

VI.—*Observations on the Genus Actinocamax.*

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HAVING lately had the honour of submitting to the Geological Society some observations on the Belemnites, I proceed to lay before them the result of my inquiries with regard to another class of organic remains nearly connected with these ;—namely, those spathose bodies which resemble the belemnitic guard in general appearance, but are distinguished from it by presenting, instead of the terminal conical cavity intended for the reception of the chambered shell, a protruding and convex base ; they are of familiar occurrence in the chalky strata.

These bodies have been considered by some writers as true Belemnites, by others as Echinital spines. The object of the following communication is to show, by a minute comparison of their structure with that of these bodies,

1st, That they have no analogy with Echinital spines.

2dly, That they present very strong analogies in the minutest points of their internal structure, &c., with the guards of the Belemnites ; but yet having evidently never possessed a chambered shell, must be separated from them.

3rdly, That they were probably however, like the Belemnites, appendages of some distinct family of the same order of Cephalopodous Mollusca, possessing the same position and use with the bone of the Sepia and guard of the Belemnite ; exhibiting a new link in the series of the appendages peculiar to Lamarck's third division of this order.

Genus. ACTINOCAMAX.

Gen. Char. A club-shaped spathose concretion, consisting of two nearly equal longitudinal adhering portions. Apex pointed ; base a convex but obtuse cone. The whole formed of a series of enveloping fibrous laminae.

Animal unknown : but as these fossils occur in the strata which contain the remains of marine animals, we may infer that it also was an inhabitant of the sea.

I have derived the name I have given to these remains from *ακτις* (radius) and *καμαξ* (sudes), in allusion to its radiated fracture and the resemblance of its form to the stake-like Echinital spines. The details necessary for the illustration of the genus are embodied in the observations on the following species.

Species I. *ACTINOCAMAX verus*. Pl. IX. fig. 17.

Spec. Char. A club-shaped spathose semitransparent horn-coloured concretion; base convex, obtuse, conical; apex submamillar. Sides depressed towards the lower end, showing two longitudinal, towards the apex branching, impressions of blood-vessels.

Syn. and Ref. An Echinital spine of an uncommon character, bearing a resemblance to the Belemnite. (Parkinson's Organic Remains, vol. iii. Pl. IV. fig. 19.)

Strata. Chalk, and sometimes inclosed in the flints imbedded in it.

Locality. Kent, Wiltshire, Sussex.

Observations.

Soon after my investigation of the Belemnite, a series of specimens of this species came into my possession; and I was astonished with the great resemblance they bore to the guard of the Belemnite in numerous respects, although in general form slightly resembling the spines of *Cidarites imperialis*. This resemblance induced Mr. Parkinson and some other writers on organic remains to consider them as being true spines belonging to fossil Echini. In order to examine more fully into the foundation on which this opinion rested, and guard against those deceptions into which a resemblance of general form may so easily betray the inquirer in this branch of natural history, I commenced by a minute examination of the internal structure of the Echinital spines in my possession, as well those most nearly resembling the *Actinocamax*, as others possessing a different form.

All Echinital spines I have been able to examine, present externally a longitudinally striated or tuberculated surface. Near the base they have a more or less finely striated rim, destined for the adhesion of muscular fibres, connecting the spine to the muscular epidermis covering the plates of the shell of the Echinus.

A transverse or longitudinal section of recent spines shows that their centre is occupied by a minutely cellular calcareous substance, not unlike that (in miniature) which occupies the centre of bones of Mammalia; from this proceed laminae, to the circumference, at a greater or less distance from each other,

forming, in a transverse section, an elegant radiated ring around it. These laminæ are united together by longitudinal, circular, and horizontal laminæ, giving this part some resemblance to the organization of a Madreporæ. The envelope of this organization externally, as stated before, is longitudinally striated or tuberculated. In the fossil specimens, the spines always show an uniform substance of carbonate of lime, having a regular fracture with the angles of the primitive rhomboid; and it is not a little remarkable, that in all the calcareous fossils belonging to the Radiata, whether Crinoidea, Asteriæ, or Echini, the state is similar; they are always composed of a crystalline carbonate of lime. Only in one instance have I seen a spine imbedded in flint, with the central portion penetrated by the siliceous fluid and changed into silex, whilst the radiating portion was decomposed, thus leaving a space between the siliceous nucleus and the impression of the exterior surface in the flint.

It is unnecessary here to enter into details of the mode in which Echinital spines grow or increase in size;—this I reserve for some general views on the organization of the Echinus. But their structure, as far as detailed here, proves evidently that it differs materially from that of the Belemnite, and that it differs equally from that of the *Actinocamax*, as the following statement will show.

