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CHARLES D. WALCOTT, DIRECTOR

THE CRETACEOUS FORAMINIFERA OF NEW JERSEY

BY

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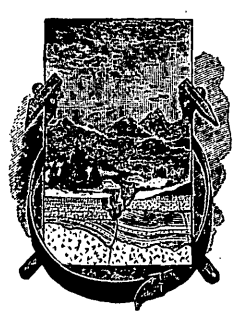

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CONTENTS.

ILLUSTRATIONS.

LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
Baltimore, Md., March 1, 1897.

SIR: I have the honor to submit herewith the manuscript of a report upon the Cretaceous Foraminifera of New Jersey, which has been prepared by Dr. R. M. Bagg as a member of my division, and I would suggest that it be published as a bulletin of the Survey.

Very respectfully,

WM. BULLOCK CLARK,
Geologist.

HON. CHARLES D. WALCOTT,
Director United States Geological Survey.

PREFACE.

The Foraminifera described in this bulletin were collected by the author from the Greensand series of the Upper Cretaceous of New Jersey, and include representatives from the Matawan, Monmouth, Rancocas, and Manasquan formations. They were determined, described, and presented as a thesis at the Johns Hopkins University for the degree of doctor of philosophy in the year 1895, and the types are deposited in the geological museum of that university, at Baltimore, Maryland. Some additional results of later study have yielded a number of interesting forms which are here described for the first time.

The author wishes to express his gratitude to Prof. W. B. Clark, who has kindly assisted in the work, and under whose direction the investigation has been carried on.

Acknowledgments are due the following persons who have furnished material for comparative study: Dr. G. Brown Goode, of Washington; Prof. Charles W. Johnson, of the Wagner Free Institute of Science, Philadelphia; Mr. T. W. Stanton and Dr. W. H. Dall, of Washington; Prof. Alonzo Linn, of Washington and Jefferson College, Pennsylvania; and Mr. Lewis Woolman, of Philadelphia.

The writer is also under great obligation to Mr. Frederick Chapman and Charles D. Sherborn, of London, England, for their kind assistance in determining doubtful forms, and for their approval of the new species herein described.

THE CRETACEOUS FORAMINIFERA OF NEW JERSEY.

By R. M. Bagg, Jr.

INTRODUCTION.

The fossil Foraminifera of America have never received much attention, although some of the most distinguished European paleontologists have been at work upon this group for many years, and have published numerous monographs and special reports upon it. Within the last few years, however, several short papers have appeared upon the Cretaceous Foraminifera of Canada, Minnesota, New Jersey, and Alabama.

The first report upon the Cretaceous Foraminifera of Canada was published by Dr. G. M. Dawson,[1] in the Canadian Naturalist for 1874. Four species of Foraminifera are described and figured in this report, namely: *Discorbina globularis*, *Planorbulina ariminensis*, *Textularia globulosa*, and *Textularia pygmæa*. These forms were discovered in the Cretaceous rocks of Pembina, Manitoba, which bear some resemblance to the "chalk" of Nebraska.

J. B. Tyrrell[2] has recognized in the Niobrara limestone of Manitoba some 25 different species of Foraminifera, a tabulated list of which appeared in the Transactions of the Royal Society of Canada and in the Annual Report of the Geological Survey of Canada[3] for 1890 and 1891.

Sixteen species of Foraminifera from the Cretaceous bowlder clays of central Minnesota were described and figured by Woodward and Thomas[4] in 1885. This report was reprinted, with additions of fossils from Nebraska and Illinois, in the Final Report of the Geological Survey of Minnesota.[5]

[1]Note on the occurrence of Foraminifera, coccoliths, and rhabdoliths in the Cretaceous rocks of Manitoba: Canadian Naturalist, new series, Vol. VII, 1874, pp. 252–257.

[2]Foraminifera and Radiolaria from the Cretaceous of Manitoba: Trans. Royal Soc. Canada, Vol. VIII, 1890, sec. 4, pp. 111–115.

[3]Geol. Surv. Canada, Rept. 1890–91, Vol. V, pt. 1, p. 211.

[4]On the Foraminifera of the bowlder clay taken from a well shaft 22 feet deep, Meeker County, central Minnesota: Geol. Nat. Hist. Surv. Minnesota, Thirteenth Ann. Rept., for 1884, pp. 164–177, Pls. I–III.

[5]Final Rept. Geol. Nat. Hist. Surv. Minnesota, Vol. III, 1893, pp. 23–54, Pls. C–E.

The Journal of the New York Microscopical Society for April, 1890,[1] contains a short article on the Cretaceous Foraminifera of New Jersey, by Dr. Anthony Woodward. This paper is entitled Synopsis of the Cretaceous Foraminifera of New Jersey, and contains only a review of previous investigations. A second part, however, appeared in the same journal for 1894,[2] in which Dr. Woodward describes 58 different species of Foraminifera from the New Jersey marl beds.

Still more recently a tabulated list of the Cretaceous and Tertiary Foraminifera of Alabama has been published in a special report of the Geological Survey of Alabama.[3]

The present memoir is a more thorough account than has previously been given of the Cretaceous Foraminifera from the marl beds of New Jersey. It was presented as a thesis at the Johns Hopkins University in May, 1895, but has been somewhat revised and enlarged, and contains descriptions of a number of species from the upper beds of the Matawan formation, which are here given for the first time. The latter were collected by the author during the last summer, while he was engaged in geological mapping in southern New Jersey. The specimens were obtained at Marshalltown, Salem County, New Jersey, in a very fossiliferous bed of sandy marl, which has been dug as a fertilizer.

A large amount of material has been collected and examined in the preparation of this report, from the following localities:

Monmouth formation (Navesink division, or lower marl bed): Atlantic Highlands, Freehold, and Cream Ridge.

Rancocas formation (middle marl bed): Blue Ball, New Egypt, Vincentown, Swedesboro, Timber Creek, and Harrisonville; also from a well boring at Quinton.

Manasquan formation (upper marl bed, lower part): Vincentown.

It was hoped that a careful study of the Foraminifera found in these various marl beds might not only result in the addition of many new species to our American Cretaceous, but might also serve as a means of identification of these strata. Such has been found to be the case, although the fact that certain species are present in several or all the beds has been established, while many of them have continued through deposits of later age and are found in existing oceans.[4]

The writer believes that the localities from which the fossils were collected for study are as typical as any which might have been chosen, although further investigation in many new localities can hardly fail to yield additional results.

The excellent state of preservation and the large size of many of the species are most striking and bear witness to the favorable conditions for their existence in the late Cretaceous sea.

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[1] Cretaceous Foraminifera of New Jersey, Part I: Jour. N. Y. Micros. Soc., Vol. VI, No. 2, April, 1890, pp. 45–55.

[2] Ibid., Part 2, Vol. X, No. 4, Oct., 1894, pp. 91–141.

[3] Geol. Surv. Alabama, Rept. Geology Coastal Plain, 1894, pp. 93, 249, 285, 286, 288, 289.

[4] For geological distribution of these forms see tabular review, pp. 69–71.

Specimens of three types have been analyzed, two of calcareous and one of arenaceous character, in order to determine the amount of silica which is present. The analyses were made by Mr. W. F. Hillebrand, and the results are as follows:

No. 1. *Verneuilina triquetra* (von Münster).

	Per cent.
Silica	38.3
Additional insoluble matter	3.07
Total insoluble matter	41.37

This is an arenaceous-siliceous type, and the large amount of silica present is in the form of polished sand grains, with scattered grains of glauconite, which have been firmly cemented together.

No. 2. *Flabellina sagittaria* (Lea).

	Per cent.
Silica	1.2
Additional insoluble matter	0.55
Total insoluble matter	1.75

The base of the additional insoluble matter consisted of alumina and magnesia, together with a trace of iron and probably alkalies.

No. 3. *Nodosaria consobrina*, var. *emaciata* (Reuss).

	Per cent.
Silica	1.8

It is an interesting fact bearing on the origin of greensand that the writer has frequently found shells of Foraminifera filled with glauconite. This has been especially noticeable in *Polymorphina communis*, which in some cases, where the shell is broken away, shows the interior filled with light-green glauconite still bearing upon its outer surface the smooth impress of the shell.

Many Cristellariæ are partially filled with a light-brown clay suggesting the early stage in the formation of the glauconite grain. Upon a few grains of glauconite I have found clinging to the central portion remnants of the original shell, while the glauconite still shows an internal cast of the shell.

It is perhaps rather remarkable that among so many grains of glauconite so few perfect casts of Foraminifera are found and so small a number of intermediate stages, but it must be remembered that the shell wall of the forms is always thin and easily destroyed through solution in the percolating waters in such porous beds. Even among the Lamellibranchiata and Gasteropoda casts of the shells are much more abundant than well-preserved shells, except the heavier, ponderous shells of *Exogyra costata* and *Gryphæa vesicularis*. From the size of the glauconite grains and the peculiarity of their shape it is probable that the glauconite has grown by accretion around an original nucleus, so that the outline of the delicate shells is only exceptionally preserved.

Transverse sections of the glauconite grains show a difference in color and texture between the internal and external parts, the inner

portion being of a light olive-green and softer than the dark-green irregular border.

Several analyses of New Jersey glauconite have been made from carefully selected grains; one made by T. Sterry Hunt is as follows:[1]

Analysis of selected grains of New Jersey glauconite.

SiO_2	50.70	K_2O	5.80
FeO	22.50	Na_2O	0.75
MgO	2.16	H_2O	8.95
CaO	1.11		100.00
Al_2O_3	8.03		

It is not the object of this paper to enter into any discussion of the much-disputed problem of the origin of greensand. This subject has been discussed by numerous writers, especially of late by Murray and Renard[2] in their report upon the deep-sea deposits obtained by the *Challenger* Expedition. A statement of the results brought out by this investigation, with a short review of former theories, has been published by Prof. W. B. Clark[3] in his discussion of the origin of the greensand of New Jersey. That both organic and inorganic materials must be present for the formation of greensand has been established, but just what proportion of each is necessary is not so readily determined. The inorganic material occurring in the New Jersey marl beds is chiefly quartz and mica, and is supposed to have been derived from the crystalline rocks of Pennsylvania and northern New Jersey.

The greensands differ in the size of the sand grains, in the amount of rounding, and in the proportion of sand to glauconite. In the Manasquan formation (lower part of upper marl bed) there is proportionately more glauconite than in any of the other beds, while the quartz grains are more rounded than in the lower beds of the Monmouth formation, though perhaps less so in the upper or Redbank series. So large an amount of quartz sand is present in this latter bed that glauconite holds only a secondary place. For this reason no Foraminifera are known from the Redbank sands, although it is probable that the upper and lower portions of the bed will furnish some when more thoroughly examined.

The Navesink marls contain more Foraminifera than the Manasquan beds, and in a somewhat better state of preservation, but it is in the limestone layer of the Rancocas formation (middle marl bed) that the greatest abundance of forms is found. This deposit, frequently consolidated, is made up of great quantities of bryozoan shells and vast numbers of perfectly preserved Foraminifera. Seventy-nine species have been determined from this horizon alone. Four species are present in all four marl beds, namely: *Nodosaria obliqua* (Linné), *Nodosaria polygona* Reuss, *Nodosaria zippei* Reuss, and *Truncatulina lobatula* (Walker and Jacob).

[1] Mineral Physiology and Physiography, 1886, p. 198.

[2] Reports *Challenger* Expedition; Deep-sea deposits, 1892.

[3] A preliminary report on the Cretaceous and Tertiary formations of New Jersey: Report of the State Geologist of New Jersey for 1892, pp. 167–246.

HISTORICAL SUMMARY.

The value of the greensand marls for fertilizing purposes has been known in New Jersey for more than a century. In 1768 a laborer, while digging a ditch in a meadow near Marlboro, threw out a substance which was pronounced to be *marl*. Some of this marl was spread upon the land with good results, but no particular attention seems to have been paid to the discovery until the year 1811, when its value began to be appreciated.

The discovery of fossils in the marl beds was made soon after, and in 1820 some of these fossils were described by Say,[1] and others by Morton[2] in 1829.

The first mention of Foraminifera was made by Isaac Lea[3] in 1833, in his Contributions to Geology, when he described *Flabellina sagittaria* as *Palmula sagittaria* from the Cretaceous deposit of Timber Creek, New Jersey, in which he considered the form a new genus of the family Spherulacea of Blainville. The genus Palmula Mr. Lea considered as intermediate between the genus Saracenaria of Defrance and the genus Textularia of the same author. This same species was described by Dr. S. G. Morton[4] in 1842 as *Planularia cuneata*.

In the American Journal of Science for 1841[5] Prof. J. W. Bailey gives a brief note on the discovery of fossil Foraminifera in New Jersey, and states that "a large portion of the calcareous rock defined by Prof. H. D. Rogers[6] as the third formation of the upper secondary is made up of great quantities of microscopic shells belonging to the Foraminifera."

Sir Charles Lyell,[7] on his visit to America in the year 1841, noticed the occurrence of Foraminifera in the Cretaceous marl beds of New Jersey, and mentioned three very common types, Cristellaria, Rotalia (Rotalina), and Nodosaria.

In his Origin of Greensand, and its Formation in the Oceans of the Present Epoch,[8] Prof. J. W. Bailey refers to the deposits at Mullica Hill and Mount Holly, New Jersey, as being very rich in greensand casts of Polythalamia.

Mr. W. M. Gabb, in Descriptions of New Species of American Tertiary and Cretaceous Fossils,[9] describes one of the Nodosariæ from Mullica Hill as a new species under the name *Dentalina pulchra*, but which is known to be *Nodosaria zippei* Reuss.

The first report of any importance upon the determination of these

[1] Am. Jour. Sci., 1st series, Vol. II, 1820, pp. 34–45.
[2] Jour. Acad. Nat. Sci. Philadelphia, Vol. VI, 1829, pp. 120–129.
[3] Contributions to Geology, 1833, pp. 219–220, Pl. VI, fig. 228.
[4] Jour. Acad. Nat. Sci. Philadelphia, Vol. VIII, 1842, pp. 214–215, Pl. XI, fig. 5.
[5] Am. Jour. Sci., 1st series, Vol. XLI, 1841, pp. 213–214.
[6] Report of the Geol. Surv. of the State of New Jersey, 1836, pp. 10–13.
[7] Quart. Jour. Geol. Soc. London, Vol. I, 1845, pp. 56, 57, and 64. See, also, Travels in North America, I, 1845, p. 64.
[8] Proc. Boston Soc. Nat. Hist., Vol. V, 1856, pp. 365, 366.
[9] Jour. Acad. Nat. Sci. Philadelphia, new series, Vol, IV, 1860, pp. 375–406, Pl. LXIX.

microscopic organisms was published in 1861 by Prof. A. E. Reuss,[1] one of the most distinguished of European paleontologists. In this article, entitled Die Foraminiferen der senonischen Gründsandes von New Jersey, Professor Reuss described some 28 different species of Foraminifera, but mentioned neither the horizon nor the localities from which they were obtained. While a few of these forms were figured in this report, the majority are given in other works.

Hermann von Credner[2] in 1870 published an article entitled Die Kreide von New Jersey, which contained a general review of the Cretaceous of New Jersey. In this report two Foraminifera from the Bryozoa bed at Brownville, *Flabellina cordata* Reuss and *Nodosaria sulcata* Nilsson, are described.

Subsequent to Professor Credner's report in 1870 no work was done upon the Foraminifera of New Jersey until the year 1894, when Dr. Woodward[3] published the second part of his Cretaceous Foraminifera of New Jersey. In this report some 58 species of Foraminifera from Timber Creek, Mullica Hill, New Egypt, and Bruere's pits, on Crosswicks Creek, are described but not figured.

The material investigated at the geological laboratory of the Johns Hopkins University has furnished nearly twice as many species as previously reported, and six of these are considered to be new. A preliminary report of this investigation, containing a description of the new forms and a tabulated list of other species identified, was published by the author[4] in 1895.

The Foraminifera described in this bulletin are deposited in the geological museum at the Johns Hopkins University, Baltimore, Maryland.

CLASSIFICATION OF STRATA.

The classification of the marl beds adopted in this report is one employed by Prof. W. B. Clark in his report, lately published, upon the Upper Cretaceous formations of New Jersey, Delaware, and Maryland,[5] viz:

Age.	*Formation.*		
EOCENE	Shark River		Upper marl bed.
UPPER CRETACEOUS	Manasquan		
	Rancocas	Vincentown lime sands	Middle marl bed.
		Sewell marls	
	Monmouth	Redbank sands	Red sand and lower marl bed.
		Navesink marls	
		Mount Laurel sands	
	Matawan	Hazlet sands	Clay marls.
		Crosswicks clays	

[1] Sitz. Akad. Wiss. Wien, Vol. XLIV, pt. i, 1861, pp. 334–342, plates.
[2] Zeitsch. d. D. geol. Gesell., 1870, Vol. XXII, pp. 191–251.
[3] Jour. N. Y. Micros. Soc., Vol. X, No. 4, Oct., 1894, pp. 91–141.
[4] Johns Hopkins Univ. Circulars, No. 121, Oct., 1895.
[5] Bull. Geol. Soc. America, vol. 8, pp. 315–358, pls. 40–50.

BIBLIOGRAPHY.

Within the last ten years several bibliographies of the Foraminifera have appeared, which have been of invaluable assistance in the preparation of this report. The best bibliography which has yet been published is that of Prof. Charles D. Sherborn, entitled A Bibliography of the Foraminifera, Recent and Fossil, from 1565 to 1888. (London, 1888.) This excellent catalogue is based upon the bibliography given by Prof. H. B. Brady in the *Challenger* report, but has been greatly enlarged and revised.

Another bibliography, less exhaustive, compiled by Dr. Anthony Woodward, was published in the Fourteenth Annual Report of the Geological and Natural History Survey of Minnesota for the year 1885.

There has lately been published in the Smithsonian Miscellaneous Collections An Index to the Genera and Species of the Foraminifera, by Charles D. Sherborn. This exhaustive work, invaluable to all students of Foraminifera, is in two parts, and forms a portion of Volume XXXVII of the Smithsonian reports. The first part was published in November, 1893, and included all names from A to N, while the second portion, published in 1896, completes the alphabetic list of forms from N to Z. The most distinguished specialists in the Foraminifera have been consulted by Professor Sherborn in the preparation of this laborious work, and too much praise can not be given the author for the completeness and accuracy of its contents.

The following is a list of works consulted in the preparation of this report. No attempt is made to give a complete bibliography; only those publications which have been most useful are included:

AGASSIZ, Alexander. On the Explorations in the Vicinity of the Tortugas during March and April, 1881 (Pelagic Fauna of the Gulf Stream).

Bull. Mus. Comp. Zool., Harvard, Vol. IX, 1881, pp. 145–149.

—— A Contribution to American Thalassography.

Bull. Mus. Comp. Zool., Harvard, Vols. XIV, XV, 1888, and 2 vols., 8°, London, 1888.

ALTH, Alojzy. Geognostisch-paläontologische Beschreibung der nächsten Umgebung von Lemberg.

Haidinger's Naturw. Abhandl., Vol. III, Abth. 2, 1850, pp. 171–284, Pls. IX–XIII (pp. 262–271, Pl. XIII).

ANDREAE, A. Ein Beitrag zur Kenntniss des Elsässer Tertiärs.

Abhandl. Geol. Special-Karte Elsass-Lothringen, Vol. II, Heft 3. 1884, 331 pp., Pls. I–XII.

