THE FORAMINIFERA OF THE THANET BEDS OF PEGWELL BAY.

WITH NOTES ON OTHER MICROSCOPIC ORGANISMS; A DESCRIPTION OF THE SECTION AT PEGWELL BAY; AND REMARKS ON THE CORRELATION OF THE THANET BEDS,

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(*Read December 4th*, 1896.)

PLATES I, II, III, IV, V.

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I.—INTRODUCTION.

a. *Foraminifera previously recorded.*

THE Foraminifera hitherto recorded from the Thanet Beds of this country are but few in number. The following lists, so far as we are aware, include all the species that have been noted. Eliminating synonyms there are thus at present eleven known species, or varieties.

Cristellaria calcar, Linn., var. *platypleura*, Jones
Nodosarina (Cristellaria) italica, Defr. (= *C. wetherelli*, Jones)
**Nodosarina (Nodosaria) raphanistrum*, Linn. (= *N. bacillum*, Defr.)
Planorbulina (Truncatulina) lobatula, W. and J. (= *Rosalina mariæ*, Jones)
Polymorphina lactea, W. and J. (= *P. ampulla*, Jones, and *Globulina* of authors)
Rotalia beccarii? Linn (? = *Rosalina*)

} *Mem. Geol. Surv.*, Vol. IV, 1872, p. 575.

* In the Monograph Crag Foram., pt. iii, Pal. Soc., 1896, p. 218, the allocation of this species to the Thanet Sands is considered doubtful.

Polymorphina gibba, d'Orb. (*ampulla*, Jones) *Nodosaria acicula*, Lamk. *Cristellaria italica*, Defr. (var. *wetherellii*, Jones) ,, *cultrata*, (Mohtf.) (*platypleura*, Jones) *Truncatulina lobatula*, (W. and J.) (var. *mariæ*, Jones)	*Cat. Foss. Foram. Brit. Mus.*, 1882, p. 19.
Cristellaria crepidula, (F. and M.) var. *prima*, d'Orb. ,, ,, ,, var. *varians*, Born. ,, ,, ,, var. *simplex*, d'Orb. ,, ,, ,, var. *protracta*, Born. *Nodosaria farcimen* (Soldani)	Parker Coll., *Brit. Mus. Nat. Hist.* (MS.)

These species are all from Pegwell Bay, and are not recorded from other localities, with the single exception that *Nodosaria raphanistrum* has also been met with at Goodnestone, east of Faversham, but the reference, as already mentioned, is doubtful.

The few species which have been recorded not having been assigned to their proper horizons in the Thanet series, it seemed to us desirable that a more careful examination should be made of the several beds of, at least, some one typical section, in order that the known species should, if possible, be properly located, and others added.

b. *Section at Pegwell Bay.*

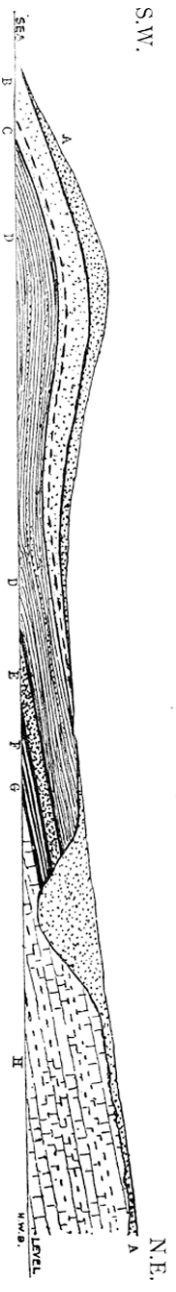
Pegwell Bay affords by far the best exposure of the Thanet Beds. It is quite clear in its section, and not liable to serious misinterpretation; and it does not include the risk of containing an admixture of recent species, washed in from the sea, as is in part possible with the lower beds at Herne Bay and Reculvers. We were also induced to select this section as Mr. Percy Emary had kindly supplied us with a sample of one of the lower beds (F) which proved to be rich in Foraminifera.

To avoid, as far as possible, all chance of error, we did not trust to old material already in our possession from Pegwell Bay, but visited the section, and selected specimens from each of the beds. The result of the detailed examination of these specimens will be dealt with in due course, but before discussing them we will briefly describe the section at Pegwell.

The beds form low cliffs (Fig. 1) and stretch, broadly speaking, from north-east to south-west, dipping very slightly to the south-west. They rest upon the Upper Chalk (zone of *Micraster cor-anguinum*) at the Broadstairs, or north-east, arm of the Bay, and show the vertical section given on p. 22.

Some discussion has been waged over this section, both with regard to its actual thickness and as to the interpretation to be placed upon the age of some of the beds.

The bed A has particularly been the subject of inquiry with regard to its geological position. Mr. J. Starkie Gardner, in his



THANET BEDS.
A. Drift Loam.
B. Yellow and buff sands.
C. Greenish-grey and buff sands.
D. Dark greenish-grey sandy marl.
E. Dark grey shaly marl, with iron stains.

THANET BEDS.
F. Dark grey, green and buff to orange sandy marl, in bands.
G. Bed of green-coated flints.
H. Upper chalk of Broudstairs (zone of *Marsupites angustum*).

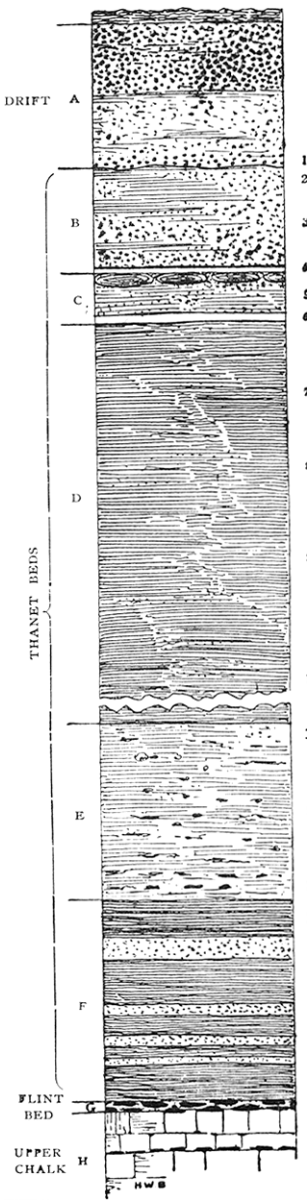
FIG. 1.—SKETCH SECTION OF THE CLIFFS AT PEGWELL BAY.

paper on the Lower London Tertiaries,* gives a section differing somewhat from that shown in the *Survey Memoirs*. In the Survey section this bed is described† as "Light-brown loam, often with flints and bits of chalk at the bottom, sometimes a few black flint-pebbles and shells washed out of the Thanet Sand below."

Mr. Gardner in the paper alluded to, on the other hand, divides this bed into two portions, an upper of Drift Loam and a lower of Buff Clayey Sand with black pebbles at the base, and he states on the plate that the last-named bed is not noticed by either Prestwich ‡ or the Survey. In the latest edition of the *Survey Memoirs* § Mr. Whittaker devotes some attention to this question, and says: "One of the reasons given [by Mr. J. S. Gardner] for including the Sand that has been mapped as belonging to the Woolwich Series in East Kent with the Thanet Beds is based on a mistake. The author says that 'at Pegwell a layer of black flint pebbles occurs in what is acknowledged to be Thanet Sands.' The layer in question is really at the base of the Drift Brickearth, and has not been acknowledged to belong to anything else; Mr. Gardner indeed himself infers this in his plate, though only saying 'apparently classed as Drift.' The statement (on the plate) that it is 'not mentioned by Prestwich or

* *Quart. Journ. Geol. Soc.*, vol. xxxix, 1883, p. 204.
† *Mem. Geol. Surv.*, vol. iv, 1872, p. 96.
‡ *Quart. Journ. Geol. Soc.*, vol. viii, 1852, pp. 235 *et seqq.*
§ *Mem. Geol. Surv.* (Geology of London), vol. i, 1889, p. 97.

FIG. 2.—VERTICAL SECTION OF THE CLIFF AT PEGWELL BAY.



Vegetable earth, reddish brown.

Reddish-brown sandy loam, lower part lighter in colour; worked for bricks; black or dark green pebbles at the base; with *Astrorhiza arenaria* and other Foraminifera of northern habitat.
11 ft. 0 in. to 13 ft. 0 in.

Yellow and buff to grey sands; 3-inch shell band at the base, with spicules of *Geodia*, and Foraminifera, *Textilaria sagittula*, *Truncatulina ungeriana*.
8 ft. 0 in. to 15 ft. 0 in.

Greenish grey and buff sands, topped by a layer of sandy concretions and with 6-inch shell bed at base; the latter with many Foraminifera; *Textilaria sagittula*, *Nodosaria obliqua*, *Cristellaria gibba*, *C. platypleura*, etc.
3 ft. 6 in. to 4 ft. 0 in.

Dark greenish-grey sandy marl, with ochreous pockets, passing insensibly into fossiliferous dark bluish-grey harder sandy marl, with Mollusca, *Thracia*, *Pholodomya arctica*, and Foraminifera, *Textilaria sagittula*, *Bulimina elongata*, *B. ovata*, *Anomalina grosserugosa*, *Pulvinulina exigua*, var. *obtusa*, and others.
34 ft. 0 in. to 40 ft. 0 in.

Dark-grey shaly, sandy marl; mottled with decomposing marcasite; with Foraminifera; *Ammodiscus incertus*, *Bulimina ovata*, *B. elongata*, and others.
15 ft. 0 in.

Dark grey sandy marl at top, passing to dark green sand at bottom. Weathered surface shows distinct bands alternately light and dark in colour; the light bands varying from buff to orange; the top band full of Foraminifera, *Cristellaria crepidula*, with many varieties, *Bulimina elongata*, *Anomalina grosserugosa*, *Pulvinulina exigua*, var. *obtusa*, and other species, and Diatomaceæ and Radiolaria.
17 ft. 0 in.

Bed of green-coated flints, with Cretaceous Foraminifera, *Bulimina pirula*, *Globigerina cretacea*.
6 in. to 9 in.

Broadstairs Chalk; zone of *Micraster cor-anguinum*.

the Survey' is incorrect, for it has been mentioned by both as Drift."

From the Drift bed A to the base of the Thanet Series at Pegwell Bay the section is quite clear; but the green-coated flint-bed G has been the subject of considerable controversy, both as to its origin and as to whether it should be classed with the Thanet Beds or with the underlying chalk.

Mr. Dowker* suggested that the green-coated flint-bed was due to sub-aërial denudation of the chalk before the deposition of the Thanet Beds.

Mr. J. S. Gardner† contends that as the Thanet fauna was deposited within the Laminarian Zone [low water to 15 fathoms] the peculiar green tint was probably caused by the sea-weed in which the flints were imbedded.

Mr. Whitaker‡ summarises the various views which have been expressed by the authors already mentioned, by Prof. Morris, Prof. T. McKenny Hughes, and others, and comes to the general conclusion that the green-coated bed is due to the removal of chalk by chemical action, either before, but more probably subsequent to, the deposition of the Thanet Sand; and that during that time the flints also received their coating of silicate of iron.

As with the age of the beds, so with their relative thickness close agreement is not to be found.

The bed A is stated by Mr. Gardner to be 12 feet thick. We notice that it is somewhat variable in its dimensions, the upper division varying from 5 to 6 feet, and the lower from 6 to 7 feet, so that in places it measures at least 13 feet.

The beds B and C taken together, when measured by the Survey, showed 12 to 15 feet thick; Mr. Gardner computes them at 10 feet, and we consider they vary from 12 to 19 feet. This apparent discrepancy can be readily explained. The beds, no doubt, are variable in themselves, and it depends to some extent upon the position in which they are measured, and upon the different conditions pertaining at different periods, consequent upon the cutting back of the cliffs. Bed B is certainly variable, in our view ranging from 8 to 15 feet, while C is more constant and averages 3 feet 6 inches to 4 feet.

