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184. *AMMOCYCLOLOCULINA*, N. GEN., AN UNKNOWN FORAMINIFERAL GENUS

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ABSTRACT

An arenaceous isomorph of **Cycloloculina** Heron-Allen and Earland, 1908, is herewith described and figured as **Ammocycloloculina**, n. gen. This hitherto monotypic new genus is based on **Spirocyclina erratica** Joukowsky and Favre, 1913, from the Infravalanginian of Mt. Salève, Haute-Savoie (France).

INTRODUCTION

While revising the species of the genera *Pseudocyclammina* and *Spirocyclina* by means of both original and topotype material, I also had the opportunity of a firsthand study of a largely ignored form, described by E. Joukowsky and J. Favre (1913, p. 491-492) as *Spirocyclina erratica*, n. sp. Numerous specimens of this large discoid form were found in the Infravalanginian of Monnetier, Petit Salève in Haute-Savoie, France, whereas the same beds of Grand Salève contain only a few tests (*loc. cit.*, p. 492). These basal Valanginian limestones which surmount the Purbeckian beds (with *Planorbis, Clypeina, Chara,* ostracods, etc.) are reported to contain, moreover, *Natica leviathan* Pictet and Campiche and *Heterodiceras lucii* Defrance.

The original material on which this species from the Salève was based is deposited in the Museum of Natural History at Geneva, Switzerland. Dr. E. Lanterno, head of the Department of Geology and Paleontology of the museum, very kindly placed over a hundred isolated specimens (original collection of J. Favre) at my disposal for which I feel greatly obliged to him.

The large-sized foraminifer which is being discussed in the present note has been assigned by its authors to the lituolid genus *Spirocyclina* Munier-Chalmas, 1887. As will be pointed out on the following pages, this attribution is refuted as *"Spirocyclina" erratica* Joukowsky and Favre differs in its fundamental structural features from the Senonian type of the genus (*Spirocyclina choffati* Munier-Chalmas, 1887; unfigured). Nor can it be aligned with the forms or form described as *"Spirocyclina" lusitanica* and *"S." infravalanginiensis* from Portugal neither of which should be placed in the genus *Spirocyclina* Munier-Chalmas (*non* Schlumberger *et auct.*) on account of their different interior structure (Maync, 1938, 1956, 1958)[1].

It is with these Portuguese species that E. Joukowsky and J. Favre (*loc. cit.*, p. 492) have compared their new species *erratica* but neither of them has much in common with the form described from the Infravalanginian of Mt. Salève. However, specimens which generically may be placed in the Portuguese genus occur in great number in the Purbeckian of Mt. Salève. Thanks to the kindness of Dr. E. Gasche from the Geological Department of the Museum of Natural History at Basel, Switzerland, I was able to examine a sample from that locality which is labeled *"Spirocyclina* cf. *infravalanginiensis* Choffat (det. J. Pfender), Purbeckian, Salève (Etournelles)"[2].

Genus **Ammocycloloculina** Maync, n. gen.

(incertae familiae)

Type species.—*Ammocycloloculina erratica* (Joukowsky and Favre), pl. 13, figs. 1a-c.

Synonymy.—1913, *Spirocyclina erratica*, n. sp.: Joukowsky and Favre, Mém. Soc. Phys. et d'Hist. Nat. Genève, vol. 37, fasc. 4, p. 491-492, text fig. 56, pl. 34, figs. 10-13.

Lectogenotype.—Joukowsky and Favre (1913, pl. 34, fig. 10)[3].

Paratypes.—(*loc. cit.*, pl. 34, figs. 11-13); *Ammocycloloculina erratica*: pl. 13, figs. 2-5, pl. 14, figs. 1-5.

Locus typicus.—Quarry of Monnetier on SW slope of Petit Salève, Haute-Savoie (France).

Stratum typicum.—Infravalanginian (beds with *Natica leviathan* Pictet and Campiche); bed No. 11 (Joukowsky and Favre, 1913, p. 331, fig. 9—section).

Diagnosis.—A large-sized arenaceous isomorph of *Cycloloculina* Heron-Allen and Earland, 1908.

Description.—The excellent original description of *Spirocyclina erratica* Joukowsky and Favre is quoted in full in the following:

"SPIROCYCLINA ERRATICA n. sp.
(Pl. 34, fig. 10-13)

"Diamètre du plus grand individu ..... 15 mm.
Epaisseur " " " " ..... 0 mm,8.

"Dans le jeune âge et jusqu'à un diamètre de

1 A special paper on the reinterpretation of the heterogeneous genus **Spirocyclina** will be published in the near future.

2 According to a published citation, this sample contains "?**Spirocyclina infravalanginiensis** Choffat" (det. J. Pfender) and is derived from the Valanginian (Bernoulli, 1946).

3 No holotype specimen had been selected by the authors but the designation "n. sp." unmistakably indicates that the figured specimens were regarded as syntypes (cotypes). All the tests figured by E. Joukowsky and J. Favre (1913) have kindly been placed at my disposal by Dr. E. Lanterno, Geneva.

0 mm,7 à 0 mm,8 environ, cette espèce possède un plasmostracum discoïde formé de 6 à 8 loges disposées en spirale. A partir de ce moment, le mode de croissance change complètement; la dernière loge du jeune plasmostracum spiralé est recouverte à sa périphérie par des loges toujours plus embrassantes qui finissent par se rejoindre à leurs extrémités et à entourer complètement la partie centrale spiralée (fig. texte 56 et pl. 34, fig. 13). A partir de ce moment, les loges deviennent annulaires, le plasmostracum prend alors la forme d'un disque très aplati, rarement plan, mais en général légèrement gauche ou ondulé et présentant des côtes concentriques correspondant aux loges annulaires. Ces dernières sont au nombre de 16 à 17 pour un individu de 8 mm de diamètre. Le test de cette espèce est arénacé calcaire. Les parois des loges sont plus épaisses que le vide qu'elles laissent entre elles, surtout vers la périphérie. Les loges ne présentent pas de cloisons proprement dites à leur intérieur, mais comme le test est arénacé et muni par conséquent d'aspérités, elles montrent de rétrécissements irréguliers. Nous n'avons pu observer le réseau polygonal constaté chez *S. choffati* Mun. Chalmas, ni les ouvertures de la périphérie du disque.

"Nous n'avons constaté qu'une seule forme chez cette espèce.

"*Rapports et différences. Spirocyclina erratica* se distingue très aisément de *S. choffati* Mun. Chalmas. Il est inutile d'insister sur les différences qui séparent ces deux expèces. Signalons seulement le caractère qui permet de les distinguer à l'oeil nu. Les loges annulaires de la seconde espèce sont beaucoup plus nombreuses et étroites. Ainsi, à un diamètre de 8 mm, l'espèce du Salève compte 16 à 17 loges, celle du Portugal une quarantaine.

"*Gisement.* Cette espèce se rencontre dans une couche marneuse de l'assise à *Natica leviathan* (no. 9 de la coupe fig. 11[4]), en compagnie de *Terebratula valdensis* de Lor., dans les carrières de Monnetier, sur le versant du Petit Salève où elle est assez abondante et sur le versant du Grand Salève où elle est très rare.

"*Nombre d'exemplaires:* environ 200." (Joukowsky and Favre, 1913, p. 491-492).