ANSTED, David Thomas. The Deposits of the North Atlantic in Deep Water, and their Relation to the White Chalk of the Cretaceous Period.

Pop. Science Review, Vol. IX, 1870, pp. 24–33, Pl. LV.

BAILEY, Jacob Whitman. Note on the Discovery of "Fossil Foraminifera in the Green Sand of New Jersey."

Am. Jour. Sci., ser. 1, Vol. XLI, 1841, pp. 213–214.

—— American Polythalamia from the Upper Mississippi, and also from the Cretaceous Formation of the Upper Missouri.

Am. Jour. Sci., ser. 1, Vol. XLI, 1841, pp. 400–401; 4 woodcuts.

—— On Fossil Foraminifera in the Calcareous Marl from the Cretaceous Formation on the Upper Missouri.

Proc. Acad. Nat. Sci., Philadelphia, Vol. I, 1843, p. 75.

—— Microscopical Examination of Soundings made by the U. S. Coast Survey off the Atlantic Coast of the United States.

Smithsonian Contributions, Vol. II, 1851, art. 3, pp. 1–15; plate. Reprinted in Rept. U. S. Coast Survey for 1855 (1856), p. 360.

—— Silicified Polythalamia in Florida.

Am. Jour. Sci., ser. 2, Vol. II, 1851, p. 86.

—— On the Origin of Greensand and its Formation in the Oceans of the Present Epoch.

Proc. Boston Soc. Nat. Hist. Vol. V, 1856, pp. 364-368. Am. Jour. Sci., ser. 2, Vol. XXII, 1856, pp. 280–284. Quart. Jour. Microsc. Science, Vol. V, 1857, pp. 83–87.

BEISSEL, Ignaz. Die Foraminiferen der Aachener Kreide.

Abhandl. geol. Specialkarte von Preussen und d. Thüringischen Staaten, Neue Folge, Heft 3, 1891, Pls. I–XVI.

BERTHELIN, Georges. Mémoire sur les foraminifères fossiles de l'étage Albien de Moncley (Doubs).

Mém. Soc. Géol. France, ser. 3, Vol. I, No. 5, 1880, pp. 1–84, Pls. XXIV–XXVII.

BORNEMANN, Johann Georg. Die microscopische Fauna des Septarienthones von Hermsdorf bei Berlin.

Zeitsch. d. D. geol. Gesell, Vol. VII, 1855, pp. 307–371, Pls. XII–XXI.

BRADY, Henry Bowman. Report on the Foraminifera dredged by H. M. S. *Challenger* during the years 1873–1876.

Reports of the Scientific Results of the Voyage of H. M. S. *Challenger*, Vol. IX, (Zoology), 1884, pp. 814, figures and volume of 115 plates.

—— PARKER, W. K., and JONES, T. R. A Monograph on the Genus Polymorphina.

Trans. Linn. Soc., London, Vol. XXVII, 1870, pp. 197–253, Pls. XXXIX–XLII, and figures in text.

BRONN, Heinrich Georg. Lethaea Geognostica, Ed. 3, 1851–1856.

Vol. I, Theil I, pp. 106–109; Vol. II, Theil V, pp. 81–96, Pls. XXIX, XXXIII, XLII; Vol. III, Theil VI, pp. 197–255, Pls. XXXV^2, XXXV^3, XLII.

—— Die Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild.

Band I, Amorphozoen, 1859, pp. 45–81, Pls. V–VII.

BURROWS, H. W., SHERBORN, C. D., and BAILEY, George. The Foraminifera of the Red Chalk.

Jour. Royal Microsc. Soc., London, ser. 2, Vol. VIII, 1888, pp. 383-385.

—— —— —— The Foraminifera of the Red Chalk of Yorkshire, Norfolk, and Lincolnshire.

Jour. Royal Microsc. Soc., London, 1890, pp. 549-564, Pls. VIII-XI.

CARPENTER, William Benjamin. On the Systematic Arrangement of the Foraminifera.

Nat. Hist. Review, Vol. I, 1861, pp. 456-472.

—— PARKER, W. K., and JONES, T. R. Introduction to the Study of the Foraminifera.

Ray Society, London, 1862, 319 pp., 22 plates.

CHAPMAN, Frederick. Some new forms of Hyaline Foraminifera from the Gault.

Geol. Mag., Decade III, n. s., Vol. IX, 1892, no. 11, pp. 52-54, Pl. II.

—— The Foraminifera of the Gault of Folkstone.

Jour. Royal Micros. Soc. London, 1891, Part I, pp. 565-575, Pl. IX; Ibid, 1892, Part II, pp. 319-330, Pls. V, VI; Ibid, 1892, Part III, pp. 749-758, Pls. XI, XII; Ibid, 1893, Part IV, pp. 579-595, Pls. VIII-IX.

—— Microzoa from the Phosphatic Chalk of Taplow.

Quart. Jour. Geol. Soc. London, 1892, pp. 514-518, Pl. XV.

—— On a Phosphatic Chalk with *Holaster planus* at Lewes. (By A. Strahan.) Appendix by F. Chapman. The Foraminifera and Ostracoda.

Quart. Jour. Geol. Soc. London, Vol. LII, 1896, pp. 470-472.

—— On the Rhizopodal Genera Webbina and Vitrewebbina.

Ann. and Mag. Nat. Hist., ser. 6, Vol. XVIII, 1896, pp. 326-333; figures.

CONRAD, Timothy Abbot. Description of New Species of Organic Remains from the Upper Eocene Limestone of Tampa Bay.

Am. Jour. Sci., ser. 2, Vol. II, 1846, pp. 399-400.

—— Check List of the Invertebrate Fossils of North America. Eocene and Oligocene.

Smithsonian Misc. Coll., Vol. VII, 1866, No. 200, pp. 1-34.

CORNUEL, J. Description de nouveaux fossiles microscopiques du terrain crétacé inférieur du département de la Haute-Marne.

Mém. Soc. Géol. France, ser. 2, Vol. III, 1848, pp. 241-263, Pls. III, IV.

CREDNER, Hermann. Die Kreide von New Jersey.

Zeitsch. d. D. geol. Gesell., Vol. XXII, 1870, pp. 191-251; plate.

DAWSON, George Mercer. On the Occurrence of Foraminifera, Coccoliths, and Rhabdoliths in the Cretaceous Rocks of Manitoba.

Canad. Nat., n. s., Vol. VII, 1874, pp. 252-257; figures.

DAWSON, George Mercer. On the Microscopic Structure of Certain Boulder Clays, and the Organisms contained in them.

Thirteenth Ann. Rept. Geol. and Nat. Hist. Sur. Minn. for 1884 (1885), pp. 150–163.

DAWSON, John William. Notice of Tertiary Fossils from Labrador, Maine, etc.

Canad. Nat., Vol. V, 1860, pp. 188–200; figures.

—— On some New Species of Fossil Protozoa from Canada.

Proc. Am. Assoc. Adv. Sci., Vol. XXIV, 1876, pp. 100–106; figures.

EGGER, Johann Georg. Die Foraminiferen der Miocän-Schichten bei Ortenburg in Nieder-Bayern.

Neues Jahrb. f. Min., etc., 1857, pp. 266–311, Pls. V–XV.

EHRENBERG, Christian Gottfried. Ueber die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen.

Abhandl. königl. Akad. Wiss. Berlin for 1838, 1839, pp. 59–147, Pls. I–IV.

—— Verbreitung und Einfluss des microscopischen Lebens in Süd- und Nord-Amerika.

Abhandl. k. Akad. Wiss. Berlin for 1841, 1843, pp. 291–446, Pls. I–IV.

—— Ueber das mikroscopische Leben in Texas.

Bericht k. preuss. Akad. Wiss. Berlin, 1849, pp. 87–91.

—— Mikrogeologie, 2 vols., 1854; 40 plates.

See PARKER, W. K., et al., Ann. Mag. Nat. Hist., Vols. IX, X, 1872.

ENGELMANN, Wilhelm. Bibliotheca Historico-Naturalis, 1846.

Section Protozoa.

GABB, William M. Catalogue of the Invertebrate Fossils of the United States, with References.

Issued as a separate publication of the Proceedings Acad. Nat. Sci. Philadelphia for 1859 (1860), pp. 1–20.

—— Descriptions of New Species of American Tertiary and Cretaceous Fossils.

Jour. Acad. Nat. Sci. Philadelphia, n. s., Vol. IV, 1860, pp. 375–406.

—— and HORN, G. H. Monograph of the Fossil Polyzoa of the Secondary and Tertiary Formations of North America.

Jour. Acad. Nat. Sci. Philadelphia, n. s., Vol. V, pt. 2, 1862, p. 179, Pl. XXI, fig. 71.

GEINITZ, Hans Bruno. Characteristik der Schichten und Petrefaction des Sächsisch-böhmischen Kreidegebirges; second edition, 1850.

HEILPRIN, Angelo. Notes on Some New Foraminifera from the Nummulitic Formation of Florida.

Proc. Acad. Nat. Sci. Philadelphia, 1884, pp. 321–332; figures.

JOHNSON, H. A., and THOMAS, B. W. Report of the Committee on the Microscopic Organisms in the Boulder Clays of Chicago and Vicinity.

Bull. Chicago Acad. Sci., Vol. I, No. 4, 1884, pp. 35–40; figures.

JONES, Thomas Rupert. Remarks on the Foraminifera, with Especial Reference to their Variability of Form, illustrated by the Cristellarians.

Monthly Microsc. Jour., Vol. XV, 1876, pp. 61-92, Pls. CXXVIII, CXXIX.

—— and PARKER, W. K. On the Foraminifera of the Family Rotalinæ (Carpenter) found in the Cretaceous Formation, with Notes on their Tertiary and Recent Representatives.

Quart. Jour. Geol. Soc. London, Vol. XXVIII, 1872, pp. 103-131.

—— —— and BRADY H. B. A Monograph on the Foraminifera of the Crag. Part I.

Paleontographical Soc., Vol. XIX, 1866, pp. 1-72, Pls. I-IV.

—— and SHERBORN, C. D. Remarks on the Foraminifera, with Especial Reference to their Variability of Form, illustrated by the Cristellarians; Part II.

Jour. Royal Microsc. Soc. London, ser. 2, Vol. VII, 1887, pp. 545-557.

JUKES-BROWNE, A. J. The Origin of Greensand.

Science Gossip, 1876, pp. 30, 170.

KARRER, Felix. Ueber ein Vorkommen von oberer Kreideformation in Leitzersdorf bei Stockerau, und deren Foraminiferenfauna.

Jahrb. k. k. geol. Reichsanst., Vol. XX, 1870, pp. 157-184, Pls. X, XI.

LEA, Isaac. Contributions to Geology, 1833, pp. 227, Pls. I-VI.

LEIDY, Joseph. Foraminifera of the Coast of New Jersey.

Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 292.

LYELL, Charles. Notice of the Foraminifera of the Cretaceous Beds of New Jersey.

Quart. Jour. Geol. Soc. London, Vol. I, 1845, pp. 55-60; figures.

MEEK, Fielding Bradford. Check List of the Invertebrate Fossils of North America; Cretaceous Formation.

Smithsonian Mis. Col., Vol. VII, 1864, No. 177, pp. 26.

—— Synopsis of the Invertebrate Fossils of the Cretaceous Formation of New Jersey.

Appendix A, Geology of New Jersey, 1868, p. 721.

MORTON, Samuel G. Synopsis of the Organic Remains of the Cretaceous Group, 1834; Plates.

—— Description of Some New Species of Organic Remains of the Cretaceous Group of the United States; with a Tabular Review of the Fossils hitherto discovered in this Formation.

Jour. Acad. Nat. Sci. Philadelphia, Vol. VIII, pt. 2, 1842, pp. 207-227, Pls. X, XI.

D'ORBIGNY, Alcide Dessalines. Tableau méthodique de la classe des céphalopodes.

Annales Sci. Nat., Vol. VII, 1826, pp. 245-314, Pls. X-XVII.

—— Voyage dans l'Amérique Méridionale—Foraminifères.

Vol. V, pt. 5, 1839, pp. 1-86, Pls. I-IX.

D'ORBIGNY, Alcide Dessalines. Mémoire sur les foraminifères de la craie blanche du bassin de Paris.

Mém. Soc. Géol. France, Vol. IV, 1840, pp. 1–51, Pls. I–IV.

—— Foraminifères fossiles du bassin tertiaire de Vienne, Pls. I–XXI.

PARKER, W. K., and JONES, T. R. On Some Foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay.

Phil. Trans. (1864), 1865, pp. 321–441, Pls. XII–XIX.

—— —— Description of Some Foraminifera from the Coast of Norway.

Ann. and Mag. Nat. Hist., ser. 2, Vol. XIX, 1857, pp. 273–303, Pls. X, XI.

—— —— BRADY, H. B, and KIRKBY, J. W. On the Nomenclature of the Foraminifera.

Ann. and Mag. Nat. Hist., 1859–1872, ser. 3, Vol. III, to ser. 4, Vol. X.

POURTALES, L. F. de. On the Distribution of the Foraminifera on the Coast of New Jersey, as shown by the Off-shore Soundings of the Coast Survey.

Proc. Am. Assoc. Adv. Sci., Vol. III, 1850, pp. 84–88.

—— The Gulf Stream. Characteristics of the Atlantic Sea-bottom off the Coast of the United States.

Rept. Supt. U. S. Coast Survey for 1869 (1872), pp. 220–225.

REUSS, Aguste E. In H. B. Geinitz, Grundriss der Versteinerungskunde, 1845–46, pp. 635–686, Pl. XXIV.

—— Die Versteinerungen der böhmischen Kreideformation, 1845–46; Plates.

—— Neue Foraminiferen aus den Schichten des österreichischen Tertiärsbeckens.

Denks. Akad. Wiss. Wien, Vol. I, 1850, pp. 365–390, Pls. XLVI–LI.

—— Die Foraminiferen und Entomostraceen des Kreidemergels von Lemberg.

Haidinger's Nat. Abhandl., Vol. IV, 1851, pp. 17–52, Pls. I–V. (Referred to as Pls. II–VI.)

—— Ueber die fossilen Foraminiferen und Entomostraceen der Septarienthone der Umgegend von Berlin.

Zeits. d. D. Geol. Gesell., Vol. III, 1851, pp. 49–92, Pls. III–VII.

—— Beiträge zur Charakteristik der Kreideschichten in den Ostalpen besonders im Gosanthale und am Wolfgangsee.

Denks. Akad. Wiss. Wien, Vol. VII, Abth. 1, 1854, pp. 156, Pls. 31.

—— Beiträge zur Charakteristik der Tertiärschichten des nördlichen und mittleren Deutschlands.

Sitz. Akad. Wiss. Wien, Vol. XVIII, 1855, pp. 197–272, Pls. I–XII.

—— Ein Beitrag zur genauren Kenntniss der Kreidegebilde Mecklenburgs.

Zeits. d. D. geol. Gesell., Vol. VII, 1855, pp. 261–292, Pls. VIII, IX.

REUSS, Aguste E. Die marinen Tertiärschichten Böhmens und ihre Versteinerungen.

Sitz. Akad. Wiss. Wien, Vol. XXXIX, 1860, pp. 207–284, Pls. I–VIII (Pl. III).

—— Die Foraminiferen der Westphälischen Kreideformation.

Sitz. Akad. Wiss. Wien, Vol. XL, 1860, pp. 147–238, Pls. I–XIII.

—— Beiträge zur tertiären Foraminiferen-Fauna. I. Die Foraminiferen des Crag's von Antwerpen (pp. 355–364). II. Die Foraminiferen von Dingden in Westphalen (pp. 364–370).

Sitz. Akad. Wiss. Wien, Vol. XLII, 1860, Pls. I, II (see 1864).

—— Die Foraminiferen des senonischen Grünsandes von New Jersey.

Sitz. Akad. Wiss. Wien, Vol. XLIV, Abth. 1, 1861, pp. 334–340, Pls. I–VIII.

—— Die Foraminiferen des nord-deutschen Hils und Gault.

Sitz. Akad. Wiss. Wien, Vol. XLVI, Abth. 1, 1862 (1863), pp. 5–100, Pls. I–XIII.

—— Beiträge zur Kenntniss der tertiären Foraminiferenfauna.

Sitz. Akad. Wiss. Wien, Vol. XLVIII, Abth. 1, 1863, pp. 36–69, Pls. I–VIII.

—— Zur Fauna des deutschen Ober-Oligocäns, I Abth.

Sitz. Akad. Wiss. Wien, Vol. L, Abth. 1, 1864 (1865), pp. 435–482, Pls. I–V.

—— Die Foraminiferen und Ostrakoden der Kreide am Kanara-See bei Küstendische.

Sitz. Akad. Wiss. Wien, Vol. LII, Abth. 1, 1865 (1866), pt. 1, pp. 445–470, Plate.

—— Die Foraminiferen, Anthozoen, und Bryozoen des deutschen Septarienthones.

Denks. Akad. Wiss. Wien, Vol. XXV, 1865, pp. 117–204, Pls. I–XI.

—— Die Bryozoen und Foraminiferen des unteren Quaders.

Palæontographica, Vol. XX, pt. 1, 1871–1875, pp. 97–142, Pls. XXIV–XXXIII.

ROEMER, Ferdinand. Die Kreidebildungen von Texas, 1852, p. 86, Pl. X, fig. 7.

ROEMER, Friedrich Adolph. Die Versteinerungen des norddeutsches Kreidegebirges, 1840–41, pp. 145, Pls. I–XVI (Pl. XV). Neue Kreide-Foraminiferen.

Neues Jahrb. f. Min., etc., 1842, pp. 272, 273, Pl. VII B.

SCHWAGER, Conrad. Saggio di una classificazione dei Foraminiferi avuto riguardo alle loro famiglie naturali.

Boll. R. Com. Geol. Ital., 1876, pp. 475–485; 1877, pp. 18–24; plate.

SCIENCE GOSSIP, 1870. Recent Foraminifera, pp. 9–12, figs. 17–31; Chalk Foraminifera, pp. 81–83, figs. 75–94; d'Orbigny's Foraminifera, pp. 106–108, figs. 103–119; d'Orbigny's Foraminifera, pp. 155–157, figs. 138–156.

SEGUENZA, G. Studi geologici e paleontologici sul cretaceo medio dell' Italia meridionale.

Atti R. Accad. Lincei., ser. 3, Vol. XII, 1879, pp. 65–214, Pls. I–XXI.

SHERBORN, C. D. A Bibliography of the Foraminifera, Recent and Fossil, from 1565 to 1888. London, 1888.

—— An Index to the Genera and Species of the Foraminifera.

Part I, A–Non. Smithsonian Misc. Coll. No. 856, 1893. Part II, Non–Z. Smithsonian Misc. Coll. No. 1031, 1896. Part of Vol. XXXVII, not yet published.

—— and CHAPMAN, F. On Some Microzoa from the London Clay exposed in the Drainage Works. Piccadilly, London, 1885.

Jour. Royal Microsc. Soc., ser. 2, Vol. VI, 1886, pp. 737–764, Pls. I–III.

SOLLAS, W. J. On the Perforate Character of the Genus Webbina, etc.

Geol. Mag., Decade II, Vol. IV, No. 3, March, 1877, pp. 102–105, Pl. VI.

TASCHENBERG, O. Bibliotheca Zoologica II, Third Lief., 1887. Protozoa, pp. 880–925.

