V.—On *Stomatopora antiqua*, Haime, and its related Liassic Forms.

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(WITH A FOLDING TABLE I AND PLATE XIV.)

STOMATOPORA ANTIQUA was first described and figured by Haime[1] from specimens occurring on *Gryphæa* in the Lower Lias of France. I have not been able to find any record of an English specimen except that in the Survey memoir on the Lias of England and Wales.[2] But recently several specimens of a *Stomatopora* resembling *S. antiqua*, Haime, were found in the collection of the late Mr. R. F. Tomes. The fact that all the specimens were encrusting *Gryphæa* is remarkable; for though many hundred specimens of various molluscs from the Lower Lias were searched, and of these all sorts of oysters with especial care, *Gryphæa* was the only form encrusted by *Stomatopora*.

In the British Museum catalogue[3] *S. antiqua*, Haime, is made a synonym of *S. dichotoma* (Lamouroux),[4] a Bradfordian form. But an examination of the material alluded to, of which more than a dozen zoaria were sufficiently well preserved to admit of measurements of portions of them after the method described in a former number,[5] has shown not only that this form is a distinct species, but that it exhibits features which make it probable that it is more primitive than any other Jurassic *Stomatopora* as yet described. Even Gregory included it with some hesitation in *S. dichotoma*, for in writing of that species he says[6]: "The one [form] in regard to which I feel most doubt is *S. antiqua*, Haime, from the Lower Lias. Haime founded this practically only on variations in the branching of the lines of the zoœcia. This character is shown by the large series of specimens in the British Museum collection to be of little value. The peristomes are not so much raised as in the typical form, but in this character likewise there are such variations in the same zoarium that the difference is not sufficiently well marked." The systematic value of the two characters mentioned has been discussed in the paper[7] just quoted, in which the author attempts to show that the branching is of paramount importance.

It seems advisable, having the material in hand, to define the species with greater exactness, revising Haime's definition, and by investigating the stages of growth to gain some idea of its relations to other forms.

[1] J. Haime, "Description des Bryozoaires Fossiles de la formation Jurassique": Mémoires de la Société Géologique de France, ser. II, vol. v (1854), pp. 162–163.

[2] H. B. Woodward: "The Lias of England and Wales," 1893, p. 365.

[3] J. W. Gregory: British Museum Catalogue of Jurassic Bryozoa, 1896, p. 44.

[4] J. Lamouroux: "Exposition Méthodique des genres de l'ordre des Polypiers," 1821, p. 84, pl. lxxxi, figs. 12–14.

[5] W. D. Lang, "The Jurassic Forms of *Stomatopora* and *Proboscina*": Geol. Mag., Dec. V, Vol. I (1904), p. 315.

[6] J. W. Gregory: loc. cit., p. 48.

[7] W. D. Lang: loc. cit., pp. 318–322.

It is to facilitate the comprehension of the method of investigation employed that the reader is referred to the paper on "The Jurassic Forms of *Stomatopora* and *Proboscina*."[1] In this paper great prominence was given to the mode of branching; and it was pointed out that the remarkable regularity of this character was peculiar to the Jurassic forms. Three types of branching were described as Type I, the Intermediate type, and Type II; and the order of succession was invariable, the first passing gradually into the second, and the second into the third type. If it may be inferred from the irregularity of the branching in the few Silurian specimens of *Stomatopora* examined that the pre-Jurassic ancestors of the species under consideration were irregular in their mode of branching, the Jurassic regularity appears in the Lower Lias form as a new character superimposed upon a pre-Jurassic irregularity. The apparent expression of this is that although in the Lower Lias form the regular dichotomous branching after Type I, the Intermediate type, and Type II may be observed, it is somewhat obscured by a slight irregularity, and the daughter zoœcia at each dichotomy are of unequal length. Thus a second character becomes involved—the proportion of the length of the zoœcium to the breadth. These points are illustrated in Pl. XIV, Figs. 4 and 5.

Moreover, a slight irregularity occurs in a third character—the shape of the zoœcium. In the Oolitic forms primitive cylindrical zoœcia become pyriform, and in more specialized forms often revert to a cylindrical shape. In *Stomatopora antiqua*, Haime, though the general sequence is cylindrical—very slightly pyriform—cylindrical by far the greater part of the zoarium having cylindrical zoœcia, occasionally a comparatively pyriform zoœcium occurs without any relation to the general sequence in shape. This is well shown in Terquem & Piette's figure of *S. antiqua*, Haime,[2] and in the specimen B.M. D. 7623 (Pl. XIV, Fig. 5). It is true that such sporadic irregularity in any one character is liable to occur to some extent among the most regular Jurassic forms. And the explanation is suggested that so plastic and undifferentiated are these primitive forms that rigid stability of character is not to be expected in the same degree as in the case of the ornamentation of such a highly specialized group as the Ammonites.