With the beds D and E there is a similar divergence in the measurements. By the Survey they are stated together to be 40 feet thick, Mr. Gardner assigns 49 feet as the thickness, and we are inclined to consider that bed D alone is 40 feet thick, making a total for beds D and E of, say 55 feet.

Bed F when measured by the Survey showed 9 feet, and

* *Geol. Mag.*, vol. iii, 1866, pp. 210, 239.
† *Quart. Journ. Geol. Soc*, vol. xxxix, 1883, p. 202.
‡ *Mem. Geol. Surv.* (Geology of London), vol. i, 1889, pp. 104-106, and *Mem. Geol. Surv.* vol. iv, 1872, p. 58.

when seen by Mr. Gardner 17 feet thick; which thickness it still retains.

The base bed of dark clayey greensand (part of our bed F), recorded as $1\frac{1}{2}$ feet by the Survey, is included in the above-mentioned 17 feet.

The following shows the differences of measurements at various times:

		Survey (1872).	J. S. Gardner (1883).	H. W. B. & R. H. (1896).
Drift.	A.	?	12 ft.	11 ft. to 12 ft.
Thanet Series.	B.	12 ft. to 15 ft.	7 ft.	8 ft. to 15 ft.
	C.		3 ft.	3 ft. 6 in. to 4 ft.
	D.	40 ft.	34 ft.	40 ft.
	E.		15 ft.	15 ft.
	F.	9 ft.	17 ft.	17 ft.
		1 ft. 6 in.		
Flint bed.	G.	?	?	6 in. to 9 in.

In selecting our specimens we were careful to take them, as will be seen by reference to Fig. 2, so that their exact position might be known. We measured up or down from well defined bands.

c. *Correlation of Thanet Beds with those of Belgium and France.*

A few words may be said upon the correlation of the English Thanet Beds with those of similar age upon the continent.

The late Sir J. Prestwich, in his paper on the "Correlation of the Eocene Strata in England, Belgium, and France,"* in comparing the Thanet Sands with the Lower Landenian says: "There can be no doubt of the synchronism of these English and Belgian deposits," and in the classification he then proposed,† the Thanet Sands of England were correlated with the Lower Landenian and Heersian in Belgium and with the sands of St. Omer, Douai, and the lower sands of La Fère in France.

Mr. G. F. Harris dissents somewhat from this view of the correlation. He had previously pointed out‡ that the Landenian Beds overlie the Heersian, and that the Lower Landenian has a fauna quite unlike that of the Thanet Beds; so that while admitting the Lower Landenian to be in part equivalent to the Thanet Beds, he is inclined to think they also represent newer beds. He regards the Heersian Beds as the true equivalents of the Thanet Beds and the "beds which entomb the Gelinden flora, homotaxial with the lower part of our Thanet Beds."

d. *Foraminifera of Foreign Beds of Thanet Age.*

The Foraminifera of beds of this period appear to have received but scanty attention upon the continent. In a letter to

* *Quart. Journ. Geol. Soc.*, vol. xliv, 1888, p. 91.
† *Op. cit.*, p. 108.
‡ *Geol. Mag*, Decade iii, vol. iv, 1887, pp. 110, 111.

us on the subject in answer to our inquiries, M. Gustave Dollfus says that no author has yet to his knowledge noted any Foraminifera in the Thanet Sands of the Paris Basin. He doubts if they have hitherto been properly sought for, but in any event he believes them to be very rare.

M. Dollfus has himself carefully studied the fauna of the *Sables glauconieux inférieur*, and has only found a single species of Foraminifera, which he refers to *Rosalina mariæ*, Jones.

At Châlons-sur-Vesle there are, if his memory serves him rightly, some *Polymorphinæ*, but the subject generally has been neglected in France.

M. Dollfus also informs us that some Radiolaria have been recorded from the *Tufeau de la Fère* (zone of *Arctica morrisii*) but no Foraminifera were apparently met with.

With regard to Belgium, M. E. Van den Broeck is good enough to inform us that no lists of Foraminifera have yet been published of either the Heersian or of the Landenian Beds. The Rhizopodal fauna is, however, rich in individuals, if not in species, particularly of the genera *Dentalina*, *Frondicularia*, and *Marginulina* among others. It would be interesting to compare the fauna of the Belgian deposits with that of our own beds, and M. Van den Broeck has kindly promised to forward us some material which will, we trust, enable us to institute a comparison at a later date.

II.—LITHOLOGICAL AND PALÆONTOLOGICAL CHARACTERISTICS OF THE SEVERAL BEDS AT PEGWELL BAY.*

Bed A. Drift. Specimen 1.—A pale-brown, fine grained sandy loam, with a scattered band of greenish-black flint pebbles at the base. The larger grains are principally fragments of mollusca, and sub-angular and well-rounded grains of quartzose sand, cemented in part into small concretionary masses by an oxide of iron. A very large proportion (84 per cent.) of the bed is composed of very small angular and sub-angular quartzose sand, with some flakes of mica and a few grains of glauconite. Organic remains are generally scarce. Our washings yielded: a small *otolith*, numerous fragments of mollusca, one Ostracod valve, which Professor T. Rupert Jones, who kindly helped us with the Ostracoda throughout, considers to be near to *Cythereis bowerbankiana*, a few spines of Echinoidea, and still fewer spicules of Tetractinellid sponges.

The Foraminifera are not well represented in this bed, with the

* *Note.*—The specimens 1 to 17 inclusive were taken from each bed at various levels, as indicated by the small numerals on the section, Fig. 2. A table showing the size of component particles and amount of insoluble residue is appended, p. 30.

exception of two species, which are rather common. These are the arenaceous form, *Astrorhiza arenaria*, and the hyaline *Truncatulina akneriana*. The other species of Foraminifera are rare, but it should be noted that the forms met with are such as are now abundant in high latitudes, though they are not confined to northern waters.

Bed B. Specimen 2.—Colour a pale fawn. This bed is principally formed of rather angular and splintery grains of quartzose sand of very small size, cemented in part into concretionary masses with carbonate of lime. The minute granules of sand are in many cases cemented to the entombed organisms, which are not so rare as they appear to be at first sight; but it is difficult to extract recognisable species. Mollusca, represented in our gatherings by fragments only, are not rare. The Ostracoda are represented by two species, probably referable to *Cythereis bowerbankiana ?* and *Cytheridea papillosa*. Spines of Echinoidea are rather common, and spicules of Tetractinellid sponges and of Alcyonarian corals not rare. Some minute ovoid bodies in this specimen particularly attracted our attention, and we submitted them to Dr. G. J. Hinde. As these organisms are abundantly distributed throughout the material we have collected at Pegwell Bay we venture to quote the remarks upon them which Dr. Hinde was good enough to favour us with. He says: "The small ovoid bodies from the Thanet Sands of Pegwell Bay are detached dermal spicules of siliceous Tetractinellid sponges belonging to the genus *Geodia* probably. These sponges have a thick outer crust composed of the same kind of microscopic bodies as in your slide. The spicules are made up of numerous diverging fibres starting from a centre, and their heads project slightly beyond the general surface of the spicules like the heads of so many pins on the outside of a pincushion. There is a small round smooth spot in each where the animal filament was attached which held them in position when the sponge was alive. They vary in size and form in different species of the genus and even in the same specimen. Some are round, nearly, others ovoid or reniform. They occur detached in most deposits where siliceous sponges are present. . . . In some of the fossil forms the central portions are dissolved or removed, and give rise to the apparent air-bubble which you refer to in your specimens. No alteration in other respects have gone on in yours; they still remain in their opalized condition, giving no colours in polarized light between crossed nicols; those in the chalk are now usually chalcedonic or wholly crystalline. The body spicules of these *Geodia* sponges consist of needle, fusiform spicules, and trifid spicules." Dr. Hinde also favoured us with drawings of similar spicules of *Geodia* from the upper chalk of Norwich and of Westphalia, and of *Geodia japonica*, recent from Japan, by which it would seem that the spicules from Pegwell Bay are rather

larger than the recent species, and somewhat smaller than those from the cretaceous beds referred to.

In the finest washings from this Bed we notice a few Radiolaria, more or less fragmentary, but probably belonging to the genus *Cœnosphæra*.

The Foraminifera are of few species, and very rare, with the exception of *Textilaria sagittula* and *Nodosaria obliqua*, which are rather common.

Bed B. Specimen 3. This specimen is very similar to the last described, but the sand-grains are more compacted into concretions. Glauconite is not rare. Organic remains are very similar to those in specimen 2, except that we have not detected any Ostracoda or Radiolaria. The common Foraminifera are the same as in specimen 2.

Bed B. Specimen 4 (3-inch shell-band). A very similar specimen to No. 2, so far as the matrix is concerned; but, being a shell-band, fragments of mollusca are much more abundant. Other organic remains are scarce; one valve of an Ostracod, *Cytheropteron* sp., was found; spicules of *Pachastrella* and *Geodia* occur sparingly, and in the finest sediment after washing a few Radiolaria, probably *Cœnosphæra*. The common Foraminifera are as in the other specimens from bed B; *Truncatulina ungeriana* is, however, rather more plentiful than in the other gatherings from this bed.

Bed C. Specimen 5. In colour a dull earthy fawn or buff, composed of fine angular grains of quartzose sand, in part cemented with carbonate of lime. A large proportion of the grains quite clear, mixed with others stained with limonite or other oxide of iron. Bright green grains of glauconite not rare. Organic remains are very scarce, principally fragments of mollusca. One valve of an Ostracod, *Cytheridea papillosa*, was detected, with a few spines of Echinoidea and spicules of *Geodia*. The Foraminifera are few in number. Poor and stunted specimens of the following species, among others, were met with: *Textilaria sagittula*, *Bulimina ovata*, *B. elongata*, *Cristellaria platypleura*, *Truncatulina ungeriana*, and *Anomalina grosserugosa*.

Bed C. Specimen 6 (6-inch shell-band). In colour and composition very like the last-described specimen, the large particles being almost wholly fragments of mollusca. Some of the glauconite grains simulate casts of Foraminifera, showing a lobulated outline. In addition to the mollusca other organic remains occur. We notice spines of Echinoidea, and several specimens of Ostracoda, allied to, if not identical with, *Cythereis quadrilatera*. The Foraminifera are fairly abundant; indeed this is one of the richest beds in the Pegwell Bay section for representatives of the Class. *Cristellaria gibba*, *C. platypleura*, and intermediate varieties approaching *C. cultrata* are very

abundant, together with *Textilaria sagittula* and *Nodosaria obliqua*, while *Truncatulina ungeriana* and *Anomalina grosserugosa* are rather common. A fair number of other species occur, but individually they are more rare.

Bed D. Specimens 7, 8, 9, and 10. Each of these specimens is similar in colour and composition, being a dark grey, hard, sandy marl, breaking for the most part with a tendency to "conchoidal" fracture. When the carbonate of lime is removed the matrix is seen to consist of very minute grains of quartzose sand, with a few grains of glauconite and flakes of mica. For the most part these specimens are exceedingly poor in organic remains. Ostracoda are represented in specimen 9 by one valve allied to *Bythocypris silicula*; Echinoidea in each specimen by a few spines; Bryozoa in specimen 7 by one example, which Dr. J. W. Gregory, who was good enough to examine it, refers to the genus *Filisparsa*; Radiolaria by *Cœnosphæra*, in specimens 7 and 8; Sponges by spicules of *Geodia*, sparingly in each specimen; Diatoms by very small forms of *Coscinodiscus* in the finest washings from each specimen.

The Foraminifera are not well represented in any of the specimens. The most common are *Bulimina ovata* and *B. elongata*, *Textilaria sagittula*, *Truncatulina ungeriana*, *Anomalina grosserugosa*, and a variety of *Pulvinulina exigua* (var. *obtusa*, nov.)

Bed E. Specimens 11, 12, *and* 13. It is only in the mass that this bed differs from Bed D, as it is more shaly and mottled with iron and decomposing pyrites or marcasite. Each of the samples examined presents much the same microscopic characters as those of Bed D, except that there are many particles of ferruginous material and more abundant glauconite, especially in No. 13. Organic remains are again very scarce, Echinoidea, Radiolaria, Spongida, and Diatomaceæ being represented as in Bed D, and very sparingly. The Foraminifera are rare, with the exception of *Bulimina ovata* and *B. elongata*. Among the rarer forms may be noted *Ammodiscus incertus*, *Chilostomella ovoidea*, *Cristellaria arcuata*, *Cristellaria platypleura*, *Pullenia sphæroides*, *P. quinqueloba*, and others as tabulated.

Bed F. Specimen 14. This sample is a dark grey, hard, sandy marl, breaking with a "conchoidal" fracture. The colour is rather darker than in Bed E, and it has in consequence been called "the black band," by Dr. A. Rowe. In composition it is very similar to the gatherings from Bed E, very fine-grained quartzose-sand, cemented by carbonate of lime. The fauna of this bed is, in many respects, the richest we have met with in the Thanet Beds of Pegwell Bay.

Sponges are represented, as in other gatherings, by ovoid spicules of *Geodia*; Radiolaria, though the specimens are small

and rare, by *Cœnosphæra*, *Stylosphæra* and *Ceratospyris*; and Diatomaceæ by the genera *Triceratium*, *Coscinodiscus*, and *Omphalopelta*. Some of the specimens of the two last-named genera are large and well developed examples, and it is interesting to note that they are comparable with some Diatoms recorded from the London Clay by W. H. Shrubsole and F. Kitton*; and, like the species recorded by those authors, occur, not in the siliceous condition, but as pseudomorphs in dark brown glistening iron-pyrites. The Foraminifera are abundant, and the bed is particularly rich in the large ensiform varieties of *Cristellaria crepidula*, figured on Plate I. More common, but not so conspicuous by reason of their small size, are *Bulimina elongata*, and the new variety of *Pulvinulina exigua*. Among the rarer species may be noted *Ammodiscus incertus*, *Dentalina communis*, *Nodosaria farcimen*, and *Pullenia quinqueloba*.

Bed F. Specimen 15, from near the base of the Thanet Series, is composed of a pale fawn-coloured sand, of exceedingly fine grain, sharp and angular, stained with limonite or other iron salt. We have failed to detect a trace of any organic remains.

Bed F. Specimen 16. This is often referred to as the "greensand-bed," and its lithological characters have been discussed at length by Miss M. J. Gardiner,† who shows that the principal component minerals are quartz, about 45 per cent., flint in angular chips, 20 per cent., with a fair proportion of glauconite; which is, however, less well-developed than in most greensands.

In addition to the minerals already referred to, Felspar, Zircon, Rutile, Tourmaline, and other rarer minerals are also found in this bed. Miss Gardiner obtained casts of Foraminifera, "probably of the genera *Planorbulina* and *Textilaria*." We have not been so fortunate as to detect any with certainty, but the lobulated character of many of the glauconite grains suggests a Foraminiferal origin.

The siliceous spherical (or ovoid) spicules of *Geodia* are alluded to in Miss Gardiner's paper, but they are erroneously, though with doubt, referred to the Radiolaria or Diatomaceæ.

Bed G. Specimen 17. (Bed of green-coated flints.) This bed calls for but little remark; it is chiefly composed of broken, angular, and splintery fragments of flint, green-coated in part, with many grains of glauconite and other minerals, more or less cemented by ferruginous material.

We have only detected a few specimens of Foraminifera after a long search, and they are referable to cretaceous species; particularly *Textilaria globulosa*, *Bulimina pirula*, *Globigerina cretacea*, and some poor *Truncatulinæ*.

* *Journ. Roy. Micro. Soc.*, 1881, p. 381, pl. v.
† *Quart. Journ. Geol. Soc.*, 1888, vol. xliv, pp. 755-760.

Table showing amount of insoluble residue and size of component particles of specimens of the Various Beds at Pegwell Bay.

Bed.	No. of Specimen.	Percentage of Insoluble Residue.	Percentage amount of Residue on Meshes.			
			$\frac{1}{30}$ inch.	$\frac{1}{60}$ inch.	Less than $\frac{1}{60}$ inch.	
A.	1	80·00	2·0	14·0	84·0	Drift.
B.	2	—	0 5	5 0	94·5	
„	3	80·00	9·0	48·5	42·5	
„	4	—	19 0	60·0	21·0	
C.	5	—	7·0	24·0	69 0	
„	6	84·00	0·0	5·0	95 0	
D.	7	—	24·0	47·0	29·0	
„	8	—	19·0	59·0	22 0	Thanet
„	9	82·00	25·7	52 9	21·4	Series.
„	10	—	30·0	55·0	15·0	
E.	11	—	15·0	62·0	23·0	
„	12	88·00	19 0	56·0	25·0	
„	13	—	7·0	52·0	41·0	
F.	14	64·00	8 0	45·0	47·0	
„	15	—	13·0	19·0	68·0	
„	16	—	8·0	42·0	50·0	
G.	17	90·00	20.0	48·0	32·0	Bed of green-coated flints.

NOTE.—All molluscan fragments above $\frac{1}{30}$ inch sifted off.

III.—THE FORAMINIFERA.

In a review of the Foraminifera from the Pegwell Bay Section, one of the most striking features is the entire absence of the porcellanous type. We have not been able to find a single specimen nor even a cast in glauconite. It is noteworthy that the whole Cretaceous system which precedes the Thanet series in time shows, so far as it has been at present worked out, great poverty in forms of this type. M. Berthelin* reports the entire absence of porcellanous Foraminifera from the beds of L'Etage Albien de Montcley. Mr. Chapman records† a very limited and sparsely-represented number of species from the Gault of Folkestone. The same author found the *Porcellanea* exceedingly rare in the (Neocomian) Bargate Beds of Surrey, and equally so in the Phosphatic Chalk of Taplow.‡ Messrs. Burrows, Sherborn, and Bailey met with very few specimens in the Red Chalk of Speeton.§ Not one specimen is recorded in d'Orbigny's paper on the Craie Blanche;‖ and the family is altogether absent from Mr. Joseph

* *Mem. Soc. Geol. France*, 1880, Ser. 3, Tom. 1, p. 17.
† *Journ. Roy. Mic. Soc.*, 1891, pp. 572-575.
‡ *Quart. Journ. Geol. Soc.* 1892, vol. xlviii, p. 516.
§ *Journ. Roy. Mic. Soc.*, 1890, pp. 551-552.
‖ *Mem. Soc. Geol. France*, 1840, Tom. 1, Part 1.

Wright's list* of the Foraminifera from the Chalk of the North of Ireland ; and also (save for one undetermined specimen) from the collection of Cretaceous Foraminifera in the British Museum.† Other workers on Cretaceous Foraminifera—Reuss, for example—have noted a similar absence of the *Porcellanea*.

On the other hand, the *Spiroloculinæ* in particular have been found abundantly by MM. Terquem and Berthelin in the beds of the Middle Lias at d'Essey-les-Nancy (*Mem. Soc. Geol. France*, 1875, Sér. 2, Tom. x), and there are records by other authors of the occurrence of *Spiroloculinæ* and other genera of the Porcellanous type in beds of pre-cretacean age.

Family **LITUOLIDÆ.**

Sub-Family **Trochammininæ.**

AMMODISCUS, Reuss.

1. **Ammodiscus incertus** (d'Orb.).

Operculina incerta, d'Orb, *Foram. Cuba*, 1839, p. 71, Pl. vi, Figs. 16, 17 ; *Trochammina incerta*, Haeusler, 1882, *Ann. Mag. Nat. Hist.*, Ser. 5, vol. x, p. 54, Pl. iii, Fig. 6 ; *Ammodiscus incertus*, Brady, *Report Chall.*, vol. ix, 1884, p. 330, Pl. xxxviii, Figs. 1-3.

The specimens of *A. incertus* from Pegwell Bay are of the elliptical variety, and not unlike Fig. 6 of Pl. III in Haeusler's paper above referred to. They are small, very fine in texture, pure white, generally smooth, and, under a low power, have a strong resemblance to *Cornuspira*. Specimens were found only in Beds D, E, and F, and always rarely. The largest specimen was from Bed D, but it was somewhat abnormal in growth—being more than usually compressed, and having a somewhat angular periphery.

Family **TEXTILARIDÆ.**

Sub-Family **Textilarinæ.**

TEXTILARIA, Defrance.

2. **Textilaria sagittula**, Defrance.

Pl. II, Fig. 10.

T. sagittula, Def., 1824, *Dict. Sci. Nat.*, vol. xxxii, p. 177 ; vol. liii, p. 344 ; *Atlas Conch.*, Pl. xiii, Fig. 5 ; Brady, *Report Chall.*, 1884, vol. ix, p. 361, Pl. xlii, Figs. 17, 18.

This form calls for little remark save as to its range. In the

* *Cat. Foss. Foram. Brit. Mus.*, p. 89.
† *Op. cit.*, p. 86.

Pegwell Beds it seems to make its appearance first in the upper part of Bed E, where we found it rarely. In Bed D it is less rare; in Bed C common; and very common in Bed B. All the specimens are of about the average size, and of the usual texture; but the final chambers are rather more largely grown than in typical specimens.

Sub-Family **Buliminin**æ.

BULIMINA, d'Orb.

3. **Bulimina ovata**, d'Orb.

Pl. II, Fig. 11.

B. ovata, d'Orb., *For. Foss. Vienne*, 1846, p. 185, Pl. xi, Figs. 13, 14; Brady, *Report Chall.*, 1884, p. 400, Pl. l, Fig. 13.

4. **Bulimina elongata**, d'Orb.

Pl. II, Fig. 12.

B. elongata, d'Orb., *For. Foss. Vienne*, 1846, p. 187, Pl. xi, Figs. 19, 20; Brady, *Report Chall.*, 1884, p. 401, Pl. li., Fig. 1.

These *Buliminæ* are among the most noticeable forms in our gatherings from Pegwell Bay. The range of the two species extends throughout the series of beds, but *B. elongata* occurs plentifully in Bed F, where we did not find its fellow, and *B. ovata* is met with rarely in Bed B, while our specimens of *B. elongata* were not obtained higher than Bed C. Both species are common in Bed E. In Bed D, *B. ovata* is rather common, and *B. elongata* rare; and in Bed C both species are rare.

BOLIVINA, d'Orb.

5. **Bolivina ænariensis** (Costa).

Brizalina ænariensis Costa, 1856, *Atti dell' Accad. Pont.*, vol. vii, p. 297, pl. xv, fig. 1; *Bolivina ænariensis*, Brady, *Report Chall.*, 1884, vol. ix, p. 423, pl. liii, figs. 10 and 11.

