PALÆONTOLOGICAL NOTES ON THE MILLSTONE GRIT BEDS BETWEEN
MASHAM AND GREAT WHERNSIDE.

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From time to time some Millstone Grit Fossils have been noted from the district round Harrogate and Pateley Bridge, the list given in the Memoir of the Geological Survey, "The Geology of the Country north and east of Harrogate," by Fox-Strangways, page 7, being the most recent and up-to-date.

I was fortunately able to make a fairly extensive collection from these localities at the time of the visit of the Yorkshire Geologists' Association to Pateley Bridge in 1906, and have been waiting since then for an opportunity to pursue the subject. Fortunately Mr. Bisat took up the question of fossil horizons in the Millstone Grits, and has kindly allowed me to examine all his material and now to collaborate with him.

Several new species of lamellibranchs have occurred in the Cayton Gill Beds which I now propose to describe, but perhaps the most interesting fact is the facies of the fauna, which contains a large number of species common to it and the *Dibunophyllum* beds of the Carboniferous Limestone, and does not contain the *Goniatite* fauna and its associated lamellibranchs so frequently met with in the slate beds between the different members of the Millstone Grit, for example at Wadsworth, Eccup and Sabden.

Messrs. Barnes and Holroyd described a fossiliferous bed of Millstone Grit on Pule Hill (Trans. Manch. Geol. Soc., Pt. vii., Vol. xxv.), but the fauna seems to be almost entirely different from the one under description. No brachiopoda were found there.

The recurrence in the Cayton Gill Beds of so many species of fish, brachiopods, lamellibranchs and cephalopoda which were last seen in the *Dibunophyllum* zone opens up the whole question of stratigraphy. Do the grits of the Pateley Bridge area represent a horizon totally different from those further south? Is the horizon of this fauna accurately known with regard to the occurrence of the same fauna elsewhere? Why is not the real Millstone Grit fauna met with in the series except at Colsterdale, and there only in part?

The Colsterdale fauna is almost totally different from that of the

Cayton Gill Beds, and may be said to have a Pendleside facies. If this bed is shown to be below the Cayton Gill Beds, then we at once have evidence of the fact that at the close of the *Dibunophyllum* period in the area in discussion, the fauna was not extinguished, but merely migrated and returned at a much later date when the conditions were favourable, but though favourable very different from those of the Carboniferous Limestone sea.

In connection with this band the occurrence of *Prothyris elegans* is interesting. This shell occurs in the Millstone Grit of Scotland, and I have obtained it from Congleton Edge quarry just above the zone of *Glyphioceras spirale*. It is a North American species and is not uncommon in the Coal Measures of Nebraska.

GRAMMATODON REGULARIS sp. nov.

[Figs. 12-14; Plate IV.].

Parallelodon meridionalis Hind, 1897. Brit. Carb. Lamell., Pl. XIII., Fig. 9.

„ *obtusum*, 1902, Trans. N. Staff. F. C., Vol. XXXVI., Page 78.

SPECIFIC CHARACTERS.—Shell transverse, narrow and tumid, very inequilateral. The anterior border rounded. The lower border and hinge line almost parallel, the posterior border obliquely truncate from above downwards and backwards. The posterior superior angle obtuse. Umbones small, somewhat raised, nearer the anterior end. The valve is moderately tumid except on the dorsal slope where it is rapidly compressed and hollowed above an oblique rounded ridge passing from the umbo towards the posterior inferior angle. Escutcheon large and well marked.

INTERIOR.—The hinge plate and muscle scars normal.

EXTERIOR.—The surface is ornamented with fine lines of growth which become more pronounced and thicker on the posterior part of the valve. Fine decussating radiating lines are to be noted, which become much more apparent on the dorsal slope.

DIMENSIONS.—Fig. 14, Pl. IV. measures :—

Anteroposteriorly, 32 mm.

Dorsoventrally, 11 mm.

Transversely, 10 mm.

LOCALITIES.—The marine bed of Millstone Grit, Hazel Hill and Clint Quarries. The marine band associated with *Glyphioceras spirale* at Congleton Edge.

