

ART. XIII.—*On some Foraminifera and Ostracoda from Jurassic (Lower Oolite) Strata, near Geraldton, Western Australia.*

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(With Plates XXII., XXIII.).

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INTRODUCTORY REMARKS.

During an inspection of a series of fossils collected in Western Australia for the Hon. (then Mr.) A. C. Gregory, F.R.G.S., and sent by Mr. R. Daintree, F.G.S., to Professor McCoy, at the National Museum, Melbourne, I noticed that the calcareous and sandy infilling of specimens of *Cucullaea* and *Trigonia* was so friable and promising for microzoa, as to justify a careful search through the material after it had been broken down and washed. The result was very gratifying, as some entirely new Ostracoda were found; whilst the Foraminifera were represented by an interesting series of twenty-three species, some of which are also new, and those already known throw a certain light on the affinity of these beds with others containing similar mesozoic faunas elsewhere.

The only earlier record of jurassic Foraminifera which I can find is that of *Cristellaria cultrata*, Montfort sp., given by Charles Moore<sup>1</sup> in his list of West Australian fossils, but unaccompanied by any reference as to its locality. The evidence of the context in that paper respecting the localities of the mesozoic fossil collections in Moore's hands, points in favour either of the district of Shark's Bay or of Champion Bay.

As regards later mesozoic microzoa, nine species of Foraminifera and an entomostracan have been recorded from Wollumbilla,

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<sup>1</sup> Quart. Journ. Geol. Soc., vol. xxvi., 1870, p. 231.

Queensland, by Charles Moore,<sup>1</sup> who was himself uncertain as to the age of these beds, but made the suggestion that they belonged to strata between the lias and cretaceous, and showing most affinity to the Oxford clay. These Queensland beds have now been correlated with the lower cretaceous formation, as part of the Rolling Downs series.

Whilst referring to upper mesozoic Foraminifera in Australia, mention must also be made of the important and interesting series, comprising fifty-six species, discovered by the Rev. W. Howchin, F.G.S., in the material from artesian well-borings in the lower cretaceous of Central Australia.<sup>2</sup>

Our present series of Foraminifera has several species in common with Howchin's list, but they are also common to beds ranging from upper jurassic to lower cretaceous elsewhere, and other species comparable even with those of recent origin.

As regards the Ostracoda there appears to be no previous record for these fossils in Australian jurassic strata.

## DESCRIPTION OF THE FOSSILS.

### Order FORAMINIFERA.

#### Family *Lituolidae*.

#### Sub-family *Lituolinae*.

#### Genus *Haplophragmium*, Reuss.

*Haplophragmium neocomianum*, Chapman. (Pl. XXII., Fig. 1).

*H. neocomianum*, Chapman, 1894, Quart. Journ. Geol. Soc., vol. l., p. 695, pl. 34, figs. 2a, b.

*Idem*, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. xvi., p. 315, pl. xi., fig. 7.

*Remarks*.—This is a compressed, spiral, arenaceous form, having an irregular, sub-circular outline. The whorls of the test are involute, and the chambers are obscurely seen on the surface ;

<sup>1</sup> *Tom. cit.*, p. 239 ; also R. Etheridge, Junr., "A Catalogue of Australian Fossils," Cambridge, 1878, pp. 102-4.

<sup>2</sup> Trans. Roy. Soc. S.A., vol. viii., 1885, p. 79 ; vol. xvii., 1893, p. 346 ; Rep. Adelaide Meeting, A.A.A.S., 1893 (1894), pp. 362-5.

but the latter are made apparent by moistening the test. This species is a frequent concomitant of mesozoic microzoa, and has been found in the rhaetic of Somerset, and the neocomian of Dorking, England; also in the cretaceous of South Africa (author's MS.).

*Occurrence.*—One specimen of medium size, jurassic, Greenough River district, West Australia. [2121.]

Family *Textulariidae*.

Sub-family *Textulariinae*.

Genus *Textularia*, DeFrance.

*Textularia crater*, sp. nov. (Pl. XXII., Figs. 2 and 2a).

*Specific characters.*—Test very short, laterally slightly compressed, and, therefore, sub-elliptical in cross-section. Aboral end rounded. Oral surface depressed, the apertural margin limbate. The margin of the last and penultimate chambers somewhat square with the upper surface of the test. Chambers few, obscurely seen on the surface of the shell, but the textularian arrangement may be made out without much difficulty. Texture finely arenaceous. Length of test, 0.14 mm. Greatest width, 0.3 mm.

*Affinities.*—The short textularians with more or less limbate sutures and apertural margin fall into the groups of *T. trochus*, D'Orb., and *T. conica*, D'Orb.; according to their circular or sub-elliptical outline in cross-section. Our specimen naturally falls into the latter group, but may be distinguished from typical forms of *T. conica*, by its rounded basin-shaped test and strongly concave oral surface.

*Occurrence.*—One specimen; Greenough River district, West Australia. [2122.]

Sub-family *Bulimininae*.

Genus *Bulimina*, D'Orbigny.

*Bulimina gregorii*, sp. nov. (Pl. XXII., Figs. 3 and 3a).

*Specific characters.*—Test sub-rhomboidal, compressed, with rounded lateral edges. Aboral end terminated by a blunt spike.

Aperture typically bulimine. Sutures faintly marked; chambers not very numerous. Shell-texture finely arenaceous. Length, 0.22 mm., greatest width, 0.13 mm.

*Affinities.*—The form of the test and comparative fewness of the chambers remind one of *Bulimina pyrula*, D'Orb.<sup>1</sup> Our species, however, is readily distinguished from that form by the strong compression of the test. The two species *B. caudigera*, D'Orb.,<sup>2</sup> and *B. ovula*, D'Orb.,<sup>3</sup> also bear some relationship to our form, both in the compression of the test, and in having an aboral spine. The compression in our species is so marked, amounting to a concavity of the external surface, that it will be as well to regard it as a distinct form. It is worth noting that *B. pyrula*, D'Orb., occurs in certain jurassic clays in England, as recorded by Messrs. Jones and Parker ("triassic" clay of Chellaston).<sup>4</sup>

The above species is named after the of Hon. A. C. Gregory, F.R.G.S., under whose auspices the larger fossils were collected, and who gave them to Mr. Daintree.

*Occurrence.*—One specimen; jurassic, Greenough River district, West Australia. [2123.]

### Family *Lagenidae*.

#### Sub-family *Nodosariinae*.

#### Genus *Marginulina*, D'Orbigny.

### *Marginulina compressa*, D'Orbigny, (Pl. XXII., Fig. 4).

*M. compressa*, D'Orb., 1840, Mém. Soc. Géol. France, vol. iv., p. 17, pl. i., figs. 18, 19.