The *Actinocamax verus* is, like the guard of the Belemnite, formed of superposed laminæ of fibrous crystals agglutinated and covered by a thin nacreous investment, nearly corresponding in colour and transparency to it. It loses also its colour and becomes of an opaque white on decomposition, like the guard of the Belemnite under the same circumstances. This has enabled me to ascertain (since in both instances the nacreous matter first yields to decomposition) that in the *Actinocamax*, as in the Belemnite, an axis of nacreous matter has existed, which by its decomposition has left a central tubular cavity exactly resembling that formerly noticed in the *Belemnites electricus*. The submamillar apex of *Actinocamax verus* resembles that of the last-cited Belemnite, and the fibrous crystals assuming in both instances a transverse direction conformable to the curvature of the laminæ, render the apex equally liable to decomposition, and to drop out in a conical form. The *Actinocamax* on holding it against the light shows that, like the belemnitic guard, it is formed of two longitudinal portions, uniting by irregular edges, and separating easily on fracture; thereby demonstrating that in both instances the nacreous cement is less firm than the body itself.

The lower end shows the truncated edges of all the laminæ forming the club-like concretions of the *Actinocamax*; but, contrary to what we observe in the Belemnite, the exterior laminæ do not project in regular succession above the

interior ones, so as to inclose a conical cavity for the reception of the chambered shell; but, following an inverted arrangement, permit the interior laminæ to rise in succession above them; so that the centre, instead of presenting a deep conic cavity, becomes convex, forming a protruding cone of which the vertical angle is about 45. This is an excellent proof of the non-existence at any time of a chambered cone in this place; since the structure described, not only affords no traces of a cavity fitted for its reception, but is altogether of an opposite character. From the centre elevation of the base to the circumference, radiating ridges extend, widening as they reach it, forming by intersecting the edges of the enveloping laminæ a subtubercular surface, well adapted for adhesion to an animal substance.

Along each of the two flattened sides is a groove, branching as it approaches the apex,—the evident impression of blood-vessels: in all other parts the surface is smooth, and not striated as in the Echinital spines, or provided with a ring near the base, which would essentially serve for the adhesion of a radiating muscle, and must therefore have been possessed by it had it been an Echinital spine.

The above observations demonstrate, that the resemblances between the *Actinocamax* and the belemnitic guard are not merely general and external, but extend to the minutest points of internal structure; and that both, particularly in regard to *Belemnites electricus*, present the very essential and remarkable fact, that similar impressions of ramifying vessels may be traced on their outer surface.

These analogies seem too many and too great to admit any other explanation, than that both substances have once formed the analogous parts of animals belonging to the same great natural order; while the important difference,—that one of these bodies has been provided with an internal chambered shell, and the other cannot be supposed ever to have possessed a similar appendage, equally proves them to have appertained to different genera, or perhaps even to different families of that order.

What that order was, is a question in which we have analogy only to guide us, the whole families of Belemnite and *Actinocamax* having long vanished from the actual *Systema Naturæ*, or at least having hitherto escaped our researches, and being known only from the preservation of their more solid parts in the strata of the earth.

These analogies, however, are such as to afford probable evidence of a very high degree; and the tendency of that evidence is, as we have before seen, and as is now universally admitted with regard to the Belemnite, to rank it as the appendage of a family of Cephalopodous Mollusca, enveloped by the animal

as the lamellar bone is by the *Sepia*, and the chambered shell by the *Spirula* and *Nautilus*. The chambered shell of the latter class has a structure not altogether dissimilar to that of the lamellar Sepiaceous bone.

The observations now given on the *Actinocamax* appear to extend the application of these analogies to that genus also. It appears to represent the belemnitic guard destitute of its chambered shell: and if the analogy between this part and the lamellar bone of the *Sepia* shall appear well founded, the *Actinocamax* will furnish a beautiful link connecting the Sepiaceous Cephalopoda with the multilocular (the *Sepiaria* with the *Polythalama*) of Lamarck: and we shall have a regular series of these animals, arranging them according to their concretions or appendages as follows.

- A. Cephalopoda with a horny lamina. *Loligo*.
- B. Cephalopoda with a concretion composed of many concentric lamellæ (improperly called bone) adhering to each other by transverse laminæ placed at intervals, the curve of these lamellæ forming only a portion of a circle. *Sepia*.
- C. Cephalopoda with a concretion or appendage consisting of similar lamellæ enveloping or embracing a complete circle: intervals of the lamellæ filled with radiating spar secreted at the same time. *Actinocamax*.
- D. Cephalopoda with a similar appendage and a small multilocular shell. *Belemnites*.
- E. Cephalopoda with a multilocular shell and no lamellar appendage. *Orthocera*, *Nautilus*, &c.