Additional remarks.—The largest specimen observed shows a diameter of 14.2 mm. Another one is 11.2 mm. in diameter, its thickness at the center is 0.40 mm., near the periphery 0.71 mm. The smallest test measured has a diameter of 3.5 mm. and a peripheral thickness of 0.45 mm. The dimensions and variability of the test of *Ammocycloloculina erratica* (Joukowsky and Favre) are graphically represented on Figure 1.

The axial thin section on Pl. 14, fig. 1 shows a diameter of 7 mm. while its thickness amounts to 0.40 mm. (center) and 0.54 mm. (near the margin of the disc).

The tests of *A. erratica* are, in other words, very thin *Nummulites*-like discs which show a thickening from the center towards the periphery. They are, moreover, irregularly undulated (Pl. 13, figs. 1b, 2b, 3b, 4b, 5b) on which account perfect median thin sections are very rare.

The prepared equatorial (median) thin sections reveal a closely coiled initial stage (nepionic spire of 6 chambers) which corresponds to a diameter of 0.7 to 0.85 mm. Then follows a fan-shaped or *Pavonina*-like stage with 5-6 strongly embracing chambers which finally infold the entire series of previous chambers. This dual spiral stage occupies 1.7-1.9 mm. in diameter (central part of the disc) and is succeeded by a

4 Typographic error; the correct reference is "bed No. 11, section fig. 9 (see Joukowsky & Favre, 1913, p. 331).

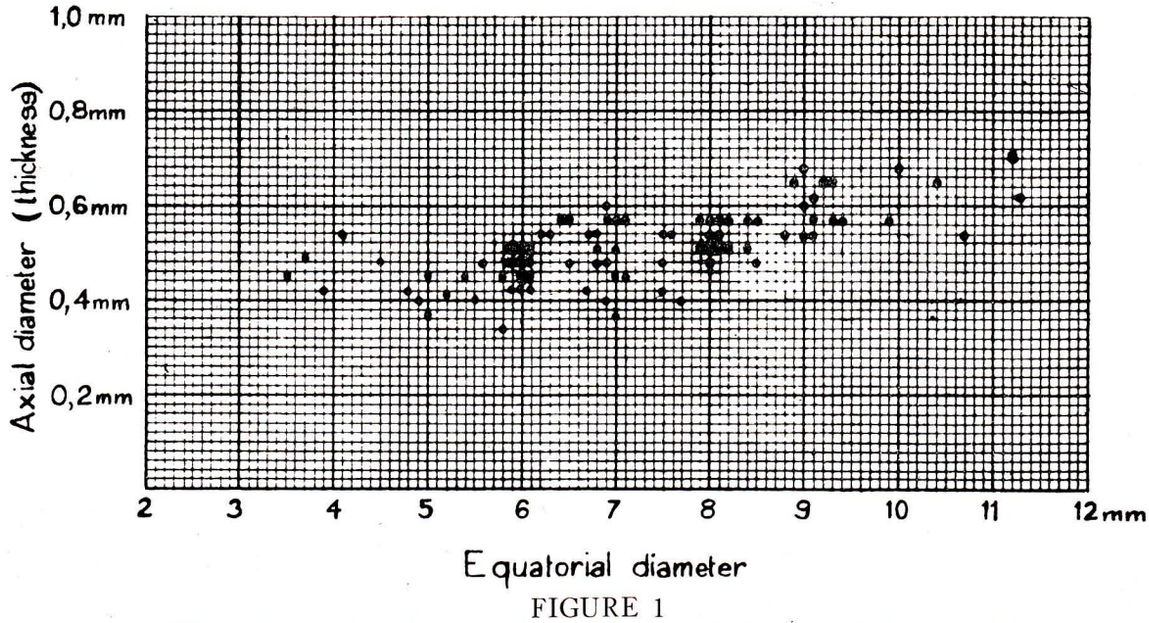


FIGURE 1
Biometric diagram showing the variability of the test of *Ammocycloloculina erratica* (Joukowsky and Favre); measurements of 100 specimens.

series of concentrically arranged (annular) chambers. In the studied specimens attaining 10-11 mm. in diameter, the adult cyclical stage consists of 8-9 annular chambers; in a test measuring 13 mm. the number of cyclical chambers amounts to 12.

The thin-sectioned specimen figured by E. Joukowsky and J. Favre (1913, pl. 34, fig. 13) shows an initial coil of 7 chambers followed by 3-4 strongly embracing to semi-cyclical and 5 annular ones.

E. Joukowsky and J. Favre (*loc. cit.*, p. 491, 492) report having observed forms of 8 mm. in diameter which contain as many as 16-17 annular chambers but none of the numerous tests I could examine showed such a great number of adult cyclical chambers.

The studied specimens reveal a coarsely agglutinated test with incorporated grains of quartz and of a dark mineral, smaller foraminifera, shell and echinoid fragments, etc., held together by a calcareous cement. The circular test externally shows concentric striae which correspond with the sutures of the annular chambers. The imperforate surface coating is of a finely microgranular texture. There is no subepidermal alveolar layer developed which is a fundamental feature of the choffatelline (*olim* spirocyclinine) group of lituolid foraminifera.

The chamber walls, being usually thicker than the width of the lumina which they enclose, are irregularly perforated by tubular passages (Pl. 14, figs. 2-5) which in coarsely textured parts coincide with the interstitial spaces between the individual foreign particles.

The chambers are not systematically subdivided by any radially set elements (septa or buttresses). However, owing to the different size and shape of the coarse grains and fragments that build up the wall, the interior side of the chambers generally shows an uneven outline, viz. the irregular particles of which the septa are composed project more or less into the cyclical chambers.

Nothing definite is known concerning the apertural character of the form; in view of the irregularly perforated chamber walls (septa), however, it may be assumed that the aperture consists of peripheral pores.

Taxonomy and relationship.—Originally, the form *Ammocycloloculina erratica* was placed in the lituolid genus *Spirocyclina* Munier-Chalmas, 1887, and it has been compared with the Portuguese species (*"Spirocyclina" lusitanica* and *"S." infravalanginiensis*). These forms differ, however, principally from the unfigured genotype *Spirocyclina choffati* Munier-Chalmas, cited from the Senonian of the Marseille region, a fact which has led me to separate them from the latter (Maync 1938,1952, 1956, 1958). Anyway, the Portuguese species disclose a complex interior structure and possess the characteristic reticulate network (alveolar sub-epidermal layer) of the Choffatellinae[5] either of which is lacking in the species described from Mt. Salève. It is, therefore, not justified to align *"Spirocyclina" erratica* with *Spirocyclina, s. str.*, or with any genus of the choffatelline group of the Lituolidae.

Other genera showing a cyclical adult stage are found in the Meandropsinidae[6] which include microgranular and/or finely agglutinated tests, respectively: In *Meandropsina* Munier-Chalmas, 1898, the annular chambers are subdivided by regular partitions and *Taberina* Keyzer, 1945 (-*Edomia* Henson, 1948), reveals the presence of both pillars and meandropsinid partitions. *Broeckinella, Saudia, Qataria, Dohaia*, etc. (Henson, 1948), develop annular chambers in the adult; showing a more or less complex subepidermal structure and displaying some kind of systematic subdivision of the cyclical chambers, none of them can, on this account, be compared with *Ammocyclolocu-lina,* n. gen.

