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TRANSACTIONS OF THE SOCIETY.

XVI.—*On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex.—IV.*

By EDWARD HERON-ALLEN, F.L.S., F.R.M.S.,
and ARTHUR EARLAND.

(Read Nov. 17, 1909.)

PLATES XX., XXI.

Family IX. ROTALIDÆ.

Sub-family 2. Rotalinae.

Cycloloculina Heron-Allen and Earland.

172. *Cycloloculina annulata* Heron-Allen and Earland.

173. *Cycloloculina polygyra* Heron-Allen and Earland.

THIS generic form, with its two species, has been fully described in the first paper of this series.* At the date of publication of that paper, we had failed to find the genus represented in any gathering north-west of Medmerry Farm, and its notable abundance in a small gathering made at high-water mark just south-east of Medmerry Farm in May 1909 seemed to point to some bed of Eocene clay, exposed just below low-water mark at that place, as its locality of origin, regard being had to the strong set of tides from that point to the extreme end of Selsey Bill, east of the Marine Hotel. It has, however, been found since then in considerable quantity in an extended shore-gathering made between

* See this Journal, 1908, pp. 529-43.

West Wittering and Earnley, some miles north-west of the north-west limit of our researches up to that date, and again in a remarkably rich gathering made recently at the west end of the "House-pond" Beds, just south-east of the sluices, where one of the principal exposures of Bracklesham Bay fossils occurs between tide-marks. It would, therefore, appear to be present wherever any Foraminifera are to be found derived from the Eocene clays of the Bracklesham Beds.

In making a more careful and detailed study of the specimens originally selected from the main gathering referred to in our first paper, we have found the first specimen picked out, which we then referred to the species *Planorbulina costellata* of Terquem. This specimen exhibits certain noteworthy peculiarities, to wit, the large (megalospheric) size of the primordial chamber, which is followed by a curved chamberlet about three times the length, and equal in breadth to the primordial chamber. The Pavonine stage is represented by the next three chambers, all of which are equal in diameter to the primordial chamber. The fifth chamber is completely annular, retaining the same breadth. From this point the annular chambers show a very slight increase in diameter. Three such annular chambers are visible in the specimen under consideration, which is quite flat, the septal lines being distinctly marked, although flush with the surface. From this point the character of the shell changes entirely: the annuli are but very slightly defined, and the shell increases considerably in thickness. The surface of these outer rings is strongly crenulated, as in fig. 5 of the original plate, and this gives a very decided, but illusory suggestion of a division of the annular chamber into chamberlets. The specimen is somewhat broken round the edges, but there were probably at least three annuli presenting this crenulated surface. It is possible that further specimens, should we be so fortunate as to discover them, may necessitate the separation of this form from *C. polygyra*.

Planorbulina d'Orbigny.

174. *Planorbulina mediterranensis* d'Orbigny.

Planorbulina mediterranensis (d'Orbigny) 1826, Ann. Sci. Nat., vol. vii. p. 280, No. 2, pl. xiv. figs. 4-6: Modèle No. 79.

Planorbulina vulgaris (d'Orbigny) Williamson, 1858, Recent Foram. Gt. Britain, p. 57, pl. 5, figs. 119, 120.

Planorbulina mediterranensis (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 656, pl. xcii. figs. 1-3.

Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Recent and fossil, the latter being much larger than the former, which are of the regular type commonly found in British gatherings.

175. *Planorbulina larvata* Parker and Jones.

Planorbulina vulgaris var. *larvata* Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser 3, vol. v. p. 294.

Planorbulina larvata Id., 1865 Phil. Trans., vol. clv. p. 379, pl. xix. fig. 3 a, b.

Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 658, pl. xcii. fig. 5, 6.

Ditto. (Parker and Jones) Guppy, 1909, Trans. Canadian Institute, vol. viii. p. 387.

Several specimens, in various stages of development. All fossils; some pyritised, and evidently from a clay, the others from a shell-sand: the latter are not so well preserved as the former. Brady's specimens were recent, from tropical shallow waters, and, so far as we are aware, it has not previously been recorded as fossil except by Mr. R. J. Lechmere Guppy (*suprà*), who records it as abundant in the shallow-water Miocene beds of Trinidad, West Indies.

Truncatulina d'Orbigny.176. *Truncatulina lobatula* Walker and Jacob sp.

Nautilus lobatulus Walker and Jacob, 1798, Adam's Essays, Kanmacher's edition, p. 642, pl. xiv. fig. 36.

Truncatulina lobatula (Walker and Jacob) Williamson, 1858, Recent Foram. Gt. Britain, p. 59, pl. v. figs. 121-3.

Ditto. (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 660, pl. xcii. fig. 10; pl. xciii. figs. 1, 4, 5.

Ditto. (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.

Abundant, both fossil and recent. Typical, and presenting every aspect of this very variable species. Among the fossils are some of a very regular depressed type, which renders them almost indistinguishable from the genus *Discorbina*.

177. *Truncatulina variabilis* d'Orbigny.

Truncatulina variabilis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 279, No. 8.

Ditto. (d'Orbigny) Terquem, 1878, Mém. Soc. géol. France, sér. 3, vol. i. Mém. iii. p. 20, pl. i. fig. 18-25.

Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 661, pl. xcii. figs 6, 7.

Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 225.

Ditto. (d'Orbigny) Sidebottom, 1909, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. liii. pt. iii. No 21, p. 2, pl. i. figs. 5, 6, pl. ii. figs. 1-3.

A great number of specimens, illustrating fairly well the vagaries of *T. lobatula*, which have been separated under this name. The majority are fossils, but many recent specimens occur. Recent specimens are recorded by Earland from Bognor—rare. Sidebottom (*suprà*) figures a remarkable series of specimens from Delos.

178. *Truncatulina tenuimargo* Brady. (Plate XX. fig. 2, a, b.)

Truncatulina tenuimargo Brady, 1884, Foram. 'Challenger,' p. 662, pl. xciii. figs. 2, 3.

The specimens are sufficiently typical to claim place in Brady's species. The line of demarcation between this and *T. lobatula*, however, entirely depends on the development of the keel, and the extent to which this keel is developed probably depends upon the nature of the surface to which the specimen was adherent. We have observed that whereas *T. lobatula* is extremely abundant in the recent stage attached to polyzoa and seaweeds, such specimens rarely or never develop any trace of the keel, whilst individuals which have grown in the attached form on smooth shells and stones have a marked tendency in this direction.

179. *Truncatulina wuellerstorfi* Schwager sp.

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

Truncatulina wuellerstorfi (Schwager) Brady, 1884, Foram. 'Challenger,' p. 662, pl. xciii. figs. 8, 9.

Planorbulina Wuellerstorfi (Schwager) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 89, pl. xv. fig. 777.

Fossil. The specimens are small, compared with recent types, and particularly so when compared with those obtained by R. Lechmere Guppy from the Miocene clays of Trinidad, in which deep-water deposits the species occurs of a size such as we have not seen elsewhere.

180. *Truncatulina haidingerii* d'Orbigny sp.

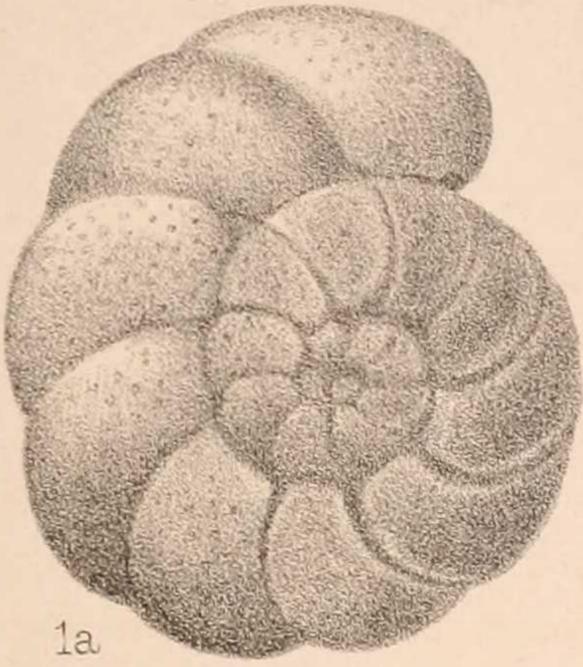
Rotalina haidingerii d'Orbigny, 1846, Foram. Foss. Vienne, p. 154, pl. vii. figs. 7-9.

Planorbulina haidingerii (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond. vol. xxiv. p. 469, pl. xlvi. fig. 11.

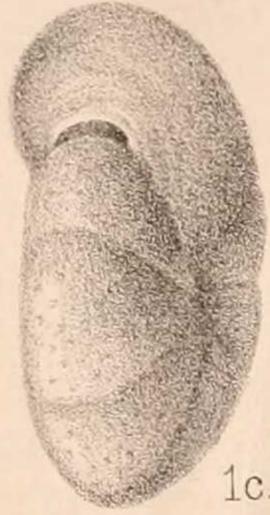
EXPLANATION OF PLATE XX.

- Fig. 1 (a).—*Truncatulina ungeriana* d'Orbigny. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ (c).—Ditto. Side view.
 „ 2 (a).—*Truncatulina tenuimargo* Brady. Inferior surface.
 „ (b).—Ditto. Superior surface.
 „ 3 (a).—*Pulvinulina semi-marginata* d'Orbigny. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ (c).—Ditto. Side view.
 „ 4 (a).—*Pulvinulina concentrica* Parker and Jones. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ 5 (a).—*Pulvinulina hauerii* d'Orbigny. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ (c).—Ditto. Side view.

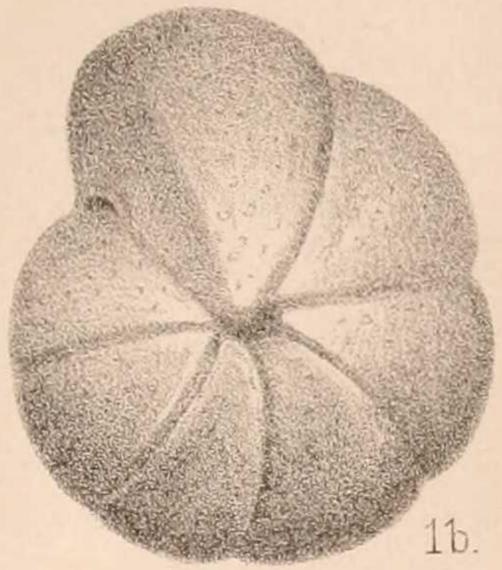
Figs. 3 a, b, c × 200 diam.; the others × 100 diam.



1a.



1c.



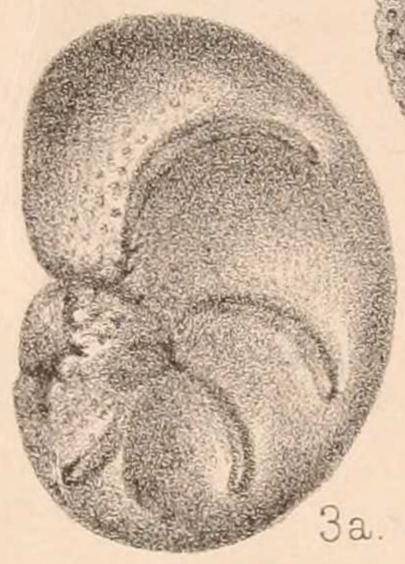
1b.



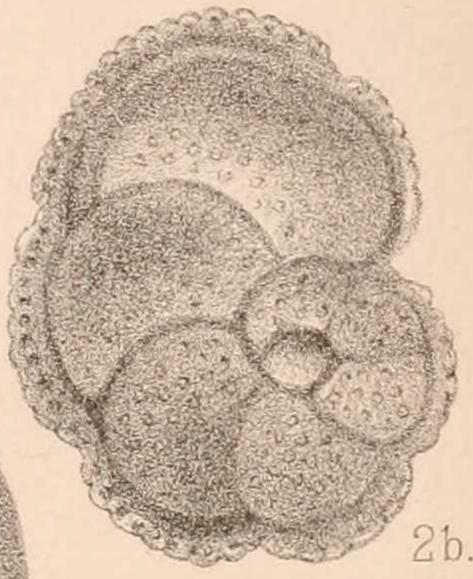
2a.



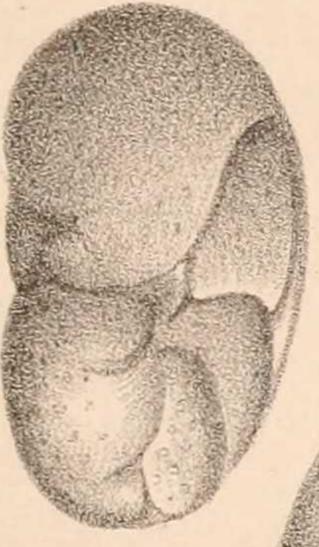
3b.



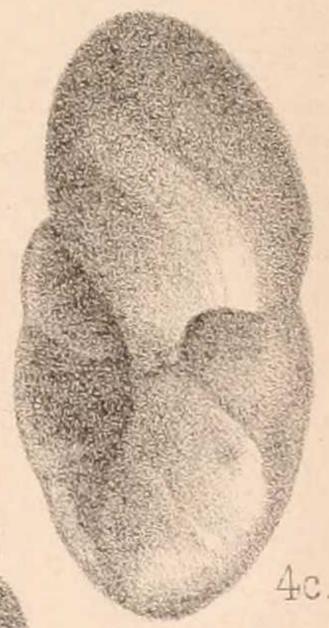
3a.



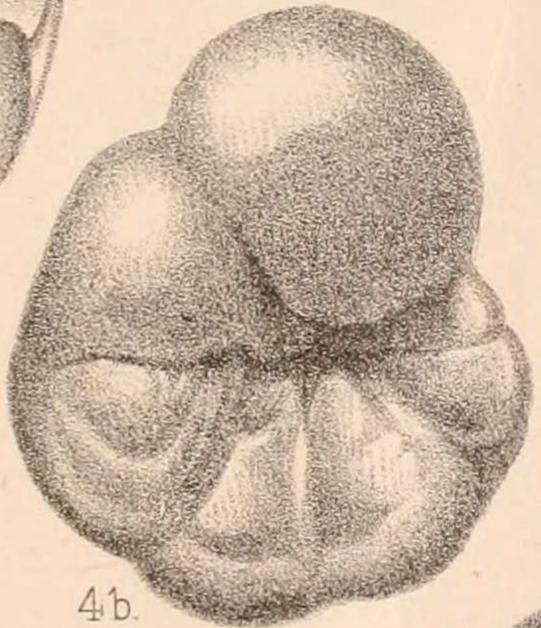
2b.



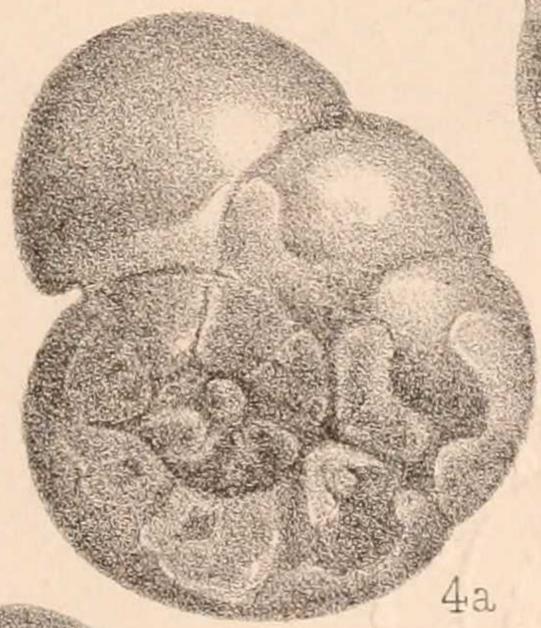
3c.



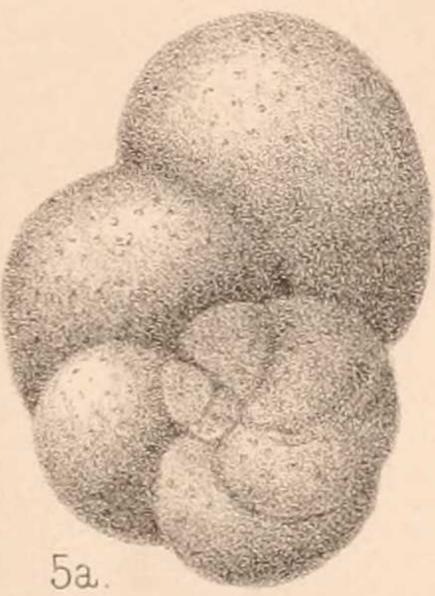
4c.



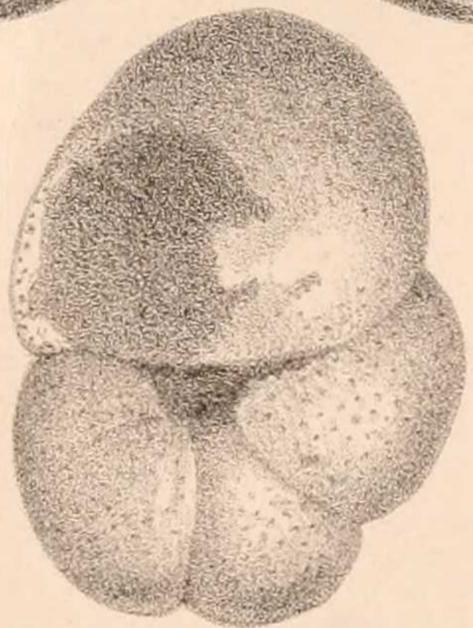
4b.



4a.



5a.



5b.



5c.

- Planorbulina farcta* var. *haidingerii* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 382, pl. xvi. fig. 22, *a, b*.
Rotalina haidingerii (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, sér. iii. vol. ii. Mém. III. p. 80, pl. viii. fig. 4, *a, b, c*.
Truncatulina haidingerii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 663, pl. xcv. figs. 7, *a, b, c*.

Fossil; pyritised.

181. *Truncatulina akneriana* d'Orbigny sp.

- Rotalina akneriana* d'Orbigny, 1846, Foram. Foss. Vienne, p. 156, pl. viii. figs. 13-15.
Truncatulina akneriana (d'Orbigny) Reuss, 1866, Denkschr. k. Akad. Wiss. Wien, vol. xxv. p. 160, No. 6.
Truncatulina akneriana (d'Orbigny) Brady, Foram. 'Challenger,' p. 663, pl. xciv. fig. 8, *a, b, c*.
Planorbulina akneriana (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 89, pl. xv. fig. 778, 779.

Fossil and typical; pyritised, probably from a clay.

182. *Truncatulina ungeriana* d'Orbigny sp.

(Plate XX. fig. 1, *a, b, c*.)