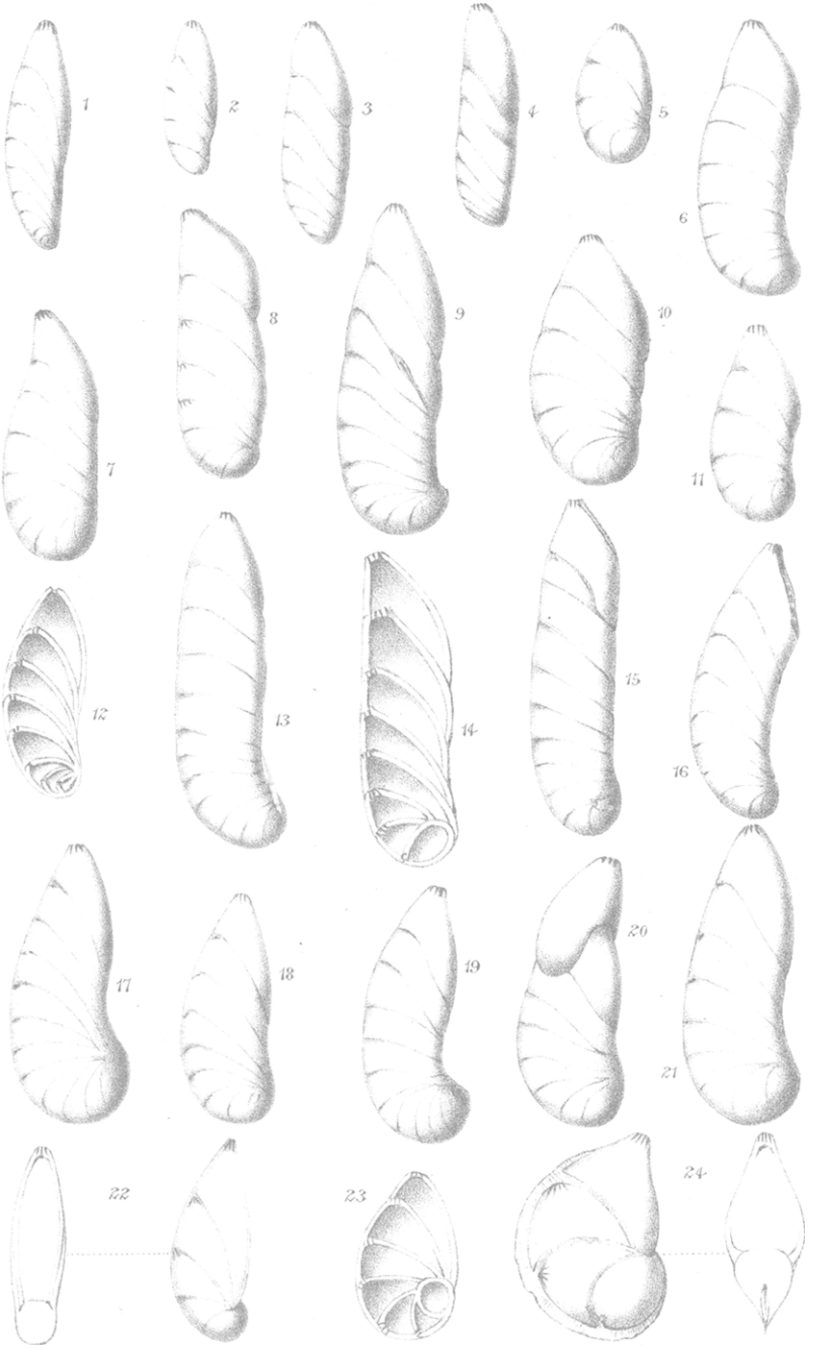
One very small example was found in the 6-inch shell-band of Bed C. So far as is known, the "species" in recent seas is confined to comparatively shallow waters. As a fossil we believe it has not previously been recorded from deposits older than the Miocene.

Family **CHILOSTOMELLIDÆ.**

CHILOSTOMELLA, Reuss.

6. **Chilostomella ovoidea**, Reuss.

C. ovoidea, Reuss, 1849, *Denkschr. d. k. Akad. Wiss. Wien*, vol. i, p. 380, pl. xlviii, fig. 12; Brady, *Rep. Chall.*, 1884, vol. ix, p. 436, pl. lv, figs. 12–23.



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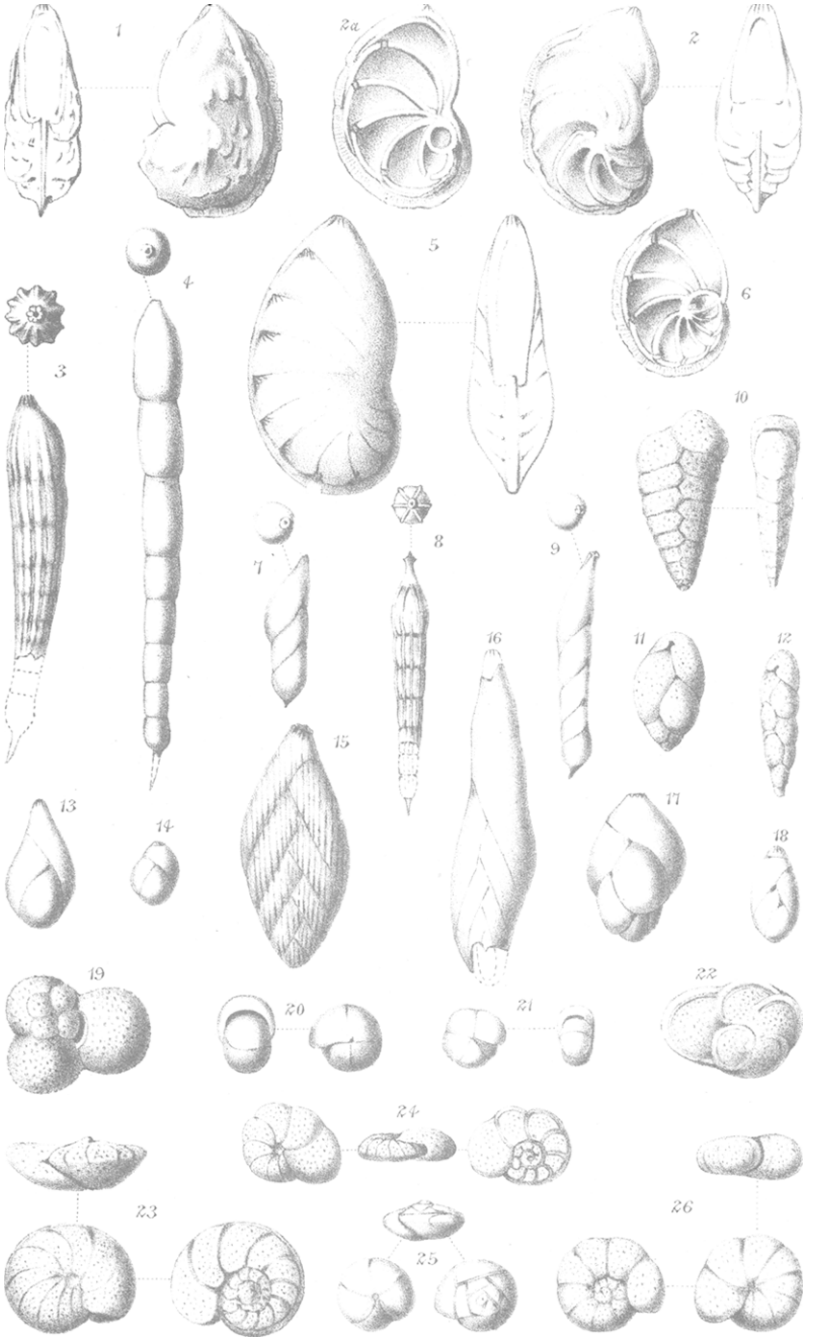
R.Holland } del. ad. nat.

Geo. West & Sons lith. et imp.

FORAMINIFERA
THANET BEDS, PEGWELL BAY.



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R.Holland
} del. ad. nat.

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FORAMINIFERA
THANET BEDS, PEGWELL BAY.

One specimen of this not uncommon Tertiary fossil occurs in our gatherings from the upper part of Bed E.

FAMILY **LAGENIDÆ.**

SUB-FAMILY **Lageninæ.**

LAGENA, Walker and Jacob.

7. **Lagena apiculata** (Reuss).

Oolina apiculata, Reuss, 1850, Haidinger's *Naturw. Abhandl.*, vol. iv, p. 22, pl. i, fig. 1; *L. apiculata*, Brady, *Rep. Chall.*, 1884, p. 453, pl. lvi, figs. 4, 15–18.

8. **Lagena lævis** (Montagu).

Vermiculum læve, Montagu, 1803, *Test. Brit.*, p. 524; *L. lævis*, Brady, *Rep. Chall.*, 1884, p. 455, pl. lvi, figs. 7–14, 30.

9. **L. lævigata** (Reuss).

Fissurina lævigata, Reuss, 1849, *Denkschr. d. k. Akad. Wiss. Wien*, vol, i, p. 366, pl. xlvi, fig. 1; *L. lævigata*, Brady, *Rep. Chall.*, 1884, p. 473, pl. cxiv, fig. 8.

10. **L. reticulata** (Macgillivray).

Lagenula reticulata, Macgillivray, 1843, *Moll. Anim. Aberdeen*, etc., p. 38.

11. **L. marginata** (Walker and Jacob).

Serpula (Lagena) marginata, Walker and Jacob, 1784, *Test. Min.*, p. 2, pl. i, fig. 7; *L. marginata*, Brady, *Rep. Chall.*, 1884, vol. ix, p. 476, pl lix, figs. 21–23.

The *Lagenæ* are very rare indeed in the Pegwell Bay beds, and the specimens found are small. *L. apiculata* (one specimen) was found in Bed E, *L. lævis* (one specimen) in Bed F, *L. lævigata* (one specimen) also in Bed F, *L. reticulata* (two specimens) in Bed B, *L. marginata* (one specimen) in Bed C.

The enumeration of these very rare and, so to speak, accidental occurrences of *Lagenæ* leads us to call attention to the uselessness for all practical purposes beyond a mere record of range of many of the published lists of Foraminifera occurring in different formations and horizons. Too often such lists record the *occurrence* of the species only, without the slightest clue as to the frequency with which they occur, or the condition in which

they are found—whether well grown or starved, for example. Where a series of forms occurs in such profusion, and in such vigour of growth, as the ensiform *Cristellariæ* assume in Bed F of the Pegwell Bay Section, there can be little doubt that the conditions under which that particular horizon was laid down must have been peculiarly favourable to the particular form of Foraminifera, and the record becomes valuable for comparison with other records of occurrences of the same type in recent or geologic times. Far otherwise is the case with records of the occurrence of single or very few specimens of a particular form. It is by no means certain that such forms ever lived within many miles of the spot in which the dead shells are found; and this is especially the case with the smaller varieties of Foraminifera.

With a view to obtaining some insight into this part of the question of the distribution of Foraminifera, we made an experiment in September, 1895, which it may, perhaps, be useful to record here. Towards the end of the month mentioned, on a fine day, and after a prolonged period of fine weather, a tow-net was taken out into the English Channel to a point about three miles due south of the mouth of the River Arun, and towed for about a mile in a direction still due south, and at the surface of the water. The depth of water was nine fathoms at the starting point, and doubtless gradually increased, though not rapidly. There was just enough wind to sail by, and the water was almost absolutely free from floating weed. The solid contents of the tow-net, when taken in, were very meagre in quantity, doubtless owing in no small degree to the fact that the net, or bag, being made of calico in order to stop the smallest organisms, did not admit of much draught of water through its substance. The bulk of the solid matter proved to be minute crustacea, with which we were not concerned. There was also a considerable percentage of very fine sand and a very considerable number of perfect Foraminifera. The Foraminifera comprised some thirty "species," including several *Lagenæ* and one species of *Haplophragmium*. There were several specimens of some of these forms. The *Haplophragmium*, for instance, was rather common, and *Lagena lævis* and *L. clavata* were distinctly so.

Whether these forms were living at the surface, or whence they were derived, does not affect the question under consideration, namely, the distribution of fossil Foraminifera; but it is obvious that the shells thus taken from the English Channel might have floated away to very great distances before they finally found a resting place on the sea-floor or on the beach; and there can be no doubt that many of the *smaller* forms, at any rate, found in fossil deposits, whether belonging to species pelagic in their habit or not, have undergone transportation of this nature.

Sub-Family **Nodosarinæ.**

NODOSARIA, Lamarck.

12. **Nodosaria farcimen** (Soldani).

(Pl. II, Fig. 4.)

Orthoceras farcimen, Soldani, 1791. *Testaceographia*, vol. i, pt. 2, p. 98, pl. cv, fig. O; *Nodosaria (Dentalina) farcimen*, Brady, 1884, *Rep. Chall.*, vol. ix, p. 498.

We found no complete specimen of this form in our material, but fragments sufficiently large for identification were met with very rarely in Beds D and E. Through the kindness of Dr. Henry Woodward we are able to figure a fine and almost perfect specimen, which is preserved in the Parker Collection of Fossil Foraminifera in the British Museum (Natural History), and which was obtained by Dr. A. Rowe from Bed F.

13. **Nodosaria raphanus** (Linné).

(Pl. II, Fig. 8.)

Nautilus raphanus, Linné, 1767, *Syst. Nat.*, 12th ed., p. 1164, 283; *Nodosaria raphanus*, Brady, 1884, *Rep. Chall.*, vol. ix, p. 512, pl. lxiv, figs. 6–10.