The strongest resemblance, especially with respect to the mode of coiling, exists between *Cycloloculina* Heron-Allen and Earland, 1908, and *Ammocyclolocu-lina,* n. gen.

Cycloloculina is a calcareous coarsely perforated form which is superficially ornamented by radial ripples or folds but which lacks any radial partitions of the cyclical chambers. It displays an initial evolute spire involving 6-7 chambers ("Discorbine" stage) which is followed by 2-3 chambers which overlap and infold the "Discorbine" early coil. This "Pavonine" stage is finally succeeded by a series of chambers which are concentrically arranged round the precedent stages ("Annular" stage). The very same succession of the same type of coiling also characterizes the new genus *Ammocycloloculina,* and this parallelism or isomorphism finds its expression in the etymology of the proposed generic name. *Cycloloculina* shows, like *Ammocycloloculina,* a definite thickening of the test from the center toward the periphery.

Cyclolina d'Orbigny, 1846, differs from *Ammocyclo-loculina,* n. gen., in having a very delicate calcareous test formed by an insignificant embryonic stage (trochoid coil) succeeded by a great number of narrow annular chambers. Some species referred to that genus are reported to have the cyclical chambers subdivided into chamberlets but in the specimens of *C. cretacea*

5 Spirocyclininae in previous papers (Maync 1950, 1952); because of the foreseen breaking-up of the genus **Spirocyclina**, the name Choffatellinae, n. subfam., has recently been proposed (Maync, 1958).

6 In his latest paper, F. R. S. Henson assembles both the agglutinated/microgranular (lituolid-meandropsinid) and the porcellaneous (peneroplid) tests in the family Peneroplidae (Henson, 1950), a viewpoint which is not shared by the writer.

d'Orbigny I was able to examine (collection Ch. Schlumberger, Paris)[7] such partitions are as a rule not developed.

Another, although still somewhat problematical genus, showing a calcareous finely microgranular test made up by undivided annular chambers is *Cyclopsinella* Galloway, 1933 (substitute for *Cyclopsina* Munier-Chalmas, 1887, preoccupied). In this form, of which also material was available for direct comparison (collection of Ch. Schlumberger, Paris)[8], the cyclical undivided chambers are, as in *Dicyclina,* arranged in two parallel planes on which account it cannot be an isomorph of *Ammocycloloculina,* n. gen.

Orbitopsella Munier-Chalmas, 1902, also develops annular chambers in the adult. The test, though calcareous-microgranular, may contain more or less agglutinated detrital material (*see,* e.g., Henson, 1948, p. 18) and shows a spiral, then a reniform, and finally a cyclical phase of coiling similar to that outlined above in *Ammocycloloculina,* n. gen. Thin sections disclose, however, that the annuli are systematically subdivided into rectangular chamberlets by radial partitions as well as by irregular pillars (especially in the central region); an alveolar near-surface layer is reportedly not developed. Thin sections of *Orbitopsella praecursor* (Gümbel) from the Liassic Rotzo beds of Tyrol (*stratum typicum*), present in the collection of Ch. Schlumberger, Paris, very distinctly reveal this regular subdivision of the narrow cyclical chambers by delicate partitions. In view of the lack of such a systematic interior organization *Ammocycloloculina,* n. gen., obviously cannot be compared with the genus *Orbitopsella.*

Other calcareous genera showing concentrically arranged chambers in the adult are *Orbiculina* Lamarck, 1816, and *Broeckina* Munier-Chalmas, 1882, which are endowed with some kind of dividing elements in the annular chambers and, therefore, neither can be compared with *Ammocycloloculina,* n. gen. The cyclical calcareous tests of *Dicyclina* Munier-Chalmas, 1887, display an alveolar sub-epidermal layer which is absent in *Ammocycloloculina. Dicyclina* shows, moreover, a double layer of chambers each of which is subdivided by regular partitions whereas *Ammocycloloculina* shows undivided annuli.

There is, to sum up, no described genus of Foraminifera into which *"Spirocyclina" erratica* Joukowsky and Favre from the Infravalanginian of Mt. Salève (Haute-Savoie) would fit. Hence, the genus *Ammocycloloculina,* n. gen., is herewith proposed which is still monotypic.

Ammocycloloculina, n. gen., is, as suggested by the proposed name, an arenaceous isomorph of the genus *Cycloloculina* Heron-Allen and Earland, 1908.

7 **Cyclolina cretacea** d'Orbigny from the Cenomanian of Ile Madame, Charente Maritime; from the Turonian of Etang de Berre near Marseille, and from the Senonian of Les Martigues (Marseille area).

8 **Cyclopsinella steinmanni** (Munier-Chalmas) from the Cenomanian of Ile Madame, Charente Maritime, and from the Senonian of Les Martigues (Marseille).

BIBLIOGRAPHY

Bernoulli, W., 1946, Bericht über das Basler Naturhistorische Museum für das Jahr 1945: Verh. Naturf. Ges. Basel, vol. LVII (1945-1946), p. 22, 37.

Henson, F. R. S., 1948, Larger imperforate Foraminifera of south-western Asia: London, Brit. Mus.

———, 1950, Middle Eastern Tertiary Peneroplidae (Foraminifera), with remarks on the phylogeny and taxonomy of the family: West Yorkshire Printing Co., Wakefield, Engl., p. 1-70.

Heron-Allen, E., and Earland, A., 1908, On *Cycloloculina,* a new generic type of the foraminifera: Journ. Roy. Micr. Soc., London, p. 529-543.

Joukowsky, E. and Favre, J., 1913, Monographie géologique et paléontologique du Salève (Haute-Savoie, France): Mém. Soc. de Phys. et d'Hist. Nat. de Genève, vol. 37, fasc. 4, p. 295-523.

Maync, W., 1938, Die Grenzschichten von Jura und Kreide in der Titliskette: Ecl. Geol. Helv., vol. 31, no. 1, p. 21-70.