OBSERVATIONS.—I figured a specimen of this species showing the hinge-plate and both valves, Op. supra cit., referring it to *Parallelodon meridionalis* de Koninck, to which species it has a fairly close resemblance. The Belgian shell comes from the Tournasian beds and is less transverse, comparatively deeper and has its ornament and lines of growth more deeply incised and more irregular. *Grammatodon obtusus* is comparatively deeper in a dorsoventral direction and has a well-marked broad byssal sinus, which is practically absent in the species under discussion.

In lists of fossils from Congleton Edge I have referred to this species as *Parallelodon obtusum*.

Several specimens have been found at each locality.

SEDGWICKIA TRANSVERSA sp. nov.

[Figs. 18, 19, Pl. V.]

SPECIFIC CHARACTERS.—Shell transversely ovate, moderately gibbose, compressed and narrowed posteriorly, inequilateral, somewhat oblique.

The anterior end short, its margin broadly elliptical. The inferior border convex; the posterior end obliquely truncate and almost straight, posterior superior angle obtuse. The hinge line is gently arcuate. The umbones are tumid, raised and incurved, placed at the junction of the anterior and middle thirds of the hinge plate. Passing backward from the umbo is a fairly well marked oblique ridge which marks off a very narrow dorsal slope from the rest of the valve. The curvature of the valve is regular but more convex from above downwards than antero-posteriorly.

INTERIOR.—Anterior and posterior adductor scars large and well-marked; the former close to the margin. Hinge edentulous.

EXTERIOR.—The markings on the valve, as in all shells of the genus, consist of concentric lines of growth, strong, regular and well-marked on the anterior end, and becoming finer as they cross the shell and gradually obsolete, so that the posterior half of the valve seems smooth.

DIMENSIONS.—Fig. 18, Pl. V., measures :—

Anteroposteriorly, 50 mm.

Dorsoventrally, 35 mm.

From side to side, 22 mm.

LOCALITY.—Millstone Grit, Hazel Hill near Ripon and boulder near Masham.

OBSERVATIONS.—Two specimens of this species have been obtained. Each is a cast of the interior of both valves. The figured specimen was in a matrix which showed the characteristic external ornament of the genus.

Sedgwickia transversa is comparatively much less deep dorsoventrally than *S. gigantia*, and more tumid.

It is not likely to be mistaken for any other species of the genus.

SANGUINOLITES MODIOLARIS, sp. nov.

[Fig. 23, Pl. V.]

SPECIFIC CHARACTERS.—Shell transverse, very inequilateral, modioliform. The anterior end is very short and narrowed, its margin rounded. The inferior border is straight, the posterior bluntly rounded and the hinge line straight, gently raised as it passes backwards. The umbones are placed very far forward, not terminal, narrowed and compressed, only slightly raised. Projecting backwards from the umbo is a well marked ridge which is separated from the rolled external margin of the escutcheon by a elongate concavity, which becomes slightly broader and shallower as it approaches the posterior superior angle. Below this ridge is the dorsal slope, which passes almost imperceptibly into the rest of the valve, but in some and more adult specimens there is a tendency to form an obscure oblique ridge from the umbo to the posterior inferior angle. The tumid portion of the valves is oblique from the umbo to the posterior inferior angle, in front of and below which the valve is gently compressed. The escutcheon is well developed. On the dorsal slope another obscure radiating line is sometimes seen.

INTERIOR.—The large, marginal, deep, anterior muscle scar, with the ridge behind it, so typical of the genus, is well marked. Hinge plate apparently edentulous and normal.

EXTERIOR.—The surface is ornamented by fine concentric lines of growth.

DIMENSIONS.—Fig. 23, Pl. V., measures :—

Anteroposteriorly, 45 mm.

Dorsoventrally, 18 mm.

Elevation of valve, 8 mm.

LOCALITY.—The Millstone Grit of Hazel Hill and Clints quarry.

OBSERVATIONS.—A typical *Sanguinolites* somewhat resembling *S. tricostrata*, but more transverse and not so markedly tricostrate and there is no oblique ridge. The anterior end is very short indeed and almost entirely filled by the anterior adductor muscle scar.