TERSUEM, Olry. Les foraminifères de l'Eocène des environs de Paris.

Mém. Soc. Géol. France, ser. 3. Vol. II, Mém. 3, 1882, pp. 193, Pls. IX–XXVIII.

VERRILL, A. E. Characters of the Deep-sea Deposits of the Eastern American Coasts.

Amer. Nat., Vol. XIX, 1885, pp. 69, 70.

WHITE, C. A. Bibliography of North American Invertebrate Palæontology, 1878, pp. 132.

WILLIAMSON, William Crawford. On the Recent Foraminifera of Great Britain. Ray Society, 1858; plates.

WOODWARD, Anthony. A Bibliography of the Foraminifera, Recent and Fossil, including Eozoön and Receptaculites, 1565–1886.

Fourteenth Ann. Rept. Geol. Nat. Hist. Surv. Minn. for 1885, pp. 167–311, 1886.

—— Cretaceous Foraminifera of New Jersey, Part I.

Jour. N. Y. Micr. Soc., Vol. VI, No. 2, Apr., 1890, pp. 45–55.

—— Cretaceous Foraminifera of New Jersey, Part II.

Jour. N. Y. Micr. Soc., Vol. X, No. 4, Oct., 1894, pp. 91–141.

—— Foraminifera found in the Alabama Chalk.

Geol. Surv. Ala., Report of Geol. Coastal Plain, 1894, p. 289.

—— and THOMAS, B. W. On the Foraminifera of the Boulder Clay taken from a Well Shaft 22 feet deep, Meeker County, Central Minnesota.

Thirteenth Ann. Rept. Geol. and Nat. Hist. Surv. Minn. for 1884, pp. 164–177, Pls. III, IV.

—— —— The Microscopical Fauna of the Cretaceous in Minnesota, with Additions from Nebraska and Illinois.

Final Rept. Minn. Geol. and Nat. Hist. Surv. Vol. III, 1893, pp. 23–51, Pls. C–E.

WOOLMAN, Lewis. Microsc. Bull. Queen & Co., Vol. V, No. 6, 1888, p. 41.

ZITTEL, Karl A. von. Handbuch der Palæontologie, 1876–1880, Band I, Abth. 1, pp. 61–114; pp. 723–732.

DESCRIPTIVE TERMS.

The following descriptive terms, adopted in this memoir, are taken, with some modification, from the report on the Recent Foraminifera of Great Britain, by Prof. W. C. Williamson.[1] The figures employed have been copied, but the lettering has been changed.

The *length* is measured in the direction or axis of growth, as indicated by the line A B in fig. 1 of Pl. I, and the *breadth* by a line at right angles to the former one, C D in the same figure.

The above terms are applicable for evolute and convolute types, but in certain forms, either monothalamous and rounded or when the growth of chambers is around a central aperture, it is more convenient to use the term *diameter*.

The separate divisions of a shell or test are spoken of as *segments*, designated in fig. 1 of Pl. I as P, I, and U, of which P is the *primordial* and U the *ultimate* segment, while I, holding an intermediate position, is known as an *intermediate* segment. That part of the external surface nearest the end of the ultimate segment is called the *anterior margin* (fig. 1, *a*), while the opposite end is referred to as the *posterior margin* (fig. 1, *p*). These terms have a direct reference to the direction of growth.

The various segments are separated from one another by partitions called *septa*, and these are usually indicated externally by more or less definite constrictions known as *septal lines* (fig. 1, *s*). In old age these constrictions often become filled up and appear as ridges instead of depressions. The *septal plane* is the superficial area of each septum and corresponds in dimensions with the entire breadth of the constricted portion of the shell (fig. 1, *s p*).

Each septum is provided with one or more openings known as *septal apertures*, which serve as a means of communication between contiguous segments. The perforation of the anterior end of the ultimate segment is spoken of as the *oral aperture* (fig. 1, *o a*).

The different views of the shell are referred to as the *anterior*, *lateral*, and *periphero-lateral* aspects. The anterior aspect is seen by looking down upon the septal plane of the ultimate segment; the lateral aspect shows the shell from one side, as in fig. 1; while the periphero-lateral aspect is seen in depressed forms where the shell is viewed from its thin edge, as in fig. 3 of Pl. II. When the segments are arranged in a complete circuit around the primordial cell they constitute a *convolution*. Each convolution joins a contiguous one by a spiral line called the *spiral suture* (Pl. I, fig. 2, *m*). In the simplest case these convolutions are arranged in a single plane, but in more complex types each convo-

[1] On the Recent Foraminifera of Great Britain, Ray Society, London, 1858, pp. 14–18.

lution is formed in a different plane, and a *trochoid* type of shell results, as in Discorbina (fig. 4). The word "rotaliform" is used to express a form in which all of the segments are visible upon the superior surface, but only those of the last convolution are visible upon the inferior surface.

Each side of the shell in convolute types presents a *lateral surface* (fig. 3, L L). The sides of the shell at right angles to these lateral surfaces constitute the *peripheral margin* (fig. 3, *x x*). The margin is very varied in shape, and the angle formed by its outline is called the *peripheral angle.*

The depression formed in the center of the shell is called the *umbilicus.* Sometimes, instead of being depressed the early chambers are raised or elevated into a sort of boss by deposit of exogenous material, but the area is always referred to as the umbilical area, whether raised or depressed.

The terms *superior* and *inferior* lateral surface are constantly referred to and should be clearly understood. When a form continues its convolutions in a single plane both sides remain similar and there is no distinction between the upper and lower lateral surfaces, but when the coils are arranged spirally, as in trochoid types, there is a difference between the surfaces and it becomes necessary to indicate by the terms "superior" and "inferior" the surface referred to.

The term *superior lateral surface* (fig. 4, S L S) is the one in which the primordial segment is situated, while the opposite side, in which the form is extending its growth, is the *inferior lateral surface* (fig. 4, I L S). There are some exceptions to this rule, as, for example, in certain Truncatulina types, which are approximately flat upon the side that bears the primordial segment, as if the shell were cut in halves, the line of division passing through the center of the primordial segment. In such cases the lower (flat) surface becomes the superior lateral side.

The term *distal end* refers to the portion of the shell which carries the oral aperture and is usually farthest removed from the primordial segment. The portion of the shell in which the primordial segment is situated is called the *proximal end.*

It is often necessary to speak of a given type of shell, and therefore the following terms are employed in this report:

1. Nodosarian (Pl. I, fig. 1). Chambers typically arranged in a straight row.

2. Nautiloid (Pl. I, figs. 2 and 3). Chambers wound in a horizontal manner, forming an equilateral spire.

3. Trochoid (Pl. I, fig. 4). Chambers wound around one side of the primordial segment in an inequilateral spire.

4. Textularian (Pl. I, fig. 5). Chambers arranged alternately in an elongated series (biserial).

5. Milioline (Pl. I, fig. 6). Chambers wound spirally about an imaginary axis.

DESCRIPTION OF GENERA AND SPECIES.

Subkingdom PROTOZOA.

Class RHIZOPODA.

Order FORAMINIFERA.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

Genus HAPLOPHRAGMIUM Reuss.

HAPLOPHRAGMIUM CONCAVUM Bagg.

PLATE II, figs. 1a, 1b.

Test arenaceo-siliceous, rough, of a dull-gray color; consisting of eight or nine chambers, which are concave upon their inner margin, giving the form an approximately triangular outline in transverse section; chambers variable in size; ultimate chamber largest and very slightly elevated in the central portion; septal lines straight, marked by definite deep constrictions; aperture a large elongated oval opening, situated toward the outside edge of the ultimate chamber and nearer the convex side.

Length, 1 mm.; breadth, 0.43 mm.

Locality.—Rancocas formation, Blue Ball, New Jersey.

Geological distribution.—Cretaceous.

HAPLOPHRAGMIUM IRREGULARE (Roemer).

Spirolina irregularis Roemer, 1840–41; Verstein. norddeutsch. Kreide, p. 98, Pl. XV, fig. 29.

Haplophragmium irregulare Reuss, 1860; Sitz. Akad. Wiss. Wien., Vol. XL, p. 219, Pl. X, fig. 9; Pl. XI, fig. 1.

Test arenaceous, rough, flask-shaped; chambers unequal and irregular, at first involute, then evolute and arranged in an elongated series, closely set, numerous (about fifteen), narrow, separated by straight depressed septa; aperture divided.

Length, 2.6 mm.; breadth, 0.6–0.9 mm.

Locality.—Rancocas formation, Vincentown, New Jersey. Rare.

Geological distribution.—Cretaceous.

Subfamily TROCHAMMININÆ.

Genus TROCHAMMINA Parker and Jones.

TROCHAMMINA INFLATA (Montagu).

Nautilus inflatus Montagu, 1808; Test. Brit. Suppl., p. 81, Pl. XVIII, fig. 3.

Trochammina inflata Brady, 1884; Chal. Rept., Vol. IX, p. 338, Pl. XLI, fig. 4, a–c.

"Test free; trochoid or convex, depressed, rotaliform; consisting of about three convolutions, the outermost of which is formed of five or six very ventricose segments with deeply excavated septal lines. Inferior

face somewhat concave, with sunken umbilicus; peripheral margin lobulated. Aperture small, arched; situated on the inferior side of the final segment, close to the previous convolution, a little within the periphery. Color pale brown, the small primary segments much darker than the rest." (Brady, loc. cit.)

The above description agrees closely with the New Jersey specimens, but the color is rather a yellowish white than a brown, and the external view shows only two convolutions instead of three, as in Professor Brady's figure.

Diameter, 0.43 mm.

Locality.—Rancocas formation, Timber Creek, near Mullica Hill, New Jersey.

Geological distribution.—Lias to Recent.

Family TEXTULARIDÆ.

Subfamily TEXTULARINÆ.

TEXTULARIA Defrance.

TEXTULARIA AGGLUTINANS d'Orbigny.

Textularia agglutinans d'Orbigny, 1839; Foram. Cuba, p. 136, Pl. I, figs. 17, 18, 32–34.
Textularia agglutinans Brady, 1884; Chal. Rept., Vol. IX, p. 363, Pl. XLIII, figs. 1–3; var., figs. 4, 12.

Test agglutinous, elongated, of a dull gray color, laterally convex; chambers rather numerous, ten to twelve in long specimens; septa nearly straight; aperture semilunar.

Length, 2.37 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, Timber Creek, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This is a rather common species at Vincentown, where it occurs in the "lime sand." It is interesting to see the small, smooth glauconite grains which help to form the shell substance.

TEXTULARIA AGGLUTINANS var. PORRECTA Brady.

Textularia agglutinans var. *porrecta*, Brady, 1884; Chal. Rept., Vol. IX, p. 364, Pl. XLIII, fig. 4.

Test much elongated, agglutinous, of nearly uniform width; chambers more numerous than in *Textularia agglutinans*, otherwise both forms are very similar.

The New Jersey specimens are not quite so elongated as the figure in the *Challenger* Report.

Length, 2 mm.; breadth, 0.6 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This form has been described by Tyrrell from the Cretaceous rocks of Canada.

TEXTULARIA GIBBOSA d'Orbigny.

Textularia gibbosa d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 262, No. 6.
Textularia gibbosa Terrigi, 1891; Mem. R. Com. G. Regno, Vol. IV, pt. 1, p. 68, Pl. I, fig. 10.

Test ovate elongate, smooth, of a dull-gray color; transverse section round; shell composed of only four chambers in each series; septal lines arched, scarcely discernible externally; aperture a median semilunar arch in the ultimate segment.

Length, 0.9–1 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous to Recent.

TEXTULARIA GLOBULOSA Ehrenberg.

Textularia globulosa Ehrenberg, 1839; Abhandl. k. Ak. Wiss. Berlin (1838), p. 135, Pl. IV, fig. *β*.
Textularia globulosa Woodward and Thomas, 1885; 13th Ann. Rept. Geol. Nat. Hist. Survey Minnesota for 1884, p. 166, Pl. III, figs. 1-5.

Test small, consisting of a few smooth, spherical, or globular chambers; suture lines deep; shell posteriorly acute, anteriorly obtuse.

Length unknown.

Locality.—Monmouth formation, Freehold, New Jersey. Rare.

Geological distribution.—Cretaceous.

It has been impossible to find shells in perfect preservation, since the constructions between the chambers are so pronounced that the chambers are easily broken off, but the few globular chambers we do find are sufficient for the determination of the species.

TEXTULARIA GRAMEN d'Orbigny.

Textularia gramen d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 248, Pl. XV, figs. 4–6.
Textularia gramen Brady, 1884; Chal. Rept., Vol. IX, p. 365, Pl. XLIII, figs. 9, 10.

Test arenaceous, rough externally, stoutly built, laterally compressed, margin subangular; five to six wide chambers, very slightly convex; posterior end neatly rounded; general outline very similar to *Textularia hauerii*, but distinguished from that species by its more angular lateral edges, and differing from *Textularia abbreviata*, which it also resembles, in being less short and thick.

Length, 1 mm.; breadth, 0.52 mm.

Locality.—Rancocas formation, Vincentown, Timber Creek, etc., New Jersey.

Geological distribution.—Cretaceous to Recent.

TEXTULARIA SAGITTULA Defrance.

Textularia sagittula Defrance, 1824; Dict. Sci. Nat., Vol. XXXII, p. 177; 1828, Vol. LIII, p. 344; Atlas, Conch., Pl. XIII, fig. 5.
Textularia sagittula Brady, 1884; Chal. Rept., Vol. IX, p. 361, Pl. XLII, figs. 17, 18.

Test elongated, strongly compressed, with sharp-angled peripheral margin; chambers numerous (12 to 15), closely set, visible externally in the upper portion only; septal lines almost straight, curving very gently toward the central portion; aperture linear.

Length, 0.45–0.55 mm.

Locality.—Rancocas formation, Vincentown, New Egypt, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

TEXTULARIA TURRIS d'Orbigny.

Textularia turris d'Orbigny, 1840; Mém. Soc. Géol. France, ser. 1., Vol. IV, p. 46, Pl. IV, figs. 27, 28.

Textularia turris Brady, 1884; Chal. Rept., Vol. IX, p. 366, Pl. XLIV, figs. 4, 5.

Test nearly round in transverse section, elongate, conical, rugose, tapering, anteriorly truncate; chambers numerous, complanate, somewhat irregular, quite distinct at the distal end.

Length, 1 mm.

Locality.—Rancocas formation, Vincentown, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

Genus VERNEUILINA d'Orbigny.

VERNEUILINA POLYSTROPHA (Reuss).

Bulimina polystropha Reuss, 1845–46; Verstein. böhm. Kreide, pt. 2, p. 109, Pl. XXIV. fig. 53.

Verneuilina polystropha Brady, 1884; Chal. Rept., Vol. IX, p. 386, Pl. XLVII, figs. 15–17.

Test arenaceous, rough, somewhat triangular, composed of only a few chambers, which increase very rapidly in size from below downward; aperture a central arched opening in the ultimate segment.

Length, 0.43 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous to Recent.

VERNEUILINA TRIQUETRA (Münster).

Plate II, fig. 2.

Textularia triquetra Münster, 1838; in Roemer's paper, Neues Jahrb., p. 384, Pl. III, fig. 19.

Textularia atlantica Bailey, 1851; Smithsonian Contrib., Vol. II, art. 3, p. 12, figs. 38–43.

Verneuilina triquetra Brady, 1884; Chal. Rept., Vol. IX, p. 383, Pl. XLVII, figs. 18–20.

Test composed of coarse sand grains and scattered grains of glauconite, triserial; chambers with flattened sides, definitely marked by sutures, eight to ten in each series; transverse section an almost equilateral triangle; surface rugose, and the coarse sand grains are interspersed with grains of glauconite; septal lines arched in the central

portion and directed downward toward the edges; triangular edges not always straight, but curved somewhat in passing from the primordial to the distal end; aperture a median elongated slit with a depressed margin.

The shell is of a dull-gray color, and attains large size.

An analysis of *Verneuilina triquetra* gave 41.37 per cent of silica. The sand grains are very firmly cemented by calcareous substance which forms the base of the shell.

It is a very common species.

Length, 3.13 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, and Timber Creek, New Jersey. Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

Genus TRITAXIA Reuss.

TRITAXIA TORTILIS (Reuss).

Bulimina tortilis Reuss, 1861; Sitz. Akad. Wiss. Wien, Vol. XLIV, pt. 1, p. 338, Pl. VIII, fig. 3, a, b.

Test small, trihedral; chambers few, five to seven in each series, somewhat inflated and depressed at the septal lines; peripheral margins rather sharp; primordial end bluntly pointed; ultimate segment large, overreaching, and bearing the elliptical aperture near the upper part of the septal face.

Length, 0.52 mm.

Locality.—Rancocas formation, Swedesboro, New Jersey.

Geological distribution.—Cretaceous.

TRITAXIA TRICARINATA (Reuss).

Textularia tricarinata Reuss, 1845–46; Verstein. böhm. Kreide, pt. 1, p. 39, Pl. VIII, fig. 60.

Tritaxia tricarinata Brady, 1884; Chal. Rept., Vol. IX, p. 389, Pl. XLIX, figs. 8, 9.

Test tricarinate; lateral surfaces slightly concave, consisting of a few (four or five) rather indistinct segments in each row; aperture central, rotund, in a short elevated neck.

Length, 1.3 mm.

Locality.—Rancocas formation, Swedesboro, Timber Creek, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

Genus GAUDRYINA d'Orbigny.

GAUDRYINA PUPOIDES d'Orbigny.

Gaudryina pupoides d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 44, Pl. IV, figs. 22–24.

Gaudryina pupoides Brady, 1884; Chal. Rept., Vol. IX, p. 378, Pl. XLVI, figs. 1–4.

"*Gaudryina pupoides* is an easily recognized species. Its dimorphous mode of growth is generally very apparent, and its variability is

limited to such features as the number of segments, the relative length and breadth of the test, and the degree of lateral compression. In recent shells the walls are thin and calcareous, smooth externally, and almost invariably of a grayish hue; fossil specimens sometimes exhibit slightly rough exterior. In form and position the aperture resembles that of the typical Textulariæ, but it is often surrounded by a raised tip or border." (Brady, loc. cit.)

Length, 2 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

Genus CLAVULINA d'Orbigny.

CLAVULINA COMMUNIS d'Orbigny.

Clavulina communis d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 268, No. 4.

Clavulina communis, d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne; p. 196, Pl. XII, figs. 1, 2.

Test elongate, straight, rough externally and arenaceous; early segments triquetrous, spiral, and forming a pointed apex, a transverse section of which is round, not angular as in *Clavulina parisiensis* d'Orbigny; anterior chambers marked by depressed septa, somewhat irregular in size, but the ultimate one is the largest; aperture normally a central opening in a short tubular neck of the ultimate chamber.

Length, 2.1 mm.

Locality.—Rancocas formation, Brownsville, New Jersey.

Geological distribution.—Upper Cretaceous to Recent.

CLAVULINA PARISIENSIS d'Orbigny.

Clavulina parisiensis d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 268, No. 3; Modèle, No. 66.

Clavulina parisiensis Brady, 1884; Chal. Rept., Vol. IX, p. 395, Pl. XLVIII, figs. 14–18.

Test coarsely arenaceous, elongated, straight or nearly so; ultimate chambers nodosarian, short, marked by straight, somewhat depressed septa; primordial segments triquetrous as in *Clavulina communis* d'Orbigny, but wedge-shaped and triangular in outline instead of being rounded; aperture a central opening in a short tubular neck.