Reuss, 1845, Verstein. böhm. Kreidef., pt. i., p. 29, pl. xiii., fig. 33.

Chapman, 1894, Quart. Journ. Geol. Soc., vol. l., p. 709.

*Remarks.*—The genera *Marginulina* and *Vaginulina* insensibly graduate into one another, exemplified in certain forms of the

1 D'Orbigny, 1846, For. Foss. Vienne, p. 184, pl. xi., figs. 9, 10.

2 D'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 270, No. 16—, Modèle, No. 68.

3 D'Orbigny, 1839, Foram. Amér. Mérid., p. 51, pl. i., figs. 10, 11.

4 Jones, T. R., and Parker, W. K.: Quart. Journ. Geol. Soc., vol. xvi., 1860, pp. 453, 454, and 457, pl. xx., fig. 45.

present type, the marginuline species becoming vaginuline by the continued compression of the test. Our specimen seems to occupy a place midway between these genera, but since it agrees with the original figure of *Marginulina compressa* given by D'Orbigny, rather than with the flatter type, *Vaginulina legumen*, Linné sp., it may be conveniently retained in the former genus. *M. compressa* has been previously found in the neocomian pebble beds of Littleton, near Guildford, England (Chapman); the greensand of Le Mans, and the chalk of Meudon, France (D'Orbigny); the chalk of Charing, Kent, England (Jones in Morris's Catalogue); and the chalk of Bohemia (Reuss).

*Occurrence*.—One specimen; jurassic, Greenough River district, West Australia. [2124.]

***Marginulina solida*, Terquem. (Pl. XXII., Fig. 17).**

*Marginulina hybrida*, Zwingli and Kübler (non Terquem), 1870, Foraminif. Schweiz. Jura, p. 27, pl. iii., fig. 25.

*M. solida*, Terquem, 1886, Mém. Soc. Géol. France, ser. 3, vol. iv., Mém. ii., p. 24, pl. ii., figs. 34 to 43 (*cf.*, fig. 40).

*M. cf. solida*, Terquem, Wisniowski, 1890, Pamietnik wydz. matem.—przyrodn. Akad. Umiejtn. w. Krakowie, vol. xvii., p. 26, pl. viii. (i.), fig. 59.

*Remarks*.—The Australian specimen evidently belongs to this species, which, although variable, shows certain features which enable one to place it in the group with *Marginulina glabra*, D'Orb., for a central type; this particular form being altogether slenderer and more compressed than the species just mentioned.

The specimens to which references are made above came from the upper jurassic beds of Poland and Switzerland.

Comparison may also be made with the *M. pauciloculata* of Hantken,<sup>1</sup> from the eocene of Hungary, which is also a compressed few-chambered form of the type of *M. glabra*.

*Occurrence*.—One specimen; jurassic, Greenough River district, West Australia. [2125.]

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<sup>1</sup> Mitth. a. d. Jahrb. k. ungar. Geol. Anstalt, vol. iv., 1875 (1881), p. 47, pl. xiv., figs. 10a, b.

Genus *Vaginulina*, D'Orbigny.

***Vaginulina schloenbachi*, Reuss, var. *interrupta*, nov.**  
(Pl. XXII., Fig. 5).

This variety is distinct from the specific form *V. schloenbachi*<sup>1</sup> in having the long curved costae interrupted in the posterior area of each chamber. The costae themselves are also more numerous, averaging six in each series in the variety, against three in the type form. The original species came from the neocomian beds of North Germany.

*Occurrence*.—One specimen of this variety was found in the jurassic of the Greenough River district, West Australia. [2126.]

***Vaginulina lata*, Cornuel sp.** (Pl. XXII., Fig. 6.)

*Marginulina lata*, Cornuel, 1848. *Mém. Soc. Géol. France*, ser. 2, vol. iii., p. 252, pl. 1, figs. 34-7.

*Planularia pauperata*, Jones and Parker, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi., p. 454, pl. xx., fig. 39.

*Cristellaria simplex*, Terquem, 1863. *Foram. du Lias*, troisième *Mém.*, p. 203, pl. ix., fig. 15.

*Planularia pauperata*, Jones, Parker, and Brady, 1867. *Proc. Somerset Arch. and Nat. Hist. Soc.*, vol. xiii., p. 110, pl. ii., figs. 24, 25.

*Cristellaria pauperata*, (Jones and Parker) Blake, 1876. *The Yorkshire Lias*, p. 465, pl. xix., fig. 12.

*C. lata* (Cornuel), Brady, 1884. *Rep. Chall.*, vol. ix., p. 539, pl. lxvii., figs. 18*a*, *b*.

*C. lata* (Cornuel), Crick and Sherborn, 1891. *Journ. North N. H. Soc.*, vol. vi., p. 213, pl. —., fig. 32.

*Remarks*.—These compressed *quasi* cristellarian forms appear more properly to belong to the genus *Vaginulina*, as it is now understood, since the present type of shell has no distinct spiral commencement, and the test is uniformly flattened. The few-chambered, broad, compressed shells which may be referred to

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<sup>1</sup> Reuss, 1862 (1863), *Sitzungsb. d. k. Ak. Wiss. Wien.*, vol. xlv., Abth. 1, p. 46, pl. iii., figs. 6*a*, *b*.

the above species are mostly characteristic of mesozoic strata; but the species has also been recorded from recent soundings off Moncoeur Island, Bass Strait, at a depth of 38 fathoms.

Our specimen somewhat resembles a closely allied form which was found in the gault of France and England, *Vaginulina biochei*, Berthelin.<sup>1</sup> The latter form, however, is distinguished by the thickened sutures of the chambers having a tendency to become salient, especially on the inner (anti-stoloniferous) margin of the test.

*Occurrence*.—One specimen (small); jurassic, Greenough River district, W. Australia. [2127].

### *Vaginulina strigillata*, Reuss. (Plate XXII., Fig. 7).

*Vaginulina (Citharina) strigillata*, Reuss, 1846. Verstein böhm. Kreidef., pt. ii., p. 106, pl. xxiv., fig. 29.

*V. strigillata*, Reuss, Jones, and Parker, 1860. Quart. Journ. Geol. Soc., vol. xvi., pp. 453, 457, pl. xx., figs. 30-35.

*V. strigillata*, Reuss, Wisniewski, 1890. Pamiętnik wydz matem.—przyrodn. Akad. Umiejetn w. Krakowie, vol. xvii., p. 29, pl. ix. (ii.), fig. 5.