Mr. Buckman has offered another explanation of the sporadic appearance of the comparatively pyriform zoœcia. Jackson[3] has shown that in plants a new branch tends to recapitulate former characters more primitive than those peculiar to that part of the plant whence it springs. He applies this to animals as well as to plants, and voices it in the law that "throughout the life of the individual, stages may be found in localised parts, which are similar to stages found in the young, and the equivalents of which are to be sought in the adults of ancestral groups."

[1] W. D. Lang: loc. cit.

[2] O. Terquem et E. Piette, "Le Lias inférieur de l'est de la France": Mém. Soc. Géol. France, ser. II, vol. viii (1868), p. 124, pl. xiv, fig. 32.

[3] R. T. Jackson, "Localised Stages in Development": Mem. Boston Soc. Nat Hist., vol. v, No. 4 (1899), p. 92; see also pp. 139, 141.

Applying this principle, we may say that at every branch in a colonial form such as we are considering there is a potential recapitulation. Now the slight tendency to pyriformation at dichotomies 1 and 2 in the present form shows that the general cylindrical stage was preceded by one which was more or less pyriform. The tendency, then, at each dichotomy is to recapitulate this stage. The potential recapitulation occasionally becomes actual, and appears as the sporadic production of somewhat pyriform zoœcia.

A third explanation of these sporadic zoœcia is that they are simply gonœcia. And the fact that in all organisms reproductive tissue arises from undifferentiated cells may furnish a hint as to why primitive characters are shown in reproductive zoœcia.

Having indicated the directions in which difficulties may be expected in applying the scheme of measurement advanced in the former paper, it is possible to limit Haime's species by the following definition, which takes into account stages of growth :—

I. *Stomatopora antiqua*, Haime. (Pl. XIV, Figs. 2, 4, 5, and 7.)

Characters.—Zoarium loose and spreading, the first dichotomy being after Type I at an angle of about 180°. The Intermediate type of branching appears at the third or fourth dichotomy, and Type II by the fifth or sixth. As has already been remarked, the branching is often somewhat irregular, so that the exact type is hard to determine. There are two peristomes before the first dichotomy, and generally one between the first and second. The acme is reached with three or four peristomes between the third and sixth dichotomies; after which, with a small check at about dichotomy 7, the number of peristomes between each dichotomy rapidly diminishes. The proportion of the length of the zoœcium to the breadth is very variable, but by examination of a number of specimens a general sequence can be recognised. That of the protœcium is about 1, of the second zoœcium about 2. The acme of length is at dichotomies 1 and 2, where it is from 2 to $2\frac{1}{2}$. From dichotomy 2 it gradually diminishes until it is only $1\frac{1}{2}$ at dichotomy 9. The shape of the zoœcia is irregularly cylindrical, with a slight tendency to pyriformation between dichotomies 1 and 2, and with an occasional irregular pyriform zoœcium as already noticed. The ornamentation is a very slight, fairly fine ribbing, but the zoœcia often appear smooth, owing to bad preservation, for which reason it is hard to see any regular change in this character during the growth of the colony. The sides of the zoarium tend to be flattened on to the object which it encrusts.

For comparison the original description by Haime is here given[1] :—

"Les mailles de ce testier ont une tendance à se rapprocher de la forme d'une rhombe irrégularier, et dont les angles seraient émoussés. Les sept premières testules produisent deux bourgeons; il arrive fréquenment que deux testules jumelles soient un peu inégales en grosseur, et restent presque complétement accolées l'une à l'autre;

[1] J. Haime: loc. cit., pp. 162–163.

TABLE OF OBSERVATIONS ON INDIVIDUALS OF *STOMATOPORA ANTIQUA*, HAIME.

