

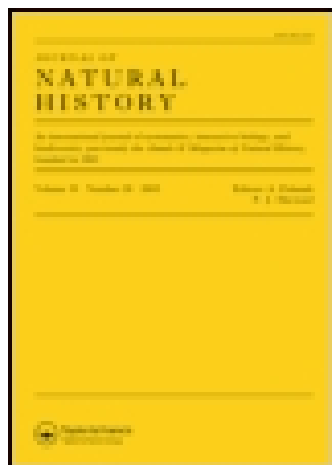
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XXIX.—On the Ventriculidæ of the chalk; their classification

J. Toulmin Smith Esq.

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chyma, it appears to me that the laws of growth of leaves must be looked for in the course of the development of their framework, the nerves. These are apparently organized gradually out from the stem into the nascent leaves, just as the vascular bundles into the apex of the stem, and their point of separation in the blade being fixed from the first, it is clear that all growth in the blade of the leaf must occur beyond this, and it is most natural to suppose that the nerves become organized from this centre outward as the vascular bundles were from the stem at first. Thus it would happen that Dicotyledonous leaves in general would grow at their base until they were sketched out as it were, in the bud, but as soon as the nerves were formed and the plan of the framework of the future expanded lamina laid down, the growth would be apical, marginal and interstitial. In Monocotyledonous leaves with straight veins there appears to be nothing to prevent the continued development of the base, and as we usually find the tissue in a softer and less consolidated condition there, it is probable that that part is the seat of development. These ideas are merely suggested as rational interpretations of the facts before us, but much systematic observation is required before this question can be settled.

XXIX.—*On the Ventriculidæ of the Chalk; their classification.*
By J. TOULMIN SMITH, Esq.

[Continued from p. 220.]

Genus CEPHALITES.

Character. Pouch-shaped : very constant in size and dilatation : cavity usually regular and with a single opening ; sometimes winding and with more openings than one : membrane forming the wall of the cavity always deeply folded : marginal edges—and, sometimes, most prominent points—of the plaits attached to a simple apolypiferous membrane stretched across their whole breadth and forming the upper margin or head of the wall : membrane of wall polypiferous on both external and internal surfaces.

The differences between the genera *Cephalites* and *Ventriculites* are so broadly marked that, except in one or two species, it would be difficult to confound even fragments of the two. In every species of *Cephalites* the head is conspicuous and unmistakeable. This very remarkable peculiarity is alone sufficient to distinguish the genus*.

* See ante, p. 16.

The provisions found through the whole family of Ventriculidæ for ensuring the free access of sea-water to all parts of the surface, and for securing permanence of form as one great means to that end, have been already noticed*. The present genus offers fresh and most remarkable illustrations of those provisions.

In every species of this genus the fold is, comparatively to the size of the whole body, much deeper and broader—in many species positively much deeper and broader—than in any species of the genus *Ventriculites*. The size also is much smaller than the average size of the *Ventriculites*; the height of specimens of the present genus seldom exceeding two inches, rarely attaining three inches†. The form is never expanded, as usual in *Ventriculites*, but, with few exceptions, approaches nearly to the cylindrical, as in *V. tenuiplicatus*.

Extent of surface was thus gained in this genus by the increased depth and complexity of the fold. But this depth and complexity would endanger the safety of the polypiferous surface were there no special provision for maintaining the normal position of the individual plaits. This was perfectly effected, and at the same time with great simplicity and beauty, by stretching across the flat upper edges, or, in a few cases, the more prominent points‡, of the plaits a simple and entire membrane§, which, spread over the whole breadth of those edges and from point to point of those prominences, retained all the plaits securely in their position; thus ensuring the safety of the whole colony and of the entire polypidom which was covered by it. See Pl. XIV.

The general constancy in the size and form of specimens of this genus throws difficulties in the way of the question of growth. It is not easy to understand why we do not find young individuals of this genus as of *Ventriculites*. It has occurred to me

* Ante, pp. 41, 203. It was the circumstance of the Ventriculidæ being polypiferous on both surfaces that rendered these provisions so necessary. In *Halodactylus*, &c. one surface only is polypiferous. See note † p. 41.

† Hence all the figures of this genus are of specimens of average size. I have much pleasure in acknowledging here the pains and care bestowed by Mr. Sowerby over these plates. The novelty of the forms and structure presented many difficulties, especially as the engravings were made only from my drawings. But nothing can be more generally successful or truthful than the figures which Mr. Sowerby has realised.

‡ These latter cases form, however, no exception to the principle of the marginal edge of the plaits being always attached to the cephalic membrane. The cases in which prominent points of the plaits are attached to the head are cases of an additional provision for security. In those cases, as in all others, the marginal edge of the membrane, after having undergone all its varied modifications of fold, reaches and is attached to the head. See the description of *C. campanulatus* and *C. constrictus*.

§ As to structure and nature of this see ante (vol. xx.) pp. 96, 188.

that, probably, the ocean in which this genus dwelt being, apparently, a more disturbed one than that in which the *Ventriculites* dwelt*, and the head possibly not forming till a certain age and size had been attained, individuals dead or destroyed below that age very rapidly lost their form and are therefore found only as shapeless masses. I do not suggest this solution of the difficulty, however, without considerable hesitation.

The whole genus *Cephalites* is characteristic of the Middle Chalk. I have never found a single specimen which I could with any probability refer to the Upper Chalk, though it may be expected that some forms will be found which endured into that later epoch. Certainly none have been ever yet found in the Lower Chalk.

§ *a. Annulati* †.