*V. strigillata*, Reuss, Chapman, 1894. Journ. R. Micr. Soc., p. 432, pl. viii., figs. 3a, b, and 4.

*Remarks*.—The striate *Vaginulinae* are of very frequent occurrence in mesozoic strata, and are fairly common throughout the whole of the jurassic and cretaceous strata.

The particular form under notice is distinguished from others closely allied by the more pronounced striations on the surface of the shell, and which bridge over the suture lines, the latter being more or less depressed.

*Occurrence*.—One specimen (fragmentary); jurassic, Greenough River district, West Australia. [2128.]

### *Vaginulina intumescens*, Reuss. (Pl. XXII., Fig. 8).

*Vaginulina intumescens*, Reuss, 1862 (1863). Sitzungsber. d. k. Ak. Wiss. Wien, vol. xlvi., Abth. 1, p. 49, pl. iv., fig. 2.

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<sup>1</sup> Mém. Soc. Géol. France, ser. 3, vol. 1, No. 5, 1880, p. 42, pl. ii., figs. 9a, b. Also Chapman, Journ. R. Micr. Soc., 1894, p. 427, pl. viii., figs. 14a, b.

*Marginulina scalprum*, Terquem, 1866. Foram. du Lias, sixième Mém., p. 509, pl. xxi., fig. 27.

*Remarks.*—This species has, typically, a sub-triangular test, strongly compressed; ornamented with fine, curved, longitudinal striae. Terquem's liassic specimen has more numerous and narrower chambers than ours.

*V. intumescens* was originally obtained from the neocomian of Germany, and it has also been recently found in the cretaceous of South Africa. (Author's MS.)

*Occurrence.*—Frequent; jurassic, Greenough River district, West Australia. [2129-31.]

Genus *Cristellaria*, Lamarck.

***Cristellaria rotulata*, Lamarck sp. (Pl. XXII., Fig. 9.)**

*Lenticulites rotulata*, Lamarck, 1804. Ann. Muséum, vol. v., p. 188, No. 3. Tab. Encycl. Méth., pl. cccclxvi., fig. 5.

*Cristellaria rotulata* (Lam.), D'Orbigny, 1840. Mém. Soc. Géol. France, ser. 1, vol. iv., p. 26, pl. ii., figs. 15-18.

*Rotulina muensteri*, Römer, 1841. Verstein. norddeusch. Kreidegeb., pt. 2, p. 98, pl. xv., fig. 30.

*Cristellaria rotulata* (Lam.), Reuss, 1846. Verstein. böhm. Kreidef., pt. 1, p. 24, pl. viii., figs. 50*a*, *b*, and 70.

*C. muensteri* (Röm.), Reuss, 1862 (1863). Sitzungsber. d. k. Ak. Wiss. Wien., vol. xlvi., Abth. 1, p. 77, pl. ix., figs. 3*a*, *b*, and 4*a*, *b*.

*C. lenticulata*, Wisniowski, 1890. Pamietnik wydz. matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xvii., p. 47, pl. ix. (ii.), figs. 24*a*, *b*.

*C. rotulata* (Lam.), Perner, 1892. Foraminifery Ceského cenomanu, p. 62, pl. iv., figs. 1-11.

*C. rotulata* (Lam.), Egger, 1899. Abhandl. K. bayer. Ak. Wiss., Cl. ii., vol. xxi., Abth. 1, p. 122, pl. xi., fig. 3.

*Remarks.*—This widely distributed and persistent type is a well-known form in jurassic deposits, but it is not nearly as common as the more ornate type with secondarily thickened sutures, exemplified by the *Cristellaria cassis* group.

*Occurrence.*—One specimen (small, but otherwise typical); jurassic, Greenough River district, West Australia. [2132].



**Cristellaria subalata**, Reuss. (Pl. XXII., Fig. 10.)

*Cristellaria subalata*, Reuss, 1854. Denkschr. k. Ak. Wiss. Wien., vol. vii., Abth. 1, p. 68, pl. xxv., fig. 13.

*Robulina megalopolitana*, Reuss, 1855. Zeitschr. d. deutsch. geol. Gesellsch., vol. vii., p. 272, pl. ix., figs. 5a, b.

*Cristellaria subalata*, Reuss, 1862 (1863). Sitzungsb. d. k. Ak. Wiss. Wien., vol. xlvi., p. 76, pl. viii., fig. 10; pl. ix., fig. 1.

*C. subalata*, Reuss, Chapman, 1896. Journ. R. Micr. Soc., p. 3, pl. 1, figs. 3a, b.

*C. subalata*, Reuss, Egger, 1899. Abhandl. k. bayer. Ak. Wiss., Cl. ii., vol. xxi., Abth. 1, p. 118, pl. xi., figs. 19, 20.

*Remarks.*—This species is also known from older tertiary strata, but is more commonly met with in the jurassic and lower cretaceous series. It has also been found recently in the cretaceous of South Africa. (Author's MS.).

*Occurrence.*—One specimen; jurassic, Greenough River district, West Australia. [2133.]

**Cristellaria prominula**, Reuss. (Pl. XXII., Figs. 11, 11a).

*Cristellaria prominula*, Reuss, 1855, Zeitschr. d. Geol. Gesellsch., vol. vii., p. 271, pl. ix., figs. 3a, b.

*C. prominula*, Reuss, Chapman, 1894, Quart. Journ. Geol. Soc., vol. 1., p. 714.

*Remarks.*—The distinctive features of this form are the prominence of the sutural lines which mark the junction of chambers, less strongly curved on the septal face than in the nearly allied *C. subalata*; and the greater height of the chambers when compared with the species just mentioned. *C. prominula* has been recorded from the lower and upper cretaceous of Europe.

*Occurrence.*—One specimen (small); jurassic, Greenough River district, West Australia. [2134].

**Cristellaria decipiens**, Wisniowski. (Pl. XXII., Fig. 12.)

*Cristellaria decipiens*, Wisniowski, 1890. Pamiętnik wydz. matem.—przyrodn. Akad. Umiejętn. w. Krakowie, vol. xii., p. 42, pl. x. (iii.), figs. 5a, b, and 11a, b.

*Remarks.*—This ornate cristellarian belongs to the group of which *C. cassis*, Fichtel and Moll. sp., forms a central type.

The original specimens figured by Wisniowski, came from the upper jurassic (*Am. ornatus* beds) of Poland.

*Occurrence.*—One specimen; jurassic, Geenough River district, West Australia. [2135].

