

single tubular prolongation (which, as the *Carpenteria* increases in size, becomes branched and thus multiplied), it also becomes even more subdivided than the branching in *Polytrema*.

What, therefore, takes place in the tubular prolongation of the aperture in *C. monticularis* may also be the case in *C. balaniformis* and in *C. (Polytrema) utricularis*; but being so delicate that the slightest force almost breaks it off, there is very little chance of a specimen of either coming into our possession with the tubular prolongation even in the imperfect state of that above mentioned; hence the rarity. While in the living state, where broken off, the margin becomes smoothed down, rounded, and thus inflated by the animal, which form presents a marked contrast with the jagged appearance occasioned by fracture after death. Thus a natural and a fractured margin may be readily distinguished. When the tubular prolongation of either *Polytrema* or *Carpenteria* is preserved, it will probably be found to arise from the specimens being situated in depressions which have protected them from coming into contact with such force as must have broken it off; for the tubular prolongation of the embryonic *Polytrema* cannot be touched with the point of the finest hair-pencil without risk of breaking; and therefore, when found in a dusty state (which is generally the case), no attempt to clean it in this or any way should be made, or the probability is that the delicate extremity, with the few sponge-spicules that generally project from it, will be destroyed.

VIII.—On the Salenidæ, Wright.—Part I. *Observations on the Morphology of a Recent Salenia*. By P. MARTIN DUNCAN, F.R.S., Pres. Geol. Soc.

[Plate II. B.]

HAVING been lately engaged in studying the comparative morphology of the group of Salenidæ, some interesting and rather important points in the structure of a recent specimen probably referable to *Salenia varispina*, A. Agassiz, have come to light.

The Salenidæ, according to Wright, form a natural family of the Echinoidea Endocyclica, their characteristics being "the peculiar structure and great development of the apical disc, which; besides the five genital and five ocular plates, has an additional or suranal plate developed in the centre of the

disc immediately before the anal opening; this plate in some genera is single, in others it is composed of from one to eight elements"*. Found in strata of the Jurassic formation and in those of the Cretaceous, the group is represented in the Nummulitic and in the Australian Cainozoic deposits† (probably Miocene). It still survives; and two species of the genus *Salenia* have been described from the result of deep-sea dredging—one by Mr. A. Agassiz, under the name of *Salenia varispina*, and another by Lovén as *Salenia Goesiana*‡. Wright first explained the correct position of the anal plate, by discovering the madreporic plate and appreciating its relation to the longitudinal axis of the body of *Salenia*; and Lovén's admirable researches on the antero-posterior axis and the asymmetry of the ambulacra have confirmed the truth elaborated by our great authority on British fossil *Echini*. In his 'Revision of the *Echini*,' pt. ii. p. 258, A. Agassiz made the important generalization, which has been so admirably worked out by Lovén, that "the structure of the abactinal system in young *Echini* explains most unexpectedly the homology of the subanal§ plate of Salenidæ." He stated that the subanal plates have no special function, are not special plates found in the group of Salenidæ alone, but are simply an embryonic feature retained in the adult; and he concludes that "this feature, which seemed so characteristic of a small group of *Echini*, is one which *alone* has no primary systematic value, so that we must, I think, hereafter consider the Salenidæ simply as a subfamily of the Cidaridæ." Mr. Agassiz gives an admirable description of the species of *Salenia* which Count Pourtales dredged up off Florida in 275 fathoms; and as the buccal membrane was preserved he could notice that his determination to abolish the Salenidæ, Wright, and to form a subfamily of the Cidaridæ was not without its difficulties; for the serial continuation of the ambulacral tubes does not take place through imbricated scales in the actinal membrane. He instances, however, the Diadematidæ as presenting, in *Diadema* and *Asthenosoma*, similar differences.

The general and minute structures, the nature and homologies of the anal plates, and the classificatory position of the Salenidæ are thus full of interest; and I propose to notice in

* Wright, Palæont. Soc. Publ. vol. xxiv. p. 144.

† Tate, Quart. Journ. Geol. Soc. vol. xxxiii. p. 256.

‡ A. Agassiz, "*Echini* of the Eastern Coast of the United States," Illust. Cat. Harvard Coll. no. vii. 1872, p. 261; Lovén, "Études sur les Echinoides," Kongl. Svenska Vetenskaps-Akad. Handlingar, Bd. ii. no. 7, p. 27.