PALÆOLIMA STRIATA, sp. nov.

[Fig. 9, Pl. IV.]

SPECIFIC CHARACTERS.—Shell small, oblique, subquadrate, compressed, broader dorsoventrally than anteroposteriorly, slightly inequivalve. The anterior border almost straight, the inferior, curved, the posterior almost straight, oblique, the hinge line straight, shorter than the inferior border. Umbones small, tumid, slightly raised and central, ears small, the posterior ear almost obsolete.

EXTERIOR.—The surface is ornamented by numerous fine, close radiating moniliform lines. The right valve almost smooth.

DIMENSIONS.—Pl. IV., Fig. 9 measures :—

Anteroposteriorly, 13 mm.

Dorsoventrally, 14 mm.

LOCALITY.—Millstone Grit, Clints quarry.

OBSERVATIONS.—The specimen consists of both valves which are exposed on the same slab, one of which has some fragments of the external surface preserved.

The species is at once distinguished from all others of the genus by its ornament and flattened shape.

One specimen shows the single adductor scar subcentral in position and indicates in the cast the ornament of the surface. The left valve seems somewhat more gibbose than the right.

LIMATULINA OCCIDENTALIS SHUMARD, sp. 1885.

[Figs. 5, 6, 7, Plate III.; Fig. 8, Plate IV.].

- Pecten occidentalis* Shumard, 1855, Missouri rep., page 207, Pl. c., Fig. 18.
 „ *cleavelandicus* Swallow, 1858, Trans. St. Louis Acad. Sci., Vol. I., page 184.
 „ *cleavelandicus* Meek & Hayden, 1864, Pal. Up. Mo., page 50, Pl. II., Fig. 10.
 „ *occidentalis* Meek & Worthen, 1866, Geol. Rep., Illinois, Vol. II., page 331., Pl. XXVII., Figs. 4 and 5.
 „ *missouriensis* (?) Geinitz, 1866, Carb. and Dyas in Neb., page 35, Tab. II., Fig. 18.
Aviculopecten occidentalis Meek and Hayden, U.S. Geol. Soc., Nebraska, page 191, Pl. IX., Fig. 10.

SPECIFIC CHARACTERS.—Shell unequivalve, the right valve almost flat, the left more gibbose, excluding the ears, subovate acute, not oblique. The anterior, inferior and posterior margins regularly rounded and moderately convex. Ears well marked and large, not extending quite as far forwards and backwards as the greatest transverse diameter of the valve. The anterior ear of the right valve is depressed and sharply marked off from the rest of the shell by an oblique groove, the posterior triangular, flattened and its posterior border falciform. The anterior ear of the left valve is triangular, well defined, and much depressed so that the shell from the umbo to the margin forms a marked angular ridge. The posterior ear more gradually compressed, and its posterior margin falciform. The umbo of the left valve is acute, erect, central.

INTERIOR.—The hinge-plate is flattened and striated transversely.

EXTERIOR.—The surface of the left valve is ornamented by numerous somewhat irregular radiating lines, some of which start from the umbo and others are intercalated between them as they pass across the surface so that it happens that in a group of four the outer lines are the strongest, the middle line a little less strong, and the intermediate lines still weaker. On the right valve the ribs are coarser and less numerous.

On the ears of the left valve the radiating costæ are crossed by concentric lines of growth which, as they cross them, make the costæ imbricate.

DIMENSIONS.—Pl. IV., Fig. 8, a left valve, measures :—

Anteroposteriorly, 40 mm.

Dorsoventrally, 38 mm.

Transversely, 10 mm.

LOCALITIES.—Millstone Grit, Hazel Hill, Clints Quarry.

OBSERVATIONS.—Some half-dozen good specimens have been obtained mostly in the form of casts, but an accurate idea of the surface marking can be obtained from squeezes of the external cast. One bivalve specimen is fortunately to hand, and this shows the typical characters of *Limatulina*. Meek, Op. supra cit., in describing the right valve of *A. occidentalis* states—"right valve nearly flat and having the general outline of the other excepting that its beak is scarcely distinct from the cardinal margin." I understand this to mean that the umbo of the left valve was raised over that of the right valve, and to indicate that the shell is a *Limatulina* and not *Aviculopecten*. The position of the opposing valves at the umbones is well shown in figures 7, 7a, Plate III.