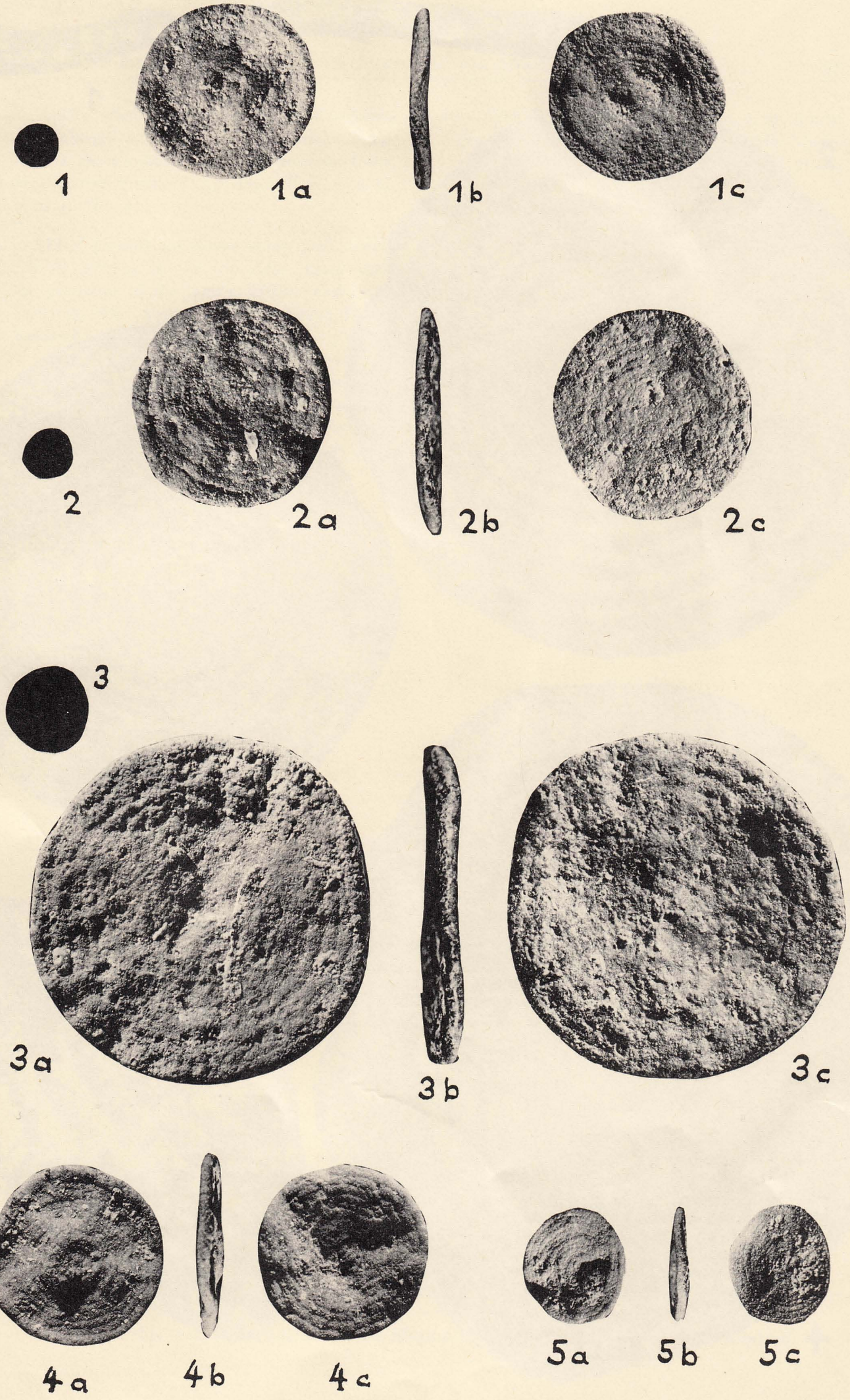
EXPLANATION OF PLATE 13

Figs. Page

1-5. *Ammocycloloculina erratica* (Joukowsky and Favre); Infravalanginian Monnetier, Petit Salève (Haute-Savoie, France) 53

Original material (collection J. Favre, Museum of Natural History, Geneva, Switzerland). 1, 1a-c, lectogenotype specimen (Joukowsky and Favre, 1913, pl. 34, figs. 10a, 10b). 1, natural size; 1a, 1c, side views, ×4; 1b, edge view, ×4. 2-5, paratypes. 2, 2a-c, (Joukowsky and Favre, 1913, pl. 34, figs. 11a, 11b). 2, natural size; 2a, 2c, side views, ×4; 2b, edge view, ×4. 3, 3a-c, (Joukowsky and Favre, 1913, pl. 34, fig. 12). 3, natural size; 3a, 3c, side views, ×4; 3b, edge view, ×4. 4a, c, side views, ×4.5; 4b, edge view, ×4.5. 5a, c, side views, ×4.5; 5b, edge view, ×4.5.

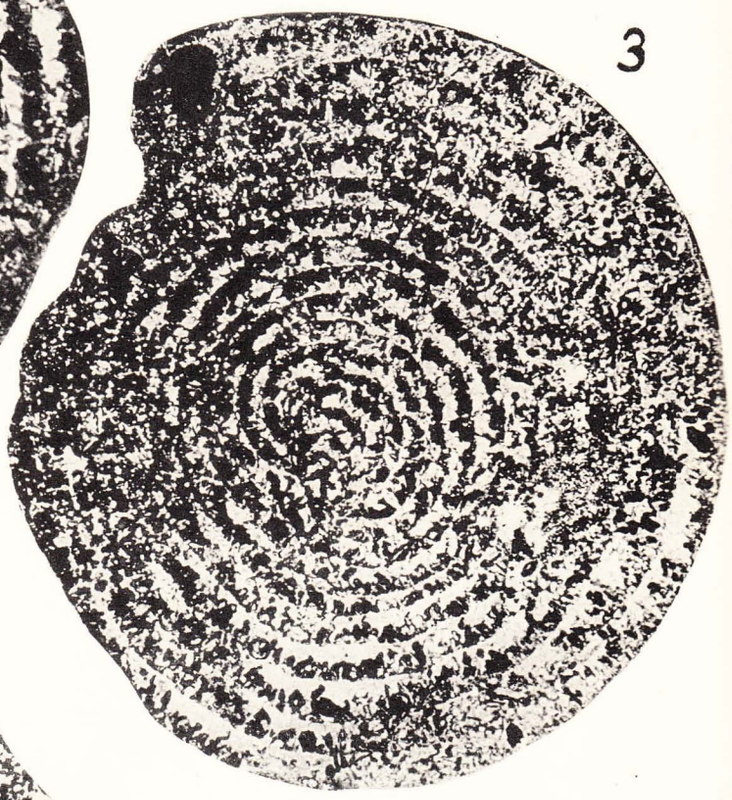
All the figured specimens are deposited at the Museum of Natural History at Geneva, Switzerland.



Maync: *Ammocycloloculina,* n. gen.

1

2



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4

5

Maync: *Ammocycloloculina,* n. gen.

———, 1950, The foraminiferal genus *Choffatella* Schlumberger in the Lower Cretaceous (Urgonian) of the Caribbean region (Venezuela, Cuba, Mexico, and Florida): Ecl. Geol. Helv., vol. 42, no. 2, p. 529-547.

———, 1952, Critical taxonomic study and nomenclatural revision of the Lituolidae, based upon the prototype of the family, *Lituola nautiloidea* Lamarck, 1804: Contrib. Cushman Found. Foram. Research, vol. III, pt. 2, p. 35-56.

———, 1956, Foraminiferal key biozones in the Lower Cretaceous of the Western Hemisphere and the Tethys province: XX Internat. Geol. Congress Mexico, 1956 (Cretaceous Symposium); *in press*.

———, 1958, *Feurtillia frequens*, n. gen., n. sp., a new genus of lituolid Foraminifera: Contrib. Cushman Found. Foram. Research, vol. IX, pt. 1, p. 1-3.

MUNIER-CHALMAS, E., 1887, Sur trois genres nouveaux de foraminifères: Compte rendu somm. séances Soc. Géol. France, no. 7, p. xxx-xxxi.

———, 1902, Sur les foraminifères ayant un réseau de mailles polygonales: Bull. Soc. Géol. France, 4e sér., t. II, p. 349-351.

SCHLUMBERGER, CH. and CHOFFAT, P., 1904, Note sur le genre *Spirocyclina* Munier-Chalmas et quelques autres genres du même auteur: Bull. Soc. Géol. France, 4e sér., t. IV, no. 3, p. 358-368.

