

Such chronicles we must have before we can hope to explain ever varying and extreme changes in crystalline habit ;—and what is even more inexplicable—the association of extreme varieties in one and the same cavity.

There can be no question that if this locality were properly opened up, it would yield a rich harvest. Possibly similar works in the Campsie group may have supplied some of the older specimens ; the heavy embanking at the Walton reservoir may have been the source of those assigned to Fintry. The three finds at this east end of the chain of hills show that once the eye is educated to accurate research in some one domain of science, it is capable of doing good work with little effort in another.

NO. V.—ON SOME *ESTHERIÆ* AND *ESTHERIA*-LIKE SHELLS FROM
THE CARBONIFEROUS SHALES OF WESTERN SCOTLAND. By
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With a Plate [No. V.]

[Read 13th March, 1890.]

Some years ago my friend Mr. John Young, F.G.S., drew my attention to some *Estheria*-like shells from the neighbourhood of Glasgow, and one of them in particular seemed to me at the time to present features sufficiently characteristic to allow of its being referred to that genus of bivalved crustacea. Since then both Mr. Young and myself have examined it and its associates again and again ; and I have come to the conclusion that its form is that of a *Posidonomya*, and that its punctate ornament can be matched among Molluscan shells. Hence it has to be removed from the Crustacean genus, and is treated of further on at page 83 as *Posidonomya punctatella*, Jones.

Among the Carboniferous specimens, however, that have come under our notice are other little *Estheria*-like fossils, and of these I offer the following descriptions, with figures very carefully executed by Mr. George West, who illustrated my "Monograph of Fossil *Estheriæ*," Palæontographical Society, 1863. The plate has been drawn with aid of a grant from the British Association for the illustration of Palæozoic Phyllopora.

1. *ESTHERIA YOUNGII*, *sp. nov.*

(Plate V., figs. 1*a*, 1*b*.)

This well-preserved right valve, retaining its outline and nearly full convexity, is sub-triangularly ovate, being straight above on the back or hinge-line, elliptically and obliquely curved below, obliquely rounded in front, and contracted and somewhat obliquely truncate behind. It is 8·5 mm. long, 4·5 mm. broad at its greatest height—that is below the umbo, and at one-fifth of the length of the valve from the extreme front margin—and only 2·5 mm. high or broad at the posterior margin.

Below the umbo, which is bare, having been damaged, there are still present ten strong concentric ridges, with wide interspaces, curving neatly in front, and turned up sharply behind, all being parallel with the free (ventral and posterior) margins. The intercostal spaces are marked with obscure and very faint longitudinal striæ (not shown in the figures), also with a scarcely-distinguishable minute punctation, seemingly arranged at one spot in vertical rows. (Fig. 1*b*.) The inside of a similar valve shows numerous longitudinal striæ much more plainly.

The chitinous aspect of the valves, the sharp concentric ridges and their broad flat interspaces, even without the obscure punctation, are characteristic of an *Estheria*. Other specimens, less perfect, occur on the face of the small piece of shale; and some less definite fragments of valves on the other face, together with some valves more circular in shape, of about the same size, and punctate (fig. 7), formerly described as *Estheria punctatella*. All these are non-calcareous.

A very small *Anthracomya* (3 × 1 mm.) very similar in shape to *Naialites angulatus*, Dawson ("Acadian Geology," 1878, pp. 204, 205, fig. 46), and calcareous, lies close to the figured specimen (fig. 1*a*).

This shale is from the Upper Limestone series of the Carboniferous Limestone, and lies below the limestone at the Arden limestone quarry near Thornliebank, four miles south-west of Glasgow. (See "Catalogue of the Western Scottish Fossils," &c., 1876, p. 91.)

2. *ESTHERIA TESSELLATA*, *sp. nov.*

(Plate V., figs. 2, 3, 4*a*, 4*b*.)