	B.M. D. 7620. 2.	B.M. D. 7620. 3.	B.M. D. 7620. 8.	B.M. D. 7622. 2.	B.M. D. 7622. 3.	B.M. D. 7623. 1.	B.M. D. 7622. 5.	B.M. D. 7623. 2.	B.M. D. 7619. 1.	B.M. D. 7619. 2.	B.M. D. 7620. 4.	B.M. D. 7620. 5.	B.M. D. 7620. 6.	B.M. D. 7620. 9.	B.M. D. 7621. 1.	B.M. D. 7621. 2.	B.M. D. 7622. 6.	B.M. D. 7624.	B.M. D. 7625.	Average.
Type of Branching.																				
At dichotomy 1	I. 180°	I. ?20°	I. 180°	...	...	I. 180°	I. 180°	I. 180°	...	...	...	I.–s.i. 180°	...	...	...	...	...	...	...	I. 180°
,, 2	I. 90°	I. ? 90°	...	i. 60°	s.i. 90°	i. 120°	?	i. 120°	...	...	...	i.–nearly II.	...	...	...	...	...	...	...	I.–i. 90°
,, 3	s.i. 60°	s.i. 90°–60°	...	i. 120°	i.–II. 120°	i. 90°	i. 90°	I. 60°–i. 90°	...	...	...	...	i. 60°	i. 60°	...	...	i. 80°	i.–II. 90°	i. 60°	i. 90°
,, 4	...	? i. 60°	...	I. 120°–i. 90°	i. 60°–90°	I.–i. 90°–60°	i. 80°	i. 60°	...	i. 60°	s.i. 90°	...	i.–II. 60°–45°	i.–II. 90°	II. 45°	i.–II. 45°	i.–II. 45°–60°	i.–II. 90°	i. 90°	i. 60°–45°
,, 5	...	...	...	I. 90°–i. 60°	i.–II. 90°	II. 180°	i. 70°–80°	i. 90°	i.–II. 60°	i.–II.	i.–II. 60°	...	i. 45°	i.–II. 90°	I.–II. 60°	i. 60°	i.–II. 45°–60°	II. 45°–60°	...	i.–II. 60°
,, 6	...	...	...	II. 60°–i. 100°	...	II. 90°	i–II. 60°	...	i.–II. 60°	i.–II. 60°–45°	...	...	...	i.–II. 45°–60°	II. 45°	i. 45°	...	...	...	II 90°–60°
,, 7	...	...	...	II. 90°	...	i. 120°	II. 45°–60°	...	i.–II. 90°–45°	II. 60°	...	...	...	...	...	...	...	...	...	II. 60°
,, 8	...	...	...	...	...	...	...	...	II. 45°–60°	...	...	...	...	...	...	...	...	...	...	II. 45°–60°
,, 9	...	...	...	...	...	...	...	...	i.–II. 45°–60°	...	...	...	...	...	...	...	...	...	...	II. 45°–60°
Number of Peristomes.																				
Before dichotomy 1 ...	? 2	2	? 2	...	...	? 2	...	2	...	...	...	...	...	...	...	...	...	..	...	2
Between dichotomies 1–2	1	? 1	? 1	...	...	1	2	1	...	...	...	...	...	...	...	...	...	...	...	1
,, ,, 2–3	1–2	1–2	...	1	1–2	1–2	1	1–2	...	...	...	1	...	...	...	...	...	...	3	1–2
,, ,, 3–4	2 shown	1–3	...	1–2	1	1–3	2	1–3	...	? 2	...	2 shown	1	2	3	...	1	3	1–3	1–3
,, ,, 4–5	...	...	...	2–3	3–4	1	1	1	4	1	1–2	...	2–3	1–2	2–3	3	3	2	3	1–4
,, ,, 5–6	...	...	...	1–2	...	1	1–2	...	2	1–2	1–2	...	...	1–2	2	2–3	...	1–2	...	1–2
,, ,, 6–7	...	...	...	2	...	1	1–2	...	1–2	2	...	...	...	1–2	...	...	...	...	...	1–2
,, ,, 7–8	...	...	...	...	...	...	...	...	2–5	...	...	...	...	1–2	...	...	...	...	...	2–3
,, ,, 8–9	...	...	...	...	...	...	...	...	1–3	...	...	...	...	...	...	...	...	...	...	2
Ratio of Length of Zoœcium to Breadth.																				
Zoœcium 1	?	1½	? 1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1¼
,, 2	2½–3	2½	2	...	...	? 2	...	1½	...	...	...	...	...	...	...	...	...	...	...	2
At dichotomy 1	2½–3	2½–3	2–2½	...	...	2	1½–2	2	...	...	...	...	...	...	...	...	...	...	...	2–2½
,, 2	2½–3	2½–3	...	1½–2	2	2–4	2	2–2½	...	...	...	2–2½	...	...	...	...	...	...	2	2½
,, 3	2½–4	2–4	...	1½–2	1½–2	1–2	2–3	2	...	...	...	2	2	2	...	...	2	? 2	1½–2	2
,, 4	...	2	...	2	1½–3	2	2–3	2–2½	...	1½–2	1½	...	2	2	1½–2	2	2–2½	2–3	2	2½
,, 5	...	...	...	2	1½–2	2	2–3	2	1½–2	2	2	...	2	1½–2	2–3	2–2½	2–2½	2–3	...	2
,, 6	...	...	...	1½–2	...	2	2–3	...	1½–2	1½–2	...	...	...	1½–2	2	2	...	2–3	...	1¾
,, 7	...	...	...	1½–2	...	2–4	2	...	1–2	1½–2	...	...	...	...	...	...	.	...	...	2
,, 8	...	...	...	...	...	...	...	...	1–2	...	...	...	...	...	...	...	...	...	...	1½
,, 9	...	...	...	...	...	...	...	...	1–2	...	...	...	...	...	...	...	...	...	...	1½
Shape of Zoœcium.	cyl.	cyl.	cyl. 2nd zoœcium is pyriform	cyl.	cyl. s.pyr. at 2	cyl. or swollen. s.pyr. at 2–3	cyl.	cyl., occasionally s.pyr.	cyl. or swollen	cyl.	cyl. or swollen	cyl., occasionally s.pyr.	cyl. or swollen	cyl.	cyl.	cyl.	cyl.	cyl.	cyl.	cyl.
Ornamentation.	sm. v.s.r. at 3	sm. v.s.r. at 3	? sm.	v.s.r.	s.r.	v.s.r.	v.s.r.	v.s.r.	v.s.r.	v.s.r.	?	s.r.	s.r.	s.r.	sm. or v.s.r.	sm. or v.s.r.	3–4 s.m. 5 v.s.r.	s r.	sm.	v.s.r.