L. occidentalis is a larger shell than *L. scotica*, comparatively broader and more gibbose. The ornament in *L. desquamata* and the radiating lines are not so regular.

L. alternata is much narrower and more convex.

TELLINOMORPHA TRANSVERSA sp. nov.

[Plate V., Fig. 24].

SPECIFIC CHARACTERS.—Shell transverse, tumid, superior and inferior borders sub-parallel, very inequilateral. The anterior end, short, depressed, narrowed, ellipsoidal. The inferior border almost straight, the posterior obliquely truncate, posterior inferior and superior angles well marked; the hinge line almost straight. The umbones are small, elongate, tumid and placed at the junction of the anterior and middle thirds of the valve. Lunule and escutcheon well marked. The latter bounded externally by a rolled margin. The dorsal slope is hollow. The rest of the valve tumid. A well-marked oblique fold passes from the umbo to the posterior inferior angle.

INTERIOR.—The anterior adductor muscle scar is large and occupies the greater portion of the anterior part of the valve. Hinge-plate apparently edentulous.

EXTERIOR.—The shell is ornamented by somewhat irregular lines and striæ of growth.

DIMENSIONS.—Fig. 24, Pl. V., measures :—

Anteroposteriorly, 26 mm.

Dorsoventrally, 14 mm.

From side to side, 10 mm.

LOCALITY.—Millstone Grit, Hazel Hill.

OBSERVATIONS.—Two specimens of this species have occurred, both are bi-valved and casts of the interior. The general shape and the narrow elongate anterior end at once distinguish the shell from *T. cuneiformis*.

ALLORISMA TUMIDA, sp. nov.

[Plate VI., Figs. 26, 27].

SPECIFIC CHARACTERS.—Shell tumid, inequilateral, transverse. The anterior end blunt and rounded is very short. The superior and inferior borders sub-parallel, the posterior border bluntly sub-truncate. The umbones are blunt, incurved, not much raised and transverse. The dorsal slope is comparatively small, but compressed, lunule and escutcheon well developed.

INTERIOR.—Anterior adductor scar large. Hinge-plate not seen.

EXTERIOR.—The surface of the shell, especially in the anterior portion, is ornamented with a few broad concentric folds and sulci which become obsolete on the posterior part of the valve, the dorsal slope is smooth.

DIMENSIONS.—Pl. VI., Fig. 26, a small example measures :—

Anteroposteriorly, 19 mm.

Dorsoventrally, 16 mm.

From side to side, 11 mm.

LOCALITY.—Millstone Grit of Hazel Hill.

OBSERVATIONS.—Four examples of this species have been found but the material is poor and leaves much to be desired. It is not likely to be mistaken for any other species of the genus.

SPATHELLA LATA sp. nov.

[Plate VI., Figs. 32, 33].

SPECIFIC CHARACTERS.—Shell broadly ovate, inequilateral, moderately gibbose, with a compressed but narrowed dorsal slope. The anterior end is fairly prolonged, its margin rounded. The inferior border is gently convex; the posterior narrower than the anterior is apparently rounded, truncate in its upper portion. The superior border is arched in front, almost straight posterior to the umbo. The umbo is well marked, incurved, raised above the hinge and situated only a short distance in front of the centre of the upper border. Passing obliquely downwards and backwards from the point of the umbo is a strong ridge which soon becomes lost in the general convexity of the valve, which separates the rather narrow dorsal slope from the remainder of the valve. The escutcheon is long and narrow.

INTERIOR.—The anterior adductor muscle scar is rounded, not deep or marked off posteriorly by a ridge. The posterior oval, placed high up in the hollow of the dorsal slope. Mantle line entire.

Hinge plate thickened, concave from above downwards and apparently edentulous.

EXTERIOR.—Apparently almost smooth.

DIMENSIONS.—Fig. 32, Pl. VI., the cast of a left valve measures:—

Anteroposteriorly, 58 mm. (estimated).