***Cristellaria daintreei*, sp. nov. (Pl. XXII., Fig. 13.**

*Specific characters.*—Test ovate-elongate, compressed, nine chambers visible, those forming the spiral portion sparsely granulate to tuberculate. The sutural depressions of the last three chambers bridged over by about seven short longitudinal costæ. The last chamber is somewhat inflated. Length 0.46 mm.; greatest width 0.2 mm.

*Affinities.*—The nearest analogue to this species is *C. gemmata*, Brady<sup>1</sup>. Both forms have a compressed test, but the ornamentation of *C. daintreei* differs essentially in the semi-costate surface markings of the last few chambers.

In the character of the ornament *C. daintreei* also resembles some extreme forms of *C. fragraria*, Gümbel sp. (= *C. wetherelli*, Jones sp.)<sup>2</sup> in which the test is strongly compressed, and the later chambers costate.

The present species is named in honour of the late Mr. Richard Daintree, F.G.S., who presented the larger fossils to the National Museum.

*Occurrence.*—One specimen; jurassic, Greenough River district, West Australia. [2136].

***Cristellaria costata*, Fichtel and Moll. sp., var.  
*compressa*, nov. (Pl. XXII., Fig. 14).**

Ref. to type-form.—

*Nautilus costatus*, Fichtel and Moll., 1798, Test. Micr., p. 47, pl. iv., figs. *g*, *h*, and *i*.

*Remarks.*—The present variety, *compressa*, is a strongly compressed form. The spiral commencement is not well developed,

1. Rep. Chall., vol. ix., 1884, p. 554, pl. lxxi., fig. 6, 7.

2 Abhandl.-k. bayer. Ak. Wiss., m. p.h. Cl., vol. x., p. 635, pl. i., figs. 58a-c.

and in this, as in other features, such as the broad curvature of the septa, it closely approaches the vaginuline style of test. The longitudinal costae are fairly well developed, but are somewhat interrupted near the sutural depressions. Length of specimen 0.4 mm. ; greatest width 0.3 mm.

*Occurrence.*—One specimen ; jurassic, Greenough River district, West Australia. [2137].

**Cristellaria costata**, F. and M. sp., var. **seminuda**, nov.  
(Pl. XXII., Fig. 15).

*Remarks.*—This variety differs from the type in the interruption of the longitudinal costae on the central area of each chamber. The test is also more elongate, with fewer chambers, and is less inrolled than the type-form. The peripheral margin is bordered by a narrow keel.

Length of test, 0.38 mm.; width, 0.22 mm.

*Occurrence.*—One specimen ; jurassic, Greenough River district, West Australia. [2138.]

**Cristellaria cf. limata**, Schwager. (Pl. XXII., Fig. 16).

*Cristellaria limata*, Schwager, 1868. Benecke's Geog. Pal. Beiträge, vol. i., p. 657, pl. xxxiv.

*C. limata*, Schwager, Wisniowski, 1890, Pamiętnik wydz. matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xvii., p. 34, pl. ix. (ii.), fig. 19.

*Remarks.*—The group of *C. crepidula*, Fichtel and Moll. sp., comprises many varieties or so-called species, but out of all the well-known examples figured none can be quoted as exactly matching the West Australian specimens. The nearest allied form is that figured by Schwager from the Ammonites (*Sonninia*) *sowerbyi* zone (middle brown jura, lower oolite) of Germany ; and by Wisniowski from the Ammonites (*Cosmoceras*) *ornatus* zone (Middle Oolite) of Poland. The well-rounded outline of the back of the test seen in our specimens is also exemplified in *C. limata*, but the latter form is not so strongly compressed on the sides. Another form which may be noticed is *C. opercula*, Crick and Sherborn, from the upper lias of Moulton, Northampton,

England,<sup>1</sup> which is also comparatively thin and compressed; C. opercula differs, however, from the above form in the relative paucity of the chambers, and the more circular form of the test.

*Occurrence.*—Somewhat frequent; jurassic, Greenough River district, West Australia. [2139-41].

Genus *Flabellina* D'Orbigny.

*Flabellina dilatata*, Wisniowski. Pl. XXII., Fig. 18).

*Flabellina dilatata*, Wisniowski, 1890, Pamiętnik wydz. matem.—przyrodn. Akad. Umiejętn. w. Krakowie, vol. xvii., p. 50, pl. x. (iii.), 21.

*Remarks.*—This species reminds one of the *F. rugosa*,<sup>2</sup> from the Chalk of France, England and Bohemia, but it has the sutures practically flush with the surface of the test, whereas in *F. rugosa* they are salient.

Terquem's *F. semi-involuta*<sup>3</sup> is a similar form of shell, but it is not so roundly ovate, and the chevron-shaped segments of the later portion tend to overlap one another on the periphery. This species came from the jurassic (fuller's earth) series of Warsaw, Poland. *F. dilatata* was obtained from the "ornatus" beds of Poland.

*Occurrence.*—One specimen; jurassic, Greenough River district, West Australia. [2142].

Sub-family *Polymorphininae*.

Genus *Polymorphina*, D'Orbigny.

*Polymorphina burdigalensis*, D'Orbigny. (Pl. XXII., Fig. 19).

*Polymorphina burdigalensis*, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 265, No. 2; Modèle No. 29.

*P. burdigalensis*, D'Orbigny, Brady, Parker, and Jones, 1870. Trans. Linn. Soc. Lond., vol. xxvii., p. 224, pl. xxxix., figs. 9a, b.

*Remarks.*—This species is distinguished by its compressed form, which, on one side at least, is decidedly concave; in this

1 Journ. Northamptonshire Nat. Hist. Soc., vol. vii., 1892, p. 71, pl. ii., figs. 23, 24.

2 Mém. Soc. Géol. France, 1840, sér. 1 vol. iv., p. 23, pl. ii., figs. 4, 5 and 7.

3 *Idid.*, 1886, sér. 3, vol. iv., Mém. ii., p. 45, pl. iv., figs. 40-44.

latter respect it is separable from *P. compressa*, D'Orbigny. The chambers are somewhat regularly alternate. D'Orbigny's specimen came most probably from the middle tertiary near Bordeaux. It is already known as a jurassic species, having been recorded from the English Lias by Tate and Blake.

*Occurrence*.—One specimen; jurassic, Greenough River district, West Australia. [2143].

***Polymorphina gutta*, D'Orbigny. (Pl. XXII., Fig. 20).**

*Polymorphina (Pyrulina) gutta*, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 267, No. 28, pl. xii., figs. 5, 6; Modèle No. 30.

*P. gutta*, D'Orbigny, Jones, Parker, and Brady, 1866. Monogr. Crag. Foram., pl. 1, figs. 46, 47.

*P. gutta*, D'Orbigny, Chapman, 1894. Quart. Journ. Geol. Soc., vol. 1., p. 715.

*Id.*, 1896. Journ. Roy. Micr. Soc., p. 10, pl. ii., fig. 7.

*Remarks*.—This is a well-known neocomian and gault species, and it has also occurred in various tertiary strata.

*Occurrence*.—One specimen; jurassic, Greenough River district, West Australia. [2144.]

***Polymorphina compressa*, D'Orbigny. (Pl. XXII., Figs. 21, 22).**

*Polymorphina compressa*, D'Orbigny, 1846. Foram. Foss. Vienne, p. 233, pl. xii., figs. 32-4.

*Remarks*.—The Australian specimens are not quite typical, since they are much broader than D'Orbigny's examples, and are sub-rhombic in outline; but the form is a very variable one, and it is perhaps better to refer it to this species rather than to regard it as a distinct form. In the prominence of the primordial chamber in at least one of our specimens it resembles *P. bucculenta*, Berthelin,<sup>1</sup> from the Gault of France; it also shows a paucity of chambers and a similar arrangement as in that species, but the segments are not quite so strongly inflated.

*P. compressa* is well distributed throughout the fossiliferous deposits commencing with the lias, and it is interesting to note that Parker and Jones record it from the oolite series of England.

1 Mém. Soc. Géol. France, ser. 3, vol. 1, 1880, p. 58, pl. iv. (xxvii.), figs. 16a-17b.

*Occurrence.*—Rare; jurassic, Greenough River district, West Australia. [2145-6].

Family *Rotaliidae*.

Sub-family *Rotaliinae*.

Genus *Discorbina*, Parker and Jones.

*Discorbina rosacea*, D'Orbigny sp. (Pl. XXII., Figs, 23, 23a, b).

*Rotalia rosacea*, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 273, No. 15; Modèle No. 39.

*Discorbina rosacea*, D'Orbigny sp., Brady, 1884. Rep. Chall., vol. ix., p. 644, pl. lxxxvii., figs. 1, 4.

*D. rosacea*, D'Orbigny sp., Chapman, 1894. Quart. Journ. Geol. Soc., vol. l., p. 719.

*Remarks.*—The occurrence of the above minute species is interesting as extending its range in time. It was previously recorded from the neocomian of England, besides being well-known as a tertiary fossil.

*Occurrence.*—One specimen; jurassic, Greenough River district, West Australia. [2147].

Genus *Truncatulina*, D'Orbigny.

*Truncatulina wuellerstorfi*, Schwager sp. (Pl. XXII., Figs. 24, 24a, b).

*Anomalina wuellerstorfi*, Schwager, 1866. Novara Exped., Geol. Theil, vol. ii., p. 258, pl. vii., figs. 105, 107.

*Truncatulina wuellerstorfi*, Schwager sp., Brady, 1884. Rep. Chall., vol. ix., p. 662, pl. xciii., figs. 8, 9.

*T. wuellerstorfi*, Schwager sp., Chapman, 1894. Quart. Journ. Geol. Soc., vol. l., p. 722.

*Id.*, 1898, Journ. R. Micr. Soc., p. 3, pl. 1, figs. 3a-c.

*Remarks.*—This is another species which now has its range in time extended, since it was previously known only from the English neocomian of Surrey and the gault of Kent, as regards mesozoic strata. It is also a tertiary fossil. The example before us shows all the characters of the species, and especially

the tendency of the chambers to overlay one another at the sutural lines, whereas in *T. lobatula* the separate chambers are more inflated.

*Occurrence*.—One specimen; jurassic, Greenough River district, West Australia. [2148.]

### Super-order OSTRACODA.

[All the following genera belong to the Family *Cytheridae*.]

#### Genus *Cythere*, Müller.

#### *Cythere drupacea*, Jones, var. *fortior*, var. nov.

(Plate XXIII., Figs. 3, 3a, 3b.)

*Remarks*.—The type species was described by Professor Rupert Jones<sup>1</sup> from the boring at Richmond, Surrey, England, at a depth of 1205 feet, in a stratum of calcareous marl referred by Professor Judd to the great oolite. It was also found in the Bargate beds (neocomian, with possibly older, derived, fossils) of Guildford, Surrey.

*Description*.—The present variety, although closely approximating to the type species in general shape, differs in the modified ornament of the valves which, instead of consisting of a series of concentric wrinkles as in the type form, has a concentric series of pittings, which pass from the nearly circular in the median area to linear and parallel excavations nearer the margins, especially near the ventral and posterior borders. In our specimen the anterior flange is corrugated by a few divergent and flattened ridges. The ventral aspect of the carapace is roundly ovate and tumid in the posterior third. The end view is cordate. Length of specimen figured, 0.62 mm.; greatest height, 0.36 mm.; thickness of carapace, 0.36 mm. The valves were invariably found united.

*Occurrence*.—Rare; jurassic, Greenough River district, West Australia. [2149].

#### *Cythere lobulata*, sp. nov. (Pl. XXIII., Figs. 4, 4a, 4b.)

*Specific characters*.—Valves, seen from the side, sub-quadrate, narrowing towards the posterior extremity. Highest in the

<sup>1</sup> Quart. Journ. Geol. Soc., vol. xl., 1884, p. 772, pl. xxxiv., fig. 30.

anterior third. Anterior margin rounded on the ventral angle; obliquely rounded dorsally, having a marginal flange which is feebly corrugated. Carapace thickening towards the posterior extremity and becoming steep in front of the sub-acute posterior area. Surface swollen and somewhat lumpy, with indications of shallow pittings. Hingement showing the characteristic thin ridge, which fits into the furrow of the opposite (right) valve; tooth and fossa obscure. Length of valves, 0.6 mm.; greatest height, 0.3 mm.; thickness of carapace, 0.26 mm.

*Affinities.*—At first sight the shape of the species reminds one of *Cytheridea trapezoidalis*, Terquem,<sup>1</sup> but the form of hinge in the latter species is clearly that of a *Cytheridea*. *Cythere harrisiana*, Jones,<sup>2</sup> of the English cretaceous, also bears a general resemblance to our form in its outline, but the tumid portion of the posterior region in the latter is more oblique.

*Occurrence.*—One example (represented by a left valve); jurassic, Greenough River district, West Australia. [2150.]