[To Binder.—This Table to be inserted in Mr. W. D. Lang's paper on *Stomatopora antiqua*, Haime: Geol. Mag., June, 1905, to face p. 261.]

mais les individus auxquels elles donnent naissance s'écartent notablement l'un de l'autre. Entre une bifurcation et celle qui la suit, on compte ordinairement deux ou trois péristomes en série. La partie rampante des testules est médiocrement allongée, légèrement conique à l'origine, puis cylindroide et faiblement aplatie; elle présente des plis fins et d'autres plus prononcés; les pores sont petits et assez écartés. La grande largeur des testules dépasse un peu $\frac{1}{3}$ de millemétre.

"Ce fossile rappelle tout à fait par son aspect général la *S. dichotoma*; mais les irrégularités que nous venons d'indiquer dans le mode de multiplication, ainsi que la forme légèrement conique des testules, l'en distinguent suffisamment. Ces testules sont d'un autre côté beaucoup moins longues et moins lisses que dans la *S. Waltoni*.

"Tous les exemplaires que j'ai observés étaient fixés sur Gryphées arquées, et ont été découverts par M. Terquem dans le lias inférieur de Valière (Moselle)."

It will be seen that Haime expressly indicates "les irrégularités dans le mode de multiplication"—the pre-Jurassic trait of this species; also that branching after Type II is exhibited, the "deux testules jumelles . . . . restent presque complétement accolées l'une à l'autre." But the most important fact is not given, namely, the point in the life-history of the colony when Type II makes its appearance.

The folding table (Table I)[1] of observations on nineteen zoaria will give some idea of the limits of variation in this species. The numbers in the first column are those of the dichotomies at which the observation is taken, starting at the proximal end. The columns are headed by the letters B.M. D., followed by two numbers. The letters and the first number stand for the British Museum register number of the specimen, the second number for that of the zoarium on that specimen. In the first eight examples the first dichotomy was seen, so the numbers of the dichotomies are known. In the last eleven, divided from the first eight by a double vertical line, the proximal end of the zoarium was wanting, and so the first dichotomy shown was observed as x, the second as $x + 1$, etc. But by comparison with the first eight, the value of x was surmised. For an explanation of the whole scheme I can only refer to my former paper.[2] The abbreviations used in the table are as follows:—

I, II. = branching after Type I, Type II.
i. = branching after the Intermediate type.
s. = slightly.
v. = very.
180°, 90°, etc. = branches diverging at an angle of 180°, 90°, etc.
cyl. = cylindrical.
pyr. = pyriform.
sm. = smooth.
r. = ribbed.

In Haime's figure the zoœcia are as a whole shorter than in the Tomes specimens, but there is very little difference; and, as has already been shown, partly owing to the irregular branching, the length varies considerably.

[1] Folding Table I to be inserted to face this page. [2] W. D. Lang: loc. cit.

Synonymy.—The only figured forms which are likely to be confounded with this species are those described from the Lower Lias of France by Terquem & Piette[1]; and it may be incidentally remarked here that the form mentioned as having been recorded in the Survey memoir is written "*Stomatopora antiqua*, Terquem & Piette." Unfortunately there is some confusion in the French authors' paper. Two forms are recorded—*S. antiqua*, Haime, and *S. Haimei*, Terquem & Piette. The latter species is described and figured. The former is not described, but Haime's description is referred to, and two figures are given on Pl. XIV. The figures to which the direction of the text refers are obviously wrong, being representations of *Neuropora*. However, the legend beneath the plate makes it clear which figures are meant. But the larger of these (the other being a life-size representation of the whole zoarium) is a reproduction, with rather larger peristomes and rather stouter zoœcia, of Haime's figure of *S. antiqua*. It looks, therefore, as if Terquem & Piette had meant the figures they have called *S. antiqua*, Haime, to apply to their new species *Haimei*. As it stands, their *S. Haimei* must become a synonym of *S. antiqua*, Haime, unless or until the form represented by their figure can be proved to differ from Haime's *S. antiqua*. It is a great pity that the name *Haimei* should have to be dropped; for no one who has used this author's beautifully executed plates of these forms could wish otherwise than that his name should be associated with this genus.

The form recorded as *S. antiqua*, Haime, is described below as *S. Gregoryi*, sp. nov.

Horizon and locality.—Haime records the type-specimen from "le lias inférieur de Valière (Moselle)."

The English specimens are from the Sinemurian, mostly from beds which are at the horizon of the zones of *Deroceras armatum*, *Uptonia Jamesoni*, and *Amaltheus ibex*, but the exact zone cannot be determined.

Specimens B.M. D. 7623 and 7624 are from what is probably the zone of *Uptonia Jamesoni*[2] at Aston Magna, north of Moreton-in-the-Marsh, Gloucestershire. From the same locality is a specimen B.M. D. 7622, which is labelled "junction of the Middle and Lower Lias, Aston Magna."