EXPLANATION OF PLATE 14

FIGS. PAGE

1-5. *Ammocycloloculina erratica* (Joukowsky and Favre); Infravalanginian Monnetier, Petit Salève (Haute-Savoie, France) 53

Thin sections prepared from original material (collection J. Favre, Museum of Natural History, Geneva, Switzerland). 1, axial section, ×16. 2, median section, ×16. 3, 4, median sections, ×13.5. 5, equatorial section showing the coarse structure of the peripheral portion (adult annular chambers), ×16.

All the figured thin sections are deposited at the Museum of Natural History at Geneva, Switzerland.

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185. CERTAIN SMALLER BRITISH PALEOCENE FORAMINIFERA PART IV. ARENACEA, LAGENIDEA, BULIMINIDEA AND CHILOSTOMELLIDAE

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ABSTRACT

Fifty-one species and varieties, including seven new species and four new varieties, are described from the Thanet Beds of East Kent in the United Kingdom.

INTRODUCTION

Scope of the paper.—This paper is the fourth in a series representing the results of a taxonomic and stratigraphic revision of the foraminiferal fauna of the Thanet Beds of Kent in the United Kingdom. Fifty-one species are described.

Species previously recorded.—Species recorded by H. Burrows and R. Holland (1897) in their pioneer work on the Thanet Beds but unsubstantiated by the present work are as follows:

Cristellaria crassa d'Orbigny
Cristellaria arcuata d'Orbigny
Nodosaria raphanus (Linné)
Lagena marginata (Walker and Jacob)
Lagena laevis (Montagu)
Chilostomella ovoidea Reuss

In this work specimens referred by the two authors to

Ammodiscus incertus d'Orbigny
Textularia sagittula Defrance
Lagena reticulata Macgillivray
Cristellaria fragaria Gümbel
Nodosaria obliqua (Linné)
Nodosaria communis d'Orbigny
Cristellaria gibba d'Orbigny

are described respectively as follows:

Involutina cretacea (Reuss)
Textularia thanetana Lalicker
Lagena hexagona (Williamson)
Astacolus platypleura (Jones)
Dentalina bifurcata d'Orbigny
Dentalina glaessneri Ten Dam
Astacolus danvillensis (Howe and Wallace) var. *venetii* Haynes, n. var.

Species substantiated by the present work are as follows:

Astacolus platypleura (Jones)
Lagena apiculata (Reuss)

Provenance.—Provenance of the species described is given in numbers referring to the stratigraphical columns illustrated in Certain Smaller British Paleocene Foraminifera, Part I (Haynes, 1956).

The figures of the species described were drawn by the author with the aid of a microprojector.

SYSTEMATIC PART

Family TOLYPAMMINIDAE
Subfamily INVOLUTININAE
Genus **Involutina** Terquem, 1862

Involutina cretacea (Reuss)

Plate 15, figures 3, 3a

1845, *Operculina cretacea* REUSS, Geinitz Grunder Verstein, p. 35, pl. 13, figs. 64, 65.
1946, *Ammodiscus cretaceus* CUSHMAN, U. S. Geol. Surv. Prof. Paper 206, p. 17, pl. 1, fig. 35.

Distinguishing features.—A smooth, white *Involutina* apparently composed almost entirely of cement with up to fifteen whorls in a diameter of 1 to 1.5 mm.

Description.—Test planispiral, compressed; whorls about 12, increasing in size slowly, slightly embracing; sutures distinct, deeply impressed; wall siliceous, smooth, white, cement dominant; aperture formed by the open end of the tube.

Dimensions.—Maximum diameter 1 mm.

Horizon.—P23, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42477.

Variation.—Several of the specimens were distorted and showed constrictions as described by Cushman. Alternation of generations was not observed.

Discussion.—Burrows and Holland referred certain specimens recovered from the Thanet Beds to *Ammodiscus incertus* d'Orbigny. As these specimens are lost and there is no figure it is a matter of conjecture whether these were identical with the specimens described here.

Burrows and Holland include Brady's citation of Recent specimens of *A. incertus* in their synonymy. These specimens have brown cement, are larger and show less whorls in a given diameter than *I. cretacea.*

Range.—Upper Cretaceous of N.W. Europe and N. America.

Involutina pyrotecnica Haynes, n. sp.

Plate 15, figures 2, 2a

Distinguishing features.—A smooth, white *Involutina* apparently composed almost entirely of cement

with numerous depressed whorls, up to seventeen in a diameter of 0.66 mm.

Description.—Test planispiral; whorls 15, increasing rapidy in width while remaining almost constant in height; sutures distinct, deep; wall siliceous, smooth, white, cement dominant; aperture formed by the open end of the tube.

Dimensions.—Diameter 0.35 mm.

Horizon.—P21, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42478. Additional specimens P42479.

Variation.—Round to elliptical forms occur and there is some variation in the compression of the whorls. Sections did not reveal alternation of generations.

Discussion.—This species is distinguished from other species by its extreme depression.

Genus **Glomospirella** Plummer, 1945

Glomospirella woodi Haynes, n. sp.

Plate 15, figures 1-1c

Distinguishing features.—A *Glomospirella* with up to six whorls and reaching a diameter of 0.35 mm. The second tubular chamber does not increase much in size and the test is composed almost entirely of siliceous cement. The early irregularly coiled part is dominant in some forms, possibly microspheric forms, and subsidiary in others, possibly megalospheric forms.

Description.—(Pl. 15, fig. 1). Test of 6 whorls, irregularly arranged in the initial part, planispiral in the last 3 whorls, increasing little in diameter; aperture formed by the open end of the tube; wall siliceous, finely arenaceous, white, cement dominant.

Dimensions.—Diameter 0.36 mm.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42575.

Discussion.—Owing to preservation it was found impossible to discern differences in proloculus diameters in the sections cut.

This species differs from the type species, *G. umbilicata* (Cushman and Waters), in its narrower whorls, smaller size and greater irregularity of the initial part.

Derivation of name.—The species is named in honour of Alan Wood.

Family REOPHACIDAE

Genus **Hormosina** Brady, 1879

Hormosina sp.

Plate 15, figure 13

Description.—Test oval; a unilocular megalospheric form or the initial chamber of a broken specimen; aperture terminal with a neck; wall siliceous, finely arenaceous, white, cement dominant; pores not discerned.

Dimensions.—Maximum diameter 0.4 mm.

Horizon.—P26, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42480.

Discussion.—One other smaller, single white chamber was found. This is possibly a fragment of *Hormosina* also.

Family LITUOLIDAE

Genus **Trochamminoides** Cushman, 1910

Trochamminoides sp.

Plate 15, figures 6, 6a

Description.—Test planispiral, compressed, evolute, periphery rounded; 7 chambers visible at the periphery, irregular and increasing in size slowly; sutures radial, deeply impressed; aperture median at the basal suture of the last chamber; wall arenaceous with brown cement.

Dimensions.—Diameter 0.66 mm.; width 0.15 mm.

Horizon.—Pegwell Marls, Haine Pit.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42481.

Discussion.—The specimen recovered resembles *T. velascoensis* Cushman, but is more roughly finished, more inflated and with higher chambers. These characters and its pentagonal outline similarly distinguish it from *T. proteus* (Karrer).