In the British Museum is a small slab of cannel-coal labelled

“Ayrshire (?)”* bearing a great number of small delicate valves (mostly double) of what seems to be an *Estheria*, lying close together on the surface. These are now represented by thin, light-brown, earthy, non-calcareous films.

In shape they vary much, apparently from the effects of pressure. The umbo is almost mid-dorsal, whether the valve has been elongated (fig. 4*a*) or not (fig. 2); the latter probably approximates more nearly to the normal shape, with the umbo rather forward, and the elliptically sub-oval valve measuring diagonally about 7 mm. in length, and about $4\frac{1}{2}$ mm. high. The dorsal edge or hinge-line is about 4 mm. long in each case.

The numerous, exquisitely delicate, concentric striæ on the surface have between them minute quadrate pits, defined by short vertical lines joining the long striæ at regular intervals (fig. 4*l*), and thus forming a decussated and tessellated pattern. This has the effect of giving a slight radiate appearance to some parts of the valve under the microscope. There are also coarser radial lines, which have been produced by pressure on the originally convex valves.

Among the specimens there are to be seen some edge-views (like fig. 3) of the bivalved carapace filled with matrix, about $3\frac{1}{2}$ mm. wide, and $6\frac{1}{2}$ mm. high. This relative height (if the valves have not been disarranged by pressure) goes to show that fig. 2 does not give the full height of the valves of this species. The figures of *Anthracomya lævis*,† Dawson, have some resemblance to figs. 2 and 4, but the striation is too coarse, and the umbo too near to one end of the hinge-line.

With regard to the minute sculpturing of the surface, Dr. Goldenberg figures a somewhat similar ornament for his *Estheria limbata* (“Fauna Saræpontana fossilis,” Heft 2, 1877, plate ii, figs. 12-14, p. 43), and still closer for his *E. rimosa* (*loc. cit.*, figs. 16-18). The dorsal line in our figures 2 and 4 is much too straight, however, for *E. rimosa*. Dr. Baird has figured an analogous ornament, but consisting of little round pits, closely limited by longitudinal and cross lines, in the lowest (newest) part of the edge of

* It is probably from the Upper Coal-measures of Ayrshire, and similar to a camel in the Upper Coal-measures at Airdrie, Lanarkshire.

† Salter, *Quart. Journ. Geol. Soc.*, vol. xix., 1863, pp. 79-80, fig. 2; and Dawson, “Acadian Geology,” Suppl., 1862, and 3rd ed., 1878, p. 204, fig. 44.

the valve of *E. Jonesii*, *Proc. Zool. Soc.*, 1862, plate xv., fig. 1d. The ornamentation, though microscopic, has suggested the specific name *tessellata*.

The ornament on *Chione Californiensis* and *Lucina Sowerbii* is somewhat of the same pattern.

3. *ESTHERIA TEGULATA*, *sp. nov.*
(Plate V., figs. 5, 6a, 6b.)

Scattered on or near a bed-plane in a piece of cannel-coal in Mr. John Young's collection, and probably from the Upper Coal-measures at Airdrie, Lanarkshire,* are many delicate small valves of what appear to belong to *Estheria*. They occur as thin, light-brown, earthy, non-calcareous films, leaving a glossy black surface when removed.

Some are elongate and sub-oblong (fig. 6a); others are shorter and more triangular. The umbo in each case is (or has been) at the anterior angle, as indicated by the position of the concentric striæ, which are very thin and numerous. The dorsal line is straight and about 3 mm. long in fig. 5; in fig. 6a it is longer and not quite straight, but depressed (perhaps by pressure) in the middle.