Specimens B.M. D. 7619 and 7620 are from probably the same zone[3] at Fenny Compton, Warwickshire, north of Banbury, Oxfordshire.

The specimen B.M. D. 7625 is from what is probably the zone of *Asteroceras obtusum*[4] at Honeybourne, east of Evesham, Worcestershire.

S. Haimei, Terquem & Piette, is recorded as occurring in "Lumachelle ferrugineuse à *B. acutus* de Chilly, sur une valve de l'*Ostræa chillyensis*." This horizon is Sinemurian.

[1] O. Terquem & E. Piette: loc. cit.
[2] H. B. Woodward: loc. cit., p. 155.
[3] H. B. Woodward: loc. cit., p. 161.
[4] H. B. Woodward: loc. cit., p. 154.

II. *Stomatopora antiqua*, Haime, mutation *capricornensis*. (Pl. XIV, Figs. 1 and 3.)

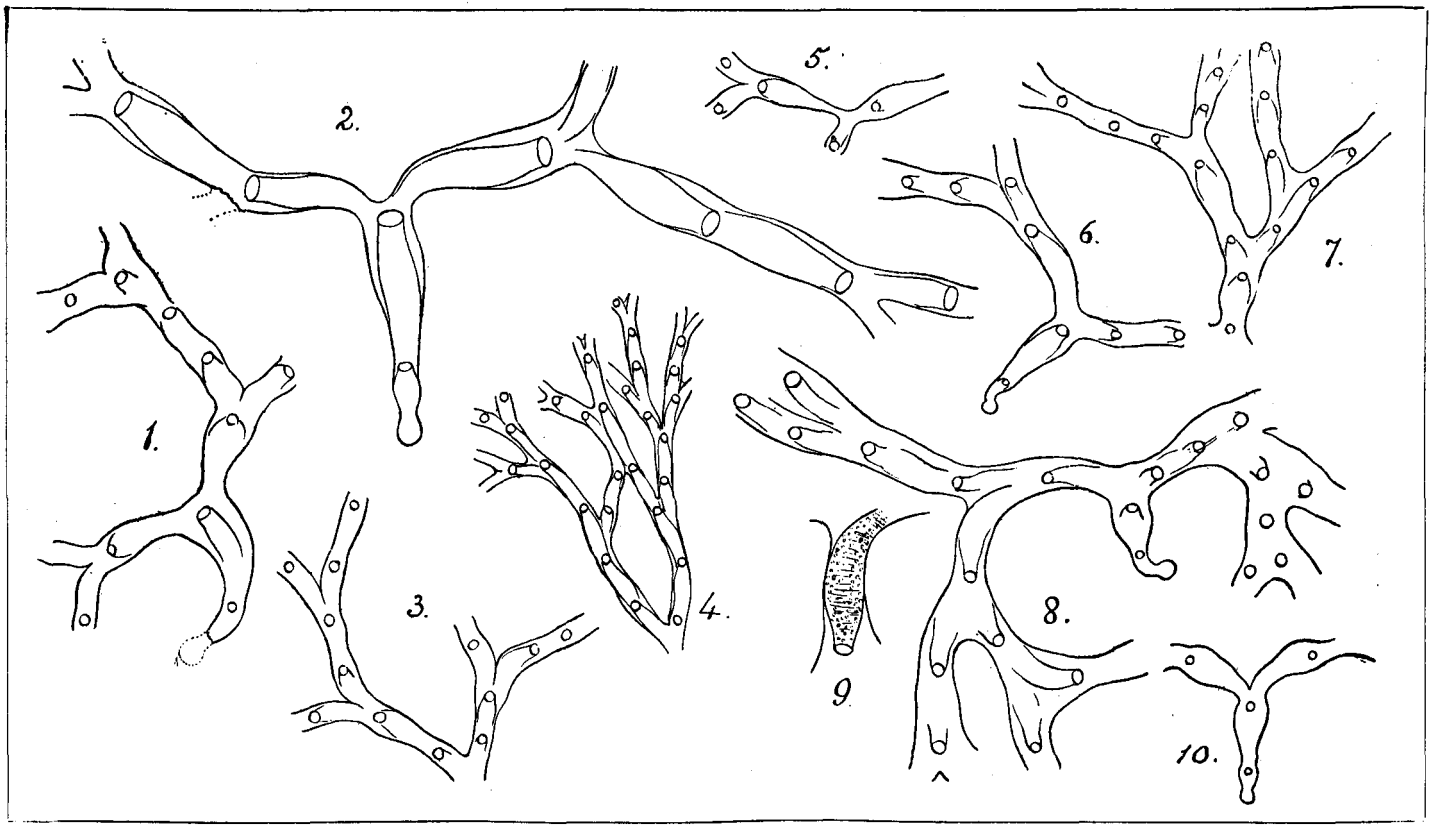
Fragmentary zoaria of a form hardly distinguishable from the Sinemurian species *Stomatopora antiqua*, Haime, occur rather commonly encrusting specimens of the coral *Montlivaltia Victoriæ*, Duncan, from the Middle Lias, zone of *Liparoceras capricornus*[1] at Cherrington, Warwickshire, north-east of Moreton-in-the-Marsh, Gloucestershire. The only apparent difference between this and the Sinemurian form is in that the branching in the former is far more regular, approaching in this respect the Oolitic species. This point is shown in Diagram I, p. 267, where Fig. 3 represents *S. antiqua*, Haime, and Fig. 4 its mutation in the *capricornus* zone. This being the only difference which the fragmentary and ill-preserved material presents, it looks as though this form was a direct modification of *S. antiqua*, Haime, in time; and since no other form has been found at this horizon resembling more closely the Sinemurian species, it may be looked upon as the modification of *S. antiqua*, Haime, in the higher zone. But because this form is not identical with *S. antiqua*, Haime, it is convenient to have a name whereby to distinguish this mutation, as it is called, and I therefore propose to name it *S. antiqua*, Haime, mutation *capricornensis*, indicating in the name the horizon at which the mutation is found.