Head narrow and flat: plaits compact and regular.

1. *Cephalites longitudinalis*. Pl. VII. (vol. xx.) fig. 1, & Pl. XIV. fig. 1.

Plaits delicate but often deep: outer plaits slightly winding: inner plaits depressed at short and regular intervals; bulging on each side around depressions till the adjoining plaits meet and open into each other: processes very conspicuous: wall moderately thick.

This species much resembles in external aspect the smaller cylindrical specimens of *Ventriculites tenuiplicatus*. It is however smaller than that species usually is, the plaits less winding, and the wall thicker. The depressions on the inside also are generally smaller, closer, and more regular than in that species. The head alone is sufficient to distinguish the two at a glance.

This is the only species of *Cephalites* in which the longitudinal fold remains unmodified on the outer face. Hence its specific name. A transverse section of it is seen on fig. 1 of Pl. VII.

It is a rare and delicate species: indeed all the species of the present genus are rare. They do not seem to have abounded in the older seas of the Middle Chalk as the *Ventriculites* did in the Upper Chalk. Though thus rare, however, their modifications are not the less clearly marked.

In regard to the head it is proper to remark, that while, throughout the present division of this genus, its breadth will always be found a very near approximation to that of a transverse section of the plaits, there is a slight variation in this respect in individual specimens. The head often slopes a little outwards, so

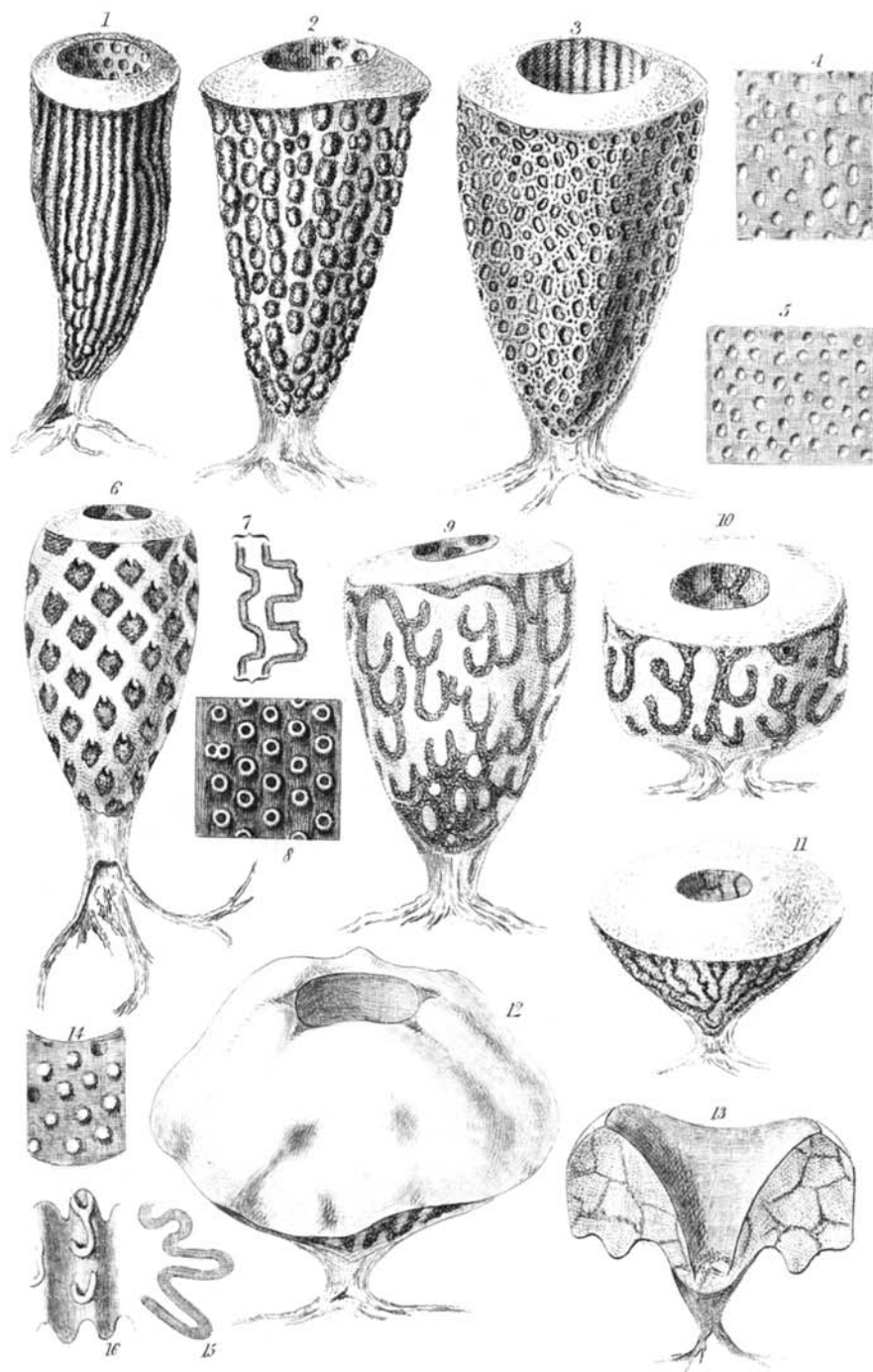
* See ante, p. 204.

† See ante, p. 47.