***Cythere corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. (Pl. XXIII., Figs. 5, 5a, 5b.)**

*Descriptive remarks.*—The above variety is distinguished from the type form,<sup>3</sup> which was found in the fuller's earth oolite of Midford, near Bath, England, essentially in its more elongate carapace, and coarser and fewer pittings. The anterior flange-like margin is corrugated in this variety, and the posterior flange is striate.

*Measurements.*—Length of valve, 0.7 mm.; greatest height, 0.32 mm.; thickness of carapace, 0.32 mm.

*Occurrence.*—Fairly common; jurassic, Greenough River district, West Australia. [2151.]

Genus *Loxoconcha*, G. O. Sars.

***Loxoconcha elongata*, sp. nov. (Pl. XXIII., Figs. 2, 2a, 2b).**

*Specific characters.*—Carapace, as seen from the side, elongate, ovate, flexuous in outline; with a sharply rounded, antero-ventral

1 Mém. Soc. Géol. France, sér. 3, vol. iv., 1885, p. 31, pl. iv., figs. 20a-c.

2 See Jones and Hinde, Suppl. Mon. Cret. Entom. (Pal. Soc.), 1890, p. 16, pl. i., figs. 47-52.

3 Jones and Sherborn, Proc. Bath. Nat. Hist. and Antiq. F. Club, vol. vi., 1888, No. 3, p. 254, pl. ii., figs. 12a-c.



angle, and an obliquely rounded antero-dorsal. A thick flange runs round the front margin, especially developed towards the ventral angle; a similar one is seen on the sub-acute posterior extremity. Highest in the anterior third. Edge view of carapace ovate, tumid. Valve edges closely adpressed but not overlapping. End view sub-cordate. Surface of valves perfectly smooth. A group of ovoid muscle spots closely arranged around a ringlike centre is seen in the middle of each valve.

*Measurements.*—Length, 0.7 mm.; greatest height, 0.35 mm.; thickness of carapace, 0.34 mm.

*Remarks.*—Most of the known species described under this genus are recent forms, but Dr. G. S. Brady remarks<sup>1</sup> that, “many fossil species described by authors under various generic terms—Cythere, Cytherina, Bairdia, etc.—belong by rights to *Loxoconcha*.”

The specimen figured here is probably a female, having regard to the comparative tumidity of the carapace, and its well-rounded angles.

*Occurrence.*—Rare; jurassic, Greenough River district, West Australia. [2152.]

### *Loxoconcha jurassica*, sp. nov. (Pl. XXIII., Figs. 6, 6a 6b).

*Specific characters.*—Valves seen from the side, sub-rectangular; hinge-line slightly concave. Ends lipped and well rounded, the antero-dorsal angle obliquely curved. Surface of valve rising towards the postero-ventral, and forming a protuberance in that region. Edge-view depressed-ovate. End view sub-cordate. Surface of carapace ornamented with a few interrupted striae parallel with the ventral margin.

*Measurements.*—Length of valve, 0.43 mm.; greatest height, 0.21 mm.; thickness of carapace, 0.21 mm.

*Affinities.*—This species has the same general features as G. S. Brady's *L. variolata*,<sup>2</sup> although it differs from it considerably in certain respects, such as the linear arrangement of the surface pittings. Brady's species is found fossil in tertiary strata, and

1 Rep. Chall. Zool., 1880, vol. i., pt. iii., p. 116.

2 Trans. Zool. Soc., vol. x., pt. 8, 1878, p. 400, pl. lxviii., figs. 4a-d; Rep. Chall. Zool., tom. sup. cit., p. 121, pl. xxix., figs. 6a-d.

it is also living at the present day, being recorded off Booby Island, in 6 to 8 fathoms.

*Occurrence.*—One carapace found; jurassic, Greenough River district, West Australia. [2153.]

Genus *Paradoxorhyncha*, gen. nov.

*Generic characters.*<sup>1</sup>—Carapace seen from the side sub-quadrate; dorsal and ventral lines with a slight convexity. Ventral border with a notch at the antero-ventral angle, in front of which is a beak similar to that in *Cypridea*. Posterior extremity produced into a beak-like process as in *Cytherura*. Right valve larger, overlapping the left. Habitat, most probably marine.

*Remarks on the genus.*—This striking form seems to combine certain characteristics of the genera *Cypridea* (a freshwater and estuarine genus) with *Cytherura* and *Cytheropteron* (marine forms). All the genera named have the two valves unequal, but whereas in *Cypridea* the left valve is the larger, in *Paradoxorhyncha* it is the right valve which overlaps; in this respect it agrees with the arrangement found in *Cytherura* and *Cytheropteron*. In the salient, almost wing-like, extension of the postero-ventral angle, *Paradoxorhyncha* further agrees with *Cytheropteron*, and the real relationship of the new genus probably lies nearer the last-named genus.

*Paradoxorhyncha foveolata*, gen. et sp. nov.

(Plate XXIII., Figs. 1, 1a, 1b).

*Specific characters.*—In addition to the above features, presumably generic, the following may be added. Carapace thickest at the posterior third. Seen from the side, the anterior margin is obliquely rounded at the angles, making the anterior extremity narrow; flanged on the extreme border. Surface of valve steep towards the ventral border, gently sloping away to the dorsal margin. Ornamented with somewhat closely set areolae or polygonal pittings, four, five or six-sided. Edge view of valve sub-rhomboidal, tumid. End view depressed cordate.

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<sup>1</sup> Since these are founded on a single specimen they must be regarded only as provisional, pending the discovery of further specimens.

*Measurements.*—Length of valve, 0.67 mm.; height, 0.5 mm.; thickness of carapace, about 0.46 mm.

*Occurrence.*—One valve; jurassic, Greenough River district, West Australia. [2154.]

Genus *Cytheropteron*, G. O. Sars.

***Cytheropteron australiense*, sp. nov.** (Plate XXIII., Figs. 7, 7a, 7b).

*Specific characters.*—Valves elongate-ovate, surface rising from the depressed dorsal area to a swollen or even ridge-like prominence along the ventral border; the summit of the ridge is in the middle of the ventral line, and its edge slopes away in a bold curve towards the antero- and postero-dorsal margin. Both extremities of valve rounded and depressed. Surface of valve marked with faint concentric striae, formed of interrupted pittings running parallel with the edge of the ventral prominence, and curving round to enclose the central area. Indications of the muscle attachments are seen as a cluster of five minute ovoid depressions, almost in the position of the median sulcus, which is often present in this genus.