A table of observations on these fragments is given below.

TABLE OF OBSERVATIONS ON INDIVIDUALS OF *STOMATOPORA ANTIQUA*, HAIME, Mut. *CAPRICORNENSIS*.

	B.M. D. 7539. $x = 1$.	B.M. D. 7470. 2.	B.M. D.7626.	B.M. D.7628.	B.M. D.7629.
Type of Branching.					
At dichotomy x	I. 140°	? i. 45°	II. 100°	I.45°–60°	i. 60°
,, $x + 1$ ...	i. 90°	II. < 45°	...	i. 90°	i. 60°
,, $x + 2$ ...	I. s.i. 60°–90°	...	...	...	i. 45°
,, $x + 3$ ...					
Number of Peristomes.					
Between dichotomies					
$x - 1$ and x ...	2	...	2	...	...
x and $x + 1$ ...	1	2	2	2	2
$x + 1$ and $x + 2$ ...	3	...	...	...	2
Ratio of Length of Zoœcium to Breadth.					
At dichotomy x	$2\frac{1}{2}$	$1\frac{1}{2}$–2	2–$2\frac{1}{2}$	$1\frac{1}{2}$–2	2–$2\frac{1}{2}$
,, $x + 1$ ...	2	2	...	...	2–$2\frac{1}{2}$
,, $x + 2$ ...	2	...	...	...	2–$2\frac{1}{2}$
,, $x + 3$ ...					
Shape of Zoœcium ...	cyl.	cyl.	cyl.	cyl.	cyl.
Ornamentation ...	?	?	?	?	?

[1] H. B. Woodward: loc. cit., p. 157.



To illustrate Mr. W. D. Lang's paper on forms of *Stomatopora* from the Lias of Warwickshire, Worcestershire, and Gloucestershire. (See Explanation of Plate on p. 268.)

III. *Stomatopora Richardsoni*, sp. nov. (Pl. XIV, Figs. 8 and 9.)

A specimen has been found in the Lias of Toddington, north-east of Cheltenham, Gloucestershire, by Mr. L. Richardson, F.G.S., which in its early stages resembles *S. antiqua*, Haime. Branching after Type II occurs as early as the second or third dichotomy, and is general by the fourth, at which point the zoarium has become Proboscinoid. This early branching after Type II is represented in Diagram I, p. 267, Fig. 5, where only the Stomatoporoid stages are shown, and the branching not carried beyond dichotomy 3, in order that an equal comparison may be made with the other forms figured. The irregularity in the branching is retained throughout the Stomatoporoid stages, showing this to be a primitive character directly derived from *S. antiqua*, Haime, and not, as appears to be the case in certain Oolitic forms, a secondary irregularity following normal branching after Type II, and giving rise to such forms as *Proboscina morinica* (Sauvage). The tendency of the sides of the zoarium to become flattened out on the object encrusted so as to form a 'selvage,' as Gregory calls it,[1] is more pronounced than in *S. antiqua*, Haime, and produces in the distal part of the zoarium the type of *Proboscina* resembling the species above mentioned.

The slight pyriformation exhibited by *S. antiqua*, Haime, between dichotomies 1 and 2 is absent. The zoœcia are cylindrical throughout after the first dichotomy.

It will be seen on referring to Pl. XIV, Fig. 8, that after the first dichotomy the right-hand branch is more specialized and becomes Proboscinoid sooner than the left-hand branch. A second zoarium on the same specimen exhibits similar characters to that described and figured, as far as can be seen through the obscuring matrix.

The zone in which this specimen was obtained was probably that of *Uptonia Jamesoni*. At any rate this is the approximate horizon.

Three more zoaria (specimens B.M. D. 7630) on an example of *Montlivaltia Victoriæ*, Duncan, in the collection of the late Mr. R. F. Tomes, from the zone of *Liparoceras capricornus* at Cherrington, Warwickshire, north-east of Moreton-in-the-Marsh, Gloucestershire, resemble the specimen just described sufficiently to be included in this species. An outline figure of one of these specimens is given on Pl. XIV, Fig. 6.

