

17. *Some INFERIOR-OOLITE PECTINIDÆ.*¹ By E. TALBOT PARIS, B.Sc., F.C.S., 2nd Lieut. R.F.A., and LINSDELL RICHARDSON, F.R.S.E., F.G.S. (Read November 4th, 1914.)

[PLATES XLIV & XLV.]

DURING the course of the field-work of one of the present authors (L. R.) in connexion with the unravelling of the detailed stratigraphy of the Inferior Oolite of the district between Stonesfield, in Oxfordshire, and Burton Bradstock, in Dorset—which is now completed—a large number of lamellibranchs have been found, many *in situ*. Some of the *Gervillia* and *Pernæ* have already been dealt with by one of us (E. T. P.).²

The present paper deals with the members of the Pectinidæ that have been found during the investigations mentioned above, and these Pectinidæ are enumerated in the following list:—

ÆQUIPECTEN Fischer.

- Æ. barbatus* (J. Sowerby).
Æ. bouchardi (Oppel).
Æ. spinicostatus (G. F. Whidborne).
Æ. symmetricus (Morris).

CAMPONECTES Meek.

- C. calensis*, sp. nov.
C. cf. annulatus (J. de C. Sowerby).
C. lens (J. Sowerby).

CHLAMYS Bolten.

- Chl. articulata* (auctt.).
Chl. articulata (auctt.), var. *not-groviensis* nov.
Chl. articulata (auctt.), var. *sauzeana* nov.
Chl. ambigua (Münster).
Chl. cf. ambigua (Münster).

ENTOLIUM Meek.

- E. demissum* (J. Phillips).
E. demissum (J. Phillips), var. *inutile* Whidborne.

VARIAMUSSIUM Sacco.

- V. fenestræ* (Whidborne).
V. læviradiatum (Waagen).
V. pumilum (Lamarck).

EOPECTEN Douvillé.

- E. abjectus* auctt.
E. articulatus, sp. nov.
E. doultiingensis, sp. nov.
E. gingensis (Waagen).
E. tenuistriatus (Münster).
E. velatus (Goldfuss).

Pecten-vagans Group:

- P. cf. anomalus* Terquem & Jourdy.
P. vagans J. de C. Sowerby.

SUBGENUS ÆQUIPECTEN Fischer.

ÆQUIPECTEN BARBATUS (J. Sowerby).

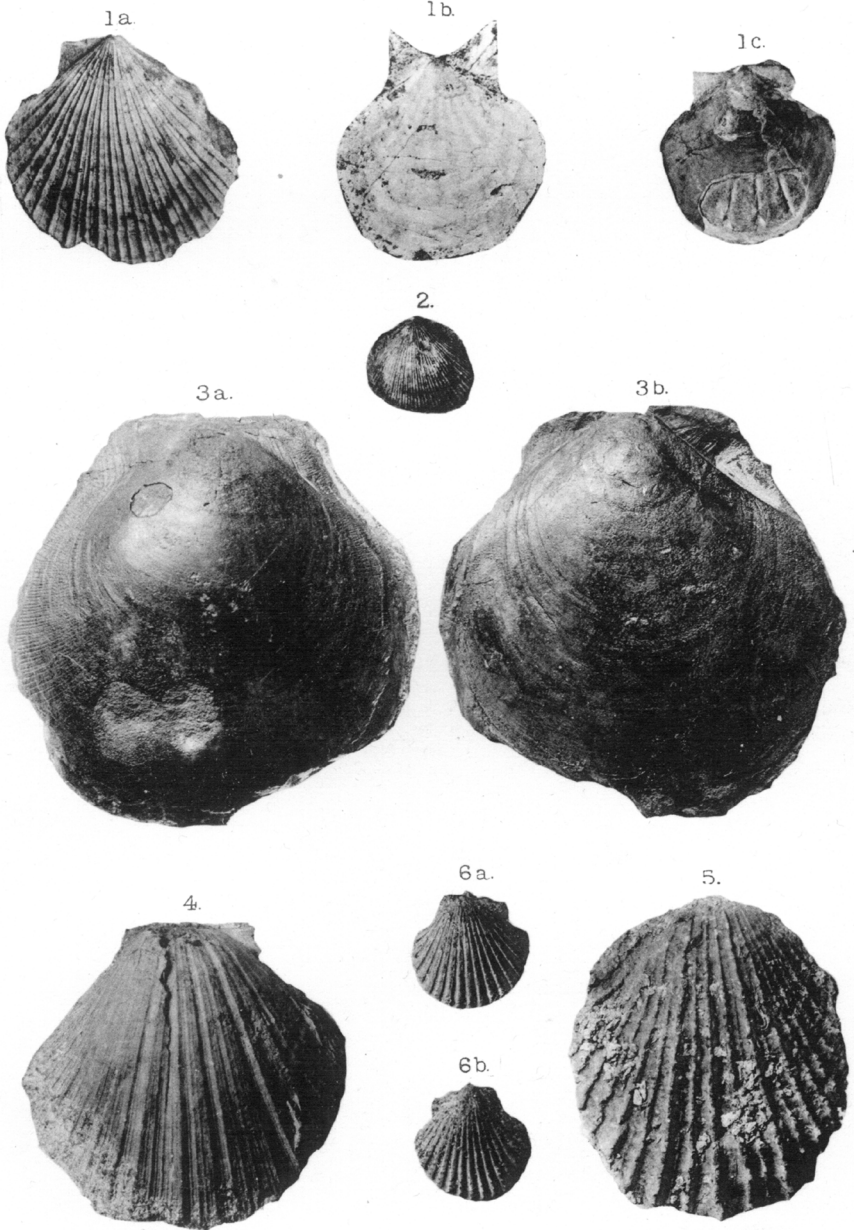
1819. 'Mineral Conchology' vol. iii. p. 53 & pl. ccxxxii.

Remarks.—Only one of the valves of this species is spinous. The type came from the Inferior Oolite of Dundry Hill, near Bristol.

There is a specimen in the Sowerby Collection at the British

¹ One of us (E. T. P.) is indebted to the Government Grant Committee of the Royal Society for assistance in figuring the specimens.