Length, 2.4 mm.

Locality.—Rancocas formation, Brownsville, New Jersey.

Geological distribution.—Cretaceous to Recent.

Occurs with the preceding not rarely in the lime sand of Brownsville.

Subfamily BULIMININÆ.

Genus BULIMINA d'Orbigny.

BULIMINA PUSCHI Reuss.

Bulimina puschi Reuss, 1851; Haidinger's Naturw. Abhandl., Vol. IV, pt. 1, p. 37, Pl. III, fig. 6.

Test elongate oval, obtusely rounded above, acutely rounded below,

shell wall very punctate; chambers rapidly increasing in size from below upward, irregularly wedge-shaped, moderately depressed at the sutures; aperture a comma-shaped slit near the margin of the ultimate segment.

Length, 0.5 mm.

Locality.—Monmouth formation, Freehold, New Jersey. Very rare.

Geological distribution.—Cretaceous.

BULIMINA VARIABILIS d'Orbigny.

Bulimina variabilis d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, pt. 1, p. 40, Pl. IV, figs. 9–12.

Bulimina variabilis Reuss, 1845–46; Verstein. böhm. Kreide, pt. 1, p. 37, Pl. VIII, figs. 56, 76, 77.

Test variable, ovate or oblong, very finely perforate; spire short, obtuse posteriorly; segments few, very narrow, slightly oblique; ultimate chamber ending in a flat surface; aperture oval, situated at the inner margin.

Diameter, 0.2–0.3 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

This small species from the New Jersey marl beds agrees closely with the figures of Professor Reuss. It has been recognized only in the lower marl bed at Freehold, and is a rare form.

Genus BOLIVINA d'Orbigny.

BOLIVINA PUNCTATA d'Orbigny.

Plate II, fig. 3.

Bolivina punctata d'Orbigny, 1839; Foram. Amér. Merid., p. 63, Pl. VIII, figs. 10–12.

Bolivina antiqua d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 240, Pl. XIV, figs. 11–13.

Bolivina punctata Brady, 1884; Chal. Rept., Vol. IX, p. 417, Pl. LII, figs. 18, 19.

Test elongate, textulariform, smooth, compressed, finely perforate, anterior end obtuse, posterior acute, lateral margins subcarinate; chambers five to seven in each series; septal lines depressed; aperture terminal, simple, oval.

Length, 0.35 mm.; greatest breadth, 0.15 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, and Bruere's pits on Crosswicks Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is common at Freehold. It resembles *Bolivina textilaroides* Reuss in the small number of chambers and somewhat broader outline, but differs from this latter species in being much more oval in outline when seen in transverse section.

BOLIVINA TEXTILAROIDES Reuss.

Bolivina textilaroides Reuss, 1862; Sitz. Akad. Wiss. Wien, Vol. XLVI, p. 81, Pl. X, fig. 1.

Bolivina textilaroides Brady, 1884; Chal. Rept., Vol. IV, p. 419, Pl. LII, figs. 23–25.

Test textulariform; segments few in number, about six in each series; septal lines depressed, and the chambers somewhat inflated; surface smooth, finely punctate; peripheral margins rounded, and more or less lobulated.

Length, 1 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is less common than *Bolivina punctata.*

Genus PLEUROSTOMELLA Reuss.

PLEUROSTOMELLA SUBNODOSA Reuss.

Nodosaria nodosa (pars) Reuss, 1845–46; Verstein. böhm. Kreide, pt. 1, p. 28, Pl. XIII, fig. 22.

Dentalina subnodosa (pars) Reuss, 1850; Haidinger's Naturw. Abhandl., Vol. IV, pt. 1, p. 24, Pl. I, fig. 9.

Pleurostomella subnodosa Brady, 1884; Chal. Rept., Vol. IX, p. 412, Pl. LII, figs. 12, 13.

Test elongate, almost straight, with somewhat irregular outline; chambers enlarging, slightly convex, separated by oblique sutures; ultimate chamber largest, shortly acute; primordial chamber smallest, rounded; aperture an elongated, naked, oval opening extending slightly down the side of the ultimate segment.

Length, 1 mm.

Locality.—Rancocas formation, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

Genus LAGENA Walker and Boys.

LAGENA GLOBOSA (Montagu).

Vermiculum globosum Montagu; Testac. Brit., 1803, p. 523.

Oolina simplex Reuss, 1851; Haidinger's Naturw. Abhandl., Vol. IV, pt. 1, p. 22, Pl. I, fig. 2.

Lagena globosa Reuss. 1863; Sitz. Akad. Wiss. Wien, Vol. XLVI, pt. 1, p. 318, Pl. I, figs. 1–3.

Lagena globosa Brady, 1884; Chal. Rept., Vol. IX, p. 452, Pl. LVI, figs. 1–3.

Test subglobular, elliptical or pyriform; surface smooth; finely perforate shell with thin, hyaline cell walls; anterior margin somewhat projecting, with aperture in an entorolenian neck.

Length, 2 mm.; breadth, 1.5 mm.

Locality.—Rancocas formation, Vincentown and Mullica Hill, New Jersey.

Geological distribution.—Jurassic to Recent.

Genus VITREWEBBINA Chapman.

"Test opaque to translucent, of a whitish or pale-brown color. Shell wall very finely perforated, consisting of a single hemispherical or pyriform chamber, or of a graduated series dispersed usually in a curved line, and adherent upon some foreign substance. The chambers are connected by stolon tubes, very distinctly seen on the under surfaces of the specimens which have become detached. The surface of the shell may be smooth, pitted, or, as in Dr. Sollas's specimen, tuberculate."[1]

VITREWEBBINA SOLLASI Chapman.

Plate II, figs. 5a, 5b.

Vitrewebbina sollasi Chapman, 1892; Geol. Mag., n. s., decade 3, Vol. IX, No. 2, Feb., pp. 53-54, Pl. II, fig. 4.

Test smooth, adherent, hyaline, finely perforate; consisting of one or many chambers arranged in a more or less curving irregular chain; chambers attached by stoloniferous tubes; aperture terminal in ultimate chamber; length variable, dependent upon the number of chambers.

Breadth, 0.2–0.6 mm.; shell diameter, 0.01 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

This is a very common form at Vincentown, and is frequently found adhering to *Flabellina sagittaria*, although often occurring on other shell fragments. Although the primordial chamber is generally the smallest and the ultimate the largest, there is no regularity of arrangement in regard to size of the chambers.

It was with some difficulty that the position of this form was determined. The structure of the shell substance alone separates it from *Trochammina irregularis* Carpenter,[2] but solution of the shell in hydrochloric acid failed to reveal any trace of arenaceous or siliceous material, although in some cases there was an inner coating of amorphous material remaining insoluble in the acid.

A form similar to the one under discussion is figured by Quenstedt[3] and described by him as *Bullopora rostrata* in the following words: "This consists of simple, small, dark hemispheres, united with each other through lengthened tubes. This tube often projects from the end cell like a beak, whence I have given it its name. Generally the pustules (chambers) increase in size, with now and then smaller ones between, while the primordial cell is similar to those succeeding." This species is described by Schwager[4] as *Placopsilina rostrata*, and is placed under the calcareous perforate division of the Dentaloidea.

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[1] Chapman, Geol. Mag., n. s., decade 3, Vol. IX, No. 2, Feb. 1892, p. 53.

[2] Introduction to the Study of the Foraminifera, p. 142, Pl. XI, figs. 6–10.

[3] Der Jura, 1858, p. 580, Atlas, Pl. LXXIII, fig. 28.

[4] Bolletino del R. Comitato Geol. d'Italia, 1877, Vol. VIII, p. 18, Pl. fig. 12.

In the original description of the genus Placopsilina[1] no mention is made of the nature of the test, whether of arenaceous or calcareous composition, but later authorities (Brady[2]) consider the genus under arenaceous types of the Lituolidæ.

The tubulated structure of the genus Webbina, simulating the arenaceous Trochamminæ, is quite striking, and its calcareous composition in this case led to a discussion by Dr. W. J. Sollas,[3] "On the perforate character of the genus Webbina," etc., and the later establishment of a new genus, Vitrewebbina, by Frederick Chapman,[4] which I have adopted as a solution of the difficulty presented by this isomorphous form.

VITREWEBBINA LÆVIS (Sollas).

Plate II, figs. 4a, 4b.

Webbina lævis, Sollas, 1877; Geol. Mag., n. s., decade 2, Vol. IV, No. 3, March, pp. 103–104, Pl. VI, figs. 1–3.

Test very similar to *Vitrewebbina sollasi* in shape and general appearance, and differing from that species only in having no external marginal flange and in being somewhat more elevated. The form occurs with the preceding in the lime sand at Vincentown, but is not very common, while *Vitrewebbina sollasi* is rather plentiful.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

Subfamily NODOSARINÆ.

Genus NODOSARIA Lamarck.

NODOSARIA ACUMINATA (Reuss).

Dentalina acuminata Reuss 1860; Sitz. Akad. Wiss. Wien, Vol. XL, p. 181, Pl. I, fig. 7.

Test elongate, straight, tapering sharply; surface smooth; nine oval, regular chambers, rapidly increasing in size toward the distal end; primordial end acuminate; ultimate chamber globose, anteriorly prolonged into a distinct eccentric tube; septa depressed, transverse; aperture nipple-shaped.

The above species is very similar to *Dentalina subrecta* Reuss, but the latter has fewer segments and the proximal end less acuminate.

Length, 0.9 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

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[1] d'Orbigny, A. D., Prodrome de Paleontologie Stratigraphique, 1850, Vol. II, p. 96.

[2] *Challenger* Report, 1884, Vol. IX, p. 314.

[3] Geol. Mag., n. s., decade 2, Vol. IV, No. 3, March, 1877, pp. 102–105.

[4] Geol. Mag., n. s., decade 3, Vol. IX, No. 2, Feb., 1892, p. 53.

NODOSARIA ADOLPHINULA (d'Orbigny).

Dentalina adolphinula d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 51, Pl. II, figs. 18–20.

Dentalina adolphinula Sherborn and Chapman, 1886; Jour. Roy. Micros. Soc., ser. 2, Vol. VI, p. 750, Pl. XV, figs. 11, *a*, *b*, 12.

Test composed of six or seven short, oval chambers, very strongly separated by septal constrictions. The anterior portions of the ultimate chambers are smooth, but upon the lower ends of these are two rows of spines or tubercles jutting out at a low angle from the surface. Upon the primordial segments these spines are found to cover the whole surface. Primordial chamber armed with a short spine; ultimate segment ending in a tubular neck, which carries the round aperture.

Length, 1 mm. and over.

Locality.—Rancocas formation, southeast Swedesboro, New Jersey.

Geological distribution.—Cretaceous to Recent.

This small nodosarian form is not uncommon in the lime-sand beds below Swedesboro.

NODOSARIA ANNULATA Reuss.

Nodosaria annulata Reuss, 1844; Geogn. Skizze Böhmen, Vol. II, pt. 1, p. 210.

Nodosaria annulata Reuss, 1845–46; Verstein. böhm. Kreide, pt. 1, p. 27, Pl. VIII, figs. 4, 67. Pl. XIII, fig. 21.

Test smooth and glistening, arcuate, very elongate, tapering sharply to a point toward the proximal end; chambers spherical, numerous, fifteen to twenty, more constricted and globose toward the ultimate chamber, which is prolonged somewhat in its upper portion and carries the round mammillate aperture; septa transverse, definitely depressed at the anterior end.

This is one of the largest of all our nodosarian types. It resembles the specimens of *Nodosaria obliqua*, but is easily distinguished from the latter by its smooth surface. The proximal end of the shell sometimes shows very faint striæ as indications of ribs, but these are never prominent, and are visible only under the microscope.

Length, over 10 mm. in long specimens; breadth of largest chamber, 1 mm.

Locality.—Monmouth formation, Freehold, New Jersey; Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

NODOSARIA COMMUNIS (d'Orbigny.)

Dentalina communis d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 254, No. 35.

Nodosaria communis Brady, 1884; Chal. Rept., Vol. IX, p. 504, Pl. LXII, figs. 19–22.

Test elongate, slightly arcuate, smooth; septa oblique, depressed; chambers numerous, ten to fifteen, convex anteriorly; aperture small, radiate, situated near the incurved margin.

Length, 3.26 mm.

Locality.—Monmouth formation, Cream Ridge, Bruere's pits on Crosswicks Creek, New Jersey; Rancocas formation, New Egypt, Mullica Hill, Timber Creek, New Jersey.

Geological distribution.—Permian to Recent.

NODOSARIA CONSOBRINA (d'Orbigny.)

Dentalina consobrina d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 46, Pl. II, figs. 1–3.

Nodosaria consobrina Brady, 1884; Chal. Rept., Vol. IX, p. 501, Pl. LXII, figs. 23, 24.

Test smooth, dentaline, attenuated, and graceful; chambers nine or ten, shorter and less distinct at the proximal end but becoming more definite above and more elongated; septa distinct, straight, or nearly so, becoming more marked in the proximal extremity; ultimate chamber somewhat prolonged into a neck which carries the oral aperture; proximal end very neatly rounded.

Length, 2 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This slender little species is very closely allied to the emaciate variety found in the Rancocas marl beds, but it is not so elongated and has a much smaller number of chambers.

NODOSARIA CONSOBRINA var. EMACIATA Reuss.

Nodosaria (D.) *consobrina*, var. *emaciata*, Reuss, 1865; Denks. Akad. Wiss. Wien, Vol. XXV, p. 132, Pl. II, figs. 12, 13.

Nodosaria (D.) *consobrina*, var. *emaciata*, Brady, 1884; Chal. Rept., Vol. IX, p. 502, Pl. LXII, figs. 25, 26.

Test smooth, greatly elongated, tapering; segments numerous, short, elongate oval; similar to *Nodosaria consobrina*, but more elongated and slender; septa somewhat depressed, transverse, primordial end rounded; aperture mammillate, somewhat prolonged into a tube.

Length, 2 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

NODOSARIA FARCIMEN (Soldani).

Orthoceras farcimen Soldani, 1791; Testaceographia, Vol. I, pt. 2, p. 98, Pl. CV, Fig. O.

Dentalina farcimen Reuss, 1863; Bull. Acad. Roy. Belge, ser. 2, Vol. XV, p. 146, Pl. I, fig. 18.

Test arcuate, tapering, with from six to ten inflated segments, separated by deep, straight, transverse sutures. The latter quality separates this species from *Nodosaria communis*, in which the sutures are oblique. There is also an irregularity in the increase of the size of the

chambers noticeable in most specimens. The ultimate chamber is prolonged into a round tube which bears the oral opening.

Length, 2.82 mm.

Locality.—Rancocas formation, New Egypt, New Jersey.

Geological distribution.—Permian to Recent.

NODOSARIA FILIFORMIS d'Orbigny.

Nodosaria filiformis d'Orbigny, 1826; Ann. Sci. Natur., Vol. VII, p. 253, No. 14.

Dentalina gracilis d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 14, Pl. I, fig. 5.

Nodosaria filiformis Brady, 1884; Chal. Rept., Vol. IX, p. 500, Pl. LXIII, figs. 3-5.

Test slender, elongated, smooth, crenate; chambers numerous (12), distinct, elongate oval; septa transverse, nonoblique; aperture simple, round.

Length, 2.1 mm.

Locality.—Monmouth formation, Cream Ridge, Redbank, New Jersey; Rancocas formation, Mullica Hill, Timber Creek, New Jersey.

Geological distribution.—Lias to Recent.

NODOSARIA INDIFFERENS (Reuss).

Dentalina indifferens Reuss, 1863; Sitz. Akad. Wiss. Wien, Vol. XLVIII, pt. 1, p. 44, Pl. II, figs. 15, 16.

Test consisting of from six to eight smooth, short, inflated chambers of unequal size; primordial chamber larger than the succeeding one, obtusely rounded; ultimate chamber large and more constricted than any of the other chambers.

Length, 1.7 mm.

Locality.—Monmouth formation, Cream Ridge, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

NODOSARIA INORNATA (d'Orbigny).

Dentalina inornata d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 44, Pl. I, figs. 50, 51.

Dentalina inornata Sherborn and Chapman, 1886; Jour. Roy. Microsc. Soc., ser. 2, Vol. VI, pt. 2, p. 750, Pl. XV, fig. 8.

Test smooth, gently tapering, with chambers distinct and more indented upon one side than upon the other; septa very oblique, and curving very slightly in the central, and more markedly so near the margin of the lowest end of each chamber; aperture nearer one side.

Only three segments preserved.

Length unknown.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

The New Jersey specimens are almost identical with the form figured by Sherborn and Chapman from the London clay of England.

According to Professor Brady, this species is considered to be identical with *Nodosaria communis* d'Orbigny, and is given by him as a synonym under that name, but it is here kept distinct for several reasons, as it is by Chapman and Sherborn.

NODOSARIA LÆVIGATA d'Orbigny.

Nodosaria (*Glandulina*) *lævigata* d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 252, Pl. X, figs. 1-3.

Glandulina lævigata d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 29, Pl. I, figs. 4, 5.

Nodosaria lævigata Brady, 1884; Chal. Rept., Vol. IX, pp. 490, 493, Pl. LXI, figs. 17-22, 32.

Test cylindrical, tapering rapidly to a point at the primordial chamber; shell smooth, consisting of five or six short, indistinct segments; septal lines transverse; aperture round, crenulate.

This small species occurs sparingly in the lime sand at Vincentown. The American specimens are very similar to the forms from Germany figured by Professor Reuss under the name *Glandulina elliptica*.[1]

Length, 0.65 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

NODOSARIA LONGISCATA d'Orbigny.

Nodosaria longiscata d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 32, Pl. I, figs. 10-12.

Test elongate, smooth, consisting of chambers greatly extended and united end to end by definite constrictions. The forms are never found of full length, owing to the weak jointing of the segments, which allows them to break apart very readily. The species is somewhat similar to *Nodosaria ovulata* Sherborn and Chapman, but the chambers are not angular at their base, as in the latter species.

Length unknown.

Locality.—Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

NODOSARIA MULTICOSTATA (d'Orbigny).

Dentalina multicostata d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 15, Pl. I, figs. 14, 15.

Test large, abruptly tapering, arcuate; surface marked by numerous (24 at the anterior end) sharp, distinct, longitudinal costæ, slightly twisted and irregular in their arrangement; chambers nine or ten, short, deeply constricted, becoming more distinct toward the proximal end; aperture small, rotund, ending in a definitely constricted neck surrounded by a crenulated margin.

Length, 4–5 mm.

[1] Sitz. Akad. Wiss. Wein, 1863, Vol. XLVIII, p. 47, Pl. III, figs. 29-31.

Locality.—Rancocas formation, Blue Ball, New Jersey.

Geological distribution.—Carboniferous to Cretaceous.

NODOSARIA NITIDA d'Orbigny.

Nodosaria nitida d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 254, No. 33.

Nodosaria nitida Parker, Jones, and Brady, 1871; Ann. Nat. Hist., ser. 4, Vol. VIII, p. 158, Pl. IX, fig. 44.

Nodosaria nitida Tate and Blake, 1876; Yorkshire Lias, p. 457, Pl. XVII, fig. 19.

"A small striate Nodosaria, deeply constricted at its septa and having few, distinct, oval, or fusiform segments. A less robust form than *Nodosaria scalaria*, and less neatly finished as to base and terminal neck than that species generally is." (Parker, Jones, and Brady, loc cit.)