Dorsoventrally, 30 mm.

Gibbosity of Valve, 10 mm.

LOCALITY.—Millstone Grit, Hazel Hill near Ripon.

OBSERVATIONS.—This is a largish shell, but almost featureless, both in external characters and the simplicity of the hinge-plate. Some half-dozen specimens have been obtained from the Hazel Hill locality, but it has not been found elsewhere in the Marine Band.

DESCRIPTION OF PLATES.

Plate III.

- Fig. 1, *Aviculopecten dissimilis* (left valve). Clints quarry.
 Fig. 2, „ „ *interstitialis* (left valve). Roundhill Reservoir.
 Fig. 3, „ „ *clathratus* (left valve). Linden Gill, Leighton. (Daystones).
 Fig. 3a, „ „ *interstitialis*. Probably Fountains Quarry.
 Fig. 4, „ „ *clathratus* (left valve). River Burn, near Shaw's Bridge, Swinton.
 Figs. 5, 6, *Limatulina occidentalis* (left valves). From a boulder, Leighton Road.
 Figs. 7, 7a, 7b, „ „ (showing both valves). Same locality.

Plate IV.

- Fig. 8, *Limatulina occidentalis* (a left valve). Near Pott Hall, Leighton. (Daystones).
 Fig. 9, *Pakeolima striata* (both valves). Clints quarry.
 Fig. 10, *Myalina peralata* (left valve). Near Linden Gill, Healey. (Daystones).
 Fig. 11, *Leiopteria thompsoni* (left valve). Near Linden Gill, Healey. (Daystones).
 Fig. 11a, „ „ *laminosa* (right valve). Near Pott Hall, Leighton. „
 Fig. 12, *Grammatodon regularis* (right valve showing posterior hinge teeth). Hazel Hill.
 Fig. 13, „ „ (right valve, from a cast showing external surface). „
 Fig. 14, „ „ (a bivalve example). Hazel Hill.
 Fig. 15, *Schizodus wheeleri* (right valve). Near Pott Hall, Leighton. (Daystones).
 Fig. 16, *Protoschizodus axiniformis*. From a boulder at Leighton Road diversion.

Plate V.

- Fig. 17, *Protoschizodus curtus* (right valve). Hazel Hill.
 Fig. 17a, „ „ „ „ Woo Gill, Nidderdale.
 Fig. 17b, „ „ „ „ (right valve). Hazel Hill.
 Fig. 18, *Sedgwickia transversa* (cast of both valves). From a boulder at Leighton reservoir.
 Fig. 19, „ „ „ „ (cast of both valves). Hazel Hill.
 Fig. 20, *Edmondia m'coyi* (right valve). Near Linden Gill, Healey. (Daystones).
 Fig. 21, „ „ „ „ Hazel Hill.
 Fig. 22, *Scaldia benedeniana* (right valve). From a boulder, Leighton Road.
 Fig. 23, *Sanguinolites modiolaris* (a left valve). Near Linden Gill. (Daystones).
 Fig. 23a, „ „ „ „ (a left valve). Hazel Hill.
 Fig. 24, *Tellinomorpha transversa* (cast of both valves). Leighton Road diversion.

Plate VI.

- Fig. 25, *Tellinomorpha transversa* (both valves). Nr. Linden Gill, Healey. (Daystones).
 Fig. 26, *Allorisma tumida* (right valve). Near Pott Hall, Leighton. (Daystones).
 Fig. 27, „ „ *sulcata* (a bivalve example). Woo Gill, Nidderdale.
 Fig. 28, *Tellinomorpha transversa* (external surface). Hazel Hill.
 Fig. 29, *Cypricardella parallela*. Quarry near Pateley Bridge.
 Fig. 30, *Prothyris elegans*. Trial hole near Gollinglith Foot, Colsterdale.
 Figs. 31, 31a, *Ephippioceras bilobatum*. Hazel Hill.
 Fig. 32, *Spathella lata* (a left valve). Near Pott Hall, Leighton. (Daystones).
 Fig. 33, „ „ „ „ (a right valve). Hazel Hill.

W.G.Browning del. et lith.

Huth imp.

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Plate III.

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