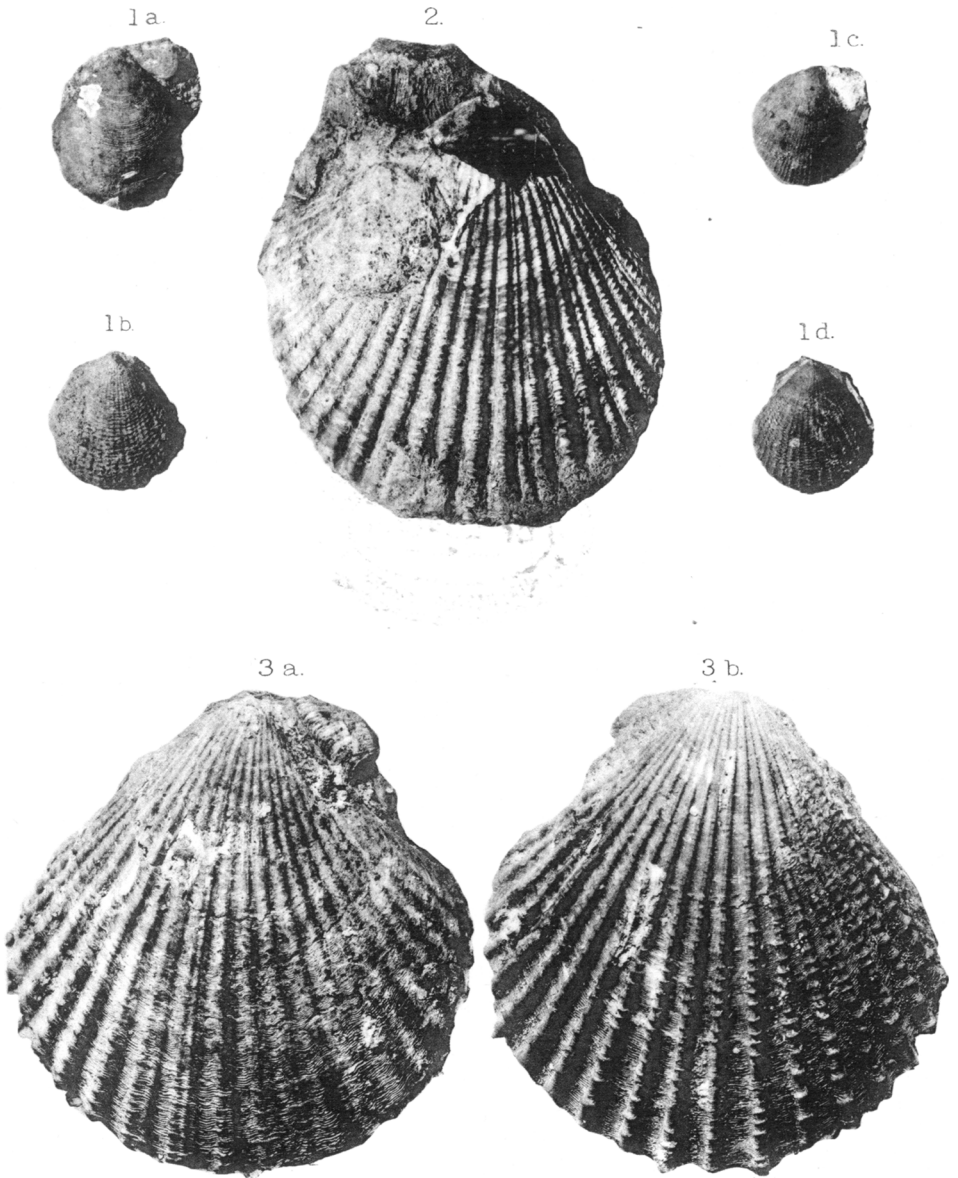
² Proc. Cotteswold Nat. F. C. vol. xvii, pt. 2 (1911) pp. 233-35 & pl. xxvii; and *ibid.* pp. 237-54 & pls. xxviii-xxix.



E.T Paris Photo.

Bemrose, Colln. Derby.

INFERIOR OOLITE PECTINIDAE.



E.T Paris Photo.

Semrose, Coll. Denby.

INFERIOR OOLITE PECTINIDAE.

Museum (Natural History), queried as coming from the Inferior Oolite of Dundry. The matrix is ironshot, and the specimen doubtless was obtained from rock of *sauzei* hemera.

Records.—*Witchellia-Shirburnia* Beds, Sunny-Hill Quarry, near Cole; *Discites* Beds (*discitæ* hemera), Sunny-Hill Quarry; Milborne-Downs Quarry, near Milborne Wick (Somerset); Baggerbush-Lane Quarry, Bradford Abbas, near Sherborne (Dorset); Barrowfield Quarry, near Beaminster (Dorset); Mythe-Hill Quarry, Mapperton, near Beaminster.

ÆQUIPECTEN BOUCHARDI (Oppel).

1857. 'Die Juraformation' p. 492.

Remarks.—This form occurs in the 'Top Beds' of the district between the Mendips and Burton Bradstock, and in particular in the *Astarte-obliqua* Bed wherever it is typically developed. It has been recorded in this country under the name of *Pecten sub-spinosus* Goldfuss. Oppel, however, separated a form that occurs in the Cornbrash of Germany from Goldfuss's species. He did not give a figure of his Cornbrash specimen, but Schlippe has figured examples; and, as those from the Inferior Oolite agree with Schlippe's figures,¹ we have relied on the latter's identification, and have made use of Oppel's specific name in preference to that of '*sub-spinosus*' Goldfuss.

Schlippe includes in the synonyms for *Pecten bouchardi* Oppel:

Pecten sub-spinosus Quenstedt non Goldfuss of

1858. Quenstedt, 'Der Jura' p. 500 & pl. lxxvii, figs. 3-4; and

1863. Lycett, 'Great Oolite Mollusca' Monogr. Pal. Soc. Suppl. p. 113 & pl. xi, fig. 14 [a specimen from the Forest Marble].

Records.—Rubbly Beds (*schlænbaehi* hemera), Doultling (Somerset); *Astarte-obliqua* Bed (*garantianæ* hemera), Limekiln Quarry, Hadspen; Cattle-Hill Quarry, Shotwell; Woolston; Rubbly Limestone Beds, section (52) near Milborne Wick (Somerset); *Astarte-obliqua* Bed, Burton-Bradstock district.