Genus **Haplophragmoides** Cushman, 1910

Haplophragmoides burrowsi Haynes, n. sp.

Plate 15, figures 7, 7a

Distinguishing features.—A smooth, finely arenaceous *Haplophragmoides* with white cement and four and a half chambers visible at the periphery. The chambers increase rapidly in size and are separated by impressed, radial sutures.

Description.—Test planispiral, involute; periphery rounded, lobate; umbilici small; 4½ chambers visible at the periphery; sutures radial, impressed; aperture median, low, at the basal suture of the last chamber; wall finely arenaceous, white, cement dominant; pores not observed.

Dimensions.—Diameter 0.38 mm.

Horizon.—Pegwell Marls, Haine Pit.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42482.

Discussion.—Only the specimen described was found in an uncollapsed state. Numerous other specimens were recovered, all distorted in various ways, but showing essentially the same features. Alternation of generations was not discerned.

This species differs from *H. fragile* Höglund, described from the Skagerak, in that it is completely involute and slightly more inflated. The closely allied species *H. kirki* Wickenden shows five chambers at the periphery and increases less rapidly in size. The Thanet species is also slightly more coarsely arenaceous than Wickenden's species from the Upper Cretaceous of the Canadian plains.

Derivation of name.—This species is named in honour of H. Burrows, a pioneer worker on the Thanet Formation.

Haplophragmoides cf. **H. obliquicameratus** Marks

Plate 15, figures 11, 11a

Description.—Test distorted, globose, periphery broadly rounded; umbilici small, deep; 9 chambers visible at the periphery, slowly increasing in size, depressed; sutures radial, distinct; aperture apparently median, low, at the basal suture of the last chamber; wall arenaceous with much white cement.

Dimensions.—Diameter 0.60 mm.

Horizon.—Pegwell Marls, Haine Pit.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42483.

Discussion.—All specimens recovered were distorted in various ways. Marks's specimens were similarly collapsed and he went so far as to suggest that it might be an inherent character. However, the case of *H. burrowsi,* only one specimen of which was found undistorted, suggests that the sheared form of *H. obliquicameratus* is also due to deformation.

Genus **Cyclammina** Brady, 1876

Cyclammina incisa (Stache)

Plate 15, figures 12, 12a

1864, *Haplophragmium incisum* Stache, Novara Exped. Geol. Theil, vol. 1, p. 165, pl. 21, fig. 1.

1926, *Cyclammina incisa* Chapman, New Zealand Geol. Surv. Pal. Bull., no. 11, p. 29, pl. 2, fig. 1.

1931, *Cyclammina incisa* Cushman and Laiming, Journ. Paleontology, vol. 5, p. 93, pl. 9, figs. 6a, b.

Distinguishing features.—A smooth, compressed *Cyclammina* with up to eight chambers at the periphery and radial sutures. The periphery is acute and white cement dominant in the wall.

Description.—Test planispiral, compressed; periphery acute; 8 chambers visible at the periphery, slowly increasing in size; sutures flush, slightly curved; aperture and supplementary apertures obscured, presumably at the basal suture; wall finely arenaceous, white cement dominant, interior coarsely alveolar.

Dimensions.—Diameter 0.7 mm.

Horizon.—P40, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42484.

Discussion.—The Thanet specimens are much compressed, presumably the result of preservation. Smaller specimens noticeably possessed a higher ratio of cement to agglutinated material.

Range.—Miocene, New Zealand, California.

Cyclammina challinori Haynes, n. sp.

Plate 15, figures 8, 8a

Distinguishing features.—An inflated *Cyclammina* with rounded, entire periphery and up to nine chambers visible, tending to increase rapidly in height. The tubuli are large, apparently of one size only and the chamber cavity is not much reduced by thickening of the wall. Agglutinated quartz grains are large, the septa being one layer thick.

Description.—Test planispiral, involute, inflated; periphery rounded, entire; umbilici shallow; 9 chambers visible at the periphery, rapidly increasing in height; sutures flush, radial; wall arenaceous with brown cement, interior coarsely labyrinthic, exterior smooth; pores not observed.

Dimensions.—Diameter 0.66 mm.

Horizon.—P26, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42485.

Discussion.—This species differs from *C. cancellata* Brady in its fewer chambers visible and in its large tubuli, apparently of one size, and in the small amount of thickening seen in section. The Recent species *C. bradyi* Cushman also shows nine chambers at the periphery but is more compressed with subangular periphery.

Derivation of name.—This species is named in honour of John Challinor.

Family TEXTULARIIDAE

Genus **Textularia** Defrance, 1824

Textularia thanetana Lalicker

Plate 15, figures 5-5c

1897, *Textilaria sagittula* Burrows and Holland (not Defrance), Proc. Geol. Assoc., vol. 15, p. 31, pl. 11, fig. 10.

1935, *Textularia thanetana* Lalicker, Contr. Cushman Lab. Foram. Res., vol. 11, pt. 2, p. 51, pl. 7, fig. 7.

Distinguishing features.—A compressed *Textularia,* rhomboid in section with subacute periphery, low chambers and an initial planispiral coil in all generations. There are up to twenty-six chambers developed in the microspheric generation, up to sixteen in those specimens with the largest megalospheres.

Description.—(Pl. 15, figs. 5, 5a). Test compressed, rhomboid in section; chambers including proloculus 23, wider than high, slowly increasing in size, the first 4 arranged in a planispiral coil, the rest biserially arranged; sutures wide, distinct, impressed between the last four chambers; wall thick, arenaceous, light brown, cement siliceous with a small amount of calcareous matter; aperture low along the basal suture of the last chamber; pores not observed.

Dimensions.—Length 0.75 mm.; maximum width 0.35 mm.; proloculus diameter about 20 microns.

Horizon.—RB2, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42486.

