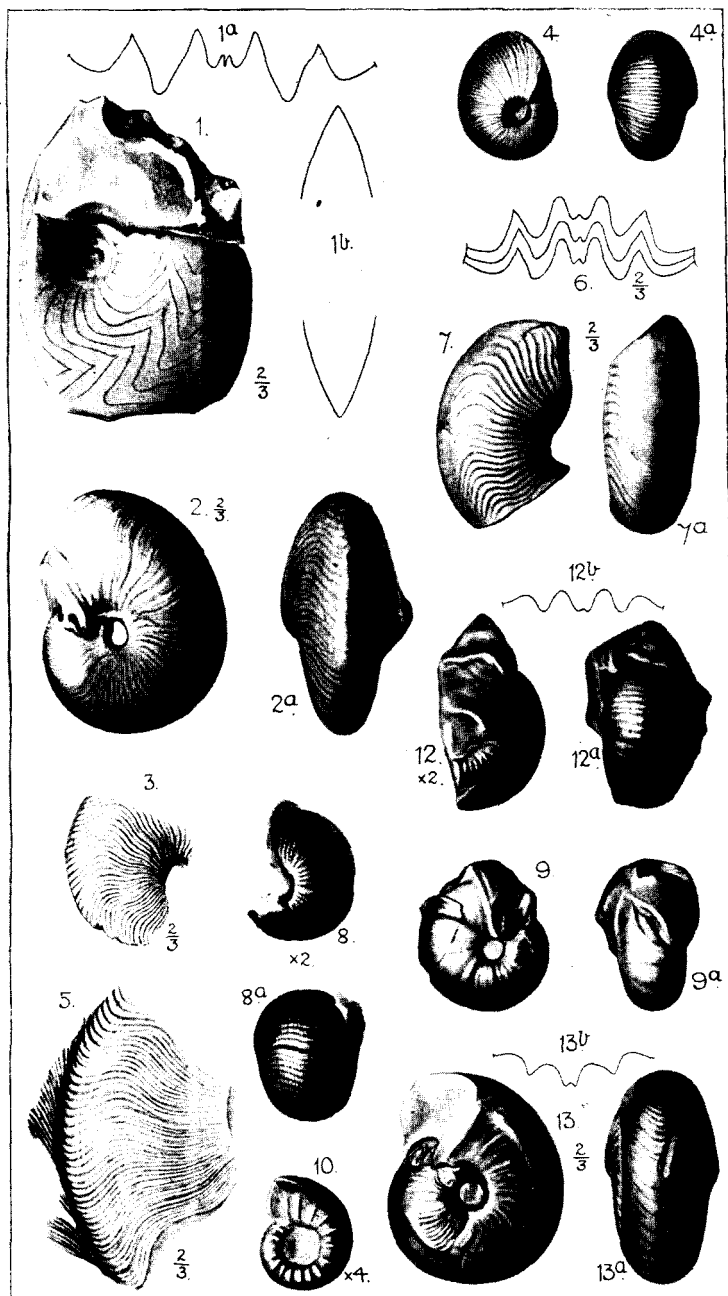
Observations.—Hitherto this shell has always been confused with *G. truncatum*, Phillips, from which it differs essentially in the shape of the periphery, which is less angular, the lateral area is less compressed, and possesses a spiral groove. The suture, too, has marked differences in the central saddle and peripheral lobe.

The late Mr. Crick pointed out to me that Fig. 13, Pl. XVI, shows an interesting condition of growth. The last septum is perfectly formed (*a*), a second septum was being formed (*b*), and a third septum is faintly indicated by a line forming the boundary of the muscle attachment. The sudden rise forward of this line indicated the commencement of the shell muscle. The spiral line on the left side of the shell is half an inch away from the margin of the umbilicus, while that on the right is much closer, only a quarter of an inch away. A younger specimen shows no spiral groove at all, so it probably is only an old-age character.

EXPLANATION OF PLATE XVI.

FIG.

1. *Sagittoceras acutum*, sp. nov. $\frac{2}{3}$ nat. size.
- 1a. Id. The suture-line. $\frac{2}{3}$ nat. size.
- 1b. Id. In profile. $\frac{2}{3}$ nat. size.
2. *Pericyclus divaricatum*, Hind. $\frac{2}{3}$ nat. size.
- 2a. Id. In profile. $\frac{2}{3}$ nat. size.
3. Id. Showing the ornament. $\frac{2}{3}$ nat. size.
4. Id. The young stage.
- 4a. Id. In profile.
5. Id. The ornament and orifice in adult. $\frac{2}{3}$ nat. size.
6. Id. The suture-line. $\frac{2}{3}$ nat. size.
7. *P. virgatus*, de Koninck. $\frac{2}{3}$ nat. size.
- 7a. Id. In profile. $\frac{2}{3}$ nat. size.
8. *P. impressus*. Showing the ornament. $\times 2$.
- 8a. Id. In profile. $\times 2$.
9. Id. Cast.
- 9a. Id. In profile.
10. Id. The young stage. $\times 4$.
12. Id. Side view showing the ornament. $\times 2$.
- 12a. Id. In profile. $\times 2$.
- 12b. Id. The suture-line. $\times 2$.
13. *P. redesdalensis*. Showing (*a*) last suture completely formed, (*b*) new suture commencing, (*c*) line forming the boundary of the muscular attachment. $\frac{2}{3}$ nat. size.
- 13a. Id. In profile.
- 13b. Id. The suture-line.



17. M. Woodward, del.

Hale, Sons and Danielsson. Ltd.

BRITISH CARBONIFEROUS GONIATITES.