A specimen, slightly flatter than *Æquipecten bouchardi* (Oppel), with more angular ribs, was obtained from the *Scissum* Beds of Barrowfield Quarry, near Beaminster.

ÆQUIPECTEN SPINICOSTATUS (Whidborne).

1883. G. F. Whidborne (*ex* Etheridge MS.), Q. J. G. S. vol. xxxix, p. 502 & pl. xv, figs. 14-14 a.

Remarks.—The type of the species came from

'the beds above the Ironstone Oolite, belonging to the higher part of the *Humphriesianus* Zone.'

that is, from the Upper Coral-Bed (*truelleri* hemera). This species has so far only been found in the Upper Coral-Bed of Dundry Hill, near Bristol.

¹ Abhandl. Geol. Spezialkarte von Elsass-Lothringen, vol. iv, pt. 4 (1888) p. 134 & pl. ii, figs. 13 a-13 b.

AQUIPECTEN SYMMETRICUS (Morris). (Pl. XLIV, figs. 6*a* & 6*b*.)

1857. J. Morris in E. Hull's 'Geology of the Country around Cheltenham' Mem. Geol. Surv. p. 103 & pl. i, figs. 3*a*-3*c*.

Remarks.—The holotype of this species, which is in the Museum of Practical Geology, Jermyn Street (No. 8853), came from the Inferior Oolite of Andoversford, near Cheltenham. The species is very characteristic of the upper portion of the *Clypeus*-Grit of the Cotteswolds and of the Rubbly Beds of Doulting.

Records.—*Clypeus* Grit, Notgrove; Workhouse Quarry, Stroud; Winners Hill, Alderley, near Wotton-under-Edge; Rubbly Beds, Doulting, near Shepton Mallet (Somerset); Upper Coral-Bed (*truellei* hemera), Dundry Hill, near Bristol (*teste* J. W. Tutchet).

SUBGENUS *CAMPTONECTES* Meek.¹

CAMPTONECTES AALENSIS, sp. nov. (Pl. XLIV, figs. 3*a* & 3*b*.)

Type-locality.—Haresfield Beacon, near Gloucester.

Horizon.—*Scissum* Beds. Hemera *scissi*.

Collection.—L. Richardson.

Diagnosis.—A *Camptonectes* with the test of both valves, in mature specimens, destitute of ornamentation, except near the margins, where a few radiating striations can be seen. Otherwise, the species resembles *C. lens* (J. Sowerby).

Remarks.—Three definite examples of this species have been examined—two from the *Scissum* Beds of Haresfield; one from the Pea-Grit of Crickley Hill. The specimen figured (Pl. XLIV, figs. 3*a* & 3*b*) is one of those from Haresfield; the other specimen from that locality (a right valve) is only about a third of the size, and the characteristic striation is rather more prominent, extending around the whole margin of the shell.

Records.—*Scissum* Beds (*scissi* hemera), Haresfield Beacon, near Gloucester; Pea-Grit (*murchisonæ* hemera), Crickley Hill, near Cheltenham.

A fragment from the *Murchisonæ* Beds of the Marston-Road Quarry, near Sherborne, and two internal casts from the Dogger (*murchisonæ* hemera) of Glaisdale (Yorkshire), probably belong to this species.

CAMPTONECTES cf. *ANNULATUS* (J. de C. Sowerby).

1826. 'Mineral Conchology' vol. vi, p. 80 & pl. dxlii, fig. 1.

Remarks.—A specimen from the *Clypeus* Grit of the Rolling-Bank Quarry, Cleve Hill, near Cheltenham, resembles *Camptonectes annulatus* (J. de C. Sowerby) except that the concentric rings on it are closer together. The characteristic striation is not well marked.

CAMPTONECTES LENS (J. Sowerby).

1818. 'Mineral Conchology' vol. iii, p. 3 & pl. ccv, figs. 2-3.

Remarks.—The type-specimens are three left valves from the

¹ *καμπτός*, flexible, and *νήκτης*, a swimmer.

Forest Marble, near Oxford, and are in the British Museum (Natural History) [No. 43326]. Two of the specimens were figured by Sowerby. The characteristic striation on the unfigured specimen appears to be coarser than on the two others, and lacks the markedly-punctate character. This, however, is probably due to the fact that the test is more worn.

There is considerable variation in the coarseness of the ornamentation among individual specimens, even when the specimens occur at precisely the same horizon. Probably, this apparent variation is due to the state of preservation of the shell. Some of the larger specimens, showing coarse *Camptonectes*-striation, have been referred to *Pecten aratus* Waagen.¹ As Benecke has remarked,² it is doubtful whether *P. aratus* Waagen is distinct from *P. lens* (J. Sowerby). The right valve of *P. lens* is practically destitute of striations.

Probably many examples of this species have received specific distinction, on account of individual differences.

No examples of this species have been found in the Stonesfield-Burton-Bradstock district in rocks of earlier date than of the hemera *discitæ*, its precursor being apparently *Camptonectes aalensis*, sp. nov. (p. 523). It is fairly common in the Great Oolite. The *Pecten arcuatus* Sowerby of Morris & Lycett³ appears to be only the right valve of their *P. lens*.

The species has been dealt with fully by Benecke (*loc. supra cit.*).

Records.—*Clypeus* Grit, Little Rissington, near Bourton-on-the-Water⁴; Birdlip; Cowley-Wood Quarry, near Cheltenham: *Anabacia* Limestones (*schlenbachi* hemera), Douling: Upper *Trigonia* Grit (*garantianæ* hemera), Rolling-Bank Quarry, Cleeve Hill; Leckhampton Hill; Rodborough Hill, Stroud; Nibley Knoll, near Wotton-under-Edge; Horton, near Chipping Sodbury; Woolston (Somerset): Lower *Trigonia* Grit (*discitæ* hemera), Roadstone Hole, Cleeve Hill; Ravensgate; Charlton Common; Tuffley's Quarry, near Cheltenham (large specimen); Dundry Hill, near Bristol.

SUBGENUS CHLAMYS Bolten.

CHLAMYS ARTICULATA (Schlotheim) (auctt.).