One specimen of this well-known species occurs in our washings from Bed B. The view of the shell from the oral end bears a strong resemblance to the *N. prismatica* of Reuss—from the Chalk of Westphalia—the six costæ there visible giving the appearance of an hexagonal prism. The number of costæ is really twelve however, and, moreover, we quite agree with Brady in reckoning *N. prismatica* as a variety of *N. raphanus* not calling for a distinguishing name.

14. **Nodosaria obliqua** (Linné).

(Pl. II, Fig. 3.)

Nautilus obliqua, Linné, 1767, *Syst. Nat.*, 12th ed., p. 1163, 281; *Dentalina bifurcata*, d'Orb, *For. Foss. Vienne*, 1846, p. 56, pl. ii, figs. 38, 39; *Nodosaria obliqua*, Brady, 1884, *Rep. Chall.*, p. 513, pl. lxiv, figs. 20–22.

This form, widely diffused in recent seas and of common occurrence in the fossil condition, at least in Tertiary strata, occurs very rarely in Bed D, commonly in Bed C, and less frequently in Bed B.

15. **Nodosaria (Dentalina) communis,** d'Orbigny.

(Pl. II, Figs. 7, 9.)

Dentalina communis, d'Orb., 1840, *Mém. Soc. Géol. France*, vol. iv, p. 13, pl. i, fig. 4. *Nodosaria (D.) communis*, Brady, *Rep. Chall.*, 1884, vol. ix, p. 504, pl. lxii, figs. 19–22.

The specimens of this well-known shell, obtained from our Pegwell Bay washings are small, and confined to the upper part of Bed F, where they occur very rarely.

CRISTELLARIA, Lamarck.

Cristellariæ are the characteristic Foraminifera of the Thanet Sands at Pegwell Bay. They are far more abundant than any other "genus," and in Bed F the ensiform or "Marginuline" varieties are exceedingly abundant and very well grown.

The *quasi* generic term *Marginulina*, has been used by authors in a somewhat inexact manner, and, as Brady remarks,* the vague use of the term "has been a source of much confusion of nomenclature." Brady himself attempts to show that the term was intended by d'Orbigny to exclude the laterally compressed *Nodosarinæ*, which have commonly been referred to the genus. He says,† "The descriptive characters of the genus *Marginulina*, as furnished by d'Orbigny in the "Tableau Methodique," are brief and insufficient; but it is manifest from the various figures referred to in the enumeration of species that it was intended to include only the sub-cylindrical, as distinct from the compressed, forms of *Nodosarinæ*; and the fuller description subsequently given in the 'Vienna Basin' monograph, in which the globular shape of the segments is expressly mentioned, confirms this view."

We fear that the "intention" of d'Orbigny, in the direction indicated by Brady, is not so manifest as was supposed. In d'Orbigny's original description the marginuline shell is distinctly stated to have the form of a "curved scabbard" (*gaîne arquée*), and this phrase is hardly consistent with the exclusion of shells showing lateral compression. Moreover, though it is true that in the description of the genus, as given in the "Vienna Basin" Monograph, the component chambers of the shell are said to be globular, and that the figures in Plate III of that work show that the transverse sections of the *final chambers* of the species figured are more or less circular in outline, yet the description given in the "Vienna Basin" memoir, which was published in 1846, appears verbatim in the "Craie Blanche" paper, which saw the light six years earlier; and the figures in Plate I of the earlier work show the *Marginulinæ* with chambers laterally compressed.

There can be no doubt either that other authors who have used the generic term in question have understood it to include shells showing a considerable amount of lateral compression. Jones and Parker, for instance, in their well-known papers on the nomenclature of the Foraminifera, published in *The Annals and*

* *Rep. Chall.*, vol. ix, p. 527.
† *Op cit.*, p. 526.

Magazine of Natural History, treat *Marginulina* as a *quasi* sub-genus of *Cristellaria*, and describe forms such as we figure on Plates I, III, and IV, as "marginuline cristellariæ"; and again, in their paper on the Foraminifera, figured by Fichtel and Moll,* they describe the typical *Nautilus* (*Cristellaria*) *crepidula*, which is much compressed, as "a delicate, elongate, marginuline, flattened cristellaria." A further illustration of their use of the term is furnished by their *Marginulina lituus*, which we figure upon Pl. IV.

Some authors have attempted to limit the scope of the "genus" *Marginulina* by making the possession of a simple or a radiating aperture distinguishing features. Thus M. Berthelin† says: "Les vraies marginulines ont l'ouverture tubuleuse et non radiée, comme les nodosaires, auxquelles elles me paraîtraient plutôt se rapporter, tandis que les formes plus ou moins enroulées, douées d'une ouverture radiée, rentrent dans les Cristellaires." In the same manner M. Berthelin separates *Nodosaria* and *Dentalina*, the former term embracing the *Nodosariæ* with tubular non-radiate apertures, and the latter comprising those with radiating apertures. But as Brady has well shown (*Report Chall.*, 1884, vol. ix, p. 443) a particular form of aperture is useless for classificatory purposes in the simple genus *Lagena*, and it is only necessary to look over a good collection of published figures—to say nothing of a wide series of actual specimens—to see that the radiating or non-radiating aperture is equally useless in the differentiation of *Nodosariæ* and *Dentalinæ*, or *Marginulinæ* and *Cristellariæ*.

It is, perhaps, worthy of remark that d'Orbigny (*For. Foss. Vienne*, 1846, p. 66), in distinguishing *Marginulina* from certain allied forms, laid stress upon the *prolongation* of the final chamber in which the aperture is situated, and upon the tendency which the earlier chambers show to a spiral form of growth. He also defined the position of the aperture as marginal, and placed on the convex side of the curved axis of the shell. We cannot help thinking, after comparing d'Orbigny's various drawings of *Marginulinæ*, that the typical *marginal* aperture is one situate in a prolongation of the final chamber, whose direction or axis is placed at a return angle with the convex curve of the shell. The combination of this character with that of the *tendency* to a spiral arrangement of the earlier chambers gives a more or less sigmoid curve to the shell; and it is interesting to notice that if this curvature were taken as a distinguishing feature, d'Orbigny's *modèle* No. 55 would satisfy the rule, as would also the *M. raphanus* of the "Tableau Méthodique," all the *Marginulinæ* figured in the "Craie Blanche" paper, and all, or nearly all, those figured in the "Vienna Basin" memoir.

* *Ann. Mag. Nat. Hist.*, 3rd ser., vol. v, p. 114.
† *Mém. Soc. Géol. France*, Sér. 3, Tom 1, 1880, p. 33.

We quite admit that even if thus restricted the genus must remain ill-defined, and, for ourselves, we should be content to see it discarded altogether, as is done by Goës, for instance. If it be retained for the sake of convenience in classification, we think it should be used less vaguely than it has been, and, at the same time, that its "characters" should not be so modified as to exclude the forms which, being among those first described, must be looked upon as typical of the genus.

CRISTELLARIA, Lamarck.

16. **Cristellaria fragraria** (Gümbel). Pl. II, Fig. 1.

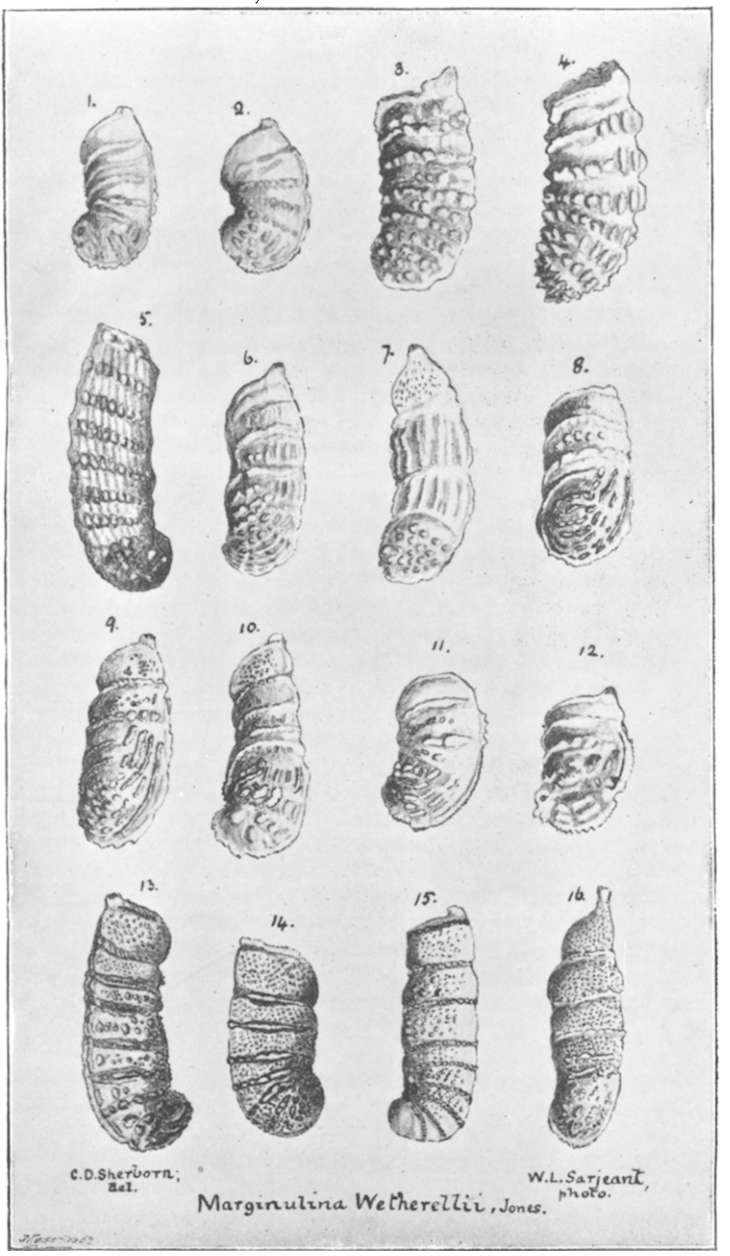
An interesting example of the confusion in nomenclature caused by the indefinite position of the genus *Marginulina* is furnished by the case of the species commonly known as *Marginulina wetherellii*, Jones—the *Cristellaria wetherelli* (Jones) of the *Challenger* Report.

The name *Cristellaria wetherellii* was first given by Prof. Rupert Jones to a form which was described, but not figured, in the *Quart. Journ. Geol. Soc.*, vol. viii, 1852, p. 267. In the *Cat. Foss. For. Brit. Mus.*, 1882, p. 19, there is a record of a *Cristellaria italica*, Defrance, var. *wetherellii*, Jones, from the Thanet Sands, and for a description of the species the reader is referred to the description of *Cristellaria wetherellii* in the *Quart. Journ. Geol. Soc.* already referred to. We have the authority of Prof. Rupert Jones for saying that the reference to *Cr. italica* in the Museum Catalogue was incorrect, and there is no doubt that the form described in the *Quart. Journ. Geol. Soc.* in 1852, and recorded in the Museum Catalogue in 1882, from the Thanet Sands is one of the ensiform smooth *Cristellariæ*, so common in Bed F, and which we have referred to *C. crepidula* and its varieties.

The name *Marginulina wetherellii* was given by Prof. Rupert Jones in 1854 to a shell figured by Sowerby in 1840 in the *Trans. Geol. Soc.* for 1837, ser. 2, vol. v, p. 135, pl. ix, fig. 12, but there named "*Marginulina*" simply. The same form has been figured and described since by other authors under different names. We need only notice the name *Marginulina fragraria* given by Gümbel in 1868. (*Abh. m.-ph Cl. k.-bayer. Ak. Wiss.* vol. x, p. 635, pl. i, fig. 58, a, b, c.)

Brady, in the *Challenger Report*, referred the species to the genus *Cristellaria*, and, if a large number of specimens are studied, especially if taken from a locality where the species occurs plentifully, we think it must be so referred.

This being so, the specific name *wetherellii* cannot stand, because it is already occupied, and *C. fragraria* (Gümbel) must be taken as the proper designation of the species.



CRISTELLARIA FRAGRARIA (GÜMBEL).