Alternation of generations.—The accompanying

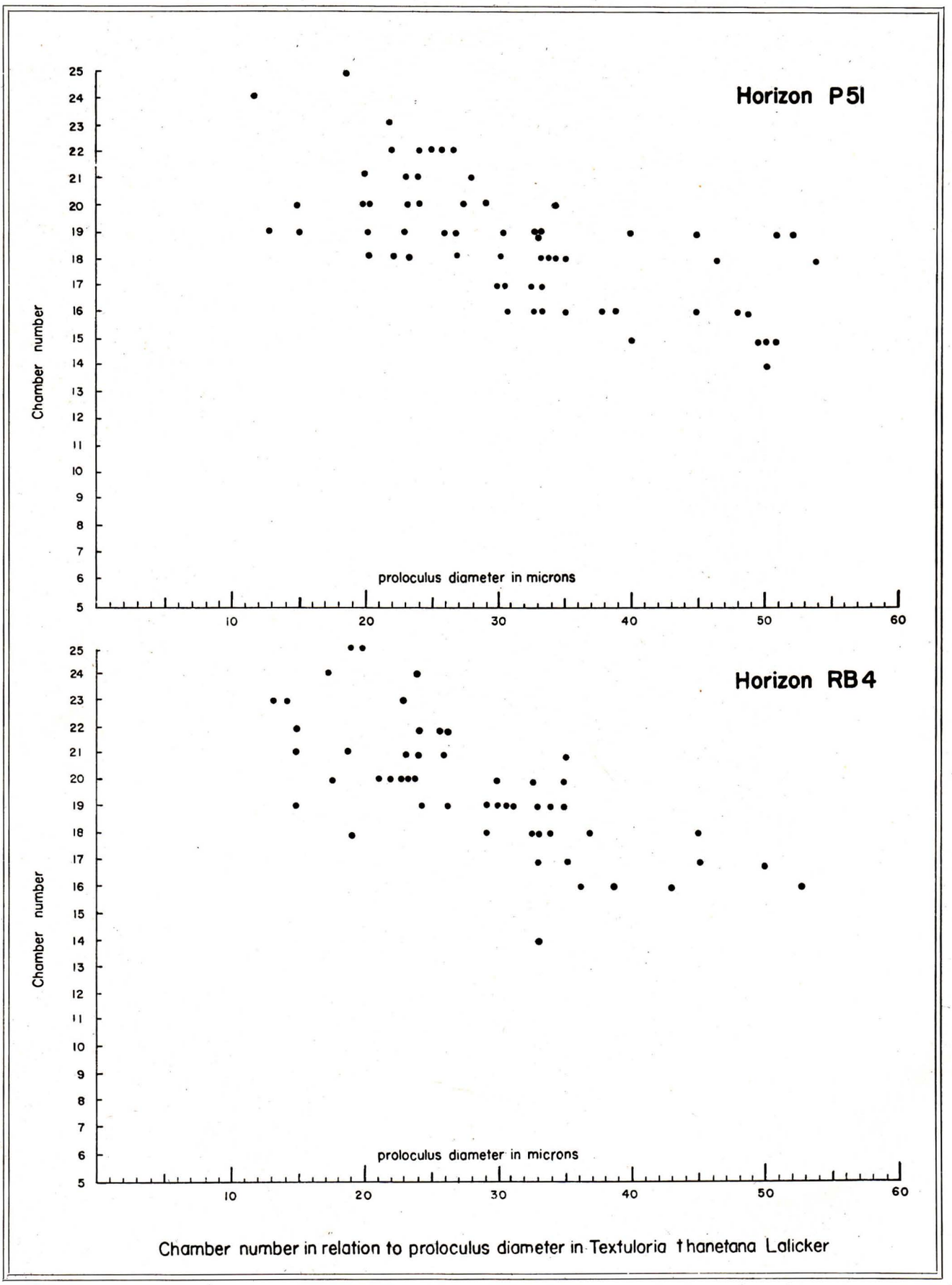

Horizon P5I
Chamber number
proloculus diameter in microns
Horizon RB4
Chamber number
proloculus diameter in microns
Chamber number in relation to proloculus diameter in Textuloria thanetana Lalicker

FIGURE 1

graphs (Fig. 1) show the relation of proloculus diameter to chamber number in specimens recovered from the Reculver Silts at Pegwell and Reculver. In both cases there is some tendency for the specimens to fall into three groups.

In group 1 proloculus diameters range from 10 to 28 microns and up to 26 chambers are developed. This may represent the microspheric generation.

In group 2 proloculus diameters range from 29 to 39 microns and up to 20 chambers are developed. This possibly represents Hofker's A1 generation. (Pl. 15, fig. 5b).

In group 3 proloculus diameters range from 42 to 54 microns and up to 18 chambers are developed. This possibly represents Hofker's A2 generation. (Pl. 15, fig. 5c).

Length in relation to chamber number is not shown on the graphs but specimens of group 3 are larger than group 2 with the same chamber number.

Discussion.—This species was lumped by Burrows and Holland under *T. saggitula* Defrance which differs, however, in its greater compression and sharp periphery. *Spiroplectammina paleocenica* Cushman appears to be closely allied to the Thanet species and may possibly be an immature form.

Range.—Paleocene, Thanet Beds.

Family VERNEUILINIDAE

Genus **Verneuilina** d'Orbigny, 1840

Verneuilina sp.

Plate 15, figure 9

Description.—Test collapsed but complete, elongate, tapering, greatest breadth above the middle, section presumably triangular with rounded angles, spiral twisting small; chambers 15, triserial throughout, slowly increasing in size; sutures deeply impressed; wall arenaceous with much white cement; aperture arched at the basal suture of the terminal chamber.

Dimensions.—Length 0.39 mm.; maximum width 0.18 mm.

Horizon.—Pegwell Marls, Haine Pit.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42487.

Genus **Pseudoclavulina** Cushman, 1936

Pseudoclavulina anglica Cushman

Plate 15, figures 4, 4a

1886, *Clavulina communis* Sherborn and Chapman, Journ. Roy. Micr. Soc., ser. 2, vol. 6, p. 743, pl. 15, fig. 1.

?1927, *Clavulina parisiensis* Franke, Dan. Geol. Under, 2, no. 46, p. 10, pl. 1, fig. 6.

1936, *Pseudoclavulina anglica* Cushman, Cushman Lab. Foram. Res. Spec. Pub. 6, p. 18, pl. 3, fig. 6.

1937, *Pseudoclavulina anglica* Cushman, *ibid.*, Spec. Pub. 7, p. 111, pl. 15, figs. 26, 27.

1944, *Pseudoclavulina anglica* Ten Dam, Med. Geol. Sticht., ser. C-V, no. 3, p. 84.

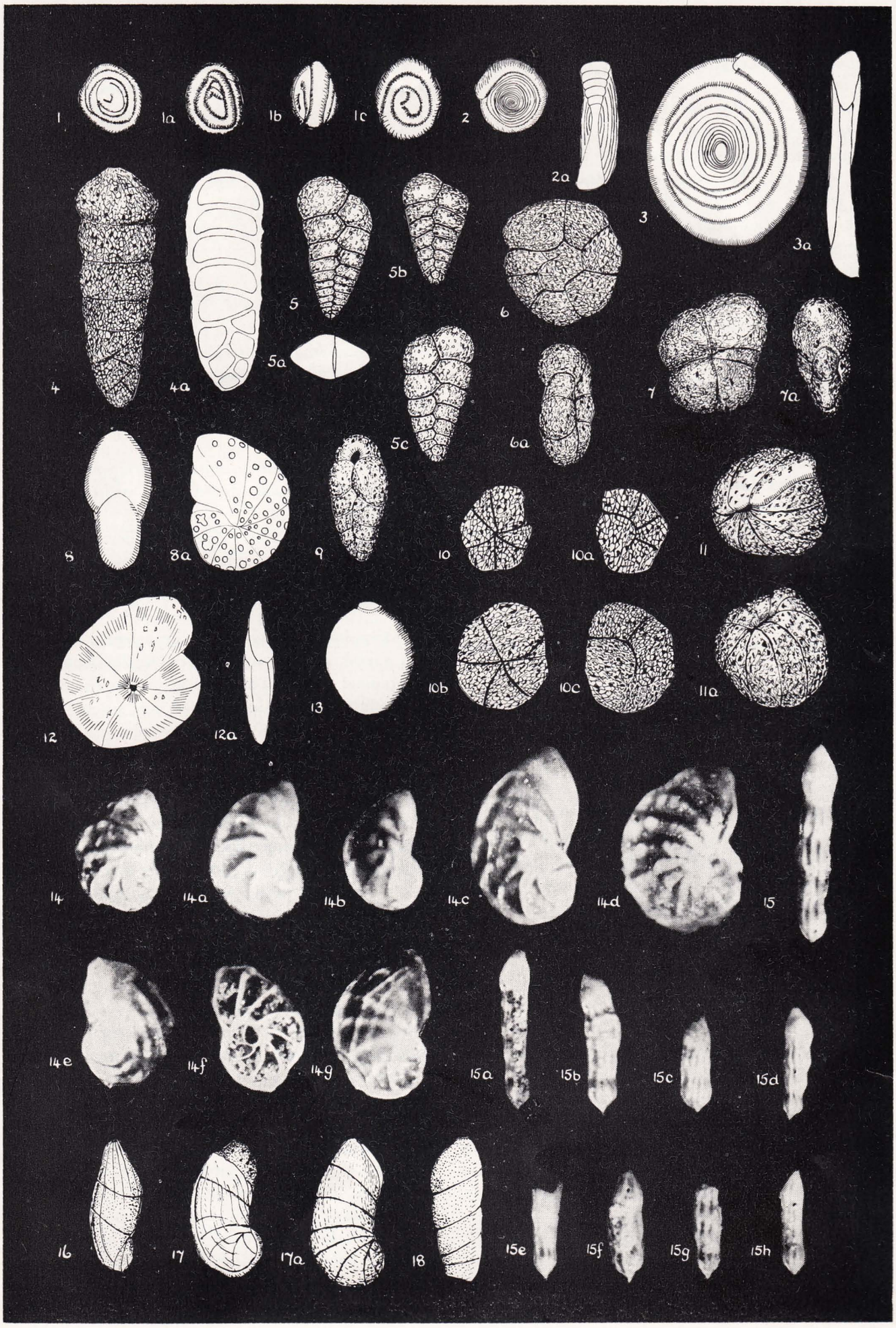
1948, *Pseudoclavulina anglica* Brotzen, Sver. Geol. Undersök, ser. C, no. 493, p. 37, pl. 5, figs. 1, 2.