1820. E. F. von Schlotheim, 'Petrefaktenkunde' p. 227.

Remarks.—The form that is usually considered to be typical of this species occurs not uncommonly in the Inferior Oolite of the Cotteswold Hills at two horizons, namely (1) in the Pea-Grit

¹ See E. W. Benecke's 'Geogn.-Pal. Beitr. vol. i: Ueber die Zone des *Ammonites sowerbyi*' 1867, p. 630 & pl. xxxi, figs. 3a-3b.

² 'Die Versteinerungen der Eisenerzformation von Deutsch-Lothringen & Luxemburg' Abhandl. Geol. Spezialkarte von Elsass-Lothringen, pt. vi (1905) p. 104.

³ 'A Monograph of the Mollusca from the Great Oolite' Palæont. Soc. pt. 2 (1853) pl. i, fig. 18.

⁴ Recorded as '*Pecten (Camptonectes) arcuatus* Sowerby' in Q. J. G. S. vol. lxiii (1907) p. 441: Little Rissington Quarries, Rubbly Beds b.

Coral-Bed (*murchisonæ* hemera), and (2) in the Upper Coral-Bed (*truellæi* hemera).

This species appears to have a considerable vertical range, and to be widely distributed. As might be expected, there is considerable individual variation, especially in the right valves of specimens—the variation lying principally in the prominence or otherwise of the ‘articulations’ of the ribs and the distance between the articulations. In some specimens the articulations on the right valve are only in evidence near the margins of the shell. Possibly they may have been denuded from the remaining part, but more probably they were never developed. In some cases the articulations on the right valve are much farther apart than on the left valve. Thus, in one specimen from the Upper Coral-Bed (*truellæi* hemera) of Rodborough Hill, near Stroud, the right valve agrees with the figure of Chapuis & Dewalque’s specimen¹ on which Opper founded his *Pecten dewalquei*,² the type of which came from near Cheltenham—probably from the Pea-Grit. *Chlamys dewalquei* (Opper) is therefore synonymous with *Chl. articulata* (auctt.).

In some of the specimens from the Pea-Grit and slightly earlier beds the ribs are more prominent, and appear—so to speak—to be laid on top of the shell. Probably it was a similar form from the Dogger that was called by Phillips ‘*Pecten virguliferus*.’³

Records.—Upper Coral-Bed (*truellæi* hemera), Rodborough Hill, Stroud; Dundry Hill, near Bristol: Upper *Trigonia*-Grit (*garantianæ* hemera), one small specimen, Brimpsfield, Glos.: ‘marl with green grains’ (*blagdeni* hemera), Milborne Wick (Somerset): (*discitæ* hemera), Limekiln Quarry, Corton Downs (Somerset): Pea-Grit (*murchisonæ* hemera), Crickley Hill: ‘Blue Bed’ (top), Bell Quarry, near Loders, near Bridport.

CHLAMYS ARTICULATA (auctt.), var. NOTGROVIENSIS nov. (Pl. XLV, fig. 2.)

Type-locality.—Cold Comfort Quarry, near Cheltenham (Gloucestershire).

Horizon.—Notgrove Freestone. Hemera *witchellæi*.

Collection.—L. Richardson.

Diagnosis.—In this variety the articulations are numerous, not prominent, and close together, so as to give the appearance of a ‘squamosè’ structure. Near the margin the articulations reassert themselves. Both valves appear to be the same in the matter of ribbing.

Remarks.—Two specimens have been obtained from the type-locality.

¹ ‘Description des Fossiles des Terrains Secondaires de la Province de Luxembourg’ 1853, pl. xxix, fig. 3.

² ‘Die Juraformation’ 1856, p. 420.

³ ‘Geology of Yorkshire—pt. 1: The Yorkshire Coast’ 1829, pl. xi, fig. 20.

CHLAMYS ARTICULATA (auctt.), var. *SAUZEANA* nov. (Pl. XLV, figs. 3 a-3 b.)

Type-locality.—Rolling-Bank Quarry, Cleeve Hill, near Cheltenham.

Horizon.—*Phillipsiana*- and *Bourquetia*-Beds. *Hemera sauzei*.

Collection.—L. Richardson.

Diagnosis.—The right valve possesses only a few 'articulations' near the margin of the shell. The left valve is well-articulated, and the ribs are prominent, few, and farther apart than in typical examples of the species.

CHLAMYS AMBIGUA (Münster).

1833. G. von Münster (in Goldfuss), 'Petrefacta Germaniæ' pt. 2, p. 46 & pl. xc, figs. 5 a-5 b.

Remarks.—This species may be distinguished from *Chlamys articulata* (auctt.) by its being somewhat more closely ribbed. The surface of the shell is ornamented with closely-set growth-lines, and the ribs do not possess the well-marked articulations which are a feature of *Chlamys articulata*. Figures of the species will also be found in Schlippe, 'Abhandl. zur geol. Spezialkarte von Elsass-Lothringen' vol. iv, pt. 4 (1888) p. 129 & pl. ii, fig. 9.

Records.—Upper Coral-Bed (*truellei* hemera), Dundry Hill (J. W. Tutcher): *Sauzei*-Beds (*sauzei* hemera), Dundry Hill, near Bristol: Lower *Trigonia* Grit (*discitæ* hemera), 'Roadstone Hole,' Cleeve Hill; Swift's Hill, near Stroud; (*discitæ* hemera), Dundry Hill: Milborne-Down Quarry, near Milborne Wick (Somerset); Bradford Abbas: (*murchisonæ* hemera), Marston-Road Quarry, near Sherborne. A closely-allied form occurs in the *Truellei*- and *Schlaenbachi*-Beds of Burton Bradstock.

SUBGENUS *ENTOLIUM* Meek.¹

It has been suggested by Mr. H. Woods² that *Entolium* should probably be united with *Syncyclonema* Meek.³ The genotype of the former is *Pecten demissus* Phillips; of the latter, *P. rigidus* Hall & Meek.

In the type-description the subgenus is defined as

'a group of thin lenticular, subequivalve, smooth or concentrically-marked shells, with short, equal, flat, obtusely angular ears, which are not defined in either valve, or on either side, by a distinct marginal byssal sinus. They differ from the typical species of *Amussium*, in having the lateral margins closed, and the valves without internal radiating costæ. This group may be distinguished by the name *Entolium* with *Pecten demissus* of Phillips (as figured by Quenstedt, in his 'Jura,' vol. i, 1858, pl. xlviii, figs. 6 & 7), as its type.'

¹ Geol. Surv. California: Geology, vol. i, Appendix B (1865) pp. 478, 479.

² 'A Monograph of the Cretaceous Lamellibranchia of England' Palæont. Soc. vol. i, pt. 4 (1902) p. 145.

³ 'Smithsonian Miscellaneous Collections' vol. vii (1864) Art. viii, p. 31.

In *Pecten demissus* and allied forms the ears are equal in size or very nearly so, and are not necessarily very small. On the other hand—according to Meek¹—one of the characteristics of *Syn-cyclonema* is its very small unequal ears (in the type-species, *Pecten rigidus* Hall & Meek, one ear is only half the size of the other).

It seems desirable, therefore, to retain *Entolium* as a subgeneric name for species allied to *Pecten demissus*.

The phylogeny of *Entolium* has been dealt with by Philippi.²

There has been some confusion in the interpretation of the subgenus *Entolium*, because A. E. Verrill³ took *Pecten demissus* (already made the subgenotype of *Entolium* by Meek) as the type of his *Protamussium*, and re-described *Entolium* with *Pecten cornutus* Quenstedt as the type-species.⁴ Verrill distinguishes his *Entolium* from *Protamussium* by the dorsal prolongation of the auricles (as shown in Quenstedt's figure of *Pecten cornutus*) and from *Amussium* by not having internal liræ. There can be little doubt, however, that Quenstedt's *Pecten cornutus* is the smooth valve of a *Variamussium*. A specimen of the smooth valve of Whidborne's *Variamussium fenestrale* from the Lower *Trigonia* Grit of the Cotteswolds agrees exactly with Quenstedt's figure. G. F. Whidborne identified the smooth valves of *Variamussium leviradiatum* with Quenstedt's *Pecten cornutus* (see p. 528).

ENTOLIUM DEMISSUM (J. Phillips).

1829. J. Phillips, 'Geology of Yorkshire' pt. 1: 'The Yorkshire Coast' p. 129 & pl. vi, fig. 5.

Remarks.—The characters that have been relied upon for distinguishing this species are its comparatively small and equal ears. In really typical specimens the height is greater than the length, and the shell has therefore a somewhat 'pyriform' appearance.

A very large number of specimens have been examined from the base of the Inferior Oolite to the base of the Oxfordian (Kellaways Rock)—the horizon of the holotype; but—except for the variety *inutile* Whidborne—it does not appear desirable to separate them.

Pecten spatulatus Römer, as figured by Quenstedt in his 'Jura' (1858) pl. lix, fig. 13, represents the form that we regard as typical *Entolium demissum* (Phillips). E. W. Benecke regards a more circular form—possibly what is here called *E. demissum*, var. *inutile* (Whidborne)—as typical *Entolium demissum*; but the more pyriform type agrees better with Phillips's original figure.

¹ Rep. U.S. Geol. Surv. of the Territories, vol. ix (1876) pp. 26–27.

² Zeitschr. Deutsch. Geol. Gesellsch. vol. lii (1900) pp. 77–82.

³ 'A Study of the Family Pectinidæ, with a Revision of the Genera & Subgenera' Trans. Connecticut Acad. vol. x, pt. 1 (1899) pp. 62 & 71.

⁴ K. A. von Zittel (Text-book of Palæontology, vol. i), following Verrill, figures *P. cornutus* Quenstedt to illustrate the subgenus *Entolium*.

Records.—It is unnecessary to enumerate in detail the places and horizons at which examples of this species have been procured: it ranges throughout the Inferior Oolite.

ENTOLIUM DEMISSUM (J. Phillips), var. **INUTILE** Whidborne.

1883. G. F. Whidborne, Q. J. G. S. vol. xxxix, p. 493 & pl. xv, fig. 15.

Remarks.—This variety has larger ears and a more circular form than the parent species. The type-specimens were obtained from the Yeovil Sands (*moorei* or *dumortieræ* hemera) at Yeovil Junction (Somerset).

Records.—*Scissum* Beds (*scissi* hemera), Haresfield Beacon, near Gloucester; *Pecten* Bed (*scissi* hemera) railway-cutting, Loders, near Bridport (very large specimen); 'Blue Bed' (*scissi* hemera), Chiselcombe Quarry, Loders Cross, near Bridport; 'Dew Bed' (*moorei* hemera), Bradford Abbas (J. W. Tutchet).

SUBGENUS VARIAMUSSIUM Sacco.¹

VARIAMUSSIUM FENESTRALE (G. F. Whidborne).

1883. Q. J. G. S. vol. xxxix, p. 500 & pl. xv, figs. 12-12 a.

Remarks.—Whidborne describes only the ribbed valve of this species. By analogy with *Variamussium læviradiatum* (Waagen), the right valve should be smooth, with prominent, pointed, dorsally-extended ears. Such a specimen has been obtained by us from the Lower *Trigonia* Grit of Cleeve Hill, near Cheltenham.

The ornamentation of the ribbed valve differs from that of *V. læviradiatum* only in having concentric markings which give to the test a reticulate appearance.

Records.—Gryphite-Grit (*shirburniæ* hemera), Leckhampton Hill; Lower *Trigonia*-Grit (*discitæ* hemera), 'Roadstone Hole,' Cleeve Hill: (*discitæ* hemera), Castle-Farm or 'West-End' Quarry, Dundry Hill; Milborne-Down Quarry, near Milborne Wick; Bradford Abbas: (*murchisonæ* hemera), Baggerbush-Lane Quarry, Bradford Abbas.

VARIAMUSSIUM LÆVIRADIATUM (Waagen). (Pl. XLIV, figs. 1 a-1 c.)

1867. W. Waagen in Benecke's 'Geogn.-Pal. Beitr.' vol. i, pl. xxxi, fig. 4.

Remarks.—This species has usually nine well-marked internal liræ. The right valve is smooth, and its ears are produced dorsally for a considerable distance beyond the umbones (Pl. XLIV, fig. 1 b). The left valve is ornamented with radiating costæ, alternating with others less prominent (Pl. XLIV, fig. 1 a).