To face p. 38.

A single specimen of *C. fragraria* occurs in our gatherings from the Pegwell Bay section, and that from Bed D.

The species is especially common in the London Clay, and Mr. C. D. Sherborn, who has devoted much time to the study of the form, has kindly placed at our disposal his MS. notes and numerous drawings. We are thus enabled to give a plate, illustrating some of the variations of the form, which was prepared by Mr. Sherborn some years since, but which has not hitherto been published. All the specimens there represented were from the London Clay; No. 1 from Chelsea, No. 13 from Islington, the rest from Piccadilly.

C. fragraria is essentially a decorated form of *C. crepidula.* There is considerable variation in the size of specimens from the same locality, and "in the relative development of the spiral and linear portions." The shorter specimens are sometimes rather stoutly built, and approach *C. platypleura* in contour. The ornamentation consists of tubercles and ridges variously disposed. The tubercles generally take the direction of the septal lines, while the ridges most frequently assume a longitudinal direction. Occasionally the longitudinal ridges are replaced by elongate tubercles; and less frequently the ridges themselves, whether transverse or longitudinal, are tuberculated. As a general rule the test of the longer specimens, while it is not cylindrical, shows no marked degree of compression, but Mr. Sherborn's drawings include a series of forms from an unnamed locality* which are excessively compressed, and which have the later chambers very much outspread. The ornamentation upon these forms is likewise very irregular, and sometimes almost wanting. They closely resemble *C. gemmata*, Brady, of the *Challenger Report.*

The *Challenger* specimens of *C. fragraria* were not perfect, and were obtained from Torres Strait, off Raine Island, at a depth of 155 fathoms, and off the coast of S. America, S.E. of Pernambuco, at a depth of 350 fathoms.

Save for the specimens collected by the *Challenger*, the species is, we believe, known with certainty only as a Tertiary fossil. As we have already stated, it is particularly abundant in the London Clay.

17. **Cristellaria crepidula** (Fichtel and Moll).

Pl. I, Figs. 1–21.

Nautilus crepidula, Fichtel and Moll, 1798. *Test. Micr.*, p. 107, pl. xix, figs. G–I.

Cristellaria recta, d'Orbigny, 1839. *Mem. Soc. Geol. France*, Tom. 2, p. 28, pl. ii, figs. 23–25.

Cristellaria crepidula, d'Orbigny, 1839. *Foram. Cuba*, p. 64, pl. viii, figs. 17 and 18.

* Mr. Sherborn tells us that these specimens were probably recent.

Marginulina gladius, Philippi, 1843. *Tertiär nordwest. Deutsch.*, p. 40, pl. i, fig. 37.

Cristellaria intermedia, Reuss, 1845. *Verstein böhm. Kreid*, part I., pp. 33. 108, pl. xiii, figs. 57 and 58; part II, pl. xxiv, figs. 50 and 51.

C. simplex, d'Orbigny, 1846. *For. Foss. Vienne*, p. 85, pl. iii, figs. 26–29.

C. cymboides, d'Orbigny, 1846. *Op. cit.*, p. 85, pl. iii, figs. 30 and 31.

C. wetherellii, Jones, 1852. *Quart. Journ. Geol. Soc*, vol. viii, p. 267.

C. protracta, Bornemann, 1854. *Lias von Gottingen*, p. 39, pl. iv, fig. 27.

C. varians, Bornemann, 1854. *Op. cit.*, p. 41, pl. iv, figs. 32–34.

C. subarcuatula, Williamson, 1858. *Rec. For. Gt. Brit.*, p. 29, pl. ii, figs. 56 and 57.

C. harpa, Reuss, 1860. *Sitz. k. Akad. Wiss. Wien*, xl, p. 211, pl. x, figs. 1 and 2.

C. crepidula, Parker and Jones, 1865. *Phil. Trans.*, p. 344, pl. xiii, figs. 15 and 16.

C. italica, Defrance, var. *wetherellii*, Jones, 1882. *Cat. Foss. Foram. Brit. Mus.*, p. 19.

C. crepidula, Brady, 1884. *Rep. Chall.*, p. 542, pl. lxvii, figs. 17, 19, 20, and pl. lxviii, figs. 1 and 2.

Commenting on some recent *Cristellariæ* which present the characters of a group of figures in Von. Schlicht's well-known work, Brady (*Chall. Rep.*, p. 536) expresses the opinion that "when the attenuated *Cristellariæ* of the Tertiary formations come to be critically studied as a whole, the number of species will be very greatly reduced." Parker and Jones had long previously expressed in effect the same view in their papers on the nomenclature of the Foraminifera already referred to; and in the papers on the variability of the Foraminifera as illustrated by the Cristellarians, Prof. Rupert Jones, and afterwards Prof. Rupert Jones and C. D. Sherborn have grouped the attenuated or ensiform varieties of *Cristellaria* round the form *Cristellaria crepidula* (F. and M.) The specimens under the consideration of these authors were in some cases recent, in others fossil; and the fossil specimens were derived from many localities and many horizons. In the last-mentioned paper, however, Messrs. Jones and Sherborn call attention specially to eight and a-half quarto plates in Von Schlicht's work, which contain 213 figures of the *Cristellariæ* alone, and they observe, "The most cursory examination of these plates will show the extremely close connection existing between all the forms; and having in hand the illustrations of so fine a series from *one* deposit, and therefore of so arge a group of forms most probably living continuously in one

area, and under one set of conditions, we are enabled to see in a striking manner how greatly one form can and does pass into manifold varieties, and how difficult it is to recognise the limitation of species, and say where they begin and where they end."

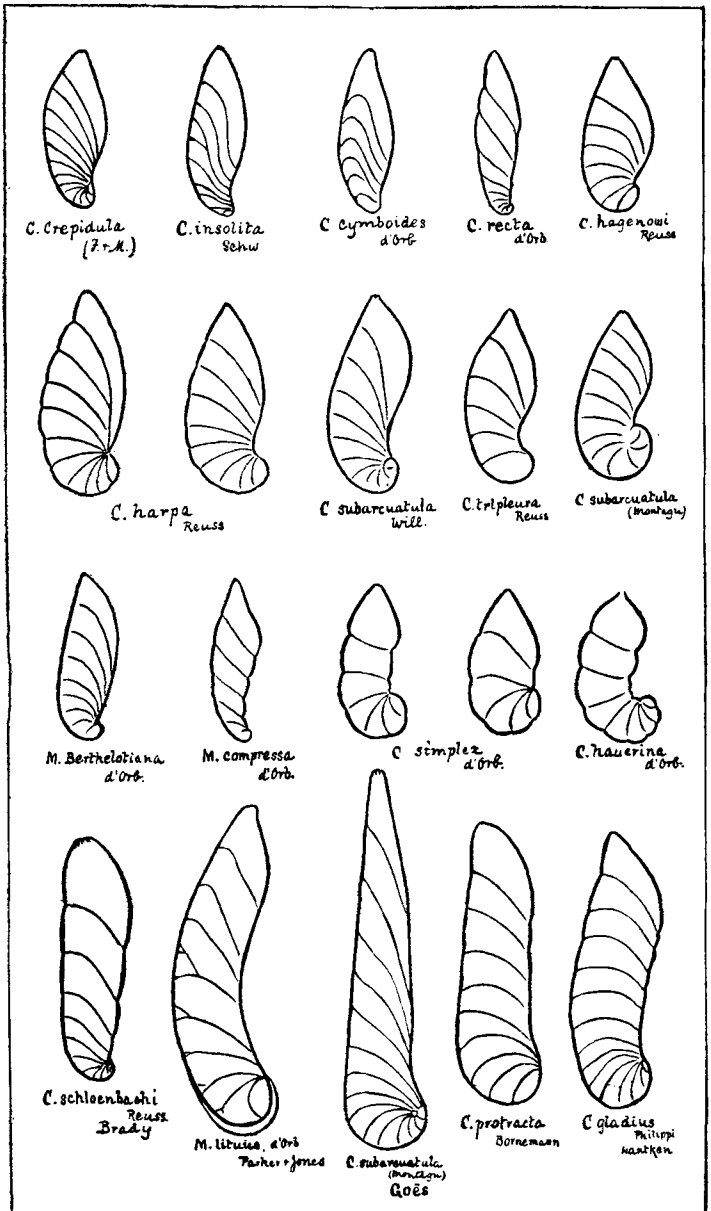
In the light of the foregoing remarks, the attenuated *Cristellariæ* obtained from the Pegwell Bay Section of the Thanet Sands furnish points of great interest.

The forms collected by us are extremely variable in minor details, and at the same time they range themselves naturally round the typical *C. crepidula* (F. and M.). The extremes of variation are closely connected by intermediate links; and the fact that all the specimens come from the same handful of material makes it impossible to suppose that the varieties can be specifically distinct, or that the differences of contour can represent more than individual variation.

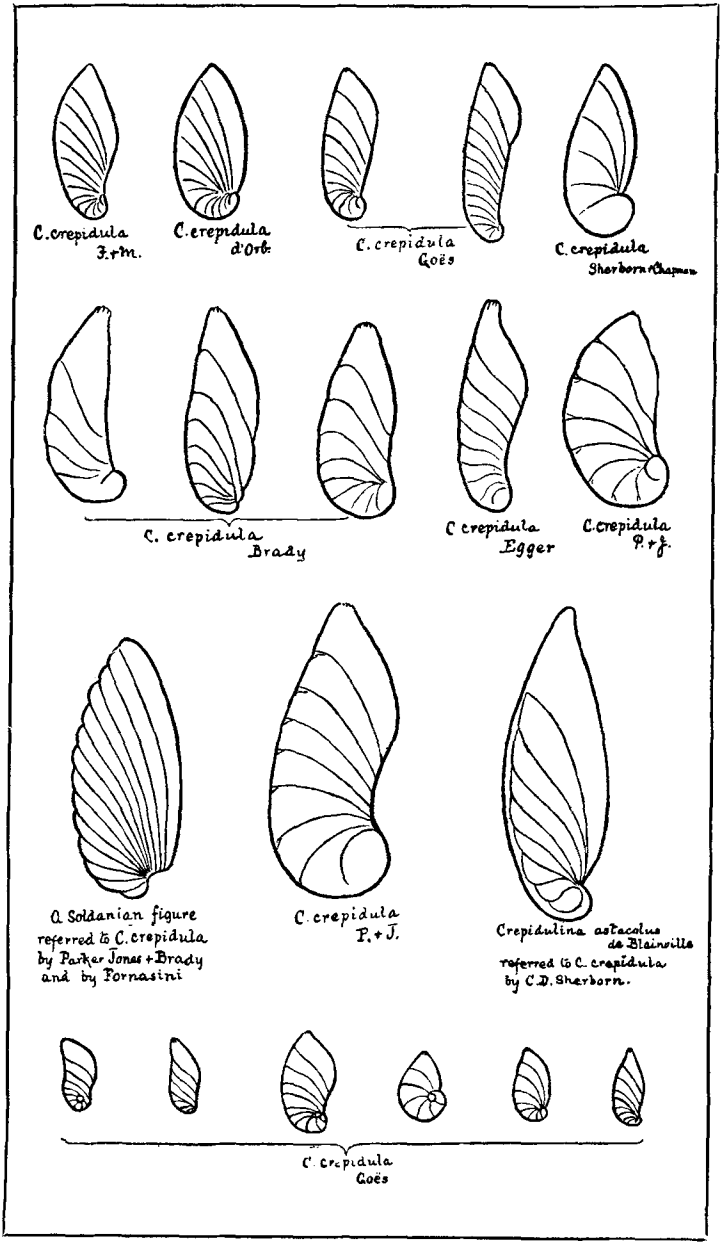
It will be seen from the figures which we give that if the attenuated forms be taken as a whole—and in the circumstances there seems to be no justification for dealing with them in any other way—they cannot really be separated from *C. crepidula*; and we may add that there is nothing in the original description of that species by Fichtel and Moll which would exclude them. Nevertheless, in the "explanation" of the Plate, we have retained as varietal names the names of the "species" to which the more distinct varieties have been assigned by different authors. As an interesting illustration of the propriety of placing these various forms under the same specific appellation, and that *C. crepidula*, we figure (Plates IV and V) two series of forms taken from various authors. The first series shows some twenty figures, rejoicing in different specific names, nearly all of which can be matched from our Pegwell Bay specimens. The second series comprises a number of forms of various authors, at least as variable as the forms in the previous series, and all referred to *C. crepidula.* It should be stated that, to make comparison more easy, we have turned the figures about in some instances so as to have all the forms face the same way, and sometimes we have relatively enlarged the figures to some degree.