- Rotalina ungeriana* d'Orbigny, 1846, Foram. Foss. Vienne, p. 157, pl. viii. figs. 16-18.
Planorbulina ungeriana (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 469, xlvi. fig. 12.
Planorbulina farcta var. *ungeriana*, Parker and Jones, 1865, Phil. Trans., vol. clv. p. 382, pl. xvi. figs. 23-5.
Truncatulina ungeriana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 664, pl. xciv. fig. 9 *a, b, c*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Frequent and typical. The majority of the specimens are pyritised fossils, but there are a few which may be of recent origin. The species occurs in Earland's list of Bognor Foraminifera, and is recorded as rare. The specimens were small, typical, and recent at this locality.

183. *Truncatulina robertsoniana* Brady.

- Truncatulina robertsoniana* Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 65.
Ditto. Brady, 1884, Foram. 'Challenger,' p. 664, pl. xcv. fig. 4 *a, b, c*.

Several small specimens of this pretty form, which have every appearance of being recent. Brady's records are from moderately deep water, ranging from 390 to 1785 fathoms. It does not appear to have been recorded as a fossil.

184. *Truncatulina culter* Parker and Jones sp.

- Planorbulina culter* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 421, pl. xix. fig. 1 a, b.
Anomalina bengalensis Schwäger, 1866, Novara. Exped. geol. Theil, vol. ii. p. 259, pl. vii. fig. 111.
Truncatulina culter (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 668, pl. xcvi. fig. 3 a, b, c.

All fossils, and apparently from a clay. The specimens are small compared with recent types. This species has been recorded principally from depths of 1000 to 2000 fathoms, but, according to Brady, Schwager states that his specimens of *Anomalina bengalensis* were from the shores of the Nicobar Islands, which would point to the fact of their living in comparatively shallow water.

Anomalina d'Orbigny.185. *Anomalina ammonoides* Reuss sp.

- Rosalina ammonoides* Reuss, 1845, Verstein. Böhm. Kreid., pt. i. p. 36, pl. xiii. fig. 66, pl. viii. fig. 53.
 Ditto. Id., 1850, Haidinger's Naturw. Abhandl., vol. iv. p. 36, pl. iv. fig. 2.
Planorbulina ammonoides (Reuss) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 379.
Anomalina ammonoides (Reuss) Brady, 1884, Foram. 'Challenger,' p. 672, pl. xciv. figs. 2, 3.

Very fine specimens, which have been derived from several distinct sources, including probably Cretaceous beds and Eocene sands and clays.

186. *Anomalina coronata* Parker and Jones.

- Anomalina coronata* Parker and Jones, 1857, Ann. and Mag. Nat. Hist., ser. 2, vol. xix. p. 294, pl. x. figs. 15, 16.
 Ditto. (Parker and Jones) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 469, pl. xlviii. fig. 13 a, b.
 Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 675, pl. xcvi. figs. 1, 2
Planorbulina coronata (Parker and Jones) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 90, pl. xv. figs. 781-3.

A single small, and imperfect example. The shell is in good preservation, and looks like a recent specimen. This is a very common species in some parts of the North Sea and in the Farøe Channel, but it rarely occurs under the 100 fathom line, and we know no previous record of its occurrence in a shore-sand, if our specimen is to be accepted as recent. The species has been recorded from several Tertiary formations in various parts of the world.

187. *Anomalina grosserugosa* Gümbel sp.

- Truncatulina grosserugosa* Gümbel, 1868, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. x. p. 660, pl. ii. fig. 104 *a, b*.
 Ditto. (Gümbel) Hanthen, 1875, Mittheil. Jahrb. k. ung. geol. Anstalt, vol. iv. p. 74, pl. ix. fig. 6 *a, b*.
 Ditto. (Gümbel) Brady, 1884, Foram. 'Challenger,' p. 673, pl. xciv. figs. 4, 5.
 Ditto. (Gümbel) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Several excellent specimens. Fossil, with perhaps one or two exceptions. Earland's record from Bognor (*suprà*) was the first from Britain, but it noted that the specimens were very poor. Its occurrence as a recent British species must therefore still be considered uncertain. Its normal habitat lies between the 500 and 2000 fathom line in both Atlantic and Pacific.

Pulvinulina Parker and Jones.188. *Pulvinulina punctulata* d'Orbigny sp.

- Rotalia punctulata* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 25; Modèle No. 12.
Pulvinulina repanda var. *punctulata* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 394, pl. xiv. figs. 12, 13.
Pulvinulina punctulata (d'Orbigny) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi. p. 20, pl. iii. fig. 82.
Pulvinulina repanda (Fichtel and Moll) Jones, Parker, and Brady, 1866, Monograph Foram. Crag, pl. ii. figs. 22-4.
Pulvinulina punctulata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 685, pl. civ. fig. 17.
 Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 96, pl. xvi. figs. 797-800.

One specimen only, but typical. A fossil, probably from a shell-sand. Brady (*suprà*) states that it occurs in the Crag, and our specimen is probably derived from a deposit of this age.

189. *Pulvinulina concentrica* Parker and Jones.

(Plate XX. fig. 4 *a, b, c*.)

- Pulvinulina concentrica* (Parker and Jones M.S.) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 470, pl. xlvi. fig. 14.
 Ditto. Parker and Jones, 1865, Phil. Trans., vol. clv. p. 393.
 Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 686, pl. cv. fig. 1 *a, b, c*.
 Ditto. (Parker and Jones) Brady, 1887, Synopsis of British Recent Foraminifera.
 Ditto. (Parker and Jones) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Typical fossil specimens, but no recent ones. The species has been recorded by Earland (*suprà*) in the Bognor specimens, but the specimens were very rare and weak. It is not uncommon in the North Sea at moderate depths. Brady's record was from Shetland, 75 to 90 fathoms.

190. *Pulvinulina vermiculata* d'Orbigny sp.

Planorbulina vermiculata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 280, No. 3.

Rotalia vermiculata (d'Orbigny) Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 305, No. 116.

Pulvinulina vermiculata (d'Orbigny) Carpenter, 1862, Introd. Foram., p. 211, pl. xiii. figs. 4-6.

Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 687, pl. cxv., fig. 2.

Ditto. (d'Orbigny) Sidebottom, 1909, Mem. Manchester Lit. and Phil. Soc., vol. liii. No. 21, p. 8, pl. iv. fig. 1.

One small but fairly typical specimen of this abnormal species. The reason for its inclusion in the genus *Pulvinulina* is, we must confess, far from obvious. d'Orbigny, who founded the species, referred it to the genus *Planorbulina*, and its affinities certainly seem to lie in this direction. Brady, however, considered that its relationship to *Pulvinulina* could be established by "intermediate gradational forms." Although the species occurs with some frequency in Mediterranean gatherings, we have not ourselves seen sufficient evidence of these intermediate forms to establish its position with any certainty.

191. *Pulvinulina oblonga* Williamson sp.

Nautilus auricula var β , Fichtel and Moll, 1803, Test. Micr., p. 108, pl. xx. figs. d, e, f.

Rotalina oblonga Williamson, 1858, Recent Foram. Gt. Britain, p. 51, pl. iv. figs. 98-100.

Pulvinulina repanda var. *auricula* (Fichtel and Moll) Parker and Jones, 1862, Introd. Foram. Appendix, p. 311.

Pulvinulina auricula (Fichtel and Moll sp.) Brady, 1884, Foram. 'Challenger,' p. 688, pl. cvi. figs. 4, 5.

Pulvinulina oblonga Williamson sp. Ibid.

Pulvinulina auricula (Fichtel and Moll sp.) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil, pyritised. According to Brady, the range of this species does not extend beyond the Tertiary period. The specimens are all referable to Fichtel and Moll's var. β , which differs from var. *a*, or true *auricula*, in the sharp peripheral edge and limbate sutures. The two forms, however, run together to such an extent that they are hardly worth separation.

192. *Pulvinulina hauerii* d'Orbigny.

(Plate XX. fig. 5 a, b, c.)

Rotalina hauerii d'Orbigny, 1846, Foram. Foss. Vienne, p. 151, pl. vii. figs. 22-4.

Pulvinulina hauerii (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 393.

Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 690, pl. cvi. figs. 6, 7.

Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Soc., ser. 2, vol. ix. No. 57, p. 227.

Frequent. The specimens are all fossil, and obviously derived from a number of different sources. A few are clearly Cretaceous, whilst others are filled with pyrites, and are probably derived from the Eocene clays. Some of the largest specimens are presumably of later date, and may be from Pliocene sands. Earland's record (*suprà*) from Bognor shore-sand, is the first recent British one.

193. *Pulvinulina menardii* d'Orbigny sp.

- Rotalia menardii* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 26;
Modèle No. 10.
Pulvinulina menardii (d'Orbigny) Brady, 1863, Report British Assoc. Newcastle-on-Tyne Meeting, Trans., p. 101.
Pulvinulina repanda var. *menardii* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 394, pl. xvi. figs. 35-7.
Pulvinulina menardii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 690, pl. ciii. figs 1, 2.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 227.

Several good and typical specimens have been found, the largest of which is almost equal in size to the specimens occurring in recent tropical oozes. They are all apparently derived from clays, and to some extent are pyritised. Earland (*suprà*) records small recent specimens from the adjacent Bognor shore-sands, "very rare."

194. *Pulvinulina truncatulinoides* d'Orbigny sp.

- Rotalinia truncatulinoides* d'Orbigny, 1839, Foram. Canaries, p. 132, pl. ii. figs. 25-7.
Rotalina micheliniana d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 31, pl. iii. figs. 1-3.
Pulvinulina micheliniana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 694, pl. civ. figs. 1, 2.
Ditto. (d'Orbigny) Wright, 1886, Proc. R. Irish Acad., ser. 2, vol. iv. (Science) p. 614.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Frequent. The specimens are probably without exception fossils. The best are unquestionably Cretaceous, but there are many others of somewhat more depressed form, which are usually pyritised and are probably derived from Tertiary clays. This species, which is of world-wide distribution, and has a history extending back at least to the Cretaceous period, is singularly unfortunate in its nomenclature. d'Orbigny described it under two different specific names in successive years (*suprà*), and the later name has been almost universally employed by subsequent writers. Following the usual practice, however, the name *truncatulinoides* is entitled to precedence, although its use must lead to confusion. It appears to be a case in which, if ever, the usual practice might be abandoned,

especially as Brady (*suprà*) quotes an extract from d'Orbigny which seems to show that the two papers were published almost simultaneously.

195. *Pulvinulina exigua* Brady.

Pulvinulina exigua Brady, 1884, *Foram. 'Challenger,'* p. 696, pl. ciii. figs. 13, 14.

Several specimens. Fossil, probably derived from a clay. The species has not apparently been recorded in the fossil state previously, but, except for its characteristically minute size, the species is with difficulty separable from *P. elegans*.

196. *Pulvinulina schreibersii* d'Orbigny sp.

Rotalina schreibersii d'Orbigny, 1846, *Foram. Foss. Vienne*, p. 154, pl. viii. figs. 4-6.

Pulvinulina schreibersii (d'Orbigny) Parker and Jones, 1865, *Phil. Trans.* vol. clv. p. 393.

Ditto. (d'Orbigny) Brady, 1884, *Foram. 'Challenger,'* p. 697, pl. cxv. fig. 1.

Ditto. (d'Orbigny) Goës, 1894, *Artic and Scandinavian Foraminifera*, p. 98.

Fossil. Rare, but typical, and in excellent preservation. The records of this form extended back to the Miocene. It is abundant in the Miocene clays of Gozo (Malta).

197. *Pulvinulina karsteni* Reuss sp.

Rotalia karsteni Reuss, 1855, *Zeitschr. deutsch. geol. Gesellsch.*, vol. vii. p. 273, pl. ix. fig. 6.

Pulvinulina karsteni (Reuss) Brady, 1864, *Trans. Linn. Soc. Lond.*, vol. xxiv. p. 470, pl. xlviii. fig. 15.

Ditto. (Reuss) Brady, 1884, *Foram. 'Challenger,'* p. 698, pl. cv. figs. 8, 9.

Ditto. (Reuss) Brady, 1887, *Synopsis British Recent Foraminifera*.

Ditto. (Reuss) Earland, 1905, *Journ. Quekett Micr. Club*, ser. 2, vol. ix. No. 57, p. 227.

Rare; fossil. This species in the recent state is best known as a cold-water form, although it has been dredged at one or two localities round the British coasts, and has been recorded by Earland (*suprà*) from the Bognor shore-sands, "very rare, very small." The Selsey specimens are probably derived from post-Glacial deposits.

198. *Pulvinulina elegans* d'Orbigny sp.

Rotalia (Turbinulina) elegans d'Orbigny, 1826, *Ann. Sci. Nat.*, vol. vii. p. 276, No. 54.

Rotalina partschiana d'Orbigny, 1846, *For. Foss. Vienne*, p. 153, pl. vii. figs. 28-30, pl. viii. figs. 1-3.

- Pulvinulina repanda* var. *elegans* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 397, pl. xvi. figs. 44-6.
- Pulvinulina elegans* (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 699, pl. cv. figs. 3-6.
- Pulvinulina partschiana* (d'Orbigny). Ibid.
- Pulvinulina elegans* (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
- Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 97, pl. xvi. fig. 808.

Fossil specimens, fairly well developed and typical, probably from a clay. The species and its ally *P. partschiana* have been recorded from various deposits ranging back as far as the Upper Trias.

199. *Pulvinulina semimarginata* d'Orbigny sp.

Plate XX. fig. 3 *a, b, c.*

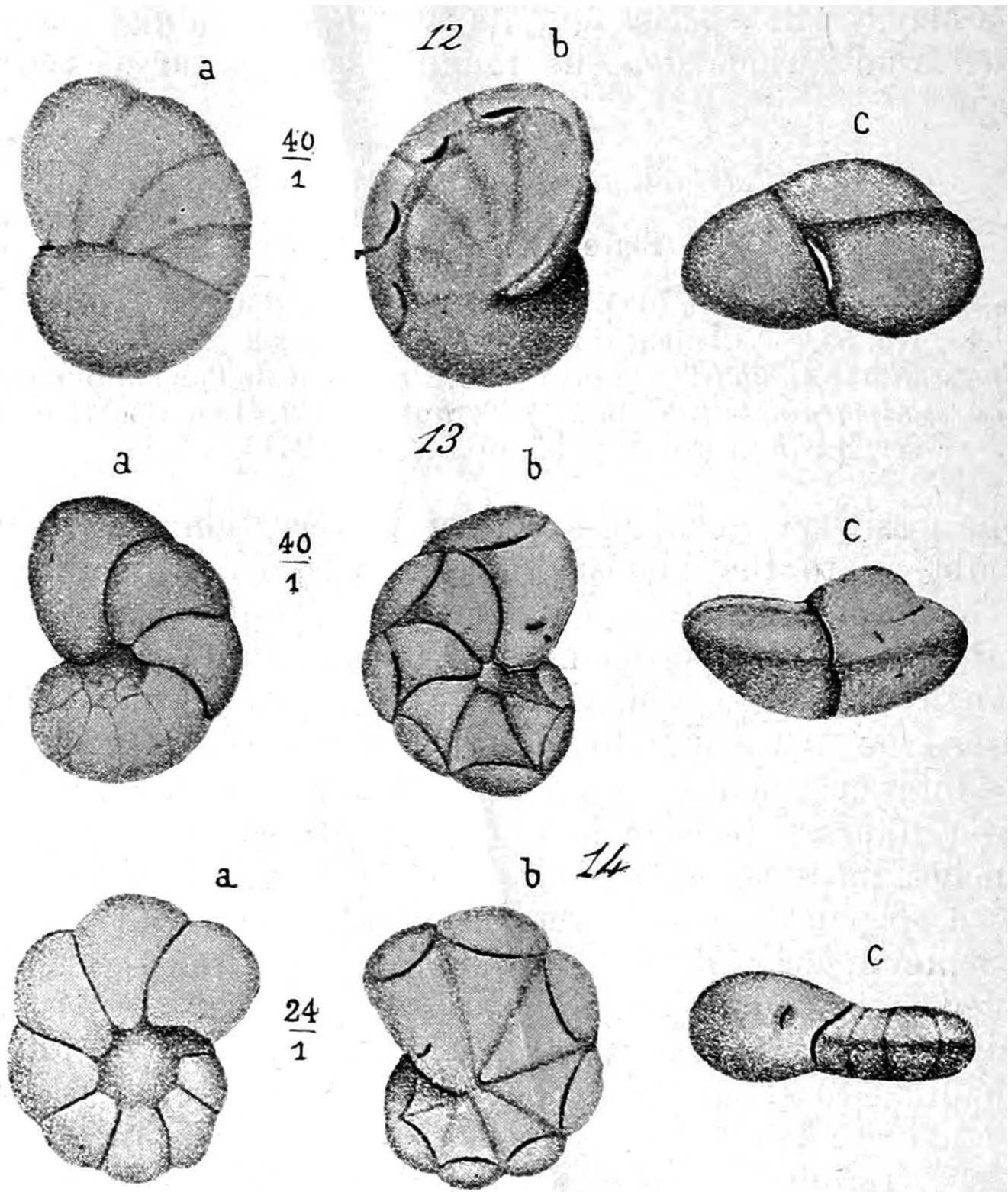
- Turbinulina semimarginata* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 53. "Planches inédites," pl. ix. fig. 53.
- Rosalina semimarginata* (d'Orbigny) 1850, Prodrome de Palæontologie, p. 407.
- Rotalina semimarginata* (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. No. 3, p. 56, pl. iii. figs. 12-14.

One fossil specimen, in excellent preservation. There can be no doubt as to the identity of the specimen which we figure with the form described and figured by Terquem as above, but as to the identity of Terquem's specimens with d'Orbigny's species we can say nothing, as this was one of the forms of which d'Orbigny published no figure, and his description ("espèce rugeuse, ovale, bordée intérieurement") is too vague to have any value. Terquem, however, appears to have had access to d'Orbigny's figure in the "Planches inédites," and gives a complete series of drawings of his own specimens, which were from the Eocene of Vaudancourt and Septeuil, near Paris. Terquem's figures must therefore be accepted as the foundation of our knowledge of this species. There are nine in all, representing different views of three individuals, which differ to some extent in size, thickness, and markings, but which may probably be regarded as mere variations within the species. Terquem gives a separate description of each of these specimens, and as his paper is not readily accessible, we deem it advisable to give here reproductions of his figures, and a précis of his descriptions.

Fig. 12 *a, b, c.*—Shell oval, compressed, smooth, of rounded circumference, sub-convex above, compressed below, the two surfaces formed of a spiral whorl, the earlier chambers indistinct, the four later ones slightly prominent, encroaching on the inferior surface, and bounded by a furrow not in conformity with the chambers of this surface. The edge of the terminal chamber is prominent, the aperture a slit, close against the spiral. (Vaudancourt.)

Fig. 13 *a, b, c*.—Shell oval, sub-convex above, depressed below, the upper surface formed of early chambers indistinctly indicated, the three later chambers being prominent. On the inferior surface all the chambers are prominent, the three latest being swollen. A secondary aperture on the anterior surface of the terminal chamber. (Septeuil.)

Fig. 14 *a, b, c*.—Shell circular, compressed on both sides, rounded circumference, with a nucleus. The superior surface formed of



strongly marked chambers with deep sutural lines. On the inferior surface the outer chambers prominent, the inner triangular and well marked. Secondary aperture, a slit on the anterior surface of the last chamber. (Septeuil.)

Terquem adds that the species is formed of two series of chambers in juxtaposition. The upper series, which encroaches upon the lower, frequently has a specialised aperture situated in the middle of the terminal chamber. The lower, which exceeds the upper in development, shows five chambers, whilst the upper has but four, occupying the same area.

Judging from our own specimen, we do not think that Terquem is correct in stating that the shell is built up of two sets of chambers. If his statement were correct, the specimens could not be referred to the genus in which he places them, but would be more correctly assigned to *Bulimina*—indeed, his drawings, especially figs. 13 and 14, are not unlike *Bulimina convoluta* Williamson; but it appears to us that the constrictions and incisions (slits) to which he refers in his description are not lines of demarcation between two separate series of chambers, but merely subsidiary marginal apertures, such as are found in certain species of *Pulvinulina* (cf. *P. elegans* d'Orbigny), and for which Terquem himself proposed the sub-genus *Epistomina*. Our specimen, as will be seen from the drawing, approaches and is almost identical with Terquem's fig. 12, and there is very little doubt that it has been derived from a similar Eocene formation. The shell presents a somewhat worn and whitish appearance, such as is characteristic of the Paris Eocene beds.

Rotalia Lamarck.

200. *Rotalia beccarii* Linné sp.

- Nautilus beccarii* Linné, 1767, Syst. Nat., 12th ed. p. 1162; 1788, *ibid.* 13th (Gmélin's) ed., p. 3370, No. 4.
- Rotalia* (*Turbinularia*) *beccarii* (Linné) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 275, No. 42; Modèle No. 74.
- Rotalina beccarii* (Linné) Williamson, 1858, Recent Foram. Gt. Britain, p. 48, pl. iv. figs. 90-2.
- Rotalia beccarii* (Linné) Brady, 1884, Foram. 'Challenger,' p. 704, pl. cvii. figs. 2, 3.
- Ditto. (Linné) Brady, 1887, Synopsis British Recent Foraminifera.
- Ditto. (Linné) Earland, 1905, Journ. Quekett. Micr. Club, ser. 2, vol. ix. No. 57, p. 228.
- Ditto. (Linné) Sidebottom, 1909, Mem. Manchester Lit. and Phil. Soc., vol. liii. No. 21, p. 10, pl. iv. fig. 6.

Very common, both recent and fossil; the latter derived from many sources, ranging from the Bracklesham clays to recent. Among the recent specimens, besides the typical *R. beccarii*, the smooth thin-shelled variety recorded by Earland (*suprà*) from Bognor, also occurs. Among the fossils are one or two of the tuberculate variety figured by Sidebottom (*suprà*), which, it appears from his paper, has also been found by Millett in the Pliocene beds of St. Erth. Such specimens are abundant in some of the Italian Tertiaries.

201. *Rotalia* (*Gyroidina*) *orbicularis* d'Orbigny.

- Rotalia* (*Gyroidina*) *orbicularis* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 278, No. 1; Modèle No. 13.
- Rotalia orbicularis* (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 470, pl. xlvi. fig. 16.

- Rotalia orbicularis* (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii. No. 3, p. 60, pl. iv. figs. 1-3.
 Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 706, pl. cvii. fig. 5; pl. cxv. fig. 6.
 Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

A few fossil specimens, rather worn, which are, however, clearly referable to this species. It has been recorded from the London Clay, and many later formations. Our specimens are probably derived from the Tertiary shell sands of the Bognor rocks.

202. *Rotalia soldanii* d'Orbigny.

- Rotalia* (*Gyroidina*) *soldanii* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 278, No. 5; Modèle No. 36.
Rotalia beccarii var. *soldanii* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 389, pl. xvi., figs. 31-3.
Rotalia soldanii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 706, pl. cvii. figs. 6, 7.
 Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 99, pl. xvi. fig. 812.

Frequent; fossil, and probably derived from Cretaceous and perhaps from other and later deposits.

203. *Rotalia exsculpta* Reuss.

- Rotalia exsculpta* Reuss, 1860, Sitz. k. Akad. Wiss. Wien, vol. xl. p. 222, pl. xi. fig. 4.

Frequent, and typical specimens of this Cretaceous fossil. Owing to its minute size and the fact that the typical markings are frequently so clogged with chalk as to be indistinguishable, this pretty little form is probably often overlooked. At any rate, there appear to be very few records of its occurrence since Reuss first described it from the Westphalian chalk. It seems to be pretty generally distributed throughout the chalk, but is apparently confined to that formation. Jones and Parker* consider it closely allied to the *Rosalina ornata* of d'Orbigny.†

204. *Rotalia suessonensis* d'Orbigny.

- Rotalia suessonensis* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 23.
 Ditto. d'Orbigny, "Planches inédites," pl. viii. fig. 23.
 Ditto. d'Orbigny, 1850, Prodrome de l'alæontologie, vol. ii. p. 336.
 Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii. No. 3, p. 65, pl. v. figs. 3, 4.

One fossil specimen, somewhat worn, but identifiable with Terquem's fig. 3. Fig. 4 is somewhat different, and probably re-

* T. Rupert Jones and W. K. Parker in Quart. Journ. Geol. Soc. May 1872, p. 108. "On the Foraminifera of the family Rotalinae found in the Cretaceous Formations, etc."

† Voyage Amér. Mérid. 1839, vol. v. pt. 5, p. 42, pl. i. fig. 18-20.

presents a distinct type. d'Orbigny published no figure of this species, and his description ("espèce plus convexe en dessus qu'en dessous") would not go far towards identification. Terquem, however, appears to have had access to d'Orbigny's figure in the "Planches inédites." The shell is smooth and almost hemispherical on the superior face. The inferior or oral face is less convex, but the central portion rises in a pronounced umbo or boss. The sutures between the chambers are marked by deep clefts, which, however, do not extend either to the umbo or the periphery. Terquem's specimens were from the Eocene of Paris.

205. *Rotalia calcar* d'Orbigny sp.

Plate XXI., fig. 1, a, b, c.

Calcarina calcar d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 1;
Modèle No. 34.

Rotalia armata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 22;
Modèle No. 70.

Ditto. (d'Orbigny) Terquem, 1882, Mem. Soc. geol. France, ser. 3, vol. ii.
No. 3, p. 67, pl. v. figs. 14, 15.

Rotalia calcar (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. ii.
vol. ix. No. 57, p. 228.

Abundant, in every stage of development, and from several distinct strata. All the specimens are unquestionably fossil, and doubtless Earland's record from the Bognor shore-sands (*suprà*) must now be removed from the list of recent British forms, as his specimens, which were small and rare, have probably been derived from the same strata as some of the smaller Selsey specimens, to which they bear great resemblance.

Sub-Family 3. Tinoporinae.

Gypsina Carter. ³

206. *Gypsina inhærens* Schultze sp.

Acervulina inhærens Schultze, 1854, Organ. der Polythal., p. 68, pl. vi. fig. 12.

Tinoporus lucidus Brady, 1870, Edinburgh Catalogue of British Foram., p. 8.

Ditto. (Brady) Wright, 1877, Proc. Belfast Nat. Field Club, 1876-7, App.
p. 105, pl. iv. figs. 4, 5.

Gypsina inhærens (Schultze) Brady, 1884, Foram. 'Challenger,' p. 718, pl.
cii. figs. 1-6.

Ditto. (Schultze) Brady, 1887, Synopsis British Recent Foraminifera.

Ditto. (Schultze) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 91,
pl. xv. fig. 787.

Abundant; recent and fossil. The latter are evidently derived from several distinct sources. Brady states that there is no record of its occurrence as a fossil, but it seems unlikely that such a simple type should not have a considerable geological range.

Polytrema Risso.207. *Polytrema miniaceum* Linné sp.

Millepora miniacea Linné, 1788, Syst. Nat., 13th (Gmelin's) ed., vol. i. pt. 6, p. 3784, No. 6.

Polytrema miniacea (Linné) Carpenter, 1862, Introd. Foram., p. 235, pl. xiii. figs. 18-20.

Polytrema miniaceum (Linné) Moebius, 1880, Foram. von Mauritius, p. 85, pl. vii.

Ditto. (Linné) Brady, 1884, Foram. 'Challenger,' p. 721, pl. c. figs. 5-9; pl. ci. fig. 1.

We have a few fragments which can hardly be ascribed to any organism other than *Polytrema*, especially as they preserve both the colour and the typical perforate exterior rugosity of the test, but in the absence of more perfect specimens, the species is recorded with some reservation. The fossil records of *Polytrema* are very confusing, owing to the superficial resemblance to a zoophyte, and Brady states that little can be said with certainty as to its occurrence as a fossil. Without a re-examination of the specimens, it is impossible to say how many of the fossil records belong to the genus as at present constituted.

Family X. NUMMULINIDÆ.

Sub-family 2. Polystomellinæ.

Nonionina d'Orbigny.208. *Nonionina depressula* Walker and Jacob sp.

Nautilus depressulus Walker and Jacob, 1798, Adam's Essays, Kanmacher's Edition, p. 641, pl. xiv. fig. 33.

Nonionina umbilicatula Williamson, 1858, Recent Foram. Gt. Britain, p. 97, pl. iv. figs. 70, 71.

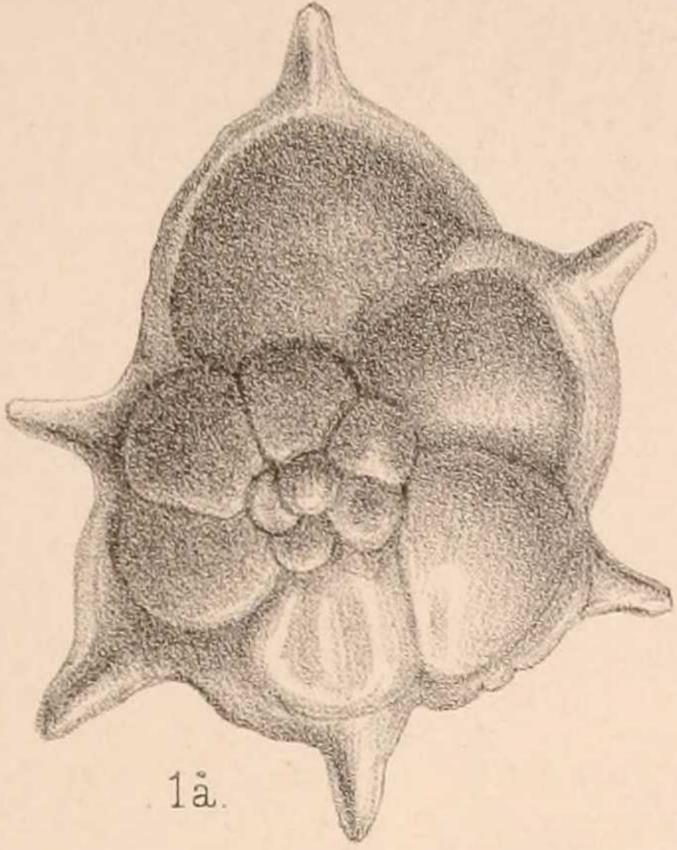
Nonionina crassula Williamson, *ibid*, p. 33.

Nonionina depressula (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 725, pl. cix. figs. 6, 7.

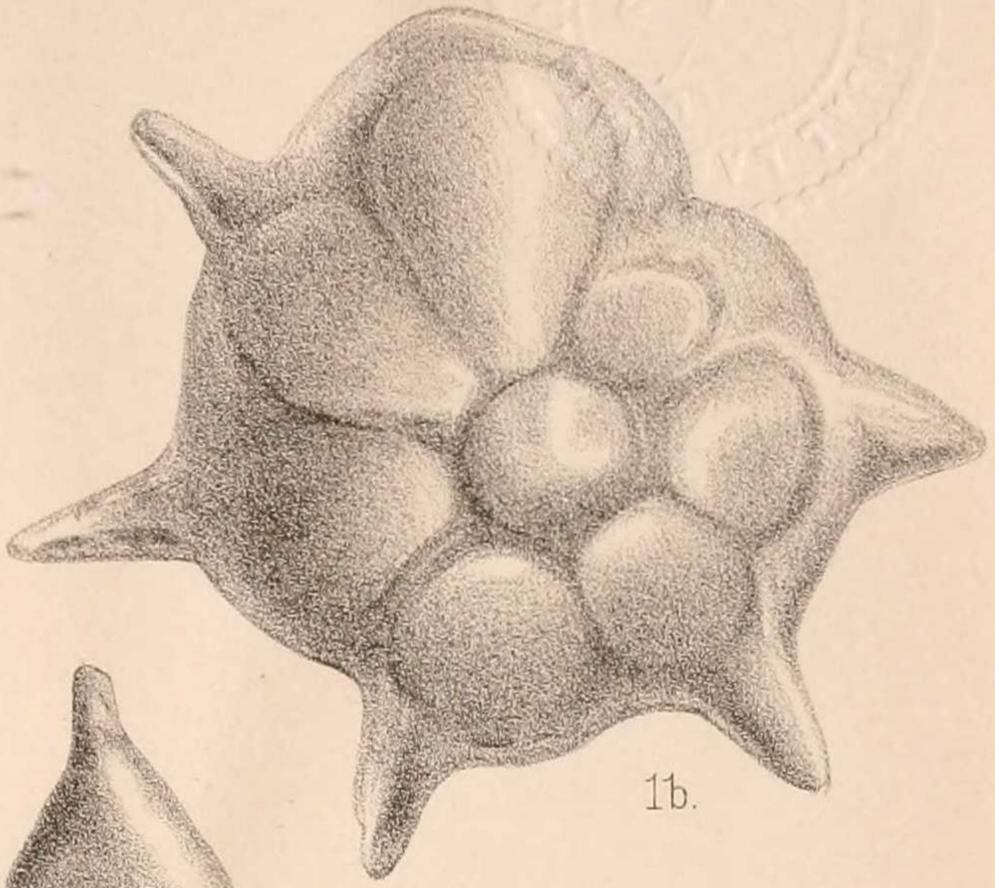
EXPLANATION OF PLATE XXI.

- Fig. 1 (a).—*Rotalia calcar* d'Orbigny. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ (c).—Ditto. Side view.
 „ 2 (a).—*Polystomella striato-punctata* Fichtel and Moll. Selsey and Bognor variety, with central (umbilical) deposit. Superior surface.
 „ (b).—Ditto. Inferior surface.
 „ (c).—Ditto. Side view.
 „ 3 (a).—*Polystomella macella* Fichtel and Moll. Superior surface.
 „ (b).—Ditto. Side view.
 „ 4 (a).—*Operculina complanata* Defrance. Superior surface.
 „ (b).—Ditto. Side view.

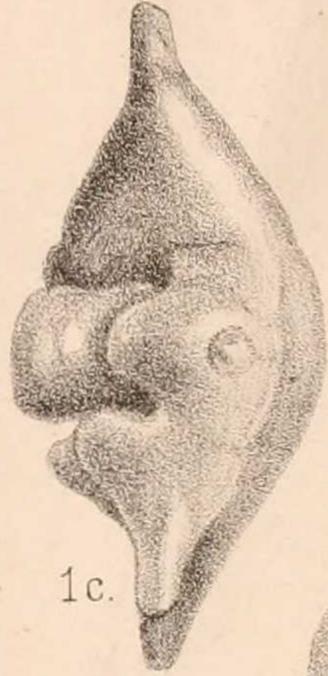
All figures × 100 diam.



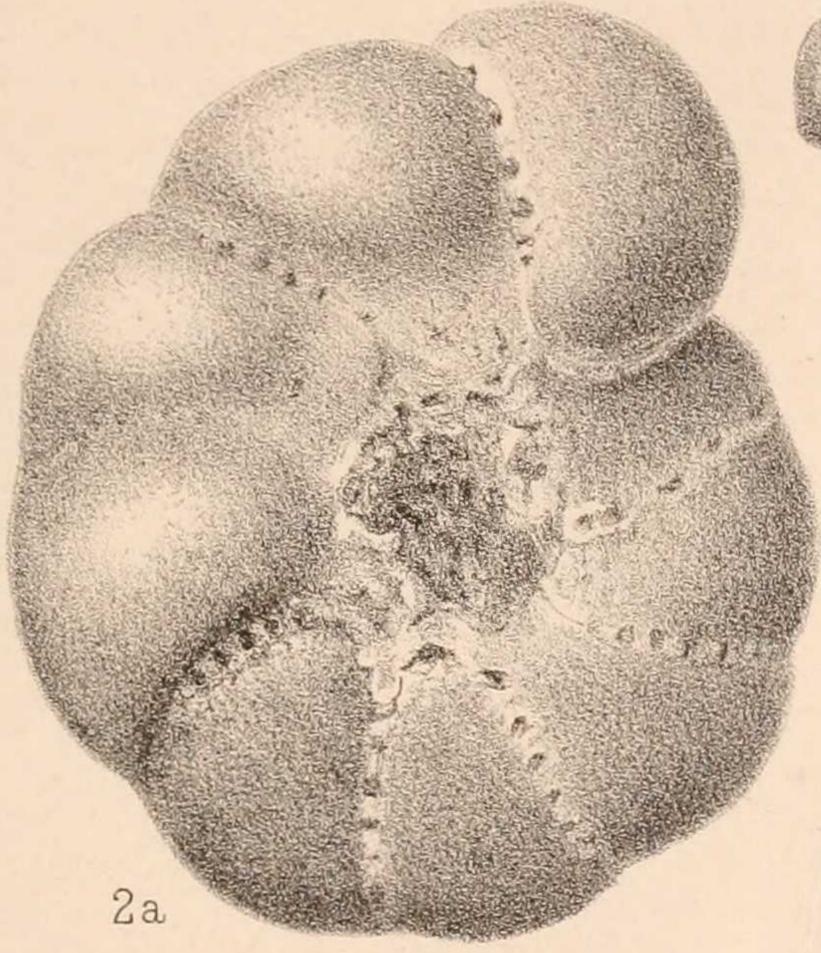
1a.