These are smaller than the valves of *E. tessellata*, figs. 2-4); but, being magnified much more, they look larger on the plate. As with those valves it may be that pressure has altered the shapes by elongating some very much (figs. 4a and 6a), whilst others almost retain their original form (figs. 2 and 5). Besides the shape of these better-preserved valves, the relative position of the umbo is very distinctive of the two species; and the minute sculpturing of the surface (shown in figure 6b) is another and peculiar feature of difference. Here the striæ, raised lines, or concentric edges of the successive layers of the shell appear to be neatly notated with numerous parallel short incisions (as it were), leaving so many squarish, tile-like portions of each edge to overlap the next little concentric furrow between the striæ.† Hence the proposed appellation *tegulata* (tiled).

* "Catalogue of the Western Scottish Fossils," 1876, p. 65.

† A similar ornament is figured in Dawson's "Acadian Geology," 1878, p. 302, fig. 102c, as belonging to *Microdon Hardingi*, Dawson, a molluscan shell (1½-inch long) allied to *Arca*, and characteristic of the upper part of the Lower Carboniferous Limestone at Windsor, Nova-Scotia.

This ornament is associated with, and indeed gives rise to, a delicate set of radial lines (under the microscope), distinct from the radiating cracks. Thinking that this radiate appearance was the same as that noted by Dr. E. Weiss in his genus *Estheriella*, I referred to the specimens under notice as belonging to this genus in the "Seventh Report to the British Association on the Phyllopoda of the Palæozoic Rocks," 1889. Since then Dr. Weiss has very kindly sent to me type-samples of his genus, and I find that the radii are of a quite different character, are fewer, and are confined to the newer part of the valve.

4. POSIDONOMYA PUNCTATELLA, JONES.

(Plate V., figs. 7a, 7b.)

Estheria punctatella, Jones. *Geol. Mag.*, vol. ii., 1865, p. 185.

Estheria punctatella, Jones. *Trans. Geol. Soc. Glasgow*,* vol. ii., part 1, 1867, p. 71, plate i., figs. 5 and 5a.

This little fossil was first noticed by Mr. John Young, F.G.S., who exhibited specimens to this Society in 1865. (See *The Geol. Magazine*, vol. ii., p. 185.) It was afterwards described and figured in the *Transactions*, *loc. cit.*, but the two figures were not perfectly true. It has now been re-figured in Plate V., figs. 7a and 7b, and accidental chipping and flaking may account for some of the alteration in its appearance.

As Mr. John Young has already pointed out, similar fossils occur in great profusion in the Carboniferous shales at several localities in the West of Scotland; particularly, for instance, at the Linn-Spout, Dalry, Ayrshire, as well as in some shale at the Arden quarry, near Thornliebank, not far from Glasgow, and about 20 miles from Dalry. This quarry has not been worked for more than twenty years, and specimens are consequently not now to be had. The little specimen, however, here figured, is very much smaller than the others referred to; and it is not calcareous, though thicker and more brittle than the *Estheria Youngii* which occurs with it in the same piece of shale.

The figured specimen measures only 8·3 × 5·5 mm.; but those referred to as occurring also as Thornliebank are 28 × 19 mm., and those from the Linn-Spout, Dalry, vary from 20 × 11 mm. to 32 × 22 mm. All these larger forms from Dalry are moderately

* A note by Mr. John Young, F.G.S., on the occurrence of the strata follows the description of the fossil.

thick, whitish, and calcareous; and the large specimens from Thornliebank, though thinner by pressure, and more or less coated with a pyritous film, are calcareous also.

Like figure 7a in general shape, all these larger specimens have also the delicate superficial reticulation and pitting, shown in figure 7b, over all the concentric wrinkles and furrows of the shell. In some cases this consists of pretty little lozenge-shaped areas close together; in others they are bound by polygonal meshes; and in some they appear to be round. This minute ornament is due most probably to a reticulate structure, which has become filled up and obscured by carbonate of lime. It is apparent only on the surface of the shell.

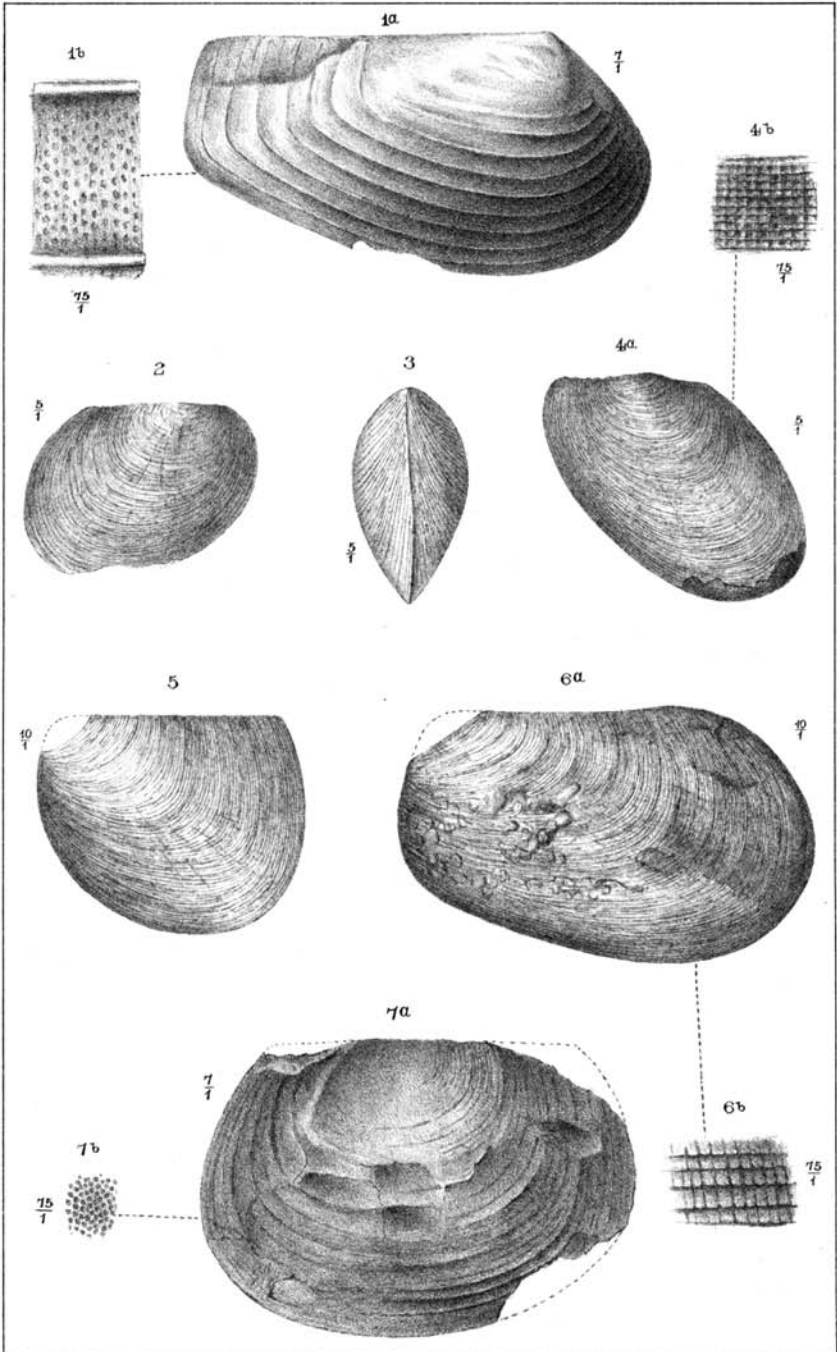
Excepting from its small size and its being non-calcareous, figure 7a may well be considered to belong to the same genus and species as the similar but larger forms above noticed. In that case it may be regarded as one of the younger individuals, and may have lost its calcic carbonate, remaining somewhat thick and brittle.

Hence I am induced to ignore my first determination (in 1865) of its relationship, and to relegate it to the Mollusca, more especially as a punctate ornament is not very rare among molluscan shells. *Lepton*, for instance, and *Kellia* have a delicate pitting or minute reticulation all over, not defined by concentric lines. Mr. John Young has noticed a somewhat similar reticulato-punctate surface on some well-preserved shells of *Posidonomya* and *Anthracopectera* of the Scottish Coal-measures, and also those of some other Carboniferous genera, as *Pinna*, *Aviculopecten*, *Pteronites*, *Myalina*, &c., sometimes associated with them.

The shales at Thornliebank and Dalry are on the same geological horizon, Mr. Young informs me, and are associated with the same group of organisms. They belong to the "Upper Carboniferous Limestone series."

The punctate bivalves under notice "exist in thousands, both at Darnley (Thornliebank), and the Linn-Spout (Dalry) in a thin shale, in which they seem to be the only organisms present;* but in the other shales lying close to it, above and below, we find examples of *Pteronites* and *Cypricardia*-like shells, having an estuarine or brackish character about them; and immediately below the lower shale is a seam of coal."—Mr. John Young, F.G.S., *in letter*, July 18, 1887.

* A Polyzoon and a small *Anthracomya* are noticeable as accompanying *Estheria Youngii*. (See above, p. 80.)



Geo. West & Sons del lith et imp.

Regarding these bivalves as molluscan, we may perhaps correctly refer them to Bronn's genus *Posidonomya*. This species may be defined as having broadly sub-ovate valves, when young almost equilateral, measuring from about 8.5×5.6 mm., with the hinge-line nearly straight, almost as long as the valve, and forming angles with the end margins; umbo in advance of the middle; anterior and ventral margins boldly curved; posterior curve rather less, being somewhat contracted below.

In the adult state the valves measure as much as 32×22 mm.; they are more nearly ovate than figure 7a; the hinge-line is straight, but is overhung by the umbo at about a third of the length of the valve from the front, and makes a more distinct angle with the posterior than with the front margin. The latter is rounder and fuller than the former; and an oblique ridge has left traces of its presence on the posterior moiety of some of the crushed shells from Dalry. The surface bears numerous concentric ridges or wrinkles, of unequal breadth, and with unequal intervening furrows. The whole is ornamented (when well preserved) with a microscopic reticulation; when perfect the meshes are slightly sunken, and the areas within them slightly convex; but varying from that condition to minute pits, and either lozenge-shaped, polygonal, or nearly round.

My friend Mr. Young has shown me clear evidence that the valves of *Posidonomya Becheri* exhibit the same punctate ornament, due probably to a prismatic structure of the shell, as is visible in the fossil valves from Thornliebank and Dalry. (See figure 7b.) The general appearance of these shells is also like that of some of the *Posidonomyæ*, and I have now little or no hesitation in referring them to this genus.

EXPLANATION OF THE PLATE.

Fig. 1.—*Estheria Youngii*, *sp. nov.* 1a, Right valve ($\times 7$ diam.); 1b, ornament (enlarged $\times 75$ diam.) Arden quarry, Thornliebank; J. Young's collection.

Figs. 2, 3, 4.—*Estheria tessellata*, *sp. nov.* 2, Right valve, probably of almost the original shape; 3, edge view of a carapace full of matrix; 4a, right valve much elongated by pressure (all $\times 7$ diam.); 4b, ornament (enlarged $\times 75$ diam.) Cannel-coal, Ayrshire (?); British Museum.

Figs. 5, 6.—*Estheria tegulata*, *sp. nov.* 5, Left valve, probably of nearly the original size; 6a, left valve, elongated by pressure (both magnified 10 diam.); 6b, ornament (enlarged $\times 75$ diam.); cannel-coal, Airdrie (?); J. Young's collection.

Fig. 7.—*Posidonomya punctatella*, Jones. Young state; 7a, left valve ($\times 7$ diam.); 7b, punctate ornament ($\times 75$ diam.). Arden quarry, Thornliebank; J. Young's collection.