1952, *Pseudoclavulina anglica* Todd and Kniker, Cushman Lab. Foram. Res. Spec. Pub. 1, p. 11, pl. 1, fig. 28.

Distinguishing features.—A coarsely arenaceous *Pseudoclavulina* with siliceous cement. The initial triserial portion is rounded and the chambers are indistinct. In the uniserial part the chambers are low and round in section with impressed sutures.

Description.—Test elongate, robust; chambers in the initial part triserial, indistinct, 4 low chambers in the uniserial part, slowly increasing in size; sutures impressed in the uniserial part; aperture round, terminal; wall coarsely arenaceous, siliceous.

EXPLANATION OF PLATE 15



Haynes: British Paleocene Foraminifera

Dimensions.—Length 1.25 mm.; maximum width 0.40 mm.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42488.

Variation.—Large specimens up to 2 mm. in length were recovered. The chambers in the uniserial part vary slightly in length and individual tests vary in width. Alternation of generations was not observed.

Range.—Upper Danian, Sweden; Paleocene, Denmark, Sweden, Holland, Magellanes; lower Eocene, England, France.

Family TROCHAMMINIDAE

Genus **Trochammina** Parker and Jones, 1859

Trochammina pentagona Haynes, n. sp.

Plate 15, figures 10-10c

Distinguishing features.—A compressed, coarsely arenaceous *Trochammina* with up to six chambers visible on the involute ventral side, radial sutures and pentagonal outline.

Description.—Test trochoid, compressed, pentagonal in outline, ventral side involute, dorsal side evolute; periphery acute, 6 chambers visible at the periphery; ventral sutures radial, dorsal sutures curved; aperture ventral, along the basal suture of the last chamber beneath a flap; wall coarsely arenaceous with siliceous cement.

Dimensions.—Diameter 0.55 mm.

Horizon.—P26, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42489. Additional specimens P42490.

Discussion.—This species has affinity with the Upper Cretaceous species *T. diagonis* (Carsey) but is smaller, more coarsely arenaceous and pentagonal rather than lobate in outline. The Miocene species *T. parva* Cushman is also closely related but is keeled and has fewer chambers visible.

Family NODOSARIIDAE

Genus **Lenticulina** Lamarck, 1804

Lenticulina sp.

Plate 16, figure 2

Description.—Test planispiral, involute, compressed, smooth; 7 chambers visible; sutures at 45 degrees to each other, the suture below the terminal chamber impressed, previous sutures raised slightly; aperture terminal, slightly produced with radial grooves; each umbilicus filled with a small boss.

Dimensions.—Diameter 0.9 mm.

Horizon.—P21, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42491.

Discussion.—The specimen described resembles *Cristellaria subangulata* Reuss but is umbonate and is round not pentagonal in outline. It is near in form to *Robulus nuttalli* Cushman and Renz but differs in its raised sutures and lack of robuline apertural slit.

Genus **Astacolus** Montfort, 1808

Astacolus platypleura (Jones)

Plate 15, figures 14-14g

1852, *Cristellaria platypleura* Jones, Quart. Journ. Geol. Soc. London, vol. 8, p. 267, pl. 16, fig. 12.

1897, *Cristellaria platypleura* Burrows and Holland, Proc. Geol. Assoc. vol. 15, p. 44, pl. 2, figs. 2, 2a.

1897, *Cristellaria fragaria* Burrows and Holland (not Gümbel), *ibid.*, p. 38, pl. 2, fig. 1.

1911, *Cristellaria multiformis* Franke, Jahrb. Kon. Preuss, Geol. Landes, vol. 52, p. 110.

1940, *Cristellaria multiformis* Staesche and Hilterman, Abh. der Reich. für Boden, heft. 201, pl. 2, fig. 1.

1944, *Cristellaria (Lenticulina) multiformis* var. *rotunda* Ten Dam, Meded. Geol. Sticht., Ser. C-V, no. 3, p. 90, pl. 1.

1944, *Cristellaria (Lenticulina) multiformis* var. *oblonga* Ten Dam, *ibid.*

1948, *Lenticulina multiformis* Brotzen, Sver. Geol. Undersök., ser. C, no. 493, p. 49, *listed only.*

Distinguishing features.—An ornamented *Astacolus* with raised sutures and a variable development of longitudinal costae. There are up to ten chambers in the evolute megalospheric generation, up to thirteen chambers in the close coiled microspheric generation.

Description.—(Pl. 15, fig. 14d). Test planispiral, involute, compressed, carinate; 13 chambers visible at the periphery, slowly increasing in size; sutures backward curving, raised, knotted and cross-grooved; aperture at the peripheral angle with radial grooves; wall radiate; pores minute; each umbilicus filled with a boss of shell material; weak longitudinal ornament developed across the raised sutures.

Dimensions.—Maximum diameter 2 mm.

Horizon.—P34, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42492. Additional specimens P42493.

Alternation of generations.—At least two groups of proloculus size could be discerned, one group ranging in diameter about 0.06 mm. and representing the microspheric generation, and another group ranging in diameter about 0.20 mm. and representing the megalospheric generation. Megalospheric specimens show uncoiling of the later chambers and a smaller total number of chambers than the rarer microspheric forms.

Variation.—This species is very variable throughout the Thanet Beds in ornament and in the amount of uncoiling shown by the later chambers in megalospheric forms. The majority of specimens recovered are similar to the specimens illustrated in fig. 14a with

ornament of raised sutures dominant. In other specimens longitