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On the Formation of the Shell in the Snails

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and editing, other accomplished and energetic Fellows of the Royal Microscopical Society, namely T. Jeffery Parker, B.Sc., A. W. Bennett, M.A., B.Sc., and F. Jeffrey Bell, B.A.; and the results of their combined work continue to be scientifically good and of great value to the Society to which they belong, and to the scientific world in general.

The original communications to the Society, upwards of forty in number, contain many excellent natural-history notes and memoirs, mostly illustrated, besides those in which the Microscope itself is the more important subject.

Proceedings of the Yorkshire Geological and Polytechnic Society.

New Series, vol. vii. part 2, pp. 107-218, with 7 plates. Edited by J. W. DAVIS, F.S.A., F.G.S., &c. 8vo. Leeds, 1879.

THIS latest publication of the long-established scientific Society of the West Riding of Yorkshire bears witness to its vitality and the intellectual activity of its Members. Mr. W. Morrison's address, short as it is, is strong in sensible remarks on the ill effects that "cramming" and prize-getting have on modern education, in which work is not done for the work's sake, but for some material end and self-aggrandizement. Local geology has many useful illustrations among the papers in this Part of the Proceedings, ranging from the coal-fields to the glacial phenomena of Yorkshire; and some of the papers, though treating of local facts, have philosophical bearings of wide application—such, for instance, as the Rev. E. M. Cole's paper on the origin and formation of the Wold Dales. For Natural History we find interesting and new matter detailed by Messrs. Cash and Hick in their communication on Fossil Fungi (pl. vi.) from the Coal-measures; and to the Cryptogams they refer Carruthers's *Traquairia*, also from the Halifax coal. Mr. J. W. Davis describes (without figures) some new Carboniferous fish-remains as *Ostracacanthus dilatatus*, which he thinks has strong Teleostean affinities. A summary of the geological literature relating to Yorkshire which has been published in 1877-78, the Minutes of Meetings (comprising a notice of Raygill Cave), the Report, and some miscellaneous matter complete this useful No. of the Proceedings.

MISCELLANEOUS.

On the Formation of the Shell in the Snails.

By MM. LONGE and E. MER.

THE shell of the *Helices* consists of two principal layers, of organic and mineral nature, clothed with a cuticle which is wholly organic. The first of these layers is composed, commencing exteriorly, of a structure showing confused striation, of about the same thickness as the cuticle, and of another thicker one formed of vertical prisms.

It is to this that is due the general coloration of the shell, as also that of the spots and bands. The second layer, which is colourless and is commonly designated *nacre*, includes several strata of prisms arranged horizontally, and the axes of which, in two successive strata, are nearly perpendicular to each other. The cuticle and the calcareous layers are produced by different regions of the mantle, approaching nearer to the collar in proportion as the layers are more superficial. The cuticle is formed by an apparatus which we believe has not yet been described, and which we shall call the *cutogenic apparatus* (*appareil cutogène*). It is composed of two special organs situated immediately behind the collar. One of them consists of a furrow, to which we have given the name of the *pallial groove*, parallel to the margin of the mantle, and at the bottom of which glandular cæca open; the other, situated behind the former, appears, upon an antero-posterior section, like an epithelial wedge buried in the substance of the mantle. It is formed of long vertical cells, shaped like bottles, the orifices of which open at the base of the organ which we shall name provisionally the *epithelial organ*. These cells contain granules, which are isolable in potash, and a nucleus situated in their deeper-seated part. We must regard them as differentiated epithelial cells.

The cutogenic apparatus exists in the embryo when still enclosed in the ovular envelopes. At this epoch the shell is already furnished with a cuticle. It persists during the whole of the growth of the young snail, the epithelial organ showing itself under the appearance of a white border surrounding the margin of the mantle. In the adult it disappears and is replaced by the tissue of the mantle. The long-necked cells become converted into ordinary epithelial cells, capable of producing nacre. The pallial groove, on the other hand, always persists; but the glandular cæca which line its bottom are gradually atrophied. The consequence of this disappearance and atrophy is that a scar in the shell can no more be covered with cuticle in this region than in the other parts of the mantle, whilst this does take place when the animal is still in its period of growth.

According to our observations the function of the cutogenic organ is as follows:—The glands of the pallial groove secrete mucus, perhaps that substance which chemists have found associated with the calcareous matter of shells, and which they have named *conchioline*. The long-necked cells of the epithelial organ afterwards deposit the granules they contain in the membrane originating from the pallial groove. The cuticle is the result of this double secretion. What justifies our thinking that this is the case is, that when a young *Helix* increases its shell it may be seen to apply closely the margin of the mantle to the last-formed part in such a manner that the cutogenic apparatus borders this part. Above the groove a membrane destitute of lime soon makes its appearance. The animal is so adherent to the shell that it does not yield to those slight irritations which at other times would cause it immediately to withdraw.

We may sometimes succeed in killing it in this position, and then make antero-posterior sections embracing at once both the apparatus and the cuticle in course of formation. In some of these sections we have seen a streak of matter issue from the groove and become impregnated, above the epithelial organ, with granules escaping from the cells of the latter, the function of which would appear to be to consolidate the membrane secreted by the glandular cæca.

It is well known that the principal character of the adult *Helices* consists in the turning-out of the margin of the shell. According to the preceding statements, this eversion is explained as follows:—After the atrophy of the epithelial organ the portion of the mantle which it occupied sinks down, and in this depression carries with it the part of the cuticle which covered it. The anterior portion of this membrane situated above the pallial groove, the level of which has not changed, is thus raised, and is soon lined on its inner surface with the calcareous deposits which this region has acquired the power of secreting.

All the parts of the mantle posterior to those we have just been considering assist in the formation of the nacre. As regards the primitive forms under which the constituent elements of the various calcareous layers are deposited, we shall limit ourselves to the following remarks. If we examine a fragment of the delicate membrane detached from the margin of a shell in process of growth, we observe that the most recent part is formed almost exclusively by the cuticle; a little further back this is furnished with lines of spherical granules; further still these granules form a continuous calcareous layer lining the inner surface of the cuticle. In a young *Helix* from which a portion of the cutogenic apparatus has been removed, the outermost layer above the injured spot is formed in a different manner. We first of all see calcareous rods appear; and these gradually become enlarged at the two extremities, and acquire the form of small wallets (or saddle-bags). By the addition of fresh particles these wallets are converted into spheres, the dimensions of which are increased by concentric deposits with radiating striæ. These spheres finally come into contact with each other. The first calcareous stratum therefore is formed differently according as it is uncovered or protected by the cuticle. It is also in the guise of rods and spheres that the elements of the outermost layer are deposited in the cicatrical fragments consequent on denudations, both in the adult and in the young animal. This is the case also in the epiphragms, but with this difference, that granules poured forth by the calcareous glands of the collar are here mingled with the spheres with concentric layers. We have ascertained that the cicatrices of the shell are produced even when the part laid bare is covered immediately with a fragment corresponding to that which has been removed. Fine plates of mica introduced between the shell and the mantle are lined on the inner surface with a calcareous deposit.—*Comptes Rendus*, April 12, 1880, p. 882.