Fig. 6 on Diagram I represents the specimens from the *capricornus* zone, the same form as Fig. 5 being repeated to indicate that that form passes into the higher zone unchanged.

The following is a table of changes in the characters of this species during its life-history:—

Type of Branching.

At dichotomy	1	...	Type I at 120°.
,,	2	...	Type I–Intermediate type at 90°–100°.
,,	3	...	Intermediate type–Type II at 60°.
,,	4	...	Type II at < 60°.

[1] J. W. Gregory: British Museum Catalogue of Cretaceous Bryozoa, vol. i (1899), p. 150.

Frequency of Branching.

Number of peristomes before dichotomy 1	... ...	2
,, ,, between dichotomies 1 and 2	...	1–2
,, ,, ,, ,, 2 and 3	...	1–2
,, ,, ,, ,, 3 and 4	...	1–2

Ratio of Length of Zoœcium to Breadth, the latter being taken as 1.

Before dichotomy 1	zoœcium 1	2
	,, 2	$1\frac{1}{2}$
At dichotomy 1	... ...	$1\frac{1}{2}$–$2\frac{1}{2}$
,, 2	... ...	2–3
,, 3	... ...	2–$2\frac{1}{2}$
,, 4	... ...	$1\frac{1}{2}$–$2\frac{1}{2}$

Shape of Zoœcium.

Before dichotomy 1 { zoœcium 1, cylindrical.
,, 2, slightly pyriform.

From dichotomy 1 to dichotomy 4, cylindrical.

Ornamentation. Very slightly ribbed.

IV. *Stomatopora Gregoryi*, sp. nov. (Pl. XIV, Fig. 10.)

Mention was made above to the figures given by Terquem & Piette[1] of *Stomatopora antiqua*, Haime. And though only a small part of the zoarium is drawn large enough to clearly show its characters in detail, it appears, by taking what is to be seen in the larger figure with the loose appearance of the branching in the smaller figure, that this form is more primitive than Haime's type, and does not exhibit branching after the intermediate type so soon, if at all, in its life-history.

Moreover, a specimen (B.M. D. 7470, zoarium 1) from the *capricornus* zone of Cherrington, encrusting *Montlivaltia Victoriæ*, Duncan, shows at its first dichotomy a more marked pyriformation than the specimens of *S. antiqua*, mutation *capricornensis*, and resembles more nearly a specimen (B.M. D. 2131) of *S. dichotomoides* (d'Orbigny). Unfortunately more of the former specimen is not preserved, so it is impossible to say whether its further branches showed the characters of *S. dichotomoides* (d'Orbigny). Now the latter species, an Inferior Oolite form, is more simple in its branching than *S. antiqua*, Haime; nor is there anything to show that this simplicity of branching, which even in the distal dichotomies does not proceed beyond Type I, is not primitive. The form, then, must have had a Liassic ancestor with as simple a type of branching. Terquem & Piette's figures of *S. antiqua*, Haime, supplies a possible ancestor. This form, for which I propose the name *S. Gregoryi*, would only differ from *S. dichotomoides* (d'Orbigny) in the pre-Jurassic irregularity of branching and in the lesser pyriformation of the zoœcia. Since the former character was lost and regular branching was acquired during the Pliensbachian time by *S. antiqua*, Haime, it is quite likely that the specimen mentioned above (B.M. D. 7470, zoarium 1) represents the proximal end of a zoarium in this stage, and the form would be known, according to the system advocated, as *S. Gregoryi*, mutation *capricornensis*. The Sinemurian

[1] O. Terquem et E. Piette: loc. cit., pl. xiv, fig. 32.

and the Pliensbachian mutation are represented by Figs. 1 and 2 in Diagram I, on this page.

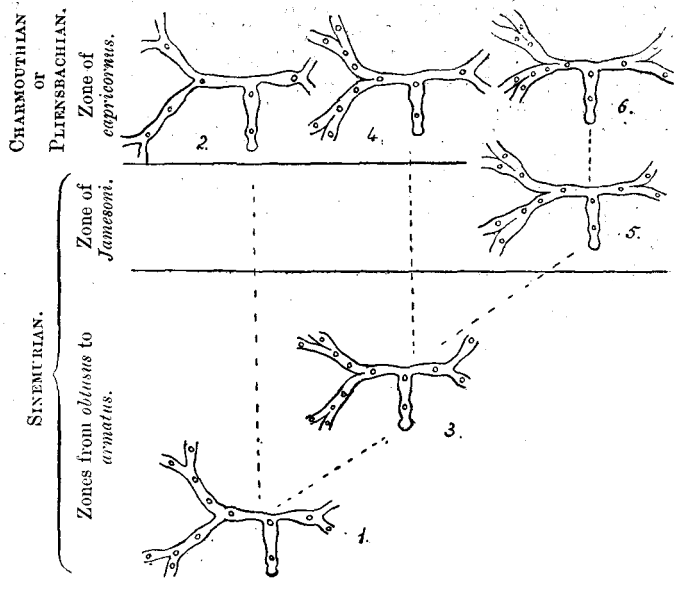


Diagram I.—To show the changes in the method of branching and in the shape of the zoœcium in *Stomatopora antiqua*, Haime, and its related forms.