Owing to the deep constrictions, this form is easily broken, and I have no specimens with more than three segments. The ribs are very distinct and elevated, and there are small intermediate striæ between some, but not all, of the main costæ. The aperture ends in a phialine neck.

Length (of the three ultimate segments), 2.82 mm.

Locality.—Rancocas formation, Blue Ball, New Jersey.

Geological distribution.—Lias to Recent (?).

NODOSARIA OBLIQUA (Linné).

Nautilus obliquus Linné, 1767; Syst. Nat., twelfth ed., pp. 281, 1163; 1788, ibid., thirteenth (Gmelins) ed., p. 3372, No. 14.

Nodosaria sulcata Nilsson, 1827; Petrefacta Suec., p. 8, Pl. IX, fig. 19.

Dentalina sulcata d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 15, Pl. I, figs. 10–13.

Dentalina steenstrupi Reuss, 1855; Zeits. deutsch. geol. Gesell., Vol. VII, p. 268, Pl. VIII, fig. 14a.

Dentalina sulcata Reuss; ibid., p. 269, Pl. VIII, fig. 14b.

Dentalina obliqua Jones, Parker, and Brady, 1866; Monograph Foram. Crag, Pal. Soc. Vol. XIX, p. 54, Pl. I, fig. 9.

Test very large, elongated, arcuate, tapering; septal lines depressed; numerous costæ upon the surface, which vary in size and number in different specimens; chambers numerous, ventricose, distinct; aperture central, radiate. Some specimens end in a spine at the distal end.

Length, 2–13.5 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, New Jersey; Rancocas formation, Vincentown, Blue Ball, Mullica Hill, Timber Creek, Harrisonville, New Egypt, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Lias to Recent.

This species is very common in the New Jersey marl beds and is one of the few forms which are found in all the horizons of the Upper Cretaceous series.

The Matawan specimens are only 2 mm. in length.

NODOSARIA PAUPERATA (d'Orbigny).

Dentalina pauperata d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 46, Pl. I, figs. 57, 58.

Nodosaria pauperata Brady, 1884; Chal. Rept., Vol. IX, p. 500, woodcuts, fig. 14a, b, c.

Test smooth, somewhat arcuate, tapering very gradually; chambers quite uniform in size, ten or eleven in number, not constricted in the lower portion of the shell, but becoming distinct and more constricted as they approach the proximal end; ultimate segment prolonged, provided with a constricted tube-like neck which carries the round aperture.

Length, 2–3 mm.

Locality—Manasquan formation, Vincentown, New Jersey.

Geological distribution—Lias to Recent.

NODOSARIA POLYGONA Reuss.

Nodosaria polygona Reuss, 1855; Zeits. deutsch. geol. Gesell., p. 265, Pl. VIII, figs. 7, 8.

Test cylindrical, elongate, costate, tapering very gradually, straight or but slightly curved; chambers numerous, ten to sixteen, becoming more constricted and globose toward the ultimate segment; primordial chamber larger than the one succeeding, bulbous, mucronate; ultimate chamber terminates in a short tubular neck, in which the round oral aperture is situated; longitudinal costæ few in number, eight to ten, very distinct, and elevated and extending from end to end.

Length, sometimes 9 mm.

The specimens from the Matawan marl beds are small (1.1 mm. in length), and have only six chambers, and are rare, while the Rancocas forms are very numerous and are among the largest of the Nodosariæ from New Jersey.

Locality—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, New Jersey; Rancocas formation, New Egypt, Blue Ball, Harrisonville, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution—Cretaceous to Recent.

NODOSARIA RADICULA (Linné).

Nautilus radicula Linné, 1767; Syst. Nat., twelfth ed., pp. 285, 1164; 1788, ibid., thirteenth (Gmelin's) ed., p. 3373, No. 18.

Nodosaria radicula d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 252, No. 3; Model No. 1.

Nodosaria radicula Brady, 1876; Palæont. Soc., Vol. XXX, p. 124, Pl. X, figs. 6–16.

Test straight, elongated, tapering, composed of from four to seven subglobose segments; surface of shell smooth; septal lines transverse, depressed; aperture a nipple-shaped protuberance on the ultimate segment.

Length, 2 mm.

Locality.—Rancocas formation, Timber Creek, New Jersey.

Geological distribution.—Permian to Recent.

NODOSARIA RAPHANUS (Linné).

Nautilus raphanus Linné, 1767; Syst. Nat., twelfth ed., pp. 283, 1164; 1788, ibid., thirteenth (Gmelin's) ed., p. 3373, No. 16.
Nodosaria raphanus Silvestri, 1872; Nodos. Fos. Viv. d'Italia, p. 43, Pl. IV, figs. 67-81.
Nodosaria raphanus Brady, 1884; Chal. Rept., Vol. IX, p. 512, Pl. LXIV, figs. 6–10.

Test elongate, straight, somewhat tapering, stoutly built; surface marked by eight sharp, elevated, distinct costæ; chambers few in number, generally fewer than ten, not very distinct, since the septal lines are nonlimbate; aperture a semilunar arch, median, surrounded by a thickened border.

Length, 1 mm.

Locality.—Rancocas formation, southeast Swedesboro, Timber Creek, New Jersey.

Geological distribution.—Upper Trias to Recent.

NODOSARIA ROEMERI (Neugeboren.)

Dentalina roemeri Neugeboren, 1856; Denks. Akad: Wiss. Wien., Vol XII, pt. 2, p. 82. Pl. II, figs. 13–17.
Nodosaria roemeri, Brady, 1884; Chal. Rept., Vol. IX, p. 505, Pl. LXIII, fig. 1.

Test smooth, consisting of six or seven large chambers separated by nearly straight, slightly depressed sutures; primordial chamber rounded and rather blunt; ultimate chamber carrying the oral aperture nearer the incurved margin. Some specimens are slightly curved, but the curvature is never very great.

Length, 0.82 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous to Recent.

NODOSARIA ROTUNDATA (Reuss.)

Glandulina rotundata Reuss, 1850; Denks. Akad. Wiss. Wien., Vol. I, p. 366, Pl. XLVI. fig. 2.
Glandulina obtussima Reuss, 1863; Sitz. Akad. Wiss. Wien., Vol. XLVIII, pt. 1, p. 66, Pl. VIII, figs. 92, 93.

Test oval, not much elongated, with rounded base, consisting of only two or three segments, usually two, of which the ultimate chamber is much the largest; surface of shell smooth and white; aperture small, rotund, crenulate, placed centrally in ultimate chamber.

Length, 1–3 mm.

This is not an uncommon form in the limes and at Vincentown. Our specimens agree very closely with those figured by Professor Reuss.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

NODOSARIA SCABRA (Reuss).

Dentalina scabra Reuss, 1850; Denk. Akad. Wiss. Wien, Vol. I, p. 367, Pl. XLVI, figs. 7, 8.

Test small, elongate, tapering; surface uniformly covered with raised longitudinal striæ, or tubercles, visible only under high power in

reflected light; chambers eight in number, strongly constricted, becoming quite spheroid in the upper portion; primordial chamber furnished with a long, delicate spine upon the inside edge of the line of flexure; ultimate chamber prolonged into a round phialine neck; aperture rotund.

Length, 1 mm.

Locality.—Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

Reuss describes this form as being very variable in character, and states that there are two extreme types, which would be considered distinct species were it not for the connecting forms. It is a rare species at Vincentown, and we can not state whether the American type is constant or not. The one described agrees very closely with Professor Reuss's figure.

NODOSARIA SPINULOSA (Montagu).

Nautilus spinulosus Montagu, 1808; Test. Brit. Suppl., p. 86, Pl. XIX, fig. 5.
Dentalina spinulosa Sherborn and Chapman, 1886; Jour. Roy. Microsc. Soc., ser. 2, Vol. VI, p. 751, Pl. XV, fig. 13.

Test slightly arcuate, elongate; surface marked by elevated rib-like spines, which cover the segments irregularly. These rib-like projections jut out prominently, especially on the posterior portion of each segment. Chambers somewhat constricted, ten or more in number on long specimens.

Length, 2.16 mm.

Locality.—Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Upper Cretaceous and Tertiary.

The specimens described by Professors Chapman and Sherborn were from the London clay.

NODOSARIA VERTEBRALIS (Batsch).

Nautilus (Orthoceras) vertebralis Batsch, 1791; Conch. Seasands, p. 3, No. 6, Pl. II, fig. 6, b.
Dentalina vertebralis Sherborn and Chapman, 1886; Jour. Roy. Microsc. Soc., ser. 2, Vol. VI, p. 752, Pl. XIV, fig. 39, *a*, *b*.

Test long, nearly straight; surface marked by slightly elevated longitudinal costæ, very slightly twisted; chambers eight in number, of uniform size, but tapering somewhat toward the primordial segment, unconstricted and marked by rather wide, straight transverse septa; aperture central, mammillate.

Length, 2.4 mm.

Locality.—Rancocas formation, New Egypt, New Jersey.

Geological distribution.—Cretaceous to Recent.

Dr. Anthony Woodward describes this species from Stratton's marl pit, near Mullica Hill, where it occurs in the shell layer of the green marl, and also from Timber Creek, in the lime-sand bed; but it is not a common form in either locality.

NODOSARIA WILLIAMSI Bagg.

Plate III, figs. 2a, 2b.

Nodosaria williamsi Bagg, 1895; Johns Hopkins Univ. Circulars, No. 121, October, 1895, No. 59.

Test small, oval or elliptical, similar to *Nodosaria comata* Batsch, but differing from that species in the arrangement of the costæ, which in our specimens extend the entire length of the shell, while in the former species the oral end is smooth. The costæ are very numerous, fine; chambers three or four, large, inflated, scarcely discernible by the transverse septa; unconstricted at the septal nodes; ultimate chamber truncate; aperture very large, rotund.

Length, 1.13 mm.

Locality.—Rancocas formation, southeast Swedesboro, New Jersey. Rare.

Geological distribution.—Upper Cretaceous.

NODOSARIA ZIPPEI Reuss.

Plate III, fig. 1 (aberrant form).

Nodosaria zippei Reuss, 1844; Geogn. Skizze Böhm, Vol. II, pt. 1, p. 210.

Nodosaria zippei Reuss, 1845–; Verstein. böhm. Kreide, pt. 1, p. 25, Pl. VIII, figs. 1–3.

Dentalina pulchra Gabb, 1860; Jour. Acad. Nat. Sci., Philadelphia, n. s., Vol. IV, p. 402, Pl. LXIX, figs. 40, 41.

Nodosaria raphanistrum Woodward, 1894; Jour. N. Y. Microsc. Soc., Vol. X, No. 4, p. 110.

Test straight, or but slightly arcuate, very large and long, sometimes reaching 10 millimeters in length; chambers numerous, becoming more distinct toward the ultimate chamber; primordial segment slightly larger than the one succeeding, mucronate; surface of shell marked by from seven to fourteen (usually about twelve) very prominent costæ, only part of which extend the whole length of the shell; ultimate chamber slightly prolonged; aperture rotund.

Length, 9 mm. and over. Small specimens, 3.2 mm.; breadth, 0.5–1 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, New Jersey; Rancocas formation, Blue Ball, Vincentown, Harrisonville, etc., New Jersey; Manasquan formation, Vincentown, New Jersey.

This beautiful species is one of the very largest forms of Foraminifera found in the New Jersey Cretaceous marl beds, and was described by Gabb as early as 1860, under the name *Dentalina pulchra.* Owing to its great length it is very easily broken, so that only a few of the largest specimens are perfect. It was very well described by Reuss in 1844 (loc. cit.), who said that its length was sometimes 1½ inches, the number of chambers twenty to thirty, the costæ seven to fourteen, and that there were secondary riblets occasionally set in between the main costæ and running a short distance along the surface of the shell.

Reuss also pointed out the similarity of *Nodosaria septemcostata* and *N. undecimcostata* Geinitz, and considered the two latter as identical with *N. zippei*. Dr. Anthony Woodward considers this species identical with *N. raphanistrum*, but the two species are sufficiently distinct to justify the retention of the original name given by Professor Reuss.

This species has a very wide geological range and distribution in the Cretaceous, and occurs in every marl bed of New Jersey.

In the large amount of material examined in the preparation of this report an interesting case of dimorphism was observed in one of the specimens of *Nodosaria zippei*. The shell which has been previously referred to begins as a textularian with two chambers side by side, each bearing the same number of costæ as the original form and united above into a straight typical nodosarian chamber. It was found in the green marl of Blue Ball, where the Nodosariæ are so perfectly preserved that mucronate forms still retain their spines in almost perfect condition.

Genus LINGULINA d'Orbigny.

LINGULINA CARINATA d'Orbigny.

Lingulina carinata d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 257, No. 1.
Lingulina carinata Brady, 1884; Chal. Rept., Vol. IX, p. 517, Pl. LXV, fig. 16, 17.

Test elliptical, elongate, laterally compressed; surface smooth and glistening; shell consisting of six somewhat extended chambers, separated by arched septa; peripheral margin obtusely angular; chambers increasing rapidly in size toward the distal end and marked by distinct transverse septal lines; primordial chamber circular, not elevated; aperture a narrow terminal slit.

Length, 1.2–1.85 mm.; breadth, 1–1.3 mm.

Locality.—Raritan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This beautiful little species is common in the lime sand at Vincentown. It resembles *Lingulina bohemica* Reuss both in its lateral compression and in its external form, but is distinguished from that form by its broader elliptical outline and in having invariably six chambers instead of five.

Genus FRONDICULARIA Defrance.

FRONDICULARIA ALATA d'Orbigny.

Plate II, fig. 4b (bottom form).

Frondicularia alata d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 256, No. 2.
Frondicularia alata Brady, 1884; Chal. Rept., Vol. IX, p. 522, Pl. LXV, figs. 20–23; Pl. LXVI, figs. 3–5.

Test broadly oval, large, complanate; surface smooth, marked by fairly distinct septal lines; chambers narrow, numerous, arched; pri-

mordial segment oval, elevated, situated a little within the periphery; basal portion of shell more or less covered by spinous projections, which are either single or united.

Length, 4.34 mm.; breadth, 3 mm.

Locality.—Rancocas formation, Vincentown, Brownsville, etc., New Jersey.

Geological distribution.—Cretaceous to Recent.

This form is rather common in many localities where the lime sand is developed.

FRONDICULARIA ANGUSTA (Nilsson) var. DIMIDIA Bagg.

Plate III, figs. 7a, 7b.

Planularia angusta Nilsson, 1827; Petref. Suec. p. 11, Pl. IX, fig. 22 a, A.
Frondicularia angusta Reuss, 1845–46; Verstein, böhm. Kreide, pt. 1, p. 29, Pl. VIII, figs. 13, 14.

Test lanceolate, very elongate, strongly compressed and leaf-like; consisting of from ten to twelve chambers, which gradually increase in size toward the proximal end, where the greatest breadth occurs; primordial chamber spherical, elevated, mucronate, and the surface marked by three sharply defined ribs; surface of shell marked by numerous fine longitudinal lines, running nearly parallel to the lateral edges; septa distinct, slightly raised externally as ridges; aperture normally round, terminal.

Length, 2.6 mm.; breadth, 1 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

This species is very closely allied to the European form, but differs principally in the number of chambers, which is invariably less than one-half of those of the former type. It is common in the lime sand at Vincentown.

FRONDICULARIA ARCHIACIANA d'Orbigny, var. STRIGILLATA, nov. var.

Plate III, fig. 5.

Frondicularia archiaciana d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 20, Pl. I, figs. 34–36.
Frondicularia archiaciana Brady, 1884; Chal. Rept., Vol. IX, p. 520, Pl. CXIV, fig. 12.

Test elongate, complanate, anteriorly acute, posteriorly obtuse, and provided with a short spine; chambers, six to eight, relatively large, equally compressed, and slightly limbate at the lateral edges; surface marked by definite elevated striæ, of which the two central rows are more prominent than those near the margin; primordial chamber globular; ultimate chamber prolonged, tube-like; aperture small, rotund.

Length, 1.6 mm.; breadth, 0.6 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

FRONDICULARIA CLARKI Bagg.

Plate III, fig. 4.

Frondicularia clarki Bagg, 1895; Johns Hopkins Univ. Circulars No. 121, October.

Test complanate, smooth, very elongate oval in outline; consisting of from twelve to fourteen narrow parallel chambers; primordial chamber bulbous, elevated, costate, mucronate; ultimate chamber elongate, bearing upon one surface a hollow, somewhat extended tube, which forms an elevated median ridge with rather angular edges, and extends for a short distance down the shell. This tube terminates anteriorly in the nearly rotund aperture.

Length, 3.4 mm.; breadth, 0.9 mm.

Locality.—Monmouth formation, Atlantic Highlands, New Jersey. Very rare.

Geological distribution.—Cretaceous.

I have named this interesting species after my friend and instructor, Prof. William B. Clark.

FRONDICULARIA GAULTINA Reuss.

Frondicularia gaultina Reuss, 1860; Sitz. Akad. Wiss. Wien, Vol. XL, p. 194, Pl. V, fig. 5.

Test rather narrow, smooth, very elongate, compressed; consisting of numerous chambers, gradually increasing in size from below upward; septal lines approximately straight, paralleled, depressed; shell broadest nearer the ultimate segment, gradually diminishing below; primordial segment not preserved.

Length unknown.

Locality.—Matawan formation, Marshalltown, New Jersey. Rare.

Geological distribution.—Cretaceous.

FRONDICULARIA INVERSA Reuss.

Frondicularia inversa Reuss, 1844; Geogn. Skizze Böhm., Vol. II, pt. 1, p. 211.
Frondicularia inversa Reuss, 1845–46; Verstein. böhm Kreide, pt. 1, p. 31, Pl. VIII, figs. 15–19; Pl. XIII, fig. 42.

Test complanate, leaf-like, elongate, smooth, broadest near the middle, tapering at the sides toward the anterior and posterior ends by straight wedge-shaped lateral margins; peripheral edges square; one lateral surface slightly curved along the median line, opposite surface approximately flat; chambers ten to twelve, narrow, elongate, nearly parallel to upper peripheral edges; primordial chamber oval, elevated, marked by a median ridge, mucronate; aperture rotund, crenulated.

Length, 2.82 mm.; breadth, 1 mm.

Locality.—Monmouth formation, Freehold, New Jersey. Rare.

Geological distribution.—Cretaceous.

FRONDICULARIA LANCEOLA Reuss.

Frondicularia lanceola Reuss, 1865; Reuss's Model No. 23 (Catalogue No. 46, 1851).

Test very elongate, lanceolate, tapering sharply to an acute point at the primordial end; segments numerous, twelve or more, quadrangular in cross section; septa depressed sharply, so that the chambers appear elevated into oblique folds; surface smooth and glistening; peripheral margin limbate; ultimate chamber extended into a distinct tube, which carries the oral aperture; primordial chamber nearly circular, not elevated; aperture radiate.

Length, 3 mm.; breadth, 0.6 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

I have only one specimen of this beautiful form.

FRONDICULARIA MAJOR Bornemann.

Plate III, fig. 3.

Frondicularia major Bornemann, 1854; Liasform, Göttingen, p. 36, Pl. III, figs. 21 a–c.

Test smooth, compressed, somewhat thicker along the median line, thinner at the peripheral margins, which are neatly rounded; chambers varying from four to nine; somewhat convex forward; septal lines distinct; posterior margin obtusely rounded; anterior acuminate; aperture a central radiate opening.