*Measurements.*—Length of valve, 0.57 mm.; greatest height, 0.3 mm.; thickness of carapace, 0.3 mm.

*Affinities.*—The nearest allied form to the above species seems to be *Cytheropteron concentricum*, Reuss sp., and especially its variety *virginia*, Jones.<sup>1</sup> *C. australiense* differs from these mainly in the squarer form of the valve as seen from the side, the more ridge-like ventral prominence, and the rhomboidal edge-view of the carapace. It is, however, closely allied to Professor Jones's variety above referred to, and further specimens from Australia may show a still nearer relationship. It is worth noting in connection with the age of the above form and its allies, that the variety *virginia* had its range extended into the neocomian by the present author's discovery of the rich microzoic fauna of the Bargate beds in Surrey.

*Occurrence.*—A specimen with united valves; jurassic, Greenough River district, West Australia. [2155.]

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<sup>1</sup> See Jones and Hinde, Suppl. Mon. Cret. Entom. (Pal. Soc.), 1890, p. 32, pl. i., figs. 14-17.

## GENERAL SUMMARY.

The present series of Foraminifera very closely resembles, as a whole, that usually obtained from the oolite formation in Europe. The family of the Lituolidae is here represented by a single species of the genus *Haplophragmium*, of a form especially typical of mesozoic strata. The family of the Textulariidae is represented by a new species each of *Textularia* and *Bulimina*, both of which are, more or less, allied to types which have a wide range in time. The family Lagenidae contains the largest number of species, the nodosarines, comprising four genera—*Marginulina*, *Vaginulina*, *Cristellaria*, and *Flabellina*,—to which fifteen species and varieties are referred, four of which are new; these have altogether a strong oolite aspect. The polymorphines have three species, belonging to the genus *Polymorphina*, and have a generally unrestricted range both in time and space. The remaining two species belong to the family of the Rotaliidae, and represent the genera *Discorbina* and *Truncatulina*; these have also a wide distribution.

Of the Ostracoda there are seven species and varieties, all of which are apparently new. They are comprised within the genera *Cythere*, *Loxoconcha*, *Cytheropteron*, and *Paradoxorhyncha*, and are all members of the Family Cytheridae. The new genus *Paradoxorhyncha* is a peculiar form, in which the carapace resembles *Cypridea* in certain features, but is, on the whole, possibly allied more nearly to *Cytheropteron* and *Cytherura*. Two of the new varieties are referred to specific types which are essentially mesozoic. The remainder are new forms.

## EXPLANATION OF PLATES XXII., XXIII.

## PLATE XXII.

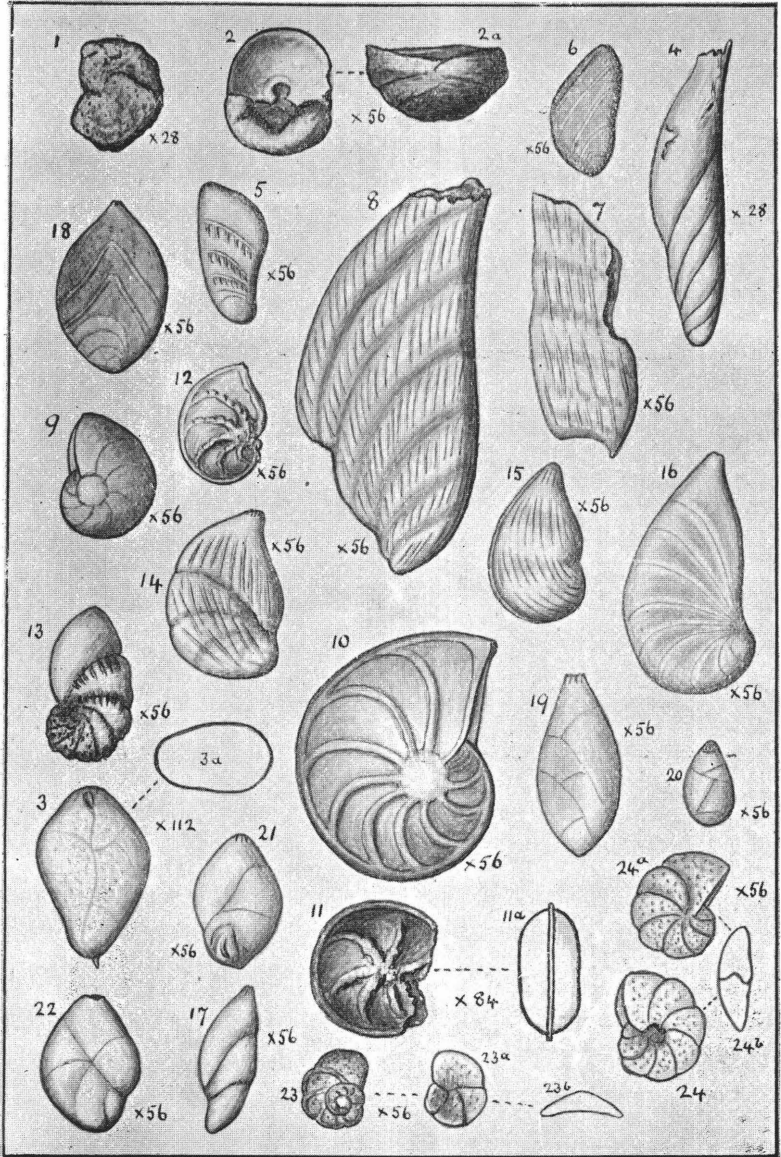
- Fig. 1.—*Haplophragmium neocomianum*, Chapman. Lateral aspect.  $\times 1$ .  
 ,, 2.—*Textularia crater*, sp. nov. Oral aspect.  $\times 56$ .  
 ,, 2a.— ,, ,, Lateral aspect.  $\times 56$ .  
 ,, 3.—*Bulimina gregorii*, sp. nov. Lateral aspect.  $\times 112$ .