Fig. 1.—*Stomatopora Gregoryi*, sp. nov.
,, 2.—*Stomatopora Gregoryi*, mut. *capricornensis*.
,, 3.—*Stomatopora antiqua*, Haime.
,, 4.—*Stomatopora antiqua*, Haime, mut. *capricornensis*.
Figs. 5 and 6.—*Stomatopora Richardsoni*, sp. nov.

Note.—A difficulty arises in the system of nomenclature advocated above, wherein the mutation of a species is named as such as if it were a variety; but with this difference, that, while a variety is named arbitrarily, just as a species, the mutation is named according to the horizon at which it occurs. The difficulty is met when the mutations of a given species pass upwards into a form already named. For suppose in the case above it could be demonstrated that *S. Gregoryi* passed upwards through its mutation *capricornensis* and other possible mutations into the Aalenian species *S. dichotomoides* (d'Orbigny), it might be asked, at what point would the one species end and the other begin. A moment's consideration would show that supposing our knowledge of the evolution of a group of organisms were absolute, we should have a number of species in various ramifying series, each merging imperceptibly backwards into its precursor and forwards into its successor. A further examination would show that the forms designated 'species' were groups of individuals taken at arbitrary points in the evolutionary series. For these points would not have been fixed upon according to any predetermined plan, as, for instance, to mark a period of comparative

stability in the evolving form. To have definitely named such evolutionary stations would have implied a complete knowledge of the evolution of the group. But as each point in the series was independently met with, so it was described and named, and its connection with other points discovered later. In the supposed case where this has been done, more than two species would occasionally be found in one unbranched series. It might be said that the names of the middle species, that is, those that lay along one branch between two bifurcations, were useless and might be discarded, or, being only mutations, might be named as such. This, however, would be a pity, for reference marks are needed along an unbroken series. Moreover, since the superfluous names are thus treated as synonyms, the question of priority is at once raised. Therefore it seems advisable in such a case to keep the intermediate names. But where, as in the species described in this paper, slight, hitherto unnamed differences occur as the form passes from zone to zone, the forms could be named as mutations, like those above, in order not unduly to multiply 'species.' The original difficulty, namely, to say where the mutations of one species end and those of another begin, could be solved conventionally by taking the first stratigraphical boundary below the higher species. And if it be objected that such a division is purely conventional, it may be answered that it is chosen no more arbitrarily than is the point in the series from which the individuals comprising a species were taken. With complete knowledge specific boundaries must be conventional. And all the difficulties in nomenclature arise from the inadequacy of the system now in use, which seeks to bind within rigid systematic limits the phases of series which are in a perpetual state of flux.

EXPLANATION OF PLATE XIV, p. 264.

FIG. 1.—D. 7539. *Stomatopora antiqua*, Haime, mut. *capricornensis*, encrusting *Montlivaltia Victoriæ*, Duncan. Middle Lias: zone of *L. capricornus*, ? Cherrington, Warwickshire. × about 12.

,, 2.—D. 7620, zoarium 2. *Stomatopora antiqua*, Haime, encrusting *Gryphæa*. Lower Lias: about *Jamesoni* zone, Fenny Compton, Warwickshire. × about 28.

,, 3.—D. 7629. *Stomatopora antiqua*, Haime, mut. *capricornensis*, encrusting *Montlivaltia Victoriæ*, Duncan. Middle Lias: zone of *L. capricornus*, Cherrington, Warwickshire. × about 9.

,, 4.—D. 7620, zoarium 4. Another zoarium on the same specimen as Fig. 2. × about 8.

,, 5.—D. 7623, zoarium 1. *Stomatopora antiqua*, Haime, encrusting *Gryphæa*. Lower Lias: about *Jamesoni* zone, Aston Magna, Worcestershire. × about 11.

,, 6.—D. 7630, zoarium 2. *Stomatopora* (?) *Richardsoni*, sp. nov., encrusting *Montlivaltia Victoriæ*, Duncan. Middle Lias: zone of *L. capricornus*, Cherrington, Warwickshire. × about 15.

,, 7.—D. 7619, zoarium 1. *Stomatopora antiqua*, Haime, encrusting *Gryphæa*. Lower Lias: about *Jamesoni* zone, Fenny Compton, Warwickshire. × about 8.

,, 8.—*Stomatopora Richardsoni*, sp. nov., on a Brachiopod. Lower Lias: about *Uptonia Jamesoni* zone, Toddington, Gloucestershire. × about 15.

,, 9.—Part of the same specimen as Fig. 8. × about 18.

,, 10.—D. 7470, zoarium 1. *Stomatopora Gregoryi*, n.sp., mut. *capricornensis*, encrusting *Montlivaltia Victoriæ*, Duncan. Middle Lias: zone of *L. capricornus*, Cherrington, Warwickshire. × about 12.