Length, 1–4 mm.; breadth, 1.6 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Lias to Cretaceous.

FRONDICULARIA OVATA Roemer.

Plate II, figs. 4a, 5b (bottom forms), and Plate IV, figs. 2a, 2b.

Frondicularia ovata Roemer, 1840; Verstein, norddeutsch. Kreid., p. 96, Pl. XV, fig. 9.

Test ovate, complanate, smooth; consisting of a small number of parallel chambers, which are distinct and marked very slightly at the lower peripheral edges by the septal endings; primordial chamber flat, basal; ultimate chamber large, slightly prolonged into the rounded aperture; peripheral margins rather squarely set off.

Length, 9.82 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

FRONDICULARIA PULCHELLA Karrer.

Frondicularia pulchella Karrer, 1870; Jahrb. k. k. geol. Reichsanstalt, Vol. XX, p. 171, Pl. 1, fig. 8.

Test large, elongated, complanate; surface smooth, marked by rather

distinct septal lines, which separate the narrow, extended, parallel chambers; greatest width near the middle of the shell, thence tapering rather sharply toward both extremities, but the lower portion slightly incurved, while the anterior end is slightly outcurved, though not markedly so; primordial segment lost.

Length, about 5 mm.; breadth (central), 1.8 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous.

FRONDICULARIA RETICULATA (Reuss).

Plate III, fig. 6.

Flabellina reticulata Reuss, 1850; Haidinger's Nat. Abhandl., Vol. IV, pt. 1, p. 30, Pl. I, fig. 22.

Test thin, leaf-like, broad at the center, but tapering rapidly toward the oral end; consisting of ten rather narrow, elongated chambers, the surfaces of which are marked transversely by numerous delicate costæ, which run from septum to septum, and completely cover the whole form like a network; primordial chamber nearly circular, but not elevated, very slightly eccentric, yet not enough to justify its being placed among flabelline types.

Length, 0.87 mm.; greatest breadth, 0.88 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

This is one of the most beautiful of all frondicularians, and is at the same time exceedingly rare. We have only one specimen from the Lower Marl at Freehold, and it is interesting to note that Professor Reuss records the single occurrence of a perfect specimen from the Kreidemergel of Lemberg.

FRONDICULARIA VERNEUILINA d'Orbigny.

Frondicularia verneuilina d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 20, Pl. I., figs. 32, 33.

Test elongate elliptical; peripheral margins gracefully curved, broadest near the center, not compressed laterally as much as most Frondicularia; chambers relatively large, few; primordial segment globose, costate, mucronate, distinctly set off from the succeeding chamber; ultimate chamber prolonged into a tubular neck, which carries the little round aperture.

Length, 1.5 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous.

Genus RHABDOGONIUM Reuss.

RHABDOGONIUM ROEMERI Reuss.

Rhabdogonium roemeri Reuss, 1860; Sitz. Akad. Wiss. Wien., Vol. XL, p. 201, Pl. VI, fig. 7.

Test coarsely arenaceous, partly composed of glauconite grains, elongate, straight, or slightly bent, sharply triangular, obtusely rounded and slightly angular at the ends; peripheral margin curved, sharp; chambers few in number, usually six, short, separated by arched depressed septa; aperture elliptical, placed centrally at the distal end.

Length, 1.5 mm.

Locality.—Matawan formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

RHABDOGONIUM TRICARINATUM (d'Orbigny).

Vaginulina tricarinata d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 258, No. 4; Modèle, No. 4.

Rhabdogonium pyramidale Karrer, 1861; Sitz. Akad. Wiss. Wien, Vol. XVI, p. 19, Pl. I, fig. 34.

Rhabdogonium tricarinatum Brady, 1884; Chal. Rept., Vol. IX, p. 525, Pl. LXVII, figs. 1–3.

Test triangular, elongated and gradually tapering toward both extremities; peripheral margins sharp, becoming slightly twisted below; anterior end prolonged into a tube-like neck; chambers about ten, narrow, arched, and separated by curved septa; aperture rotund.

Length, 2.6 mm.

Locality.—Rancocas formation, Brownsville, New Jersey.

Geological distribution.—Cretaceous to Recent.

RHABDOGONIUM TRICARINATUM var. ACUTANGULUM Reuss.

Rhabdogonium tricarinatum var. *acutangulum* Reuss, 1862 (1863); Sitz. Akad. Wiss. Wien, Vol. XLVI, Abth. 1, p. 55, Pl. IV, fig. 14, a, b.

Test small, trihedral, coarsely arenaceous; the three marginal angles sharp and distinct; chambers few, short, separated by somewhat arched septa, not very distinct externally; primordial end sharp, anterior obtusely angular; aperture triangular, with incurved lateral edges.

Length, 1.73 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous.

Genus MARGINULINA d'Orbigny.

MARGINULINA ENSIS Reuss.

Marginulina ensis Reuss, 1845-46; Verstein. böhm. Kreide, pt. 1, p. 29, Pl. XII, fig. 13; Pl. XIII, figs. 26, 27; pt. 2, p. 106, Pl, XXIV, fig. 30.

Nodosaria communis Woodward, 1894; Jour. N. Y. Microsc. Soc., Vol. X, No. 4, p. 103.

Test elongate, moderately compressed, oval or elliptical in trans-

verse section; shell variable in outline, either nearly straight throughout its whole length or incurved; septa very slightly oblique, directed toward the primordial chamber, apparent externally as ridges; proximal chambers more involute than in *Marginulina elongata;* chambers numerous, apparent externally; ultimate chamber somewhat prolonged, and ending posteriorly in a short tube; aperture rotund, with crenulated margin.

Length.—1.3, 1.73 mm.; breadth, 0.43 mm.

Locality.—Monmouth formation, Bruere's pits on Crosswicks Creek; Rancocas formation, Blue Ball, Mullica Hill, New Egypt, New Jersey.

Geological distribution.—Cretaceous.

Professor Sherborn prefers to change the word Marginulina to Cristellaria for this species, thus making it *Cristellaria ensis* (Reuss). The writer prefers to leave it under the original name of Professor Reuss.

MARGINULINA PEDIFORMIS Bornemann.

Marginulina pediformis Bornemann, 1855; Zeitsch. d. geol. Gesell., Vol. VII, p. 326, Pl. XIII, fig. 13.

Marginulina pedum d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 68, Pl. III, figs. 13, 14.

Test smooth, short, circular in transverse section; consisting of about six chambers, of which the first two or three are inrolled and rounded at the base; segments becoming more definite above; ultimate chamber largest and slightly prolonged; aperture small, rotund, crenulate; septa depressed, slightly oblique, though not markedly so.

Length, 1 mm.

Locality.—Matawan formation, Marshalltown, New Jersey.

Geological distribution.—Cretaceous, Tertiary.

MARGINULINA TRILOBATA d'Orbigny.

Marginulina trilobata d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 16, Pl. I, figs. 16, 17.

Test elongate, smooth, and glistening, compressed laterally, slightly arcuate at the primordial end; somewhat tapering; chambers short, oval, regular, numerous, ten to sixteen, slightly constricted; surface marked by small, distinct, elliptical ridges, giving the form a peculiar trilobed appearance, whence its name; primordial chamber small, nearly spherical; septal lines depressed; aperture small, radiate.

Length, 4 mm. in large specimens; breadth, 0.6 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

Genus VAGINULINA d'Orbigny.

VAGINULINA LEGUMEN (Linné).

Plate IV, fig. 4.

Nautilus legumen Linné, 1758; Syst. Nat., tenth ed., p. 711, No. 248; 1767, twelfth ed., p. 1164, No. 288.

Vaginulina legumen Terrigi, 1891; Memoire R. Com. g. Regno, Vol. IV, pt. 1, p. 94, Pl. III, fig. 6.

Test straight or nearly so, smooth, compressed laterally, pod-like; consisting of only six or seven chambers; septa nonlimbate, oblique, parallel, not very distinct externally; ultimate chamber slightly prolonged upon one side and carrying the small radiate aperture.

Length, 1.3 mm; breadth, 0.47 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Rancocas formation, Vincentown, New Egypt, Mullica Hill, New Jersey.

Geological distribution.—Trias to Recent.

The above species has been lately described from the Alabama chalk by Dr. Woodward. It is a beautiful little shell, of snow-white color, and is rather rare.

VAGINULINA STRIGILLATA Reuss.

Plate IV, fig. 3.

Citharina strigillata Reuss, 1845–46; Verstein. böhm. Kreide, pt. 2, p. 106, Pl. XXIV, fig. 29.

Vaginulina strigillata and var. Jones and Parker, 1860; Quart. Jour. Geol. Soc., Vol. XVI, Pl. XX, figs. 29–35.

Test complanate, leaf-like, very large, roughly triangular; surface smooth, marked by slightly elevated septal lines; chambers numerous, often as many as twenty-five, narrow, parallel, slightly oblique, becoming constricted toward the curved margin and passing rapidly downward toward the proximal end, where the septal lines finally appear only as fine ridges. As a result of this constriction of the chambers at the curved margin, transverse sections show only four or five chambers. Along the straight edge run three elevated, rounded costæ, with sometimes one or two smaller ones between. The latter, however, do not extend the whole length of the shell as do the ridges. Septal lines distinct, slightly crenate, becoming much thickened toward the straight edge of the shell; primordial chamber oval, elevated, slightly mucronate, covered by numerous costæ.

Length, 3–9 mm; breadth, 2.3 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

This species is very common in the lower marl of Freehold, but I have not found it elsewhere.

CRISTELLARIA Lamarck.

CRISTELLARIA ACUTAURICULARIS (Fichtel and Moll).

Nautilus acutauricularis Fichtel and Moll, 1803; Test. Micros., p. 102, Pl. XVIII; figs. *g–i*.

Cristellaria navicula d'Orbigny, 1840; Mém. Soc. géol. France, Vol. IV, ser. 1, p. 27, Pl. II, figs. 19, 20.

Cristellaria acutauricularis Brady, 1884; Chal. Rept., Vol. IX, p. 543, Pl. CXIV, fig. 17 *a, b*.

Test involute, thick, convex, smooth; septal plane broad, triangular, nearly flat; chambers seven or eight, weakly curved; keel acute carinate; aperture nipple-shaped, situated at the extremity of the convex side.

Length, 1.43 mm.; breadth, 0.65 mm.

Locality.—Rancocas formation, Timber Creek, Vincentown, New Jersey.

Geological distribution.—Lias (?), Cretaceous to Recent.

CRISTELLARIA ARTICULATA (Reuss).

Robulina articulata Reuss, 1863; Sitz. Akad. Wiss. Wien, Vol. XLVIII, p. 53, Pl. V, fig. 62.

Cristellaria articulata Brady, 1884; Chal. Rept., Vol. IX, p. 547, Pl. LXIX, figs. 10–12, also 1–4.

Test nearly circular, smooth, thickened, flattened at the sides; obtusely angular peripheral margin; chambers six or seven, broadly triangular, separated by depressed septa; aperture oval, surrounded by a fissured border.

Diameter, 1.3 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

Professor Brady considers this species a thick variety of *Cristellaria rotulata.*

CRISTELLARIA CASSIS (Fichtel and Moll).

Nautilus cassis Fichtel and Moll, 1798; Test. Micros., p. 95, var. *α*, Pl. XVII, fig. *a–d*; var. *β*, Pl. XVII, fig. *e–g*; var. *γ*, Pl. XVII, figs. *h–i*; var. *δ*, Pl. XVII, figs. *k, l*; var. *ε*, Pl. XVIII, figs. *a–c*.

Cristellaria cassis Brady, 1884; Chal. Rept., Vol. IX, p. 552, Pl. LXVIII, fig. 10.

Test very large, complanate, elongate oval, distinctly carinate; chambers irregular, ten to fifteen in final volution; septa distinct, arcuate, depressed; aperture oval with crenulated margin.

Length, 4.3–4.56 mm.; breadth, 3–4 mm.

Locality.—Rancocas formation, Vincentown, Brownsville, New Egypt, etc., New Jersey.

Geological distribution.—Cretaceous to Recent.

CRISTELLARIA CREPIDULA (Fichtel and Moll).

Nautilus crepidula Fichtel and Moll, 1803; Test Micros., p. 107, Pl. XIX, figs. *g–i*.
Cristellaria crepidula d'Orbigny, 1839; Foram. Cuba, p. 64, Pl. VIII, figs. 17, 18.

Test elongate, arcuate, smooth, compressed, pellucid; chambers ten to twelve, oblique, separated by slightly convex walls; posterior chambers involute, anterior chambers evolute; aperture rotund, slightly crenate.

Length, 0.7 mm; breadth, 0.26 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, New Jersey.

Geological distribution.—Lias to Recent.

The above form is not a common species. Our specimens are similar in shape to *Cristellaria intermedia* Reuss, which is considered as identical with the above by Professor Brady.

CRISTELLARIA CRETACEA Bagg.

Plate V, figs. 2a, 2b.

Test complanate, smooth, elongate, oval, resembling *Cristellaria cassis* in general contour, but differing from that species in the absence of the marginal keel; margin rounded; chambers numerous, about twelve in final convolution, narrow, elongated; septa distinct, convex; ultimate chamber truncate, anterior margin straight; aperture small, narrow elliptical, with crenulated margin.

Length, 4.3 mm.; breadth, 3 mm.

Locality.—Rancocas formation, Vincentown, New Jersey. Common.

Geological distribution.—Cretaceous.

The above species is less elongated than *Cristellaria projecta*, which it resembles closely.

These two forms, together with *Cristellaria cassis*, are rather abundant at Vincentown, and all attain an enormous size for the type.

CRISTELLARIA CULTRATA (Montfort).

Plate VI, fig. 1.

Robulus cultratus Montfort, 1808; Conch. Syst., Vol. I, p. 214, 54e genre.
Robulina cultrata d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 96, Pl. IV, figs. 10–13.

Test circular, biconvex, smooth and glistening, peripheral margin sharp, broadly keeled; chambers seven to eleven, in final convolution, somewhat convex, smooth or costate; aperture radiate.

Diameter, 1–2 mm.

Locality.—Monmouth formation, Freehold, Bruere's pits, on Crosswicks Creek, Marlboro, New Jersey; Rancocas formation, Mullica Hill, New Egypt, Swedesboro, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is common at Freehold and is beautifully preserved. The width of the marginal keel is variable, as is also the number of chambers. It is similar to *Cristellaria rotulata*, with the addition of the keel. Specimens of *Cristellaria cultrata* from New Egypt and Swedesboro are not smooth, as in typical forms, but are marked externally by raised septa.

CRISTELLARIA GIBBA d'Orbigny.

Cristellaria gibba d'Orbigny, 1839; Foram. Cuba, p. 63, Pl. VII, figs. 20, 21.

Test oblong, biconvex, smooth, subcarinate, narrow; chambers few (seven or eight), slightly arcuate, separated by distinct septa; aperture marginate.

Length, 1.3 mm.; breadth, 0.87 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

CRISTELLARIA ITALICA (Defrance).

Plate IV, figs. 5a, 5b.

Sarecenaria italica Defrance, 1824; Dict. Sci. Nat., Vol. XXXII, p. 177; Vol. XLVII, p. 344; Atlas Conch., Pl. XIII, fig. 6.

Cristellaria italica, Brady, 1884; Chal. Rept., Vol. IX, p. 544, Pl. LXVIII, figs. 17, 18, 20–23.

Test elongate, trihedral, planospiral segments few, succeeding chambers five or six, arranged in a nearly straight superimposed series; dorsal margin sharp, noncarinate; transverse section triangular, segments short, slightly oblique, inclined anteriorly toward initial end.

Length, 1 mm.

Locality.—Rancocas formation, Swedesboro, Blue Ball, Mullica Hill, New Jersey.

Geological distribution.—Cretaceous to Recent.

This is not a common species. It bears some resemblance to *Cristellaria acutauricularis*, but is more elongate, and the anterior edge is more erect. Another species, closely allied to the above form, is *Marginulina triangularis* d'Orbigny.[1]

CRISTELLARIA MAMILLIGERA Karrer.

Cristellaria mamilligera Karrer, 1864; Novara Exped. Geol., Vol. I, pt. 2, p. 76, Pl. XVI, fig. 5.

Cristellaria mamilligera Brady, 1884; Chal. Rept., Vol. IX, p. 553, Pl. LXX, figs. 17, 18.

Test complanate, nearly circular; anterior margin truncate, posterior margin slightly carinate; surface ornamented with a number of large raised ridges and tubercles in the umbilical region; septa depressed, the depressions partially filled by exogenous material which forms the

[1] Foram. Foss. Bassin tert. Vienne, 1846, p. 71, Pl. III, figs. 22, 23.

ridges; chambers large, slightly arcuate, eight or nine in the final convolution; septal plane narrow, surrounded by a definite border; aperture an elongate-oval opening surrounded by a crenulated margin.

Diameter, 1.74 mm.

Locality.—Rancocas formation, Blue Ball, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is very rare in the green marl of Blue Ball, and has not been recognized elsewhere.

CRISTELLARIA MEGAPOLITANA Reuss.

Robulina megapolitana Reuss, 1855; Zeits. d. geol. Gesell., Vol. VII, p. 272, Pl. IX, fig. 5.

Test circular, compressed, smooth and glistening, keeled and with more or less definite flange. There are seven or eight strongly curved chambers apparent externally as raised lines, which are thicker at the umbilicus, but become attenuated toward the peripheral margin. Umbilical disk more or less distinct. Septal plane triangular, with raised border.

Length, 1–1.5 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

CRISTELLARIA PROJECTA Bagg.

Plate V, figs. 1a, 1b.

Cristellaria projecta Bagg, 1895; Johns Hopkins Univ. Circulars, No. 121, October, 1895.

Test greatly elongated, complanate, smooth, consisting of two and one-half convolutions; chambers numerous, twenty or more in the last volution, arcuate, narrow, elongate; ultimate chamber nearly at right angles to umbilicus; margin rounded; septal lines very slightly depressed; aperture elliptical.

Length, 5.3 mm.; breadth, 2.7 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous.

This is a rare form in the lime sand at Vincentown, and has not been found elsewhere.

CRISTELLARIA ROTULATA (Lamarck).

Lenticulites rotulata Lamarck, 1804; Annales du Mus., Vol. V, p. 188, No. 3.
Cristellaria rotulata d'Orbigny, ser. 1, 1840; Mém. Soc. géol. France, Vol. IV, p. 26, Pl. II, figs. 15–18.

Test involute, biconvex, smooth; peripheral edge sharp, noncarinate; chambers numerous, but only eight or nine in final solution; septa moderately curved, visible externally as fine lines; aperture elliptical, radiate.

Diameter, 1–2 mm.

Locality.—Rancocas formation, Vincentown, Blue Ball, New Egypt, Mullica Hill, Timber Creek, etc., New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Triassic to Recent.

This is one of the most common forms in the lime-sand bed, and is especially plentiful at Vincentown. The size of the shell is very variable, some of the largest specimens being more than 2 millimeters in diameter.

CRISTELLARIA SECANS Reuss.

Cristellaria secans Reuss, 1859 (1860); Sitz. Akad. Wiss. Wien, Vol. XL, p. 214, Pl. IX, fig. 7.

Test circular, laterally compressed, sharply keeled on the peripheral margin; umbilical disc prominent and septa radiating from this in gently curving lines; about ten small triangular chambers in the last convolution.

Diameter, 1.5 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

CRISTELLARIA TRACHYOMPHALA (Reuss).