- Fig. 3a.—*Bulimina gregorii*, sp. nov. Outline in cross-section.  
× 112.
- „ 4.—*Marginulina compressa*, D'Orbigny. Lateral aspect.  
× 28.
- „ 5.—*Vaginulina schloenbachi*, Reuss. Var. *interrupta*, nov.  
× 56.
- „ 6.—*V. lata*, Cornuel, sp. Lateral aspect. × 56.
- „ 7.—*V. strigillata*, Reuss. „ „ (fragmentary).  
× 56.
- „ 8.—*V. intumescens*, Reuss. „ „ × 56.
- „ 9.—*Cristellaria rotulata*, Lamarck sp. Lateral aspect.  
× 56.
- „ 10.—*C. subalata*, Reuss. Lateral aspect. × 56.
- „ 11.—*C. prominula*, Reuss. „ „ × 84.
- „ 11a.— „ „ Peripheral aspect. × 84.
- „ 12.—*C. decipiens*, Wisniowski. Lateral aspect. × 56.
- „ 13.—*C. daintreei*, sp. nov. Lateral aspect. × 56.
- „ 14.—*C. costata*, F. and M. sp., var. *compressa*, nov. Lateral  
aspect. × 56.
- „ 15.—*C. costata*, F. and M. sp., var. *seminuda*, nov. Lateral  
aspect. × 56.
- „ 16.—*C. cf. limata*, Schwager. Lateral aspect. × 56.
- „ 17.—*Marginulina solida*, Terquem. Lateral aspect. × 55.
- „ 18.—*Flabellina dilatata*, Wisniowski. „ „ × 56.
- „ 19.—*Polymorphina burdigalensis*, D'Orbigny. Lateral as-  
pect. × 56.
- „ 20.—*P. gutta*, D'Orbigny. Lateral aspect. × 56.
- „ 21, 22.—*P. compressa*, D'Orbigny. Lateral aspects. × 56.
- „ 23.—*Discorbina rosacea*, D'Orbigny sp. Superior aspect.  
× 56.
- „ 23a.—*Discorbina rosacea*, D'Orbigny sp. Inferior aspect.  
× 56.
- „ 23b.—*Discorbina rosacea*, D'Orbigny sp. Peripheral aspect.  
× 56.
- „ 24.—*Truncatulina wuellerstorfi*, Schwager sp. Superior  
aspect. × 56.
- „ 24a.—*Truncatulina wuellerstorfi*, Schwager sp. Inferior  
aspect. × 56.
- „ 24b.—*Truncatulina wuellerstorfi*, Schwager sp. Oral aspect.  
× 56.

PLATE XXIII.

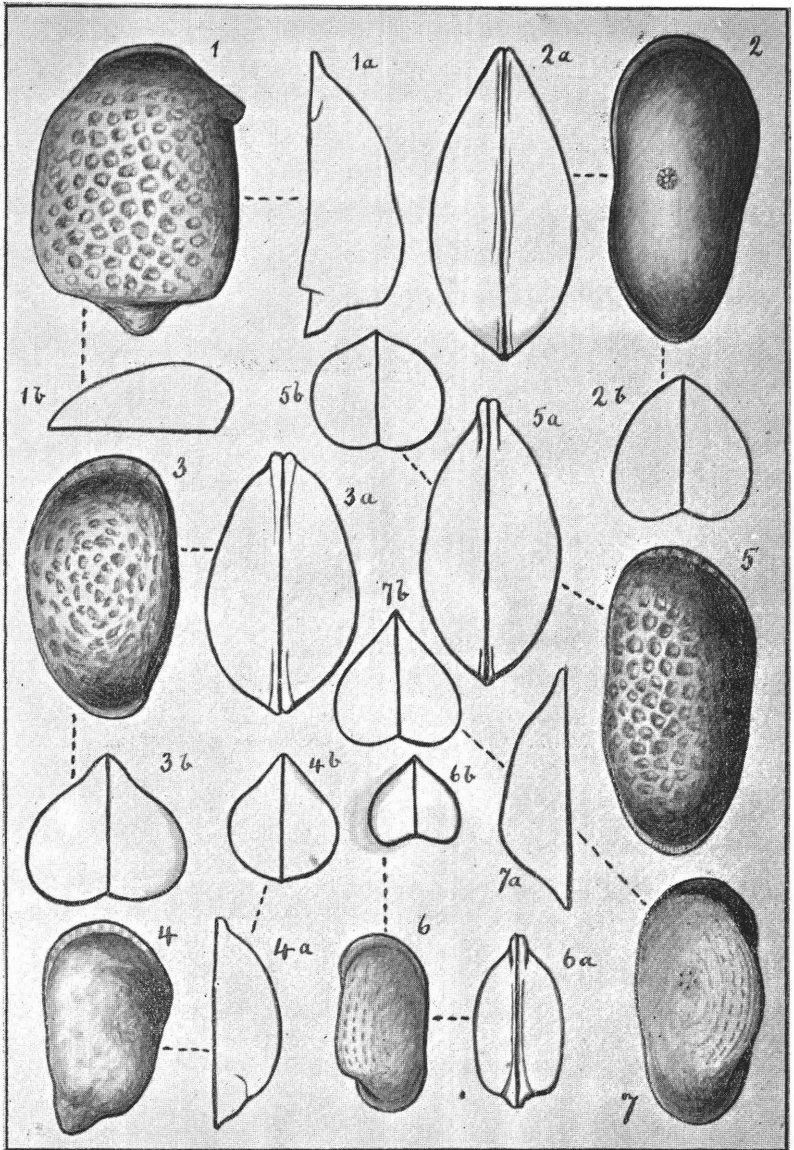
(All figures on this plate magnified 56 diameters).

- Fig. 1.—*Paradoxorhyncha foveolata*, sp. nov. Right valve. lateral aspect.
- „ 1a.—*Paradoxorhyncha foveolata*, sp. nov. Edge view, ventral aspect.
- „ 1b.—*Paradoxorhyncha foveolata*, sp. nov. End view.
- „ 2.—*Loxoconcha elongata*, sp. nov. Left valve, lateral aspect.
- „ 2a.— „ „ „ Edge view of carapace.
- „ 2b.— „ „ „ End view.
- „ 3.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. Carapace from right side.
- „ 3a.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. Edge view of carapace.
- „ 3b.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. End view.
- „ 4.—*C. lobulata*, sp. nov. Left valve, lateral aspect.
- „ 4a.— „ „ „ Edge view.
- „ 4b.— „ „ „ End view of carapace.
- „ 5.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. Left valve, lateral aspect.
- „ 5a.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. Edge view of carapace.
- „ 5b.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. End view.
- „ 6.—*Loxoconcha jurassica*, sp. nov. Left valve. Lateral aspect.
- „ 6a.—*Loxoconcha jurassica*, sp. nov. Edge view of carapace.
- „ 6b.— „ „ „ End view.
- „ 7.—*Cytheropteron australiense*, sp. nov. Right valve, lateral aspect.
- „ 7a.—*Cytheropteron australiense*, sp. nov. Edge view.
- „ 7b.— „ „ „ End view.



F.C. del.

Jurassic Microzoa.



F.C. delt.

Jurassic Microzoa.