The great dissimilarity between the right and left valves of this species appears to have caused some confusion in the matter of its identification. G. F. Whidborne (Q. J. G. S. vol. xxxix, 1883, pp. 498 & 501), while recording the ribbed valve as *Pecten læviradiatus* Waagen, deals with the smooth valve under the name

¹ See E. Philippi, Zeitschr. Deutsch. Geol. Gesellsch. vol. lii (1900) p. 110.

of *Pecten cornutus* Quenstedt, and gives an excellent figure of it (*loc. cit.* pl. xvi, fig. 1). *P. cornutus* is relatively higher than *Variamussium læviradiatum*, and comes from a much higher horizon—the Weisser Jura.

The Geological Survey¹ recorded *V. læviradiatum* from Loders railway-cutting, near Bridport (where it occurs in considerable numbers in the *Pecten* Bed—*scissi* hemera), under two names—*Pecten læviradiatus* Waagen for the ribbed valve, and *P. ? paradoxus* Goldfuss for the smooth valve. The latter species, however, has twelve internal liræ, and cannot be very different from *Pecten pumilus* Lamarck (= *P. personatus* Goldfuss, auct.).

Wherever the Brachiopod-Beds (*scissi* [early]-*opaliniformis* hemeræ) of Dorset are exposed, specimens of this *Pecten* occur in noticeable quantities. Examples also occur in the equivalent beds in the Crewkerne district, but less abundantly.

Records.—(*Witchellia-shirburniæ* hemeræ), Cole and neighbourhood, Bruton: (*murchisonæ-ancolioceras* hemeræ), Slade's Quarry, North Perrott, near Crewkerne: (*scissi* hemera), South Perrott; railway-cutting, Loders; Chiselcombe Quarry, Loders Cross, near Bridport: (*opaliniformis* hemera), South Perrott; Whaddon Hill; 'Smacombe,' Shipton George; Chideock Quarry Hill, near Bridport.

VARIAMUSSIUM PUMILUM (Lamarck).

1819. 'Animaux sans Vertèbres' vol. vi, p. 183.

Remarks.—This species has been figured by E. W. Benecke.² It has generally been recorded under the name of '*Pecten* [or *Amusium*] *personatus* Goldfuss' ('Petrefacta Germaniæ' pl. xcix, fig. 5).

The shell usually shows about eleven internal liræ. The left valve is ornamented with fine radiating costæ, and the right valve with concentric striæ and sometimes folds.

Variamussium pumilum (Lamarck) has a considerable vertical range, but is especially abundant in the neighbourhood of the junction of the Pea-Grit with the Lower Limestone and in the Notgrove Freestone of the North Cotteswolds.

Records.—Notgrove Freestone (*witchellia* hemera), North Cotteswolds: (*murchisonæ* hemera), most places in the Cotteswold Hills; Rock Pitcombe, near Cole; Louse Hill, near Sherborne; Horn Park, near Beaminster: (*murchisonæ-ancolioceras* hemeræ), Ten-Acres-Field Quarry, near South Perrott, Dorset: (*scissi*), railway-cutting, Hook Norton; Marston-Road Quarry, near Sherborne.

¹ 'The Jurassic Rocks of Britain, vol. iv—The Lower Oolitic Rocks of England (Yorkshire excepted)' Mem. Geol. Surv. 1894, p. 62.

² Abhandl. Geol. Spezialkarte von Elsass-Lothringen, pt. 5 (1905) pl. iii, figs. 20 & 21.

SUBGENUS EOPECTEN Douvillé.¹

The forms dealt with under this subgenus were, until quite recently, referred to *Hinnites*. Philippi, in 1898, pointed out the distinction between the true *Hinnites* and the forms from the Jurassic that had been assigned to that genus; but Douvillé's generic name of *Eopecten* has priority by a year over that of *Velopecten* given by Philippi. Both *Eopecten* and *Hinnites* are characterized by an irregular mode of growth consequent on a sessile habit; but, whereas in *Hinnites* the left valve is the flat one, in *Eopecten* it is the right valve that is flat.

The name '*Eopecten*' thus simply indicates a *Pecten* of the *Chlamys*-type that has adopted a sessile habit, and does not necessarily imply any close genetic relationship among the species of the subgenus. The name may, therefore, in some cases be misleading. *Eopecten articulatus*, sp. nov. (p. 531), it may be suggested, is a *Chlamys articulata* (Schlothheim) (auctt.) which has adopted a sessile habit.

EOPECTEN ABJECTUS (auctt.).

1829. *Pecten abjectus* J. Phillips, 'The Geology of Yorkshire—pt. 1: The Geology of the Yorkshire Coast' pl. ix, fig. 37.

1857. *Hinnites abjectus* J. Phillips; J. Lycett, 'The Cotteswold Hills' p. 167 & pl. v, fig. 5.

1875. *Hinnites abjectus* J. Phillips; R. Etheridge in 3rd ed. of 'The Geology of Yorkshire: pt. 1, The Geology of the Yorkshire Coast' pp. 246 & 329, pl. ix, fig. 37.

Remarks.—The specific name '*abjectus*' has for long been associated with that form of *Eopecten* which occurs commonly in the Pea-Grit of the Cotteswolds and in the Dogger of Yorkshire. The name was originally given by Phillips² to a form said to come from the Millepore Oolite, and the localities given are 'Whitwell, Westow.'³ The type is stated by Etheridge to be in the York Museum; but, unfortunately, it does not appear to have been preserved.⁴ The Millepore Oolite is probably of *discitæ* hemera,⁵ and it may be remarked that it is in a deposit of this date in the Cotteswolds that *Eopecten gingensis* (Waagen) occurs (p. 532). The most noticeable difference between *E. gingensis* (Waagen) and *E. abjectus* (auctt.) is that in the latter the primary ribbing is much more prominent. The specimen figured by Phillips appears to have had well-marked primary ribbing; but there is just the possibility that it may have been a form more nearly

¹ H. Douvillé, 'Essai de Classification Systématique des Pectinidés' Bull. Soc. Géol. France, vol. xxv (1897) p. 202: *Eopecten*=*Velopecten* of Philippi, Zeitschr. Deutsch. Geol. Gesellsch. vol. 1 (1898) p. 600.

² 'The Geology of the Yorkshire Coast,' 3rd ed. (1875) p. 246.

³ *Ibid.* p. 329.