Robulina trachyomphala Reuss, 1850; Haidinger's Nat. Abhandl., Vol. IV, pt. 1, p. 34, Pl. III (error for II), fig. 12.

Test rounded, compressed, with angular periphery; umbilical disc raised, nearly round, more marked in some forms than in others; septal lines distinct, convex. There are from eight to ten chambers in the last whorl. Aperture a triangular-shaped opening surrounded by a raised crenulated margin at the external edge of the ultimate segment.

Diameter, 0.86–1.3 mm.

Locality.—Rancocas formation, Blue Ball, New Jersey.

Geological distribution.—Cretaceous.

CRISTELLARIA TRIANGULARIS d'Orbigny.

Cristellaria triangularis d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 27, Pl. II, figs. 21, 22.

Cristellaria triangularis Reuss, 1845–46; Verstein. böhm. Kreide, pt. 1, p. 34, Pl. VIII, fig. 48.

Test triangular, very convex, smooth; periphery sharply carinate; lateral surfaces somewhat concave; chambers few, six or seven, large, evolute, superposed; septa oblique, very slightly convex anteriorly; septal plane broadly triangular; aperture radiate.

Length, 1 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

The occurrence of this species from the craie blanche of the Paris basin, France, was recorded by d'Orbigny as early as 1840. I have found but two specimens in the lower marl of Freehold.

CRISTELLARIA WETHERELLII (Jones).

Marginulina wetherellii Jones, 1854; Morris Catalogue, Brit. Foss., ed. 2, p. 37.
Cristellaria wetherellii Brady, 1884; Chal. Rept., Vol. IX, p. 537, Pl. CXIV, fig. 14.

Test elongate, pod-like, compressed; primordial segments spiral, ultimate segments straight, evolute; surface marked by large tubercles more or less regular and crossing the shell surface like septal ridges; aperture round, at the end of a somewhat prolonged neck.

Length, 1.56 mm.; breadth, 0.5 mm.

Locality.—Rancocas formation, Vincentown, Mullica Hill, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

The above species is rare at Vincentown. Dr. Woodward states that it is rare at Mullica Hill, but common at Timber Creek.

Genus FLABELLINA d'Orbigny.

FLABELLINA CORDATA Reuss.

Flabellina cordata Reuss; Verstein. böhm. Kreide, pt. 1, p. 32, Pl. VIII, figs. 37–46, 78.
Flabellina cordata Reuss, 1854; Denks. Akad. Wiss. Wien, Vol. VII, p. 67, Pl. XXV, figs. 6–8.

Test broadly ovate or heart-shaped, complanate, with numerous narrow, elongated chambers; primordial chamber somewhat elevated and more or less globular, succeeding chambers at first flabelline, later Frondicularia-like; anterior extremity wedge-like with gently curving sides, posterior border much wider than in *Flabellina sagittaria* and differing from that species in the irregularity of the basal margin caused by the extension of the primordial chamber; surface of test smooth and glistening; aperture a small radiate, terminal opening.

Length, 1.8–4 mm.

Locality.—Rancocas formation, Vincentown, Brownsville, New Jersey.

Geological distribution.—Cretaceous.

FLABELLINA SAGITTARIA (Lea).

Plate IV, figs. 1a, 1b.

Palmula sagittaria Lea, 1833; Contributions to Geol., pp. 219–220, Pl. VI, fig. 228.
Planularia cuneata Morton, 1842; Jour. Acad. Nat. Sci., Philadelphia, Vol. VIII, pt. 2, p. 214, Pl. XI, fig. 5.

Test complanate, broadly elliptical (sometimes rather narrow and more elongate), occasionally slightly convex along the median line, while the opposite side is concave, though in typical specimens both surfaces are flat; septa distinct, forming a sharp median angle;

chambers numerous, the number dependent somewhat upon the size of the individual; peripheral margins moderately rounded; primordial chamber bulbous, mucronate, or more usually smooth; surface smooth and glistening; aperture typically mammillate, though frequently the shell is worn or broken off so that a round opening appears.

Length, 1–9 mm.; breadth, 1–4.3 mm.

Locality.—Rancocas formation, Vincentown, Blue Ball, New Egypt, Brownsville, etc., New Jersey.

Geological distribution.—Cretaceous.

This species is one of the most common forms at Vincentown. It is very variable in size and shape and is found in all stages of growth. As has been previously stated, it was the first Foraminifera to be described from the New Jersey greensands. (Lea, loc. cit.)

Subfamily POLYMORPHININÆ.

Genus POLYMORPHINA d'Orbigny.

POLYMORPHINA COMPRESSA d'Orbigny.

Polymorphina compressa d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 233, Pl. XII, figs. 32–34.

Test oblong, compressed, inequilateral; chambers numerous, arranged biserially, somewhat inflated; septal lines depressed, surface smooth; aperture variable, usually simple, circular, and coronate, sometimes labyrinthic or porous.

Length, 3 mm. in large specimens.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Lias to Recent.

POLYMORPHINA COMMUNIS (d'Orbigny).

Plate VI, fig. 2.

Guttulina communis d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 266, Pl. XII, figs. 1–4; Modèles, No. 62.

Polymorphina communis, Brady, Parker, and Jones, 1870; Trans. Linn. Soc., London, Vol. XXVII, p. 224, Pl. XXXIX, fig. 10 a b.

Test irregularly ovoidal, or egg-shaped, consisting of about four visible segments; anterior extremity acute; posterior obtuse; surface smooth, with distinct septal depressions; chambers inflated, elliptical, embracing; aperture mammillate.

Length, 1.3–1.4 mm.; breadth, 1–1.3 mm.

Locality.—Rancocas formation, Vincentown, New Jersey. Common.

Geological distribution.—Lias to Recent.

POLYMORPHINA EMERSONI n. sp.

Plate VI, fig. 3.

Test elongate oval, oval end acute, posterior obtusely rounded; surface of test covered completely by fine longitudinal costæ; chambers

two, elongated, oblique, separated by nearly straight septa slightly marked near the posterior end and depressed at the peripheral margin; aperture rotund.

Length, 1.9 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

This is a very rare species, and has only been obtained in the lower marl of Freehold. I have named it after Prof. B. K. Emerson.

POLYMORPHINA GIBBA (d'Orbigny).

Globulina gibba d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 266, No. 20; Modèle No. 63.

Polymorphina gibba Brady, Parker, and Jones, 1870; Trans. Linn. Soc. London, Vol. XXVII, p. 216, Pl. XXXIX, fig 2 a-d.

Test subglobular, apex slightly produced, base obtusely rounded; consisting of from two to four chambers, compactly joined and overlapping; surface smooth, unmarked by septal constrictions; septa visible as delicate, oblique lines, laterally very slightly compressed, though usually nearly circular in transverse section; shell larger than *Polymorphina lactea*, less elongated toward the apex; aperture mammillate.

Diameter, 0.5–1.17 mm.

Locality.—Monmouth formation, Freehold, New Jersey; Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Jurassic to Recent.

POLYMORPHINA LACTEA (Walker and Jacob).

Serpula lactea Walker and Jacob, 1798 (fide Kanmacher); Adams's Essays, second ed., p. 634, Pl. XXIV, fig. 4.

Polymorphina lactea Brady, 1884; Chal. Rept., Vol. IX, p. 559, Pl. LXXI, fig 11 (typical), Pl. LXXII, fig. 14 (variety).

Test ovate or subpyriform, only slightly compressed; three or four chambers, scarcely visible externally; aperture terminal, radiate.

Diameter, 0.87 mm.

Locality.—Monmouth formation, Freehold, New Jersey; Rancocas formation, Vincentown, Blue Ball, New Egypt, Timber Creek, etc., New Jersey.

Geological distribution.—Jurassic to Recent.

POLYMORPHINA LACTEA elongate variety Brady.

Polymorphina lactea elongate variety Brady, 1884; Chal. Rept., Vol. IX, p. 559, Pl. LXXI, fig. 14.

Test similar to the preceding, but elongated.

Length, 1.5 mm.; breadth, 0.6 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.
Geological distribution.—Similar to that of preceding form.

POLYMORPHINA OBLONGA d'Orbigny.

Polymorphina oblonga d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 232, Pl. XII, figs. 29-31.

Test elongate, consisting of a small number of oblong inflated chambers separated by deep sutures. This feature separates it from *Polymorphina lactea* var. *oblonga* Williamson, which has an oval compressed shell with erect segments and flush sutures.

Length, 1.43 mm.

Locality.—Monmouth formation, Freehold, New Jersey; Rancocas formation, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

POLYMORPHINA ORBIGNII (Zborzewski).

Apioptérina d'orbignii Zborzewski, 1834; Nouv. Mém. Soc. Imp. Nat. Moscou, Vol. III, p. 311, Pl. XXVIII, fig. 2 b.

Polymorphina orbignii Parker, Jones, and Brady, 1870; Trans. Linn. Soc. London, Vol. XXVII, p. 244, Pl. XLII, fig. 38 a-c.

Test oval, with a fistulose base; surface of shell smooth. The tube-like projections are very interesting and peculiar, and are the distinguishing feature of the species. They surround the base like a crown, extend out irregularly, and branch at their distal ends. The figures of this species indicate septal divisions, but these are not discernible externally.

Diameter, 0.87 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

POLYMORPHINA PROBLEMA (d'Orbigny).

Guttulina problema d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 266, No. 14, Modèle No. 61.

Polymorphina problema Brady, Parker, and Jones, 1870; Trans. Linn. Soc. London, Vol. XXVII, p. 225, Pl. XXXIX, fig. 11, a-b.

Test oblong ovate, composed of several inflated chambers (six in one specimen) marked by strong septal depressions. Very similar to the more abundant *polymorphina communis*, but differing from that species in the greater number of chambers. Surface of shell smooth; aperture small, rotund, radiate.

Length, 1 mm.; breadth, 0.73 mm.

Locality.—Rancocas formation, New Egypt, Mullica Hill, Timber Creek, New Jersey. Common.

Geological distribution.—Lias to Recent.

POLYMORPHINA REGULARIS von Münster.

Polymorphina regularis von Münster, 1838 (fide Roemer); Neues Jahrb. für Min., p. 385, Pl. III, fig. 21.

Polymorphina regularis Brady, Parker, and Jones, 1870; Trans. Linn. Soc. London, Vol. XXVII, p. 229, Pl. XL, fig. 13 a-c.

Test oblong, compressed, biconvex, narrow below but somewhat broader above; peripheral margin thin, rounded; chambers four to nine, oblique; septal lines marked by slight constrictions visible externally; surface smooth; aperture small, round, central, surrounded by fine grooves.

Length, 1–4 mm.; greatest breadth, 1.6 mm.

Locality.—Rancocas formation, Brownsville, New Jersey.

Geological distribution.—Cretaceous and Tertiary.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA d'Orbigny.

GLOBIGERINA BULLOIDES d'Orbigny.

Globigerina bulloides d'Orbigny, 1826; Ann. Sci. Nat., Vol. VII, p. 277, No. 1, Modèle No. 17 (young) and No. 76.

Globigerina bulloides Brady, 1884; Chal. Rept., Vol. IX, p. 593, Pl. LXXVII, and Pl. LXXIX, figs. 3-7.

"Test spiral, subtrochoid; superior surface convex, inferior more or less convex, but with deeply sunken umbilicus, periphery rounded, lobulated; adult specimens composed of about seven globose segments, of which four form the outer convolution, the apertures of the individual chambers opening independently into the umbilical vestibule. Diameter, sometimes one-fortieth of an inch (0.63 mm.), but oftener much less." (Brady, loc. cit.)

Locality.—Rancocas formation, Vincentown, Swedesboro, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is not uncommon in the lime sand at Vincentown, but it is rather rare in the overlying Manasquan marl beds. It is, however, much larger in the latter, and some specimens measure 0.4 mm. in diameter.

GLOBIGERINA BULLOIDES var. TRILOBA Reuss.

Globigerina triloba Reuss, 1849; Denks. Akad. Wiss. Wien, Vol. I, p. 374, Pl. XLVII, fig. 11, a-c.

Globigerina bulloides var. *triloba* Brady, 1884; Chal. Rept., Vol. IX, p. 595, Pl. LXXIX, figs. 1, 2; Pl. LXXXI, figs. 2, 3.

Test similar to *Globigerina bulloides*, but distinguished from the latter by its consisting of only three visible chambers in the final convolution. The diameter of the shell varies from 0.5 to 1 mm.

Locality.—Rancocas and Manasquan formations, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

GLOBIGERINA CRETACEA d'Orbigny.

Globigerina cretacea d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 34, Pl. III, figs. 12–14.

Test rotaliform, but strongly depressed; superior surface flattened or but slightly convex, inferior side depressed toward the center and excavated at the umbilicus; periphery obtuse and lobulated; shell typically composed of three fairly distinct convolutions, the outermost consisting of from five to seven segments, the latter relatively small, subglobular; aperture opening into the umbilical vestibule.

Diameter, less than 1^{mm}.

Locality.—Monmouth formation, Freehold, New Jersey; Rancocas formation, Quinton, Vincentown, Mullica Hill, Timber Creek, etc., New Jersey.

Geological distribution.—Cretaceous to Recent (?).

Family ROTALIDÆ.

Subfamily ROTALINÆ.

Genus DISCORBINA Parker and Jones.

DISCORBINA BERTHELOTI (d'Orbigny).

Rosalina bertheloti d'Orbigny, 1839; Foram. Canar., Vol. II, pt. 2, p. 135, Pl. 1, figs. 28–30.

Discorbina bertheloti, Brady, 1884; Chal. Rept., Vol. IX, p. 650, Pl. LXXXIX, figs. 10–12.

Test very strongly compressed, carinate, perforate; spiral side approximately flat, reverse side low, convex; chambers depressed, numerous, convex, with limbate margins.

Similar to *Truncatulina lobatula*, but more depressed, and with more finely perforate walls.

Length, 1.22 mm.; breadth, 0.82 mm.

Locality.—Rancocas formation, Blue Ball, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

Genus TRUNCATULINA d'Orbigny.

TRUNCATULINA AKNERIANA (d'Orbigny).

Rotalina akneriana d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 156, Pl. VIII, figs. 13–15.

Truncatulina akneriana Reuss, 1866; Denks. Akad. Wiss. Wien, Vol. XXV, p. 160, No. 6.

Truncatulina akneriana Brady, 1884; Chal. Rept., Vol. IX, p. 663, Pl. XCIV, fig. 8, a, b, c.

"The superior face of the test of *Truncatulina akneriana* is flat, the inferior convex at the margin, but depressed toward the umbilicus;

and the convolutions are not completely involute on the inferior side, as in *Truncatulina lobatula*, but leave a portion of the earlier whorls visible at the center." (Brady, loc. cit.)

Diameter, 0.43 mm.

Locality.—Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This form is commonly associated with *Truncatulina lobatula* or *Truncatulina ungeriana*, or with both, and has a similar distribution.

TRUNCATULINA HAIDINGERII (d'Orbigny).

Rotalina haidingerii d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 154, Pl. VII, figs. 7, 9.

Truncatulina haidingerii Brady, 1884; Chal. Rept., Vol. IX, p. 663, Pl. XCV, fig. 7, a–c.

Test circular, biconvex, trochoid; volutions three, chambers marked by slightly depressed septa on inferior side, about twelve segments in the last convolution; aperture a small marginal slit.

Diameter, 0.58 mm.

Locality.—Rancocas formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

The above species is similar to *Truncatulina ungeriana*, but differs from it in being more vaulted and less depressed at the umbilicus. It is also a smaller form and is not so abundant, being rather rare in the middle marl bed. There is, furthermore, no distinct groove following the whorls upon the superior side, and the perforations are smaller than in *Truncatulina ungeriana*.

TRUNCATULINA LOBATULA (Walker and Jacob).

Nautilus lobatulus Walker and Jacob, 1798; Adams's Essays, Kanmacher's ed., p. 642, Pl. XIV, fig. 36.

Truncatulina lobatula Brady, 1884; Chal. Rept., Vol. IX, p. 660, Pl. XCII, fig. 10; Pl. XCIII, figs. 1, 4, 5; Pl. CXV, figs. 4, 5.

Test plano-convex, moderately vaulted; last volution consisting of seven or eight chambers, with very slightly depressed septa; septa more curved upon the superior (flat) surface; aperture a small, neatly shaped arch at the margin of the ultimate segment.

Diameter, 0.36–1.13 mm.

Locality.—Matawan formation, Marshalltown, New Jersey; Monmouth formation, Freehold, New Jersey; Rancocas formation, Vincentown, New Egypt, Mullica Hill, etc., New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Carboniferous to Recent.

The above species shows great variation. Professor Brady considers that the more convex varieties merge into *Truncatulina refulgens*, while flattened forms resemble *Truncatulina wuellerstorfi*. The regular-built convex varieties constitute the *Truncatulina boueana* of d'Orbigny, and the less regular the *Truncatulina variabilis* of the same author.

TRUNCATULINA REFULGENS (Montfort).

Cibicides refulgens, Montfort, 1808; Conch. Syst., Vol. I, p. 122, 31e genre.
Truncatulina refulgens, Brady, 1884; Chal. Rept., Vol. IX, p. 659, Pl. XCII, figs. 7–9.

Test subconical, superior surface complanate, inferior very much elevated; consisting of about eight chambers in the last convolution; sutures somewhat depressed upon the inferior (vaulted) surface; peripheral margin sharp; aperture an inframarginal opening near the base of the ultimate segment.

Diameter, 0.5 mm.

Locality.—Manasquan formation (?), Vincentown, New Jersey.

Geological distribution.—Cretaceous (Upper?) to Recent.

There is a possibility that this is an Eocene fossil, as it was obtained from some of the uppermost greensand of the New Jersey Cretaceous, which carries a number of Eocene fossils, together with some of late Cretaceous age. The specimens came from the upper marl bed at Vincentown, and only a very few forms were found.

TRUNCATULINA UNGERIANA (d'Orbigny).

Rotalina ungeriana, d'Orbigny, 1846; Foram. Foss. Bassin tert. Vienne, p. 157, Pl. VIII, figs. 16–18.
Truncatulina ungeriana, Brady, 1884; Chal. Rept., Vol. IX, p. 664, Pl. XCIV, fig. 9, a–d.

Test large, rotaliform, circular, coarsely porous, both sides moderately convex, unequal, depressed slightly on the inferior side at the umbilicus, consisting of three convolutions. The last volution consists of from ten to twelve limbate chambers. Septa arched; aperture a median semilunar slit.

Diameter, 0.78 mm.

Locality.—Rancocas formation, New Egypt, New Jersey; Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Cretaceous to Recent.

This species is rather common at New Egypt. In the upper marl bed the forms are much smaller, the shell being only about one-half the size of the New Egypt specimens.

TRUNCATULINA WUELLERSTORFI (Schwager).

Anomalina wüllerstorfi Schwager, 1866; Nov. Exped. geol. Theil., Vol. II, p. 258, Pl. VII, figs. 105, 107.

Test circular, coarsely porous; inferior surface convex, superior complanate; peripheral edge acute; chambers narrow; septa strongly curved, crescent-shaped with broad septal ridges, nine in the last convolution; aperture a small marginal cleft.

Diameter, 0.5 mm.

Locality.—Manasquan formation, Vincentown, New Jersey.

Geological distribution.—Upper Cretaceous to Recent.