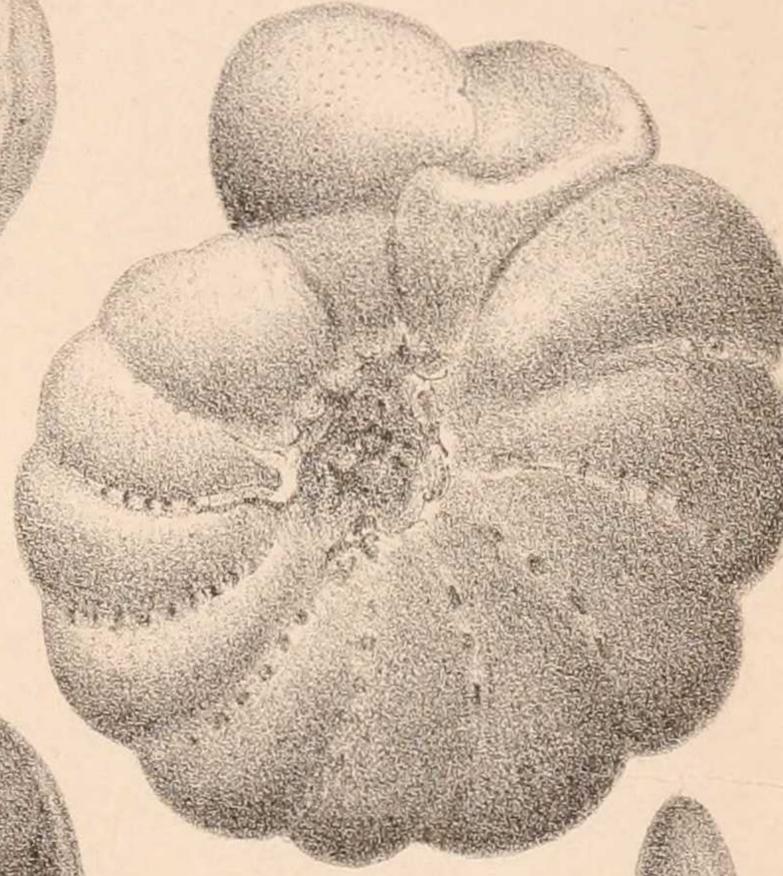
1b.



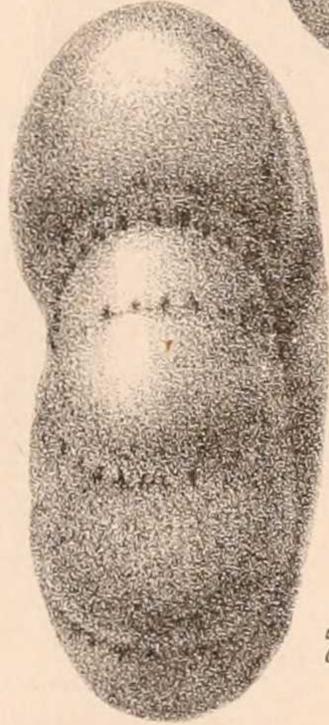
1c.



2a.



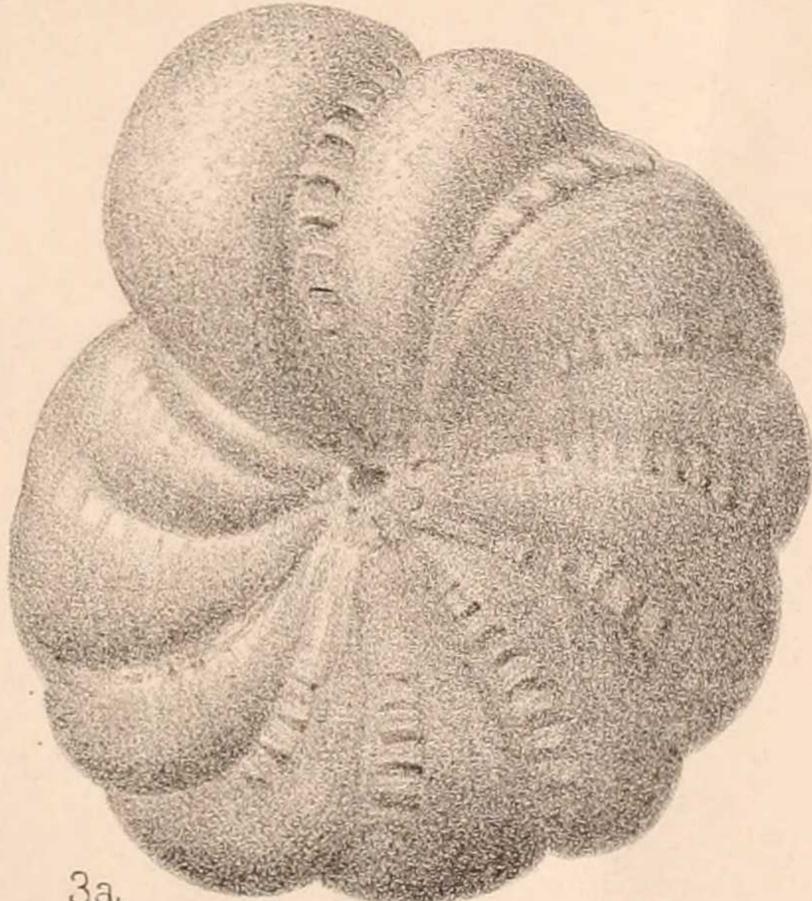
2b.



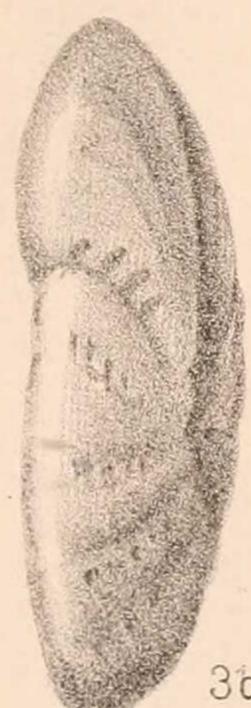
2c.



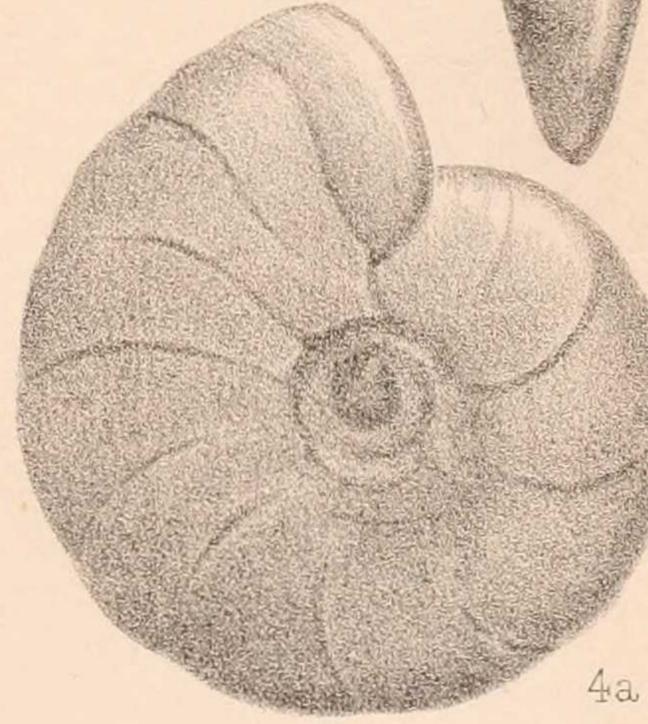
4b.



3a.



3b.



4a.

Nonionina depressula (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.

Ditto. (Walker and Jacob) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 103, pl. xvii. figs. 825-6.

Abundant, both recent and fossil. Many of the finest specimens are highly pyritised, and probably derived from the post-Glacial deposits of the peninsula. The finest of our specimens come from the extreme limit of our gathering at West Wittering. The specimens exhibit an unusual range in thickness, some of them approaching very closely to *N. orbicularis*.

209. *Nonionina umbilicatula* Montagu sp.

Nautilus umbilicatus Montagu, 1803, Test. Brit., p. 191; Suppl. p. 78, pl. xviii. fig. 1.

Nonionina soldanii d'Orbigny, 1846, For. Foss. Vienne, p. 109, pl. v. figs. 15, 16.

Nonionina barleeana Williamson, 1858, Recent Foram. Gt. Britain, p. 32, pl. iv. figs. 68, 69.

Nonionina umbilicata Terquem, 1882, Mém. Soc. géol. France, sér. 3, vol. ii. No. 3, p. 42, pl. ii. fig. 7.

Nonionina umbilicatula (Montagu) Brady, 1884, Foram. 'Challenger,' p. 726, pl. cix. figs. 8, 9.

Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.

Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 103, pl. xvii. figs. 823-4.

Frequent. Fossil, and perhaps recent, the latter doubtful.

210. *Nonionina pompilioides* Fichtel and Moll sp.

Nautilus pompilioides Fichtel and Moll, 1803, Test. Micr., p. 31, pl. ii. figs. a-e.

Nonionina pompilioides (Fichtel and Moll) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi p. 18, pl. iii. fig. 98.

Ditto. (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 727, pl. cix. figs. 10, 11.

Frequent. Fossil. The specimens are for the most part rather starved, and are probably derived from several distinct sources. A few of them are pyritised.

211. *Nonionina orbicularis* Brady.

Nonionina orbicularis Brady, 1881, Denkschr. k. Akad. Wiss. Wien, vol. xlii. p. 105, pl. ii. fig. 5.

Ditto. Brady, 1881, Ann. and Mag. Nat. Hist., ser. v. vol. viii. p. 415, pl. xxi. figs. 5a, b.

Ditto. Robertson 1882, Proc. Nat. Hist. Soc. Glasgow, vol. v. p. 274.

Ditto. (Brady) Brady, 1884, Foram. 'Challenger,' p. 727, pl. cix. figs. 20, 21.

Ditto. (Brady) Brady, 1887, Synopsis British Recent Foraminifera.

Typical specimens are not of very frequent occurrence. Such as we have found are fossils probably from the post-Glacial boulder clay. The records of this species are mostly confined to cold areas. According to Brady, it occurs in the post-Tertiary clays of Fifeshire. We have also fossil specimens from the neighbourhood of Montreal (Canada), stated to be from a post-Glacial clay.

212. *Nonionina asterizans* Fichtel and Moll sp.

- Nautilus asterizans* Fichtel and Moll., 1803, Test. Micr., p. 37, pl. iii. figs. e-h.
Nonionina asterizans (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. 3, vol. v. p. 101, No. 1.
Polystomella crispa var. (*Nonionina*) *asterizans* (Fichtel and Moll) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 403, pl. xiv. fig. 35; pl. xvii. fig. 54.
Nonionina asterizans (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 728, pl. cix. figs. 1, 2.
 Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
 Ditto. (Fichtel and Moll) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 229.

Fossil, and recent, the latter abundant. The recent specimens are of the same weak type as those referred to in Earland's paper (*suprà*).

213. *Nonionina boueana* d'Orbigny.

- Nonionina boueana* d'Orbigny, 1864, Foram. Foss. Vienne, p. 108, pl. v. figs. 11, 12.
 Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 729, pl. cix. figs. 12, 13.
 Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
 Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 104, pl. xvii. fig. 829.

Fossil. A few specimens only.

214. *Nonionina scapha* Fichtel and Moll. sp.

- Nautilus scapha* Fichtel and Moll, 1803, Test. Micr., p. 105, pl. xix. figs. d, e, f.
Nonionina scapha (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. 3, vol. v. p. 102, No. 4.
 Ditto. (Fichtel and Moll) Brady, 1865, Nat. Hist. Trans. Northumberland and Durham, vol. i. p. 106, pl. xii. fig. 10.
 Ditto. (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 730, pl. cix. figs. 14, 15, 16 (?).
 Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
 Ditto. (Fichtel and Moll) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 104, pl. xvii. fig. 830.

Rare. Fossils, derived from various sources, some being pyritised.

Polystomella Lamarck.215. *Polystomella striatopunctata* Fichtel and Moll sp.

(Plate XXI. fig. 2 a, b, c.)

Nautilus striatopunctatus Fichtel and Moll, 1803, Test. Micr., p. 61, pl. ix. figs. a, b, c.*Polystomella poeyuna* d'Orbigny, 1839, Foram. Cuba, p. 75, pl. vi. figs. 25, 26.*Polystomella umbilicatula* Williamson, 1858, Recent Foram. Gt. Britain, p. 42, pl. iii. figs. 81, 82.*Polystomella umbilicatula* var. *incerta* Williamson, *ibid.*, p. 44, pl. iii. fig. 82 a.*Polystomella striatopunctata* (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. iii. vol. v. p. 103, No. 6.*Polystomella antonina* (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii No. 3, p. 47, pl. ii. fig. 25 a, b.*Polystomella striatopunctata* (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 733, pl. cix. figs. 22, 23.

Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.

Ditto. (Fichtel and Moll) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 101, pl. xvii. figs. 815, 816.

Very common, both recent and fossil, and presenting practically every modification of this variable type. Among the recent specimens many of the largest present a modification of the usual structure—which we have thought of sufficient interest to figure. The shell is of a complanate and evolute type, and somewhat excavate at the umbilicus, which is more or less filled in with a vesicular extension of the final whorl of chambers, thus presenting as it were a secondary deposit of chamberlets in the middle of the shell. This variety also occurs in some abundance at Bognor.

216. *Polystomella crispa* Linné sp.*Nautilus crispus* Linné, 1767, Syst. Nat., 12th ed. p. 1162, 275.*Polystomella crispa* (Linné) Lamarck, 1822, Anim. sans Vert., vol. vii. p. 625. No. 1.

Ditto. (Linné) Williamson, 1858, Recent Foram. Gt. Britain, p. 40, pl. iii. figs. 78–80.

Ditto. (Linné) Brady, 1884, Foram. 'Challenger,' p. 736, pl. cx. figs. 6, 7.

Ditto. (Linné) Brady, 1887, Synopsis British Recent Foraminifera.

Ditto. (Linné) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 102, pl. xvii. figs. 820, 821.

Abundant, both recent and fossil, and in all stages of development. The spinous, young specimens are particularly fine.

The range of this handsome species extends back at least as far as Eocene times, and it is of frequent occurrence in most later deposits.

217. *Polystomella macella* Fichtel and Moll sp.

(Plate XXI. fig. 3 a, b.)

- Nautilus macellus* var. *a*, Fichtel and Moll, 1803, Test. Micr., p. 66, pl. x. figs. *e, f, g*.
Polystomella planulata Lamarck, 1822, Anim. sans Vert., vol. vii. p. 625, No. 3.
Polystomella macella (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. 3, vol. v. p. 104, No. 8
 Ditto. (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 737, pl. cx. figs. 8, 9, 11, and 10 (?).
 Ditto. (Fichtel and Moll) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 230.

Common, both recent and fossil. The species is commonly distributed all round our coast, and extends at least as far north as Shetland, but it was not recorded as a British form until 1900, when J. Wright published his list of Foraminifera from Dog's Bay, Connemara.*

Sub-family 3. Nummulitinae.

Amphistegina d'Orbigny.218. *Amphistegina lessonii* d'Orbigny.

- Amphistegina lessonii* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 304, No. 3, pl. xvii. figs. 1-4.
Amphistegina nucleata Terquem, 1882, Mém. Soc. géol. France, sér. 3, vol. ii. No. 3, p. 123, pl. xiii. fig. 1.
Amphistegina lessonii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 739, pl. cxi. figs. 1-7.

A number of small and somewhat worn specimens are probably referable to this species, and are derived from the *Alveolina* limestone of the Mixon Rocks, having in many cases portions of the silicious matrix attached. The species has been recorded as far back as the Eocene of the Paris basin, and is abundant in many Miocene deposits.

Operculina d'Orbigny.219. *Operculina complanata* DeFrance sp.

(Plate XXI., fig. 4 a, b.)

- Lenticulites complanata* DeFrance, 1822, Dict. Sci. Nat., vol. xxv. p. 453.
Operculina complanata (DeFrance) d'Orbigny, l. 26 Ann. Sci. Nat., vol. vii. p. 281, pl. xiv. figs. 7-10; Modèle No 80.
 Ditto. (DeFrance) Brady, 1884, Foram. 'Challenger,' p. 743, pl. cxii. figs. 3, 4, 5, 8.

* Irish Naturalist, March 1900.

Small specimens similar to our illustration are of moderately frequent occurrence, and are probably miniature shells of the species to which we have referred them. They are, at any rate, indistinguishable from the minute *Operculinæ*, which may be found in recent tropical gatherings; but we have seen no mature shells, either entire or fragmentary, so the species must be accepted on the evidence of these specimens only.

220. *Operculina ammonoides* Gronovius sp.

- Nautilus ammonoides* Gronovius, 1781, Zooph. Gron., p. 282, No. 1220, p. v.
Operculina complanata (Defrance) Parker and Jones, 1857, Ann. and Mag. Nat. Hist., ser. 2, vol. xix. p. 285, pl. xi. figs. 3, 4.
Nonionina elegans Williamson, 1858, Recent Foram. Gt. Britain, p. 35, pl. iii. figs. 74, 75.
Operculina ammonoides (Gronovius) Parker and Jones, 1862, Introd. Foram. Appendix, p. 810.
Ditto. (Gronovius) Brady, 1884, Foram. 'Challenger,' p. 745, pl. cxii. figs. 1, 2.
Ditto. (Gronovius) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Gronovius) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 105, pl. xvii. fig. 833.

Two specimens, one fossil, the other apparently recent. This species is frequent in the North Sea at moderate depths, and has been recorded from post-Tertiary deposits.

Nummulites Lamarck.

221. *Nummulites planulata* Lamarck.
222. *Nummulites lævigata* Lamarck.
223. *Nummulites variolaria* Sowerby.
224. *Nummulites elegans* Sowerby.
225. *Nummulites Wemmelsensis* de la Harpe.

- Nummulites lævigata* Lamarck, 1801, Syst. Anim. sans Vert., p. 101.
Ditto. (Lamarck) 1804, Ann. Mus., vol. v. p. 241.
Ditto. (Lamarck) 1806, Ann. Mus., vol. viii. No. 1, figs. 10 *a*, *b*, pl. lxii.
Nummulites lævigatus Brug. (*Lamarcki* d'Archiac) Lister, 1905, Proc Roy. Soc., vol. B. lxvi., pp. 298–318, pl. iii.

Specimens of these *Nummulites*, which are found of every dimension, from the most microscopic forms up to specimens 1.5 cm. in diameter, occur in every gathering we have made along the shores of Selsey Bill, from Pagharn Harbour to West Wittering, and they present a complete series of microspheric and megalospheric forms, running from one species into another, from *N. planulata* to *N. Wemmelsensis* (or *Prestwichii*), and it would be beyond the scope of the present paper to attempt anything like a complete classification of the series. As far as our researches have taken us, in examining

the clays from the artesian well-boring at "Large Acres," Selsey, we have found a mass of shells presenting every feature of the series as classified by Lister, and we must defer a more serious study of the genus to a future date when dealing with this well-boring. Some of the most characteristic and robust forms occur in the interior of the shells of the gigantic *Pholas* which occur in well-defined beds at various points of the coast, as well as among the detrital sand gathered at the base of the Mixon Beacon, whilst the finer and more delicate forms are found among the derived fossils in the shore gatherings in which the species washed from the outlying Eocene mud-banks ("clibs") are most numerous. Mr. J. J. Lister, F.R.S., has been good enough to look over some of our Selsey specimens, and considers the majority to be *N. variolaria* (Sowerby), though many nearly approach his species *N. Wemmelsensis* var. *elegans*. The larger specimens are practically without exception *N. lævigata* (Lamarck).

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CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO
ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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Minimis partibus, per totum Naturæ campum, certitudo omnis immititur
quas qui fugit pariter Naturam fugit.—*Linnaeus.*

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