§ = suranal of Wright.

this first communication two morphological points, one of which bears on the question of classification to a certain extent, and the other adds to our knowledge of the structures of the appendages of the test.

The specimen of a recent *Salenia* which I have studied is in the possession of Prof. Huxley, and was dredged up during the expedition of H.M.S. 'Challenger'; owing to his kindness I have been permitted to wash the apical disk carefully and to examine the form at my leisure. The specimen has its extraordinary spines upon it, and the actinal membrane is preserved; the apical disk is perfect, and the relative position of the permanent anal plate can be decided.

On careful and gentle washing under a microscope, much mud and *Globigerinæ* were removed from the peristome and anal plate and membrane. The result was that sphæridia were noticed in each ambulacrum; and short-stemmed globose-headed pedicellariæ, like those seen on the actinal membrane by A. Agassiz, were found distributed along the ambulacra between the rows of spines, and almost invariably between the numerous blunt spines of the apical disk. They were noticed also sparingly in the interambulacra.

The sphæridia of this *Salenia* (a variety of *S. varispina*?) are to be found in each ambulacrum; two are situate between the spines nearest the peristome and its edge, one in advance of the other, and they are flanked by the last two tentacles, which are rather convergent. The sphæridia are unequal in size, but have an elongated globose shape, not very unlike a stout form of those of *Strongylocentrotus dröbachensis*. Each is placed on a short and narrow stem, and is seated on a minute tubercle, and the smaller one is nearest to the smallest terminal spine of the ambulacrum. They are brilliantly glassy in appearance, and a faint longitudinal striation and a pigment-spot are visible on some. They are strikingly visible over the granular test, which has minute pigment-spots; and (considering that the *Salenia* only measures $\frac{3}{10}$ inch across the test) they are large. One other sphæridium is visible slightly higher up, and just within the range of the pores and external to the larger ambulacral spines. It is longer and larger than the others, but presents all the usual characters of these interesting structures. In height the medium-sized sphæridium is about $\frac{1}{200}$ inch, and is rather less thick than the smaller globose-headed pedicellariæ; but its short graceful stalk and base are very much shorter than those of these last-mentioned appendages to the test. The sphæridia and pedicellariæ are less transparent than in *Strongylocentrotus*.

In noticing the different characters which are common to

sphæridia and true spines, Lovén very justly observes that there is a certain resemblance between the club-shaped radioles of certain extinct Cidaridæ and the sphæridia of some other groups. Considering the great diversity of the shape of the spines in modern *Salenia* it is therefore very necessary to be assured that the bodies just described are not young spines. But their glassy appearance, their remarkable position at the peristome end of the ambulacra alone, and their absence from the interambulacra tend to prove that their resemblance to the sphæridia of *Echini* is on account of their being identical structures. Very minute globular spines of *Salenia* are striated and prickly on the top.

Hitherto sphæridia have not been found in the Cidaridæ, and therefore their presence in the *Salenia*, with the absence of a series of imbricating buccal plates perforated by tentacles, removes the genus and probably its congeners from their present classificatory position.

The pedicellariæ were noticed by A. Agassiz on the buccal membrane; but he did not find them on the test. Those in the specimen before me are very regularly placed, and their white, blunt, globose heads contrast very strongly with the spinose ornamentation of the apical disk especially. Their pedicle is moderately stout, often slightly bent, irregular in its calibre, and never sufficiently long on the apical disk to permit of the head being raised much above the level of the surrounding structures. The head somewhat resembles those so common on the buccal membrane of *Echinus norvegicus*, but it is more globose and the texture is denser. Some are found on the small plates of the periproct. The pedicellariæ with the longest stalks are in more or less regular series in the ambulacra between the rows of club-shaped spines. In the interambulacra the scanty pedicellariæ have often long stalks and small globose heads, becoming finer towards their top.

EXPLANATION OF PLATE II. B.

Fig. 1. Peristomial end of an ambulacrum, with sphæridia, spines, and tentacles, magnified. A pedicellaria is in the background.

Fig. 2. Sphæridium, magnified.

Fig. 3. The upper sphæridium, magnified.

Fig. 4. Part of the apical disk and pedicellariæ, magnified.

Fig. 5. Pedicellaria from an ambulacrum, magnified.

Fig. 6. Pedicellaria from an interambulacrum, magnified.



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