This species is similar in its outline to figure 8, Plate XCIII, Challenger Report, Vol. IX. None of our specimens are as flat as figure 9 of the same plate, which Professor Brady considers the more typical

form. This author states that this species is described from the Pliocene deposits of Kar Nicobar by Schwager, but does not mention its earlier occurrence. It is an intermediate form between *Truncatulina lobatula* and *Anomalina ariminensis*.

Genus ANOMALINA, d'Orbigny.

ANOMALINA AMMONOIDES (Reuss).

Plate VI, fig. 5.

Rosalina ammonoides, Reuss, 1845-46; Verstein. böhm Kreide, pt. 1, p. 36, Pl. VIII, fig. 53; Pl. XIII, fig. 66.
Anomalina ammonoides, Brady, 1884; Chal. Rept., Vol. IX, p. 672, Pl. XCIV, figs, 2, 3.

Test nautiloid, coarsely porous, small, compressed; lateral surfaces nearly equally convex; depressed at the umbilici; peripheral edge round; aperture an arched, nearly medium slit upon the inner margin of the ultimate segment.

Diameter, 0.5–0.8 mm.

Locality.—Monmouth formation, Freehold, Bruere's pits on Crosswicks Creek, New Jersey; Rancocas formation, Vincentown, New Egypt, Timber Creek, etc., New Jersey.

Geological distribution.—Cretaceous to Recent.

ANOMALINA GROSSERUGOSA (Gümbel).

Plate VI, fig. 4.

Truncatulina grosserugosa, Gümbel, 1868; Abhandl. d. k. bayer. Akad. Wiss., Vol. X, p. 660, Pl. II, fig. 104, a. b.
Anomalina grosserugosa, Brady; Chal. Rept., Vol. IX, p. 673, Pl. XCIV, figs. 4, 5.
Anomalina grosserugosa, Sherborn and Chapman, 1889; Journ. Royal Microsc. Soc., p. 487, Pl. XI, fig. 34.

Test nautiloid, very coarsely porous, pores larger and more numerous upon inferior surface; both sides convex; umbilici distinct; peripheral margin round; chambers large, inflated, only eight in final convolution; septa nearly straight; aperture median, arched.

Diameter, 0.43–0.82 mm.

Locality.—Rancocas formation, Swedesboro, New Jersey; Manasquan formation, Vincentown, New Jersey.

The above species is very similar to *Anomalina ammonoides*, but differs from it in being relatively larger and thicker, with a smaller number of chambers in the final convolution, and also in its more obtusely rounded margin.

Genus PULVINULINA Parker and Jones.

PULVINULINA KARSTENI (Reuss).

Rotalia karsteni Reuss, 1855; Zeit. geol. Gesell., Vol. VII, p. 273, Pl. IX, fig. 6.
Rotalia karsteni Reuss, 1861; Sitz. Akad. Wiss. Wien., Vol. XLIV, pt. 1, p. 337.
Pulvinulina karsteni Brady, 1884; Chal. Rept., Vol. IX, p. 698, Pl. CV, figs. 8, 9.

Test circular, regularly built, convex on both sides, with obtuse-

angular periphery; composed of from three to four convolutions; septal markings on superior surface apparent as fine lines, while the lower surface shows slight depressions of the radiating septa; last convolution consisting of six or seven chambers; aperture a cleft on the lower side somewhat removed from the margin.

Length, 0.45–0.5 mm.

Locality.—Rancocas formation, Vincentown, Quinton, New Jersey.

Geological distribution.—Cretaceous to Recent.

PULVINULINA MICHELINIANA (d'Orbigny).

Rotalina truncatulinoides d'Orbigny, 1839; Foram. Canaries, Vol. II, pt. 2, p. 132, Pl. II, figs. 25–27.

Rotalina micheliniana d'Orbigny, 1840; Mém. Soc. géol. France, ser. 1, Vol. IV, p. 31, Pl. III, figs. 1–3.

Test orbicular, superior surface nearly flat, inferior highly convex, with an excavated umbilicus; spire complanate, with three convolutions; last volution consisting of ten or twelve chambers, angular, separated by straight septal lines below; aperture elongate, slightly removed from the margin.

Diameter, 0.45 mm.

Locality.—Rancocas formation, Blue Ball, Timber Creek, New Jersey.

Geological distribution.—Cretaceous to Recent.

This is not a common species, but was described by Prof. A. E. Reuss under the name *Rotalina nitida*, which he considered to be a young form of *Rotalina umbilicata* d'Orbigny. Dr. W. B. Carpenter considers that the *Rotalina umbilicata* of the Chalk is identical with *Rotalina soldanii* of the Vienna Tertiaries. Prof. H. B. Brady states that *Pulvinulina micheliniana* has its isomorph in *Truncatulina refulgens*, from which species it is distinguished by the more or less excavated umbilicus and the projecting apical margins of the segments. In the Challenger Report, however, *Rotalina nitida* is not given under the synonyms of *Pulvinulina micheliniana*, but Dr. Woodward has so considered it in his report on the Cretaceous Foraminifera of New Jersey, and it seems probable that this view is correct.

PULVINULINA RETICULATA Reuss, var. CARINATA Bagg.

Plate V, figs. 3a, 3b.

Test discoidal, both sides moderately convex, peripheral margin possessing a large double heel; surface of shell smooth and shining, marked upon the superior surface by broad, curving septal lines; convolutions about three; eight chambers in the last volution; inferior surface less distinct, umbilicus marked by radiating lines nearly straight, but not distinct beyond one-third their length; no aperture visible.

Diameter, 0. 87 mm.

Locality.—Monmouth formation, Freehold, New Jersey.

Geological distribution.—Cretaceous.

GEOLOGICAL DISTRIBUTION OF THE FORAMINIFERA DESCRIBED IN THIS REPORT.

Species.	Formation.			
	Matawan.	Navesink.	Rancocas.	Manasquan.
LITUOLIDÆ.				
Haplophragmium concavum Bagg			×	
Haplophragmium irregulare Roemer			×	
Trochammina inflata (Montagu)			×	
TEXTULARIDÆ.				
Textularia agglutinans d'Orbigny			×	×
Textularia agglutinans var. porrecta Brady			×	
Textularia gibbosa d'Orbigny		×		
Textularia globulosa Ehrenberg		×		
Textularia gramen d'Orbigny			×	
Textularia sagittula Defrance			×	
Textularia turris d'Orbigny			×	
Verneuilina polystropha (Reuss)		×		
Verneuilina triquetra (von Münster)			×	×
Tritaxia tortilis (Reuss)			×	
Tritaxia tricarinata (Reuss)			×	×
Gaudryina pupoides d'Orbigny			×	
Clavulina communis d'Orbigny			×	
Clavulina parisiensis d'Orbigny			×	
Bulimina puschi Reuss		×		
Bulimina variabilis d'Orbigny		×		
Bolivina punctata d'Orbigny	×	×		
Bolivina textilaroides Reuss	×			
Pleurostomella subnodosa Reuss			×	
LAGENIDÆ.				
Lagena globosa (Montagu)			×	
Vitrewebbina lævis (Sollas)			×	
Vitrewebbina sollasi Chapman			×	
Nodosaria acuminata Reuss			×	
Nodosaria adolphinula (d'Orbigny)			×	
Nodosaria annulata Reuss		×	×	
Nodosaria communis (d'Orbigny)		×	×	
Nodosaria consobrina (d'Orbigny)	×			
Nodosaria consobrina var. emaciata Reuss	×		×	
Nodosaria farcimen (Soldani)			×	
Nodosaria filiformis d'Orbigny		×	×	
Nodosaria indifferens (Reuss)		×		
Nodosaria inornata (d'Orbigny)	×			
Nodosaria lævigata (d'Orbigny)			×	
Nodosaria longiscata d'Orbigny				×
Nodosaria multicostata d'Orbigny			×	
Nodosaria nitida d'Orbigny			×	
Nodosaria obliqua (Linné)	×	×	×	×
Nodosaria pauperata d'Orbigny				×
Nodosaria polygona Reuss	×	×	×	×
Nodosaria radicula (Linné)			×	
Nodosaria raphanus (Linné)			×	
Nodosaria roemeri (Neugeboren)	×			
Nodosaria rotundata (Reuss)			×	
Nodosaria scabra (Reuss)				×
Nodosaria spinulosa (Montagu)				×

Geological distribution, etc.—Continued.

Species.	Formation.			
	Matawan.	Navesink.	Rancocas.	Manasquan.
LAGENIDÆ—continued.				
Nodosaria vertebralis (Batsch)			×	
Nodosaria williamsi Bagg			×	
Nodosaria zippei Reuss	×	×	×	×
Lingulina carinata d'Orbigny			×	
Frondicularia alata d'Orbigny			×	
Frondicularia angusta Nilsson, var. dimidia Bagg			×	
Frondicularia archiaciana d'Orbigny var. strigillata Bagg			×	
Frondicularia clarki Bagg		×		
Frondicularia gaultina Reuss	×			
Frondicularia inversa Reuss		×		
Frondicularia lanceola Reuss		×		
Frondicularia major Bornemann			×	
Frondicularia ovata Roemer	×		×	
Frondicularia pulchella Karrer	×			
Frondicularia reticulata Reuss		×		
Frondicularia verneuilina d'Orbigny	×			
Rhabdogonium roemeri Reuss	×			
Rhabdogonium tricarinatum d'Orbigny			×	
Rhabdogonium tricarinatum var. acutangulum Reuss	×			
Marginulina ensis Reuss		×	×	
Marginulina pediformis Bornemann	×			
Marginulina trilobata d'Orbigny	×	×		
Vaginulina legumen (Linné)	×		×	
Vaginulina strigillata Reuss		×		
Cristellaria acutauricularis (Fichtel & Moll)			×	
Cristellaria articulata (Reuss)			×	
Cristellaria cassis (Fichtel & Moll)			×	
Cristellaria crepidula (Fichtel & Moll)			×	
Cristellaria cretacea Bagg			×	
Cristellaria cultrata (Montfort)		×	×	
Cristellaria gibba d'Orbigny	×		×	
Cristellaria italica Defrance			×	
Cristellaria mamilligera Karrer			×	
Cristellaria megapolitana (Reuss)		×		
Cristellaria projecta Bagg			×	
Cristellaria rotulata (Lamarck)			×	×
Cristellaria secans Reuss		×		
Cristellaria trachyomphala Reuss			×	
Cristellaria triangularis d'Orbigny		×		
Cristellaria wetherellii (Jones)			×	
Flabellina cordata Reuss			×	
Flabellina sagittaria (Lea)			×	
Polymorphina compressa d'Orbigny			×	
Polymorphina communis (d'Orbigny)			×	
Polymorphina emersoni n. sp		×		
Polymorphina gibba (d'Orbigny)		×	×	
Polymorphina lactea (Walker & Jacob)		×	×	
Polymorphina lactea var. elongate Brady			×	
Polpmorphina oblonga d'Orbigny		×	×	
Polymorphina orbignii (Zborzewski)			×	
Polymorphina problema (d'Orbigny)			×	
Polymorphina regularis von Münster			×	

Geological distribution, etc.—Continued.

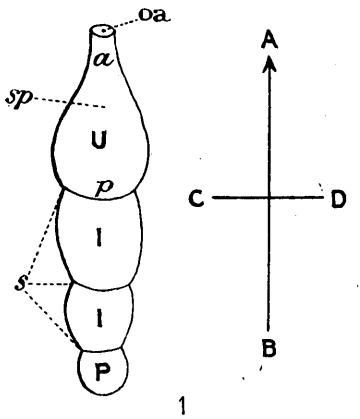
Species.	Formation.			
	Matawan.	Navesink.	Rancocas.	Manasquan.
GLOBIGERINIDÆ.				
Globigerina bulloides d'Orbigny	.....	.....	×	×
Globigerina bulloides var. triloba Reuss	.....	.....	×	×
Globigerina cretacea d'Orbigny	.....	×	×	.....
ROTALIDÆ.				
Discorbina bertheloti (d'Orbigny)	.....	.....	×	.....
Truncatulina akneriana (d'Orbigny)	.....	.....	.....	×
Truncatulina haidingerii (d'Orbigny)	.....	.....	×	.....
Truncatulina lobatula (Walker & Jacob)	×	×	×	×
Truncatulina refulgens (Montfort)	.....	.....	.....	×
Truncatulina ungeriana (d'Orbigny)	.....	.....	×	×
Truncatulina wuellerstorfi (Schwager)	.....	.....	.....	×
Anomalina ammonoides (Reuss)	.....	×	×	.....
Anomalina grosserugosa (Gümbel)	.....	.....	×	×
Pulvinulina karsteni (Reuss)	.....	.....	×	.....
Pulvinulina micheliniana (d'Orbigny)	.....	.....	×	.....
Pulvinulina reticulata Reuss, var. carinata Bagg	.....	×	.....	.....
Total	20	32	79	19

PLATES.

PLATE I.

PLATE I.

DIAGRAMS ILLUSTRATING DESCRIPTIVE TERMS.



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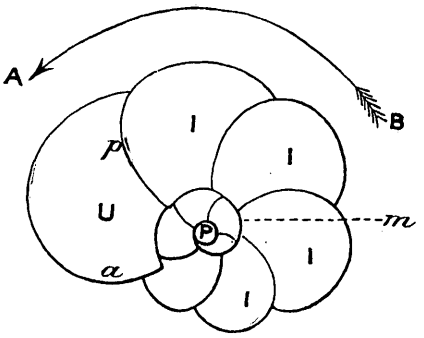

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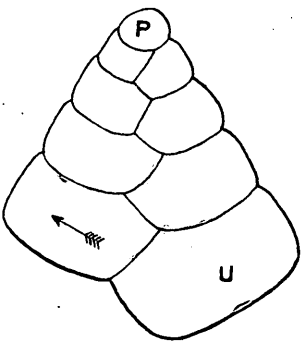

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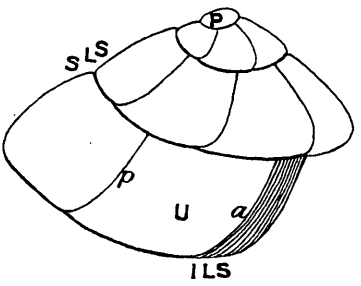

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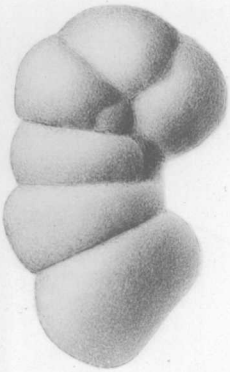
DIAGRAMS ILLUSTRATING DESCRIPTIVE TERMS

THE HELIOTYPE PRINTING CO., BOSTON

PLATE II.

PLATE II.

CRETACEOUS FORAMINIFERA.



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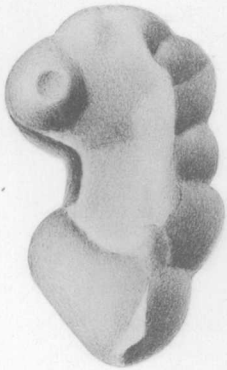

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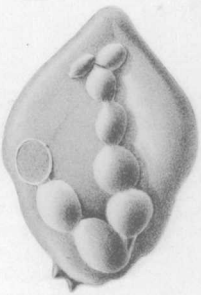

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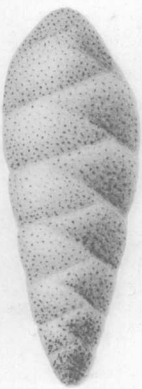

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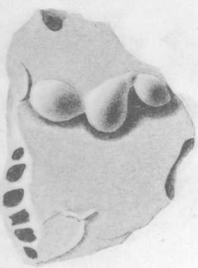

5a

5b

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CRETACEOUS FORAMINIFERA

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PLATE III.

PLATE III.

CRETACEOUS FORAMINIFERA.

1

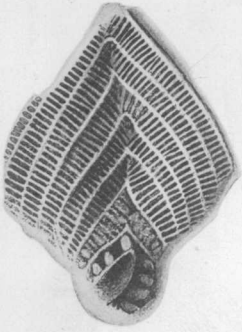
2a

2b

5

4

3



6

7a

7b

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PLATE IV.

3069——6

PLATE IV.

CRETACEOUS FORAMINIFERA.

1a

1b

3

2b

2a

4

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5a

5b

CRETACEOUS FORAMINIFERA

THE HELIOTYPE PRINTING CO., BOSTON

PLATE V.

PLATE V.

CRETACEOUS FORAMINIFERA.

Page.

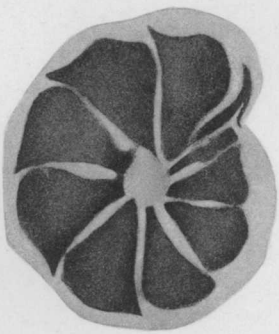
FIG. 1a. CRISTELLARIA PROJECTA Bagg (x 10) 57
FIG. 1b. CRISTELLARIA PROJECTA Bagg (longitudinal section) (x 10) 57
FIG. 2a. CRISTELLARIA CRETACEA Bagg (x 10) 55
FIG. 2b. CRISTELLARIA CRETACEA Bagg (longitudinal section) (x 10) 55
FIG. 3a. PULVINULINA RETICULATA Reuss, var. CARINATA Bagg (inferior aspect) (x 53) 68
FIG. 3b. PULVINULINA RETICULATA Reuss, var. CARINATA Bagg (superior aspect) (x 53) 68

1a

1b

2a

2b



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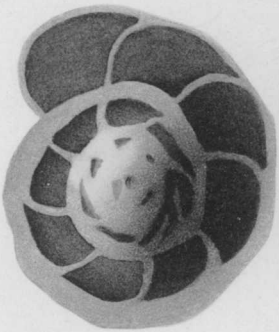

3b

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CRETACEOUS FORAMINIFERA

THE HELIOTYPE PRINTING CO., BOSTON

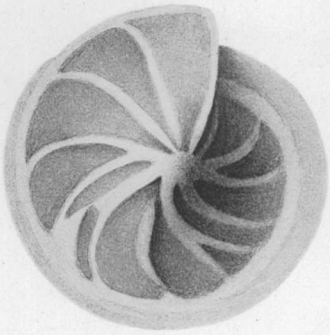
PLATE VI.

PLATE VI.

CRETACEOUS FORAMINIFERA.

Page.

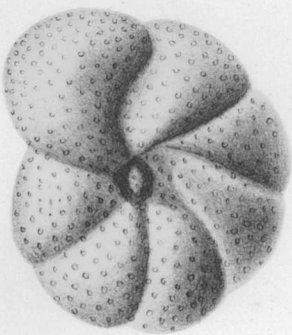
FIG. 1. CRISTELLARIA CULTRATA (Montfort) (x 22) 55
FIG. 2. POLYMORPHINA COMMUNIS d'Orb (x 37) 60
FIG. 3. POLYMORPHINA EMERSONI Bagg (x 33) 60
FIG. 4. ANOMALINA GROSSERUGOSA (Gumbel) (x 86) 67
FIG. 5. ANOMALINA AMMONOIDES (Reuss) (x 70) 67



1

2

3



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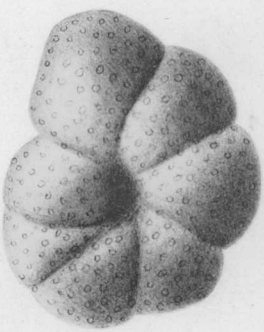

5

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CRETACEOUS FORAMINIFERA

THE HELIOTYPE PRINTING CO., BOSTON

INDEX.