As we have already observed, all these varieties of attenuated *Cristellariæ* come from one portion of the Pegwell Bay Section, that which we have named Bed F, Specimen 14. In this bed they occur in great profusion; in the six-inch shell band of bed C. one or two of the varieties sparingly occur; in the other beds we have not met with them at all.

It becomes interesting to compare the other localities from which similar specimens, both recent and fossil, have been obtained. The type of the species was a recent shell, and came from the Mediterranean. Williamson's specimens of *C. subarcuatula* came from various parts of the British coasts. The *Challenger* specimens of *C. crepidula* were not numerous, and



VARIETIES OF ENSIFORM CRISTELLARIÆ.



VARIETIES OF CRISTELLARIA CREPIDULA (F. and M.).

were for the most part obtained from comparatively shallow water; although at one locality in the South Atlantic the species was met with at a depth of 2,350 fathoms. None of the *Challenger* specimens, however, appear to have been of the extremely elongate type. Egger figures a variety strikingly like some of the Pegwell Bay specimens, and that was obtained from a depth of less than 500 fathoms. The specimens of *C. crepidula*, whose figures we have copied from Goës, were obtained from the Atlantic off the Azores, at depths of about 300 fathoms; while his *C. subarcuatula*, which we also figure, came from the North Atlantic, at a depth of about 300 fathoms. We may add that we have ourselves obtained large specimens almost indistinguishable from some of the elongate varieties of Pegwell Bay from material taken from the Indian Ocean between Zanzibar and the Seychelles by H.M.S *Stork*, at a depth of 2,550 fathoms.

C. protracta of Bornemann comes from the Lias; *C. harpa* and *C. hagenowi* of Reuss from the Cretaceous beds of Westphalia; *C. recta* of d'Orbigny from the White Chalk of France; *C. cymboides*, *C. simplex*, and *C. hauerina*, of the same author, are from the Miocene of Vienna. British fossil specimens have been obtained from the Cretaceous beds, from the London Clay, and from other Tertiary Deposits.

18. Cristellaria gibba, d'Orb.

Pl. II, Figs. 5, 6.

Cristellaria gibba, d'Orb., 1839, *Foram. Cuba.*, p. 63, Pl. vii, figs. 20, 21; *C. gibba*, Brady, 1884, *Rep. Chall.*, vol. ix, p. 546. pl. lxix, figs. 8, 9.

This "species," which stands morphologically between the elongate compressed forms grouped round *C. crepidula* and the compact lenticular varieties which have their type in *C. rotulata*, has been found by us in one part only of the Pegwell Bay Section, viz., the 6-inch shell band of Bed C. There it occurs very commonly, and the individuals are rather large and well-grown.

19. Cristellaria platypleura, Jones. Pl. II, Figs. 2, 2A.

C. platypleura, Jones, 1852, Prestwich, *Quart. Journ. Geol. Soc.*, viii, p. 267, pl. xvi, fig. 12; *C. cultrata* (Montf.) (*platypleura*, Jones), Jones, 1882, *Cat. Foss. Foram. Brit. Mus.*, p. 19.

This form has, so far as we are aware, not been found elsewhere than in the Thanet Sands, although very close allies have been recorded from various fossil deposits and from several localities in recent seas. It is very common in Bed C at Pegwell, rare in Bed D, and very rare in Bed E.

20. **Cristellaria crassa,** d'Orbigny. Pl. I, Fig. 24.

Cristellaria crassa, d'Orb., 1846, *For. Foss. Vienne*, p. 90, pl. iv, figs. 1-3; *C. crassa*, Brady, 1884, *Rep. Chall.*, p. 549, pl. lxx, fig. 1.

We have referred the form figured as above to this species of d'Orbigny because it closely agrees with the description and figures given in the "Vienna Basin" Memoir. In the Thanet Beds of Pegwell Bay there can be no doubt that the form is a mere variety of *C. platypleura*, in company with which it sparingly occurs. Our specimens show a complete sequence from the smooth *C. crassa* to the *C. platypleura*, with strongly costulate sutures.

21. **Cristellaria arcuata,** d'Orbigny. Pl. I., Fig. 22.

Cristellaria arcuata, d'Orbigny, 1846, *For. Foss. Vienne*, p. 87, pl. iii, figs. 34-36.

Two small but perfect specimens of this form were found in our material from Bed E.

We have cut a considerable number of sections of the more common forms of *Cristellaria* from the Pegwell Bay Section. We have not been able to prepare a sufficient number to justify any general statement as to the internal structure; but it may be well to record that all the sections we have cut of *C. platypleura* and its cultrate allies show a megalospheric initial chamber. On the other hand, all our sections of *C. gibba* show the initial chamber to be microspheric; while in the ensiform varieties of *C. crepidula* the initial chambers are apparently indifferently megalospheric or microspheric.

Sub-Family **Polymorphininæ.**

POLYMORPHINA, d'Orbigny.

22. **Polymorphina lactea** (Walker and Jacob).

Serpula lactea, Walker and Jacob, 1798, Adams's *Essays*, 2nd ed., p. 634, pl. xxiv, fig. 4; *Polymorphina lactea*, Brady, 1884, *Rep. Chall.*, vol. ix, p. 559, pl. lxxi, fig. 11.

23. **Polymorphina gibba,** d'Orbigny, **var. ampulla,** Jones. Pl. II, Fig. 14.

Polymorphina ampulla, Jones, *Quart. Journ. Geol. Soc.*, 1852, vol. viii, p. 267, pl. xvi, fig. 14; *Polymorphina gibba*, d'Orb., var. *ampulla*, Jones, *Cat. Foss. Foram. Brit. Mus.*, 1882, p. 19.

24. **Polymorphina amygdaloides** (Reuss.). Pl. II, Fig. 18.

Globulina amygdaloides, Reuss, 1851, *Zeitsch. deutsch. geol. Gesell*, vol. iii, p. 82, pl. vi, fig. 47; *Polymorphina amygdaloides*, Brady, 1884, *Rep. Chall.*, vol. ix, p. 560, pl. lxxi, fig. 13.

25. **Polymorphina communis** (d'Orb.). Pl. II, Fig. 13.

Guttulina communis, d'Orb., *Ann. Sci. Nat.*, vii, 1826, p. 266, pl. xii, figs. 1–4; *Polymorphina communis*, Brady, 1884, *Rep. Chall.*, p. 568, pl. lxxii, fig. 19.

26. **Polymorphina problema** (d'Orb.). Pl. II, Fig. 17.

Guttulina problema, d'Orb., 1826, *Ann. Sci. Nat.*, vii, p. 266, *Modèle* No. 61; *Polymorphina problema*, Brady, 1884, *Rep. Chall.*, p. 568, pl. lxxii, fig. 20, lxxiii, fig. 1.

27. **Polymorphina complanata** (d'Orb.). Pl. II, Fig. 16.

Polymorphina complanata, d'Orb, *For. Foss. Vienne*, 1846, p. 234, pl. xiii, figs. 25–30.

These *Polymorphinæ* are very rare in our Pegwell Bay material. They are also, as a rule, small. *P. communis* occurs in Beds B and E. The others are found only in the 6-inch shell band of Bed C.

28. **Polymorphina complanata** (d'Orb.), var. **striata**, nov.

Pl. II, Fig. 15.

Characters. Shell much compressed, sub-rhomboidal. Chambers elongate, oblique, and disposed in two regularly alternating series. Septal lines but slightly excavated. Surface ornamented with fine longitudinal parallel striæ. Aperture radiate.

One specimen of this well-marked variety occurs in our washings from the 6-inch shell band of Bed C.

Family **GLOBIGERINIDÆ.**

29. **Globigerina bulloides** (d'Orb.). Pl. II, Fig. 19.

Globigerina bulloides, d'Orb., 1826, *Ann. Sci. Nat.*, vii, p. 277, No. 1, *Modèle* No. 76; *G. bulloides*, Brady, 1884, *Rep. Chall.*, ix, p. 593, pl. lxxix, figs. 1 and 2.

This cosmopolitan species occurs very sparingly in the Thanet Sands. We have small specimens from Beds C and F. In both the shell is rare, though less rare in Bed F than in Bed C.

30. **Pullenia sphæroides** (d'Orb.). Pl. II, Fig. 20.

Nonionina sphæroides, d'Orb., 1826, *Ann. Sci. Nat.*, vii, p. 293, No. 1, *Modèle* No. 43; *Pullenia sphæroides*, Brady, 1884, *Rep. Chall.*, p. 615, pl. lxxxiv, figs. 12, 13.

31. **Pullenia quinqueloba** (Reuss.). Pl. II, Fig. 21.

Nonionina quinqueloba, Reuss, 1851, *Zeitschr. d. Deutsch. Geol. Gesellsch.*, iii, p. 47, pl. v, fig. 31; *Pullenia quinqueloba*, Brady, 1884, *Rep. Chall.*, p. 617, pl. lxxxiv, figs. 14, 15.

These forms, like their ally, *Globigerina bulloides*, occur sporadically only in the Thanet Sands. *P. sphæroides* is found in our washings from Bed E only, and our specimens of *P. quinqueloba* come from Beds E and F.

Family **ROTALIDÆ.**

Sub-Family **Rotalinæ.**

32. **Truncatulina lobatula** (W. and J.). Pl. II, Fig. 24.

Nautilus lobatulus, Walker and Jacob, 1798, Adams' *Essays*, Kanmacher's Ed., p. 642, pl. xiv, fig. 36; *Truncatulina lobatula*, Brady, 1884, *Rep. Chall.*, p. 660, pl. xcii, fig. 10, etc.

33. **Truncatulina haidingerii** (d'Orb.).

Rotalina haidingerii, d'Orb., 1846, *For. Foss. Vienne*, p. 154, pl. vii, figs. 7–9; *Truncatulina haidingerii*, Brady, 1884, *Rep. Chall.*, p. 663, pl. xcv, fig. 7.

34. **Truncatulina ungeriana** (d'Orb.). Pl. II, Fig. 23.

Rotalina ungeriana, d'Orb., 1846, *For. Foss. Vienne*, p. 157, pl. viii, figs. 16–18; *Truncatulina ungeriana*, Brady, 1884, *Rep. Chall.*, p. 664, pl. xciv, fig. 9.

The *Truncatulinæ* of the Thanet Sands call for little mention. They are nearly always small and poorly grown, and the specimens found are usually ill-preserved. *T. ungeriana* is found throughout the Thanet Beds of Pegwell Bay. It is met with commonly in Bed F, less commonly in Beds B and C, and more or less rarely in the intermediate Beds D. and E. *T. haidingerii* occurs very rarely (one specimen), in Bed E only. *T. lobatula* occurs in Beds B, C, D, very rarely in B and D, and rarely in C.

In the *Quart. Journ. Geol. Soc.*, vol. viii, 1852, p. 267, Pl. xvi, Fig. 13, Prof. Rupert Jones described and figured

Rosalina mariæ n.sp. from the Thanet Sands. The figure is, unfortunately, not a good one, and the figured specimen which is in the British Museum is not well preserved, so that it is rather difficult to make out exactly the distinctive characters of the species. In the *Cat. Foss. Foram. Brit. Mus.*, 1882, p. 19, Prof. Jones makes the species a variety of *Truncatulina lobatula*. We have carefully looked for *T. mariæ* in our washings, but the specimens which at first sight appear to possess the characters of that species are found, on further examination, to be *Truncatulina ungeriana* or *Anomalina grosserugosa*.

35. **Anomalina ammonoides** (Reuss.).