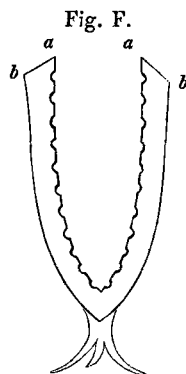


Agave deli

J. De C. Sowerby sc.



that a section of the entire body presents an outline as in fig. F, in which $a-b$ is the section of the head. The outline of the head is always quite as sharp and well-defined as in this figure. The relative arrangement and proportions of the head and the plaits are such that specimens of this division can never be confounded with any belonging to the section *Dilatati*. It is very rarely in the present division that there is any rounding, or departure from the nearly flat character of the head; a character, on the other hand, never present in the *Dilatati*.



It is proper to notice that, in every species of this genus, in order to give full strength to the head, the depressions, bulgings, and other modifications of the fold,—where it does not rise, as in *C. campanulatus*, in a simple form,—are so arranged that the membrane of the inner wall, where it adjoins the head, is always, and that of the outer wall most frequently, expanded by a lateral bulging of the plait, so as for the adjoining plaits to meet just at the point of union of the wall with the head. Thus the whole of the inner, and often of the outer, edge of the head is *continuously* attached to the wall, an arrangement of much importance. On this inner edge the membrane often rises up in a narrow and slightly prominent ridge above the otherwise smooth surface of the head.

2. *Cephalites guttatus*. Pl. XIV. fig. 2.

Plaits broad and deep: outer plaits raised in large hollow bosses, often elongated; adjoining plaits having an occasional lateral connection: inner plaits depressed at regular intervals, bulging on each side around depressions till adjoining plaits meet and open into each other: processes very conspicuous: wall usually thick.

Nothing can better express the usual character of this species than the term *guttatus*. The outer surface looks exactly as if sprinkled with drops of a viscid fluid which had just begun to run together, in some instances to a greater, in others to a less extent. It is thus generally well distinguishable, even on the outside, from *Ventriculites mammillaris*. The plaits being much broader than in *C. longitudinalis*, the depressions on the inner plaits are larger than in that species.

The lateral connection between adjoining external plaits, as in *Ventriculites latiplicatus* and *radiatus*, which is only rarely seen in *C. longitudinalis*, is always more or less present in this species,

and furnishes another characteristic by which it may be at once known from *V. mammillaris*.

3. *Cephalites paradoxus*. Pl. XIV. fig. 3.

Plaits narrow but deep: outer plaits depressed irregularly; bulging around depressions till the adjoining plaits meet and open into each other: inner plaits regular and simple: processes conspicuous: wall thick.

I have given to this remarkable species the name *paradoxus*, because it differs from every other species of this genus in having the plaits simple and regular on the inside, while all the complexity is on the outside.

The depressions, and consequently the interspaces between the anastomosing bulgings on the outside, are not of a regular figure, as is the case on the inner surfaces of *Ventriculites radiatus* and other species. They are varying and elongated; often almost angular; though, as the plaits are narrow, never very large. There do not appear to be any points of anastomosis* between the adjoining inner and regular plaits, such as are found between the outer plaits of *V. radiatus*.

4. *Cephalites alternans*. Pl. VII. (vol. xx.) fig. 2, & Pl. XIV. figs. 4 & 5.

Plaits rather broad and very deep: both outer and inner plaits depressed at unequal intervals; bulging on each side around depressions till the adjoining plaits meet and open into each other: processes conspicuous: wall thick.

The mode of fold in this species resembles that of *Ventriculites bicomplicatus* in the fact of being repeated on the plaits of each surface. It differs essentially, however, in the fact that the depressions, though generally round, are, on neither surface, at regular intervals: consequently no regular figure is assumed in the general aspect of either surface.

I have named the species *alternans* from the circumstance of the repetition on the two surfaces of the same manner of fold; while the straight plait is clearly traceable in the central portion of the wall. A transverse section of a specimen of this species is seen on Pl. VII. fig. 2. Its difference from a similar section of *C. longitudinalis* is very marked.

This is an extremely rare species.

* The appearances seen on dissecting away the inner surface must not be mistaken for this anastomosis. They are, in fact, the bases of the depressions on the outer plaits. See the description of a similar appearance on the outside of *V. tenuiplicatus*, p. 217.

5. *Cephalites bullatus*. Pl. VII. (vol. xx.) fig. 3, & Pl. XIV. figs. 6 & 7.

Plaits broad and deep: outer plaits raised in large and very prominent projections at considerable intervals, and in such manner that they range spirally round the whole body: projections nearly lozenge-shaped and terminating abruptly in an almost flat and somewhat expanded top, having a slight depression from the upper angle towards the middle: inner plaits having large circular depressions at equal intervals; bulging on each side around depressions till adjoining plaits meet and open into each other: processes very conspicuous: wall very thick.

This is a most curious and interesting as well as rare but well-marked species. The depressions on the inner folds are much larger than in *C. guttatus*, which latter have been seen to be larger than in *C. longitudinalis*. But the external fold is the most deserving of attention. When the specimen is first opened there are seen only a number of nearly semilunar marks. On carefully applying the point of the knife it is found that this semilunar appearance is caused by very prominent projections, the tops of which are all closed, but have a partial depression at their upper extremity, and which depression is filled as usual with the matrix. The projections themselves are of large size, measuring about two lines in their longest diameter. They stand out nearly or quite half the thickness of the wall, which is generally four lines thick (see fig. 3. Pl. VII.*). They differ widely from anything we have yet seen. Instead, like *Ventriculites mammillaris*, of being mere rounded elevations on the plait, they stand out prominently from it; and a careful dissection shows that their shape is generally that of a lozenge, with the acute angles in the horizontal, and the obtuse in the perpendicular, line of the whole body. Fig. 7† of Pl. XIV. shows the manner of the projections from the plait and the figure which the peculiar shape of their tops causes to be seen on a clean section exactly through the middle of any one. In all the specimens of this species which I have seen, the projections run in nearly regular spiral lines round the body.

On the inner surface of this and of some other broadly depressed species there is a very small and slight depression between each of the large depressions, and both on the plaits and on the places of the united bulgings. It is barely traceable, and

* This is a longitudinal section taken rather obliquely in order to preserve the roots. It is not quite regular therefore; but, on the side which is preserved, the projections can be well distinguished.

† In this figure I have connected the inner and outer plaits by brackets, —the outline of each merely being given for the sake of clearness.

may easily escape notice. It is however worthy of remark as an additional contrivance for gaining extent of surface, and an additional instance of the exhaustless variety of plan which nature adopts in the development of life.

6. *Cephalites retrusus*. Pl. XIV. fig. 8.

Plaits broad and very deep : outer plaits
 . . . : inner plaits raised in rather small but very prominent projections at regular and close intervals, and in such manner that they range spirally round the whole body, and quincuncially relatively to each other : projections cylindrical, rounding off slightly at the top and with an exactly central and rather deep circular depression (sometimes two) on the top of each projection : wall very thick.

This form departs from every other which has been named. It is the first and only instance in which we find projections on the *inner* plaits, which have been already more than once found, and will be so again, on the outer plaits. The fold which marked the outer plaits of *C. bullatus* is here found, with striking modifications however, on the inside. The projections are much smaller and closer than in that species, but no less prominent ; while each one is again marked by a deep though small and exactly central depression. It is altogether a very extraordinary form*. In chalk specimens it would at once be distinguished from every other species by presenting, on its inner surface, the appearance of a series of small rings, quite unconnected with each other, but arranged with the utmost regularity.

It is an extremely rare species. I have only met with a single specimen, and that is a cast of the inner surface in flint, with fragments of the characteristic ventriculitic structure preserved in

* Forms like this afford very strong ground of caution against the hasty adoption of any *development theories*. The whole of the present subject affords, indeed, the strongest ground for such caution. We see *infinite variety*—all subservient to the ends of life ; and throughout which one Unity is traceable ; but a Unity which certainly no more points to a low type of organization, or to a necessary or probable progressive development of one form from another, than does the beautiful and philosophical demonstration of the cranial vertebræ, or the fact of that demonstration being afforded by the most different members of the Vertebrata. It should be noticed that the very remarkable octahedral structure already developed as characteristic of the membrane of the Ventriculidæ has no relation whatever to those “geometrical figures” alluded to by Professor Owen. In the present case it is a *relative*, and not a positive, form ; and one assumed by *animal fibre* for a special purpose. It has been already remarked (p. 96) that no spicules, or “calcifying salts” enter into the composition of any of the Ventriculidæ. See Owen “on the Archetype and Homologies of the Vertebrate Skeleton,” 1848, p. 171.

places. I am unable therefore to describe the outer plaits. The characters of the inner ones are, however, so marked that those of the outer ones are quite unnecessary in order to establish the specific difference.

The name *retrusus* may be considered either to express the extraordinary degree in which the inner plaits are drawn back to form the projections; or that the most marked characters of the species are hidden from external observation by being on the inner plaits. In either sense the name seems equally appropriate.

7. *Cephalites catenifer*. Pl. XIV. figs. 9, 14, 15, 16.

Plaits broad and deep: outer plaits projecting prominently at irregular intervals; projections horse-shoe shaped, with one arm of a lower projection often linked to the hoop of the projection above it on the same plait; occasional points of anastomosis between adjoining plaits: inner plaits having large and generally oval depressions at regular intervals; bulging on each side around depressions till adjoining plaits meet and open into each other: processes very conspicuous: wall very thick.

Var. *Annulatus*.

Plaits broad and deep: outer plaits projecting prominently at irregular intervals; projections ring-shaped, and generally running into each other on the same plait and often anastomosing with those on adjoining plaits so as to form connected rings over the whole surface: inner plaits having large and generally oval depressions at regular intervals; bulging on each side around depressions till adjoining plaits meet and open into each other: processes very conspicuous: wall very thick.

This is a singular species. The specific name of the typical specimens exactly expresses the appearance of the outer surface, which looks as if several links of a chain were hung about it,—sometimes disconnected,—often connected,—always, or almost always, open on one (and generally the same) side.

This species will be readily distinguished from *C. bullatus* by the fact that the semilunar fold is continued down to the upper edge of the plait, as well as by the links being so often continuous, and by each individual projection being much larger.

Figs. 14, 15 and 16 of Pl. XIV., all taken from the same specimen, will probably assist in the understanding of this modification of the fold. Fig. 14 shows a part of the *core* of the matrix, that which filled the central cavity. The round spots are where depressions existed in the body itself, and where, consequently, the matrix projected outwards from the core. Being broken off at

each place, these regular marks are left, contrasting strongly with the portions of the membrane adhering to the matrix elsewhere*. Fig. 16, which should be compared with fig. 14 of Pl. XIII., shows the peculiar elevations on the plaits: and fig. 15 is a transverse section showing three plaits; the uppermost being struck at a point where there is not any projection, the two others just at the bend of two projections.

The specimens which I have distinguished as a variety, under the name of *annulatus*, appear to be cases in which the horse-shoe elevations have become more than usually continuous both on the same plait and by anastomosis with those on adjoining plaits. This character is sometimes seen on the lower part of specimens the upper part of which exhibits the true normal characters of *C. catenifer*, as in fig. 9. Pl. XIV. In some cases, however, the same appearance of connected rings, instead of rows of open links, covers a large part, or the whole, of the surface; and it is important that the true place of such specimens should be understood, whence the utility of distinguishing them as a variety of *C. catenifer*.

It generally happens that, even in the most characteristic specimens of this variety, there are places in which the projection on the outer plait stands, as it so often does in the normal *C. catenifer*, single and wholly unconnected with any other projection on the same or on any adjoining plait. In that case, instead of being horse-shoe shaped, the circle is usually complete. We thus find, on an external plait, a fold very similar to that which characterizes the inner plaits of *C. retrusus*.

8. *Cephalites compressus*. Pl. XIV. fig. 10.

Plaits broad and very deep: outer plaits projecting prominently in very elongated loops often linked at one extremity and enlarged at the other: inner plaits often inclining towards, and anastomosing with, adjoining plaits: pouch very short: processes very conspicuous: wall very thick.

This appears to be quite a distinct species from the last. Its fold is looser, approaching therein to the character of the group *Dilatati*. The external modification of fold is very different from that of *C. catenifer*; while the internal difference is even more marked. Instead of depressions we have here anastomosis with the adjoining plaits; and at the places of anastomosis the figure becomes almost angular, instead of circular as heretofore.

* See ante, p. 209, note †.

§ *b. Dilatati.*

Head broad and rounding : plaits loose and irregular.

All the species of the present section differ very remarkably from the *Annulati*. In the latter section the heads in all the species were of nearly the same size relatively to the size of the whole body ; as also was the central cavity. The various differences of contrivance by which extent of surface was gained at the same time that the free access of sea-water was maintained, were found in the different modes of folding of the membrane of the wall. In the present section the character of the fold of that membrane differs also in the different species ; but that difference is accompanied by very remarkable differences in the form and extent of the head. The latter becomes the most conspicuous instead of a mere subordinate part to the observer of the whole body. As, therefore, the difference in the heads is a necessary accompaniment of a difference in the fold of the membrane (though rather in the relation of consequence than cause), it will simplify the labour of the inquirer if the character of the head is adopted as one of specific difference. The names given have therefore a reference to this point.

It will be obvious that, the looser the folds, the more necessary would become the greater extent of cephalic membrane in order to secure the objects already suggested as those for which that remarkable structure was designed. Hence the variations in this conspicuous character in the forms immediately under consideration.

There are minor modifications in individuals of each species which would probably be held by many to justify the assignment of each species as a distinct genus ; an arrangement which would indeed be far better warranted than many such divisions both in recent and fossil classifications. It does not seem to me however that the principles of a sound classification will, in the present state of our knowledge, justify such an arrangement*. Moreover, all the species of the present section are of extreme rarity ; so rare, that it is very probable that few even diligent collectors will succeed in obtaining specimens of each, unless some bed abounding in them, and at present unknown, should be discovered.

1. *Cephalites capitatus*. Pl. XIV. fig. 11.

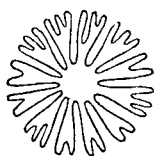
Plaits very deep ; dividing longitudinally, and so reduplicating, very constantly, as they pass from the inner to the outer surface ; points of anastomosis at irregular distances on both

* See ante, p. 41 note, and pp. 42, &c.

inner and outer surfaces : central cavity small : head rounding and very wide : wall falling in very rapidly but in a regular slope from outer margin of head to root : diameter of whole body greater than its height.

In some specimens of the present species the plaits are very traceable on the outside ; in others much less so, on account of the almost total absence of oxide of iron. In each case, however, it is equally obvious that the number of plaits seen on the outer surface is given by the *longitudinal* division and reduplication of the plaits towards that surface, in the same way as the increase of plaits from base to margin has already been described as being effected by a *transverse* division and reduplication*. The accompanying figure will explain the present mode of this reduplication. This arrangement takes place to some extent in most of the *Annulati*, but the very small size of the central cavity in *C. capitatus* renders this peculiarity constant in this species, and one of its most marked characteristics.

Fig. G.



The general form of this species is so peculiar that a vertical section through the fossil displays a triangular figure, of which the base of the fossil forms an obtuse angle, while the external margins of the head form acute angles with the wall. It is thus impossible to confound this species with *C. compressus*, as the wall of that species, like that of every other species of the section *Annulati*, usually forms, inside and outside, nearly a right angle with the head†.

2. *Cephalites campanulatus*. Pl. XIV. figs. 12 & 13.

Plaits very deep ; increasing very rapidly from base and dividing, and so reduplicating, very constantly, both longitudinally and transversely ; after attaining the fullest expansion, folding inwards and downwards, and gradually contracting till they more or less nearly approach the base, whence, folded upwards in a single plait, the membrane rises, usually simple and plain, in a funnel form, to the margin of the head surrounding the central cavity, to which its marginal edge is attached : head enwrapping the body and attached to all the prominent plaits as far as the point where they incline rapidly towards the base : diameter of body greater than height.

* See ante, p. 213.

† I have an interesting specimen of this species in which two individuals are close together ; actually *touching*. But they cannot be mistaken for an example of *C. constrictus*, each individual having separate roots or places of roots, (see before, p. 46,) and not being parts of one single body.

This species differs very widely in outward appearance from *C. capitatus*. In that species the head is indeed so largely developed as to be the most conspicuous part of the entire body ; but it still leaves a view to some extent of the wall. In the present species the whole fossil, unless actually looked at from below, is so entirely enveloped by the cephalic membrane,—rendered necessary on account of the great depth and consequent tendency to looseness of the fold,—that no idea of the character of the membrane of the wall itself can be gained externally.

The modification of the fold is exceedingly remarkable, and exceedingly difficult to be ascertained. The description given, however extraordinary it may appear, is the result of very laborious and careful examination, comparison, and section of all the specimens which I have been able to obtain. A familiar illustration may perhaps assist in understanding the arrangement of this membrane. If the inquirer will glance at the hangings of any window, looped up, as usual, in festoons at some distance from the ground by curtain pins or ropes, he will see a contrivance rudely imitating the very elegant plan adopted by nature, to give, in a small space, a very great extent of surface combined with security to the polypiferous membrane of *C. campanulatus*. Take a piece of linen cloth : join together the side-edges along their whole length, gathering the lower edge to a point : fix the upper end of the sac thus formed* to a circular plain wire : at a third of the length from the bottom fix another wire, which, though altogether uniting in a circle, is deeply zigzagged : the upper wire remaining fixed, raise the lower wire equally all round, and so that the drapery hanging from the upper simply circular wire shall fall within, and that hanging from the zigzagged circle shall fall on the outside. Over both wires draw, smoothly, a separate cloth, to which fix both wires. Then, by holding the entire contrivance at any point of the plain wire circle, the whole will be retained in its place. Such a contrivance will afford the best idea of the very remarkable arrangement of the internal membrane of the present species, and of the object and importance of its deeply extended head. It is obvious that, if the lower wire were zigzagged, not only in its horizontal plane but also in a direction perpendicular to that plane, though it would affect the points at which the outer covering or envelope would be touched, it would in no wise affect the principle of the plaits or folds whose extremities touched that envelope. The following two figures may render this matter still clearer.

* To act properly, and to give a full idea of the extent of surface gained, the sac should be very much wider at the middle than at the top or bottom, in order to fill the lower zigzagged wire and yet inclose the plain fold of the cloth without compressing or touching it.

Fig. H.

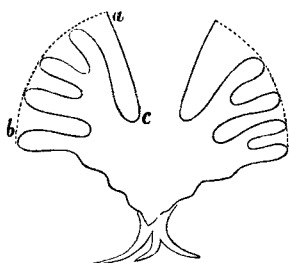
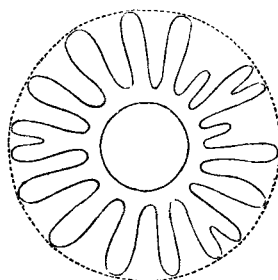


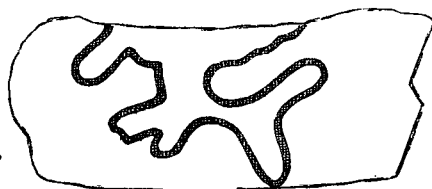
Fig. I.



In each figure the dotted line is the envelope. Fig. H is a longitudinal section as it would be seen if one could be taken exactly clear through any spot where there was no lateral division of a plait—the presence of which gives a false appearance of anastomosis to a section. It will be seen that the membrane may be traced from the point of the base to *c* and thence to *a* in a continuous line, and that the projecting plaits are affixed, at various points, to the envelope *a—b*. Fig. I is a transverse section taken about the middle of a specimen. The inner circle is the membrane where simple and unwavering, and forming therefore necessarily an unbroken circle. Between this and the envelope the plaits are seen, cut horizontally across.

The membrane begins to fold upwards in its last plait at different distances in different specimens from the inner margin of the head; and it is rarely that the folding upwards will take place on exactly the same plane all around; whence, on section, a deceptive appearance is often given, as if there were a double or triple or still more numerous ramification of the central cavity. This is seen in the following curious section of a flint of this species in my possession. Such cases only afford instances of the care and caution necessary in the investigation of such a subject as the present.

Fig. K.



It will be clearly seen that the mode of fold, of which an attempt has thus been made to convey an idea, secured free access of seawater to all parts of the surface of the membrane, external and internal. By the same contrivance that membrane was held securely in its position; the regular funnel-shape assumed by the last plait, with its margin fixed at the top, securing it within*;

* See observations on the head, before, p. 282.

the campanulate envelope, to which the projecting points of the plaits were affixed, securing it without. The size of the internal cavity varies in different specimens, as will be seen by figs. 12 and 13 of Pl. XIV. ; of which fig. 12 is a general view of the external aspect of one specimen ; fig. 13 is a section, with the matrix cleared away from the inner funnel-shaped simple membrane, of another.

There is certainly no form among the *Ventriculidæ* which might, at first sight, be less supposed than the present to have had any affinity with the fossils which have been described as belonging to the genus *Ventriculites*. This will be well understood by comparing Pl. XIV. figs. 12 and 13 with any of the figures on Pl. XIII.

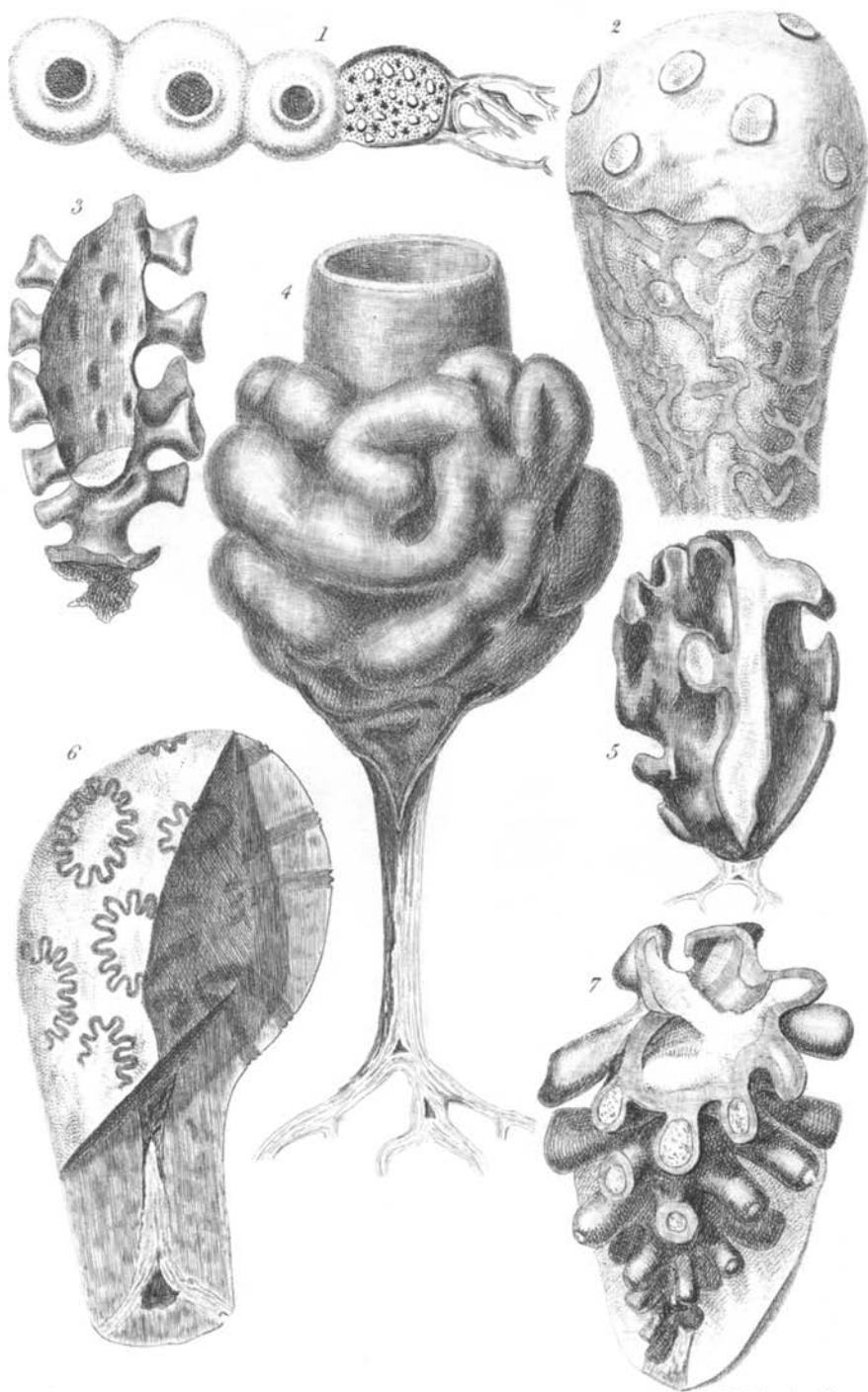
The condition in which these specimens are found,—their deep folds preventing their ever coming free from the chalk, or being developed without the laborious use of the needle,—renders it impossible to make any confident observations upon them as to the processes ; a remark which also applies to every other species of the present section.

3. *Cephalites constrictus*. Pl. XV. fig. 1.

Whole body very low, much-elongated and narrow, with roots at one end : plaits very deep, and running longitudinally from the root extremity ; each plait constricted at short and not very regular intervals, and sometimes to nearly its whole depth : cephalic membrane covering the whole upper surface and sides, to the margins of which last, as well as to many of the prominent points of the plaits, it is attached ; usually constricted at considerable intervals, with a single opening in the middle of each compartment thus caused.

The specific description will satisfy the inquirer that this is a very extraordinary form. Externally it has nothing which would indicate any *Ventriculitic* affinity, and it has indeed been described by Dr. Mantell under the name of *Choanites subrotundus* ; but it has no relation whatever to *Choanites*. The appearance of the fossils is so remarkable, that, but for the fixed rule of preserving every fragment which I could not understand, I should never have been able to establish or even suspect the true affinities. A suite of seventeen specimens enables me, however, now to point out the true general characters of the species without leaving any room even for doubt.

In the two very different states in which the fossil, or fragments of it, are found, it has very different appearances ; the one state (see left hand of figure) shows the upper, the other (see right hand of figure) the lower part only, or its cast. The com-



J. Toulmin Smith del.

Ad. C. Somerby sc.

parison of several of these apparently anomalous fossils led me however to conceive that the connected rounded bodies seen in the former set of specimens had some relation to the very peculiarly complicated and almost angularly raised surfaces seen in the latter. With this clue I cut down some of these rounded bodies, and found the identical surfaces last named below them. Several sections being made, and the whole series being then compared, order and method became at once apparent where all had previously been anomaly and confusion. The characteristic Ventriculitic structure was detected: the Ventriculitic fold was traced: and the Ventriculitic root was found.

I conceive the habit of the animal to have been very different in one respect from that of all the species which have hitherto engaged attention. While the latter stood rising upwards from a central root, this species, attached at one end by a root, and thus secured in its position, floated horizontally, like a ship riding at anchor. It had therefore no central cavity in the direction of its length, but, instead of this, it was covered by a head investing the upper and lateral surfaces of that whole length; and which head, with rare exceptions, for such exceptions do exist, was constricted at intervals, causing the animal, when seen from above and entire, as in the greater part of fig. 1. Pl. XV., to appear like several distinct globose bodies linked together. The fact of the head being occasionally, though rarely, not constricted at all, will satisfy any philosophic inquirer that such an appearance is deceptive, and that the explanation thus given of that appearance is the true one. Besides this, however, if the head be removed, and the lower surface of the fossil only seen, all trace of separation and distinctness is gone. The membrane of the wall does not divide into lobes, as in *Brachiolites*: there is simply, in order to ensure the greater security of the whole polypiferous surface, an occasional constriction of the head and narrowing of the plaits attached to it; which plaits expand again, like an open fan, in the following compartment.

The appearance of the plaits themselves is very remarkable. Their frequent constrictions give them a puckered or zigzag appearance, so that a vertical section has a figure of this kind. This figure shows, also, how the projecting points of the plaits are often attached, for security, to the head. When the body is broken away the cast left is very curious, the matrix being always broken off in many of the places where it has filled a pucker in the upper plait, depressed where there was a pucker in the lower plait. This is seen on the right hand of fig. 1. Pl. XV.

Fig. L.



The species rarely attained half an inch in height or an inch in breadth, though specimens often extend between two and three inches in length.

It seems to me that the cephalic constrictions most probably mark periods of growth*. They vary in number much in different specimens, and, as has been seen, are sometimes not found at all, in which case there are several openings in the undivided head.

Specimens sometimes assume irregular forms, as if, after death, the long body had become twisted, which I have little doubt was, in many such cases, the real fact.

I have placed this species next in order to *C. campanulatus*, inasmuch as, on the one hand, the mode of attachment of the cephalic membrane to the plaits resembles very much that which is found in *C. campanulatus*, while, on the other hand, the fact of the openings in the head of this species being generally several instead of only one, places it in some relation to the species which will next claim attention.

4. *Cephalites perforatus*. Pl. XV. fig. 2.

Plaits wide and very deep, so as to leave no distinct and single central cavity; dividing, and so reduplicating, very constantly, longitudinally, but not transversely; somewhat winding both longitudinally and laterally; occasional points of anastomosis near the outer surface: head covering the entire top and rounding to some distance down the sides; having several small round perforations arranged without any regular figure: body of nearly uniform breadth and often twice the height of its diameter.

The peculiar arrangement of the plaits and head in the last two species rendered any anastomosis of adjoining plaits not essential in either of them. The much greater height of the present species rendered occasional points of anastomosis an important means of securing the permanence of the position of the folds. The width and depth of those folds rendered a large head necessary, while it made unnecessary any large single central cavity; the several small openings in the head giving sufficient access to the sea-water for the purpose of bathing freely all the internal surface of the polypiferous membrane. The unity of form† is not in the least degree impaired by the existence of these several points of access. The one head still holds in place all the several plaits, a contrivance for the security of the entire

* Specimens, apparently entire, are sometimes found, having one only of the rounded divisions, and thus bearing some resemblance to a very small *C. campanulatus*, with its root at one end instead of at the base.

† See before, p. 207 note.

animal and of the individual polyps wholly different from that which is found in every species of the family *Brachiolites*.

In all the various and so greatly varying forms which have been thus seen to be included in the genus *Cephalites* one end is found to be subserved, namely, the maintenance of the security of the whole mass, and of each individual of its myriads of living tenants; together with the unimpeded access of the sea-water—that element upon whose constant presence the life and subsistence of those myriads depended. The great diversity is no less striking than is, in each case, the completeness of the varying methods which nature has adopted for securing that ever-teeming, ever-active life which excites the inquirer's increased admiration at every step he takes.

[To be continued.]

XXX.—*Notes, &c. on the genera of Insects Pissodes, Hypera, &c.; with descriptions of several new species.* By JOHN WALTON, F.L.S.

Fam. CURCULIONIDÆ.

Genus PISSODES, Germ., Schönh., Steph.

1. *Pissodes Pini*, Linn., Gyll., Steph., Schönh.

Recently found in Scotland rather plentifully by Mr. Weaver; "on rails, in a fir-wood, Weybridge, in June," Mr. Smith; "under side of a fir-log, Dalmeny Park, Scotland," Mr. R. N. Greville; "under the branches and chips of the Scotch fir lying on grass, Gosforth Woods, Northumberland," Mr. T. J. Bold.

2. *P. notatus*, Fab., Gyll., Steph., Schönh.

— *Fabricii*, Steph., non Leach MSS.

Two specimens of this insect in the collection of the British Museum, taken in Scotland by the late Dr. Leach, appear to have been mistaken for the following by Mr. Stephens.

A single specimen found under a stone in an old gravel-pit at Yaxham near East Dereham, Norfolk, by Mr. Wollaston.

3. *P. piceæ*, Illig., Schönh.

— *Fabricii*, Leach MSS. sec. specim. Mus. Brit.

Oblong-ovate, piceous, sparingly clothed with flavescent scales. Head short, convex, obsoletely punctulated, front with a deep fovea between the eyes; rostrum nearly as long as the head and thorax, moderately stout, cylindrical, slightly curved, closely punctured, brown, and sprinkled with scales at the base. Antennæ scarcely reaching to the middle of the thorax, rather thick, rufo-piceous, setose and pubescent. Thorax considerably narrowed