⁴ It is not mentioned in the 'List of Figured Specimens in York Museum' Ann. Rep. Yorkshire Phil. Soc. 1891, p. 56.

⁵ Proc. Yorkshire Geol. Soc. vol. xvii (1912) p. 201.

related to *E. gingensis*. Nevertheless, in the absence of any evidence to the contrary or until the type is found, it seems best to continue to use the name '*abjectus*' for the species which occurs commonly in the Pea-Grit and the Dogger.

The species described as '*Spondylus tuberculosus*' by Goldfuss is most probably the same as *Eopecten abjectus* as here understood. Both Lycett¹ and Oppel² regarded the names as synonymous; but E. W. Benecke, in writing of *E. tuberculosus*, states that he has examined specimens of it from Cleeve Hill, near Cheltenham, and from the Dogger of Yorkshire. Obviously, Benecke's *Eopecten tuberculosus* is our *E. abjectus*. There may, however, be some local variation sufficient to distinguish Goldfuss's *E. tuberculosus*.

Eopecten abjectus is characterized by the well-marked primary ribbing of the left valve. The right valve is ornamented with uniform fine ribbing.

At certain places a form of *E. abjectus* occurs, in which the primary ribbing is not so strongly developed and the secondary ribbing is also finer. In addition, the whole shell is not so irregular. This form is dealt with under the name of *Eopecten velatus* (Goldfuss).

Records.—*Schlœnbachi* Beds, Burton Bradstock (J. W. Tutchet): *Clypeus*-Grit, Rodborough Hill, Stroud: Pea-Grit (*murchisonæ* hemera), Cleeve, Leckhampton, Crickley, and Birdlip Hills, near Cheltenham; Kimsbury Castle and the Frith Quarry, near Stroud; the Dogger, Glaisdale (Yorkshire).

EOPECTEN ARTICULATUS, sp. nov. (Pl. XLIV, fig. 5.)

Type-locality.—Crickley Hill, near Cheltenham (Gloucestershire).

Horizon.—Pea-Grit. Hemera *murchisonæ*.

Collection.—L. Richardson.

Diagnosis.—An *Eopecten*, the left valve of which is ornamented with about twenty-five strong articulate ribs. The ribs are not equally spaced, and are not all of the same size.

Remarks.—The ornamentation is similar to that of *Chlamys articulata*, auctt., which also occurs in the Pea-Grit. This suggests that *Eopecten articulatus* is simply a form of *Chlamys articulata* that has adopted a sessile habit (see p. 526).

Records.—Pea-Grit (*murchisonæ* hemera), Crickley Hill, near Cheltenham (two left valves).

EOPECTEN DOULTINGENSIS, sp. nov. (Pl. XLIV, fig. 4.)

Type-locality.—Doulting (Somerset).

Horizon.—Probably *Anabacia* Limestones. Hemera, probably *schlœnbachi*.

Collection.—L. Richardson.

¹ 'The Cotteswold Hills' 1857, p. 167.

² 'Die Juraformation' 1856, p. 420.

Diagnosis.—The left valve of this species is ornamented with fine ribbing. There are also about ten sulcations radiating from the umbo, situated at unequal intervals, and some deeper than others: these features are shown in Pl. XLIV, fig. 4.

Remarks.—*Eopecten doultiensis* is quite unlike any other *Eopecten* from the Oolites with which we are acquainted. The right valve is unknown.

Records.—Probably *Anabacia* Limestones (*schlœnbachi* hemera), Doult-
ing (Somerset).

EOPECTEN GINGENSIS (Waagen).

1867. *Hinnites gingensis* W. Waagen, 'Ueber die Zone des *Ammonites Sowerbyi*'
in Benecke's Geogn.-Pal. Beitr. vol. i, p. 629.

Remarks.—This species was founded by Waagen on Quen-
stedt's *Pecten tuberculatus gingensis*.¹ *P. (Eopecten) sarthensis*
Philippi² appears to be very similar.

Records.—*Buckmani* Grit (post-*discitæ* hemera), Charlton Common, near
Cheltenham; Lower *Trigonia* Grit (*discitæ* hemera), Swift's Hill, near Stroud;
(*discitæ* hemera) Bradford Abbas (J. W. Tutchet).

EOPECTEN VELATUS (Goldfuss).

1833-36. 'Petrefacta Germaniæ' pt. 2, pp. 45 & 94, pl. xc. figs. 2a & 2b,
also pl. cv, figs. 4a-4d.

Remarks.—In Dorset, *Eopecten abjectus* (auctt.) is represented
by *E. velatus* (Goldfuss), in which—as remarked at an earlier page
(p. 531)—the primary ribbing is not so strongly developed, and the
secondary ribbing is finer. The shell is, as a rule, less irregular
than in *E. abjectus*.

Records.—Top Beds (portion of *schlœnbachi* date), Broadwindsor, near
Beaminster: (*murchisonæ* hemera), specimen attached to the 'Dew Bed,'
Halfway House, near Sherborne; Marston-Road Quarry, near Sherborne;
(*ancolioceras* hemera), Lime Works, Misterton, near Crewkerne: 'Blue Bed'
(*scissi* hemera), Bell Quarry, Loders; railway-cutting, Loders, near Bridport.

EOPECTEN TENUISTRIATUS (Münster). (Pl. XLIV, fig. 2.)

1836. Münster in Goldfuss, 'Petrefacta Germaniæ' pt. 2, p. 94 & pl. cv, figs. 3a-
3c.

Remarks.—Whidborne recorded this species from the '*Hum-
phriesianus* Zone' of Dundry Hill, near Bristol, and the '*Parkin-
soni* Zone' of Burton Bradstock.³ One of us (L. R.) possesses a
single specimen from the Upper Coral-Bed (*truellei* hemera) of
Dundry Hill.

¹ 'Der Jura' 1858, p. 379 & pl. li, fig. 4.

² Zeitschr. Deutsch. Geol. Gesellsch. vol. I (1898) p. 602 & pl. xix, fig. 1.

³ Q. J. G. S. vol. xxxix (1883) p. 503.

PECTEN-VAGANS GROUP.

The forms dealt with under this heading belong to a group which has *Pecten vagans* J. de C. Sowerby as the principal species. It will probably be necessary to create a new subgenus for the reception of these forms, with *Pecten vagans* as the type; but it does not seem desirable to do this until the forms from the Great Oolite and the Cornbrash have been investigated, as *Pecten vagans* and allied forms are exceedingly well-represented at these horizons.

PECTEN cf. ANOMALUS Terquem & Jourdy. (Pl. XLV, figs. 1 a-1 d.)

1869. Mem. Soc. Géol. France, ser. 2, vol. ix, p. 128 & pl. xiii, figs. 18-20.

Remarks.—The specimens here compared with Terquem & Jourdy's species have been probably in the past generally recorded as *Pecten vagans*.

As will be seen from Pl. XLV, figs. 1 b & 1 d, the left valve differs from that of *Pecten vagans* J. de C. Sowerby in having a far greater number of ribs and in the finer and more regular character of the projections from those ribs.

The right valve (Pl. XLV, figs. 1 a & 1 c) differs from that of *P. vagans* in not being divided into five or six broad folds and in possessing fine ribs. These ribs are not so prominent as those of *P. anomalus* appear to be from Terquem & Jourdy's figures, and are not usually grouped into two and threes as in those authors' species. In some specimens, however, there is a rough grouping of this nature near the middle of the shell; while in others the ribbing is scarcely discernible. In this latter case they resemble the corresponding valves of *P. rushdenensis* Lycett and *P. griesbachi* Lycett,¹ which appear to be forms of the *Pecten-vagans* Group, but destitute of ribbing.

Records.—*Clypeus* Grit, Fawler, near Stonesfield; Wagborough Bush, near Bourton-on-the-Water; Rolling-Bank Quarry, Cleeve Hill, near Cheltenham; Dunley's Quarry, Cranham (Gloucestershire); and base of the Doulling Stone (*truellei* hemera), Sunny-Hill Quarry, Cole, near Bruton.

PECTEN VAGANS J. de C. Sowerby.

1826. 'Mineral Conchology' vol. vi, p. 82 & pl. dxliii, figs. 3-5.

Remarks.—The specimens recorded below agree with that depicted by Sowerby in fig. 5 (*loc. supra cit.*).

Records.—*Clypeus* Grit, Stonesfield; Fawler, near Stonesfield; Proud Grove, near Stroud; Rubby Beds, Doulling (Somerset); Upper *Trigonia* Grit (*garantianæ* hemera), Rodborough Hill, Stroud.

¹ 'Great Oolite Mollusca' Monogr. Palæont. Soc. Suppl. 1863, pp. 33 & 37.

EXPLANATION OF PLATES XLIV & XLV.

[All the figures are of about the natural size.]

PLATE XLIV.

- Figs. 1 a-1 c. *Variamussium læviradiatum* (Waagen). (See p. 528.)
 1 a=Left valve. 1 b & 1 c=Right valve: 1 c showing internal ribbing.
 Horizon: *Pecten* Bed. Hemera: *scissi*.
 Locality: Railway-cutting, Loders, near Bridport (Dorset).
- Fig. 2. *Eopecten tenuistriatus* (Münster).—Left valve. (See p. 532.)
 Horizon: Upper Coral-Bed. Hemera: *truellei*.
 Locality: Dundry Hill, near Bristol.
- Figs. 3 a & 3 b. *Camptonectes aalensis*, sp. nov. (See p. 523.)
 3 a=Left valve. 3 b=Right valve.
 Horizon: *Scissum* Beds. Hemera: *scissi*.
 Locality: Haresfield Beacon, near Gloucester.
- Fig. 4. *Eopecten doultिंगensis*, sp. nov.—Left valve. (See p. 531.)
 Horizon: Probably *Anabacia* Limestones. Hemera: Probably *schlœnbachi*.
 Locality: Doultिंग, near Shepton Mallet (Somerset).
5. *Eopecten articulatus*, sp. nov.—Left valve. (See p. 531.)
 Horizon: Pea-Grit. Hemera: *murchisonæ*.
 Locality: Crickley Hill, near Cheltenham.
- Figs. 6 a & 6 b. *Æquiptecten symmetricus* (Morris). (See p. 523.)
 6 a=Left valve. 6 b=Right valve.
 Horizon: Rubbly Beds. Hemera: *schlœnbachi*
 Locality: Doultिंग (Somerset).

PLATE XLV.

- Figs. 1 a-1 d. *Pecten* cf. *anomalus* Terquem & Jourdy. (See p. 533.)
 1 a=Right valve of specimen from the *Clypeus* Grit, Rolling Bank Quarry, Cleeve Hill, near Cheltenham.
 1 b=Left valve of specimen from the Rubbly Beds (*schlœnbachi*) of Doultिंग, near Shepton Mallet.
 1 c=Right valve of specimen from the Rubbly Beds of Doultिंग, and
 1 d=Left valve of the same specimen.
- Fig. 2. *Chlamys articulata* (auctt.), var. *notgroviensis* nov.—Left valve. (See p. 525.)
 Horizon: Notgrove Freestone. Hemera: *witchelliiæ*.
 Locality: Cold Comfort, near Cheltenham.
- Figs. 3 a & 3 b. *Chlamys articulata* (auctt.), var. *sauzeana* nov. (See p. 526.)
 Horizon: *Phillipsiana-Bourquetia* Beds. Hemera: *sauzei*.
 Locality: Rolling-Bank Quarry, Cleeve Hill, near Cheltenham.

DISCUSSION.

Mr. R. B. NEWTON, in acknowledging his interest in the Authors' paper on the Pectiniform shells from the Inferior Oolite, mentioned that the true *Pecten* as represented by the type-form of *Ostrea maxima* Linnæus, did not occur in Jurassic rocks, but that the species of the Inferior Oolite usually recognized as *Pecten* were now capable of arrangement in other genera, such as *Chlamys*,

Syncyclonema (= *Entolium*), *Camptonectes*, and *Eopecten* (= *Velopecten*). Some of these names had been accepted by the Authors, and he hoped that the Authors would continue similar studies on the remaining genera of the Pelecypoda from these rocks, as systematic work in this direction was so important in advancing our knowledge of the Jurassic Mollusca.

The AUTHORS thanked those present for the way in which they had received this second contribution, and dealt with the points raised by Mr. R. B. Newton in connexion with the use of sub-generic names.