Rosalina ammonoides, Reuss, 1845, *Verstein. böhm. Kreid.*, Pt. I., p. 36, pl. xiii, fig. 66, pl. viii, fig. 53; *Anomalina ammonoides*, Brady, 1884, *Rep. Chall.*, p. 672, pl. xciv, figs. 2, 3.

36. **Anomalina grosserugosa** (Gümbel). Pl. II, Fig. 26.

Truncatulina grosserugosa, Gümbel, 1868, *Abhandl. d. k. bayer. Akad. Wiss.*, II cl., vol. x., p. 660, pl. ii, fig. 104; *Anomalina grosserugosa*, Brady, 1884, *Rep. Chall.*, p. 673, pl. xciv, figs. 4, 5.

Anomalina grosserugosa is one of the most common of the Thanet Sands Foraminifera. Its range extends throughout the Beds, but it is most common in Beds C and F. *A. ammonoides* occurs in our washings from Bed F only. The specimens are always small, and generally poorly grown and badly preserved.

37. **Pulvinulina menardii** (d'Orb.). Pl. II, Fig. 22.

Rotalia menardii, d'Orb., 1826, *Ann. Sci. Nat.*, vii, p. 273, No. 26, *Modèle* No. 10; *Pulvinulina menardii*, Brady, 1884, *Rep. Chall.*, p. 690, pl. ciii, figs. 1, 2.

38. **Pulvinulina elegans** (d'Orb.).

Rotalia (Turbinulina) elegans, d'Orb., 1826, *Ann. Sci. Nat.*, p. 276, No. 54; *Pulvinulina elegans*, Brady, 1884, *Rep. Chall.*, p. 699, pl. cv, figs. 4, 5, 6.

One small, but perfect and well-preserved, specimen of *P. menardii* occurs in our material from the 6-inch shell band of Bed C. *P. elegans* occurs in Beds C, E, and F, always very rarely. The specimens are also always small, and not very well preserved.

39. **Pulvinulina exigua** (Brady), var. **obtusa** nov.

Pl. II, Fig. 25.

Characters. Test free, rotaliform; both faces convex and generally equally so; composed of three convolutions, of which the outermost has usually five segments. Sutures non-limbate; marked on the superior face by thickened lines of opaque shell substance; on the inferior by slight depressions; periphery obtuse, and very rarely lobulated.

This is probably, next to *Bulimina elongata*, the most common Foraminifer of the Thanet Sands. It is met with in every division except Bed B, and in Bed F is very abundant. It differs from *P. exigua*, Brady (*Chall. Rep.*, p. 696, pl. ciii, 13, 14), chiefly in its obtuse periphery. This character may appear at first sight of little value, but we have carefully examined a large number of recent specimens of *P. exigua*, and we find that the acute lobulated periphery is remarkably constant, while the obtuse periphery and more compact habit are no less constant characters in the var. *obtusa* from the Thanet Sands. *P. exigua* is a deep water form. Of the thirty-four stations from which specimens were obtained by the *Challenger*, "twenty-five have depths exceeding 1,000 fathoms, and fourteen exceeding 2,000 fathoms" (*Rep. Chall.*, ix, p. 696).

40. **Rotalia beccarii** (Linné).

Nautilus beccarii, Linné, 1767, *Syst. Nat.*, 12th ed., p. 1162; *Rotalia beccarii*, Brady, 1884, *Rep. Chall.*, p. 704, pl. cvii, 2, 3. One small poor specimen of this very common form occurs in our washings from Bed F.

Family **NUMMULINIDÆ.**

Sub-Family **Polystomellinæ.**

41. **Nonionina depressula** (Walker and Jacob).

Nautilus depressulus, W. and J., 1798, Adam's *Essays*, Kanmacher's ed., p. 641, pl. xiv, fig. 33; *Nonionina depressula*, Brady, 1884, *Rep. Chall.*, p. 725, pl. cix, figs. 6, 7.

This form is represented in our washings by one small specimen from Bed B.

IV.—TABLE SHOWING THE DISTRIBUTION OF THE FORAMINIFERA IN THE BEDS OF THE PEGWELL BAY SECTION.

L. large; M. middle-sized; S. small; R.L. rather large; V.S. very small; r. rare; c. common; r.r. rather rare; r.c. rather common; v.r. very rare; v.c. very common.

No.	Genera, Species, and Varieties.	Drift.	Thanet Sands.					Flint Bed.
		A	B	C	D	E	F	G
1	*Astrorhiza arenaria*, Norman	M. r.c.						
2	*Ammodiscus incertus* (d'Orb.), var.				M. v.r.	S. v.r.	S. r.r.	
3	*Textilaria globulosa*, Ehr.							S. v.r.
4	„ *sagittula*, Defr.		M. v.c.	M. c.	M. r.	M. r.		
5	*Bulimina ovata*, d'Orb.	S. v.r.	M. v.r.	M. v.r.	M. r.c.	M. c.		
6	„ *elongata*, d'Orb.	S. v.r.		M. r.	M. r.	M. c	M. v.c.	
7	„ *pirula*, d'Orb.							V.S. v.r.
8	*Bolivina ænariensis* (Costa)			V.S. v.r.				
9	*Chilostomella ovoidea*, Reuss					S. v.r.		
10	*Lagena apiculata*, Reuss					S. v.r.		
11	„ *lævis* (Montag.)						S. v.r.	
12	„ *lævigata* (Reuss)						S. v r.	
13	„ *reticulata*, Macgillivray		S. v.r.					
14	„ *marginata* (W. & B.)			V.S. v.r.				
15	*Nodosaria farcimen* (Soldani)				S. v.r.	M. v.r.	L. r.	
16	„ *raphanus* (Linné)		S. v.r.					
17	„ *obliqua* (Linné)		M. r.r.	S. c.	S. v.r.			
18	„ (*D.*) *communis*, d'Orb.						S. r.r.	
19	*Cristellaria fragraria* (Gümbel)				M. v.r.			
20	„ *crepidula* (F. and M.), var. *cymboides*, d'Orb. ...						M. r.r.	
21	„ „ „ „ *recta*, d'Orb. ...						L r.r.	
22	„ „ „ „ *simplex*, d'Orb. ...			L. r.r.			L. v.c.	
23	„ „ „ „ *gladius* (Philippi) ...						L. v.c.	
24	„ „ „ „ *varians*, Born. ...						L. v.c.	
25	„ „ „ „ *protracta*, Born. ...						L. v.c.	

26	„ „ „ „ *intermedia*, Reuss ...									L. v.c.	
27	„ „ „ „ *harpa*, Reuss ...									L. v.c.	
28	„ „ „ „ *subarcuatula*, Will....									L. v.c.	
29	„ *arcuata*, d'Orb.								S. v.r.		
30	„ *crassa*, d'Orb.					S. v.r					
31	„ *platypleura*, Jones					M. v.c.	M. r.	M. v.r.			
32	„ *gibba*. d'Orb.					R.L. v.c.					
33	„ *rotulata* (Lamarck)	S. v.r.									
34	*Polymorphina lactea* (W. & J.)		S. v.r.		S. r.r.			S. v.r.	S. v.r.		
35	„ *gibba*, d'Orb., var. *ampulla*, Jones	V.S. v.r.			S. v.r.						
36	„ *amygdaloides*, Reuss				S. v.r.						
37	„ *communis*, d'Orb.	S. v.r.	M. v.r.					S. v.r.			
38	„ *problema*, d'Orb.				S. v.r.						
39	„ *complanata*, d'Orb.				M. v.r.						
40	„ „ var. *striata*, nov.				M. v.r.						
41	*Globigerina bulloides*, d'Orb.				S. r.				S. r.r.		
42	„ *cretacea*, d'Orb.										S. v.r.
43	*Pullenia sphæroides* (d'Orb.)							S. v.r.			
44	„ *quinqueloba* (Reuss)							S. v.r.	S. v.r.		
45	*Truncatulina lobatula* (W. & J.)		S. v.r.		S. r.		S v.r.				
46	„ *haidingerii* (d'Orb.)							S. v.r.			
47	„ *akneriana* (d'Orb.)	S. r c.									
48	„ *refulgens* (Montf.)	S. v.r.									
49	„ *ungeriana* (d'Orb.)										
50	*Anomalina ammonoides* (Reuss)		S r.c		S. r.c.		S. r.r.	S. r.	S. c.		
51	„ *grosserugosa* (Gümbel)								S. v.r.		
52	*Pulvinulina menardii* (d'Orb.)		S. r.		S. r.c.		S. r.	S. r.	S. c.		
53	„ *exigua*, Brady ; var. *obtusa*, nov.				S. v.r.						
54	„ *elegans* (d'Orb.)				S. v.r.		S. r.c.	S. r.	S. v.c.		
55	*Rotalia beccarii* (Linné)				V.S. v.r.			S. v.r.	S. v.r.		
56	„ *orbicularis*, d'Orb.	S. v.r.							S. v.r.		
57	*Nonionina depressula* (W. & J.)		S. v.r.								
58	*Polystomella crispa* (Linné)	S. v.r.									
59	„ *striato-punctata* (F. & M.)	S. v.r.									

PLATE I.

Fig. 1-3 *Cristellaria crepidula* (F. & M.), var. *cymboides*, d'Orb. × 18, p. 40
„ 4 „ „ „ var. *recta*, d'Orb. × 14, p. 39
„ 5, 23 „ „ „ var. *simplex*, d'Orb × 14, p. 40
„ 6, 9, 16 „ „ „ var. *gladius*, Philippi × 14, p. 40
„ 7, 10 „ „ „ var. *varians*, Bornemann × 14, p. 40
„ 8, 13-15 „ „ „ var. *protracta*, Bornemann × 14, p. 40
„ 11 „ „ „ var. *intermedia*, Reuss × 14, p. 40
„ 12, 18-21 „ „ „ var. *harpa*, Reuss × 14, p. 40
„ 17 „ „ „ var. *subarcuatula*, Williamson × 14, p. 40
„ 22 „ *arcuata*, d'Orb. × 30, p. 45
„ 24 „ *crassa*, d'Orb. × 30, p. 45

PLATE II.

Fig. 1 *Cristellaria fragraria* (Gümbel) × 18, p. 38
„ 2 „ *platypleura*, Jones × 20, p. 44
„ 3 *Nodosaria* (*Dentalina*) *obliqua* (Linné) × 20, p. 35
„ 4 *Nodosaria* (*D.*) *farcimen* (Soldani) × 12, p. 35
„ 5 *Cristellaria gibba*, d'Orb. × 25, p. 44
„ 6 „ „ „ (section) × 14, p. 45
„ 7, 9 *Nodosaria* (*D.*) *communis*, d'Orb. × 35, p. 35
„ 8 „ *raphanus* (Linné) × 35, p. 35
„ 10 *Textilaria sagittula*, Defrance × 30, p. 31
„ 11 *Bulimina ovata*, d'Orb. × 35, p. 32
„ 12 „ *elongata*, d'Orb. × 50, p. 32
„ 13 *Polymorphina communis*, d'Orb. × 25, p. 46
„ 14 „ *gibba*, d'Orb., var. *ampulla*, Jones × 25, p. 45
„ 15 „ *complanata*, d'Orb., var. *striata*, nov. × 25, p. 46
„ 16 „ „ „ (abnormal) × 25, p. 46
„ 17 „ *problema*, d'Orb. × 25, p. 46
„ 18 „ *amygdaloides*, Reuss × 25, p. 46
„ 19 *Globigerina bulloides*, d'Orb. × 30, p. 46
„ 20 *Pullenia sphæroides*, d'Orb. × 30, p. 47
„ 21 „ *quinqueloba*, Reuss × 30, p. 47
„ 22 *Pulvinulina menardii* (d'Orb.) × 25, p. 48
„ 23 *Truncatulina ungeriana* (d'Orb.) × 30, p. 47
„ 24 „ *lobatula* (W. & J.) × 30, p. 47
„ 25 *Pulvinulina exigua*, Brady, var. *obtusa*, nov. × 30, p. 49
„ 26 *Anomalina grosserugosa* (Gümbel) × 30, p. 48