Upon this view, the Belemnite forms the centre of the series, uniting the lamellar appendage and the multilocular shell; while the extremes on the one hand present the appendage only, and on the other the multilocular only.

I conclude, therefore, that the animal of the *Actinocamax* appears to have belonged to the Cephalopoda sepiacea, and its appendage or concretion to have been inclosed within two muscular parts of the animal which formed the two longitudinal portions, and left on their surface the impressions of the blood-vessels passing through the muscular integuments immediately under the secreting epidermis.

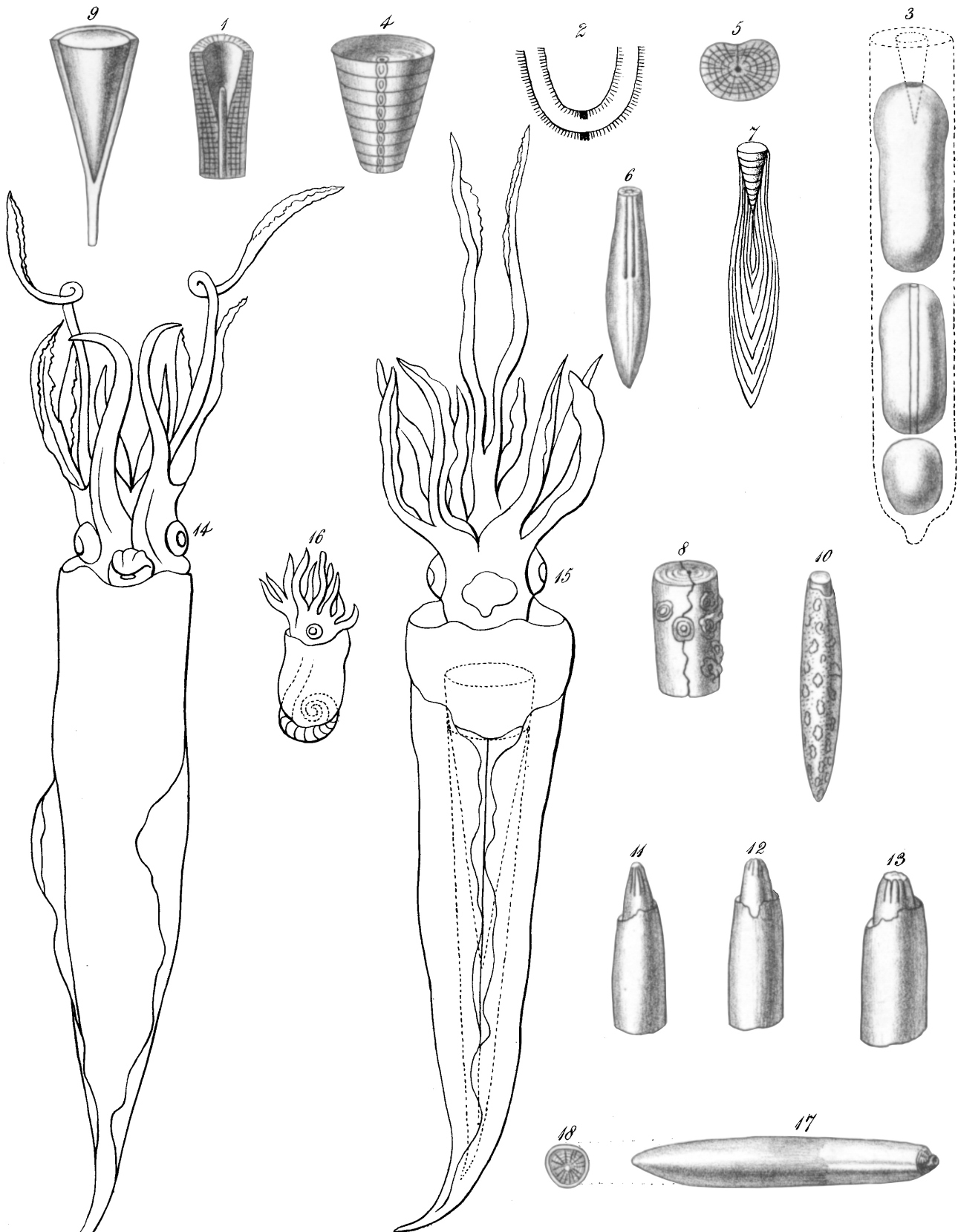


Fig 1. to 13. Belemnites. Fig 14—15. Sepia Loligo; with the supposed Position of the Belemnite Shell, within the living Animal. Fig 16. Spirula fragilis. Fig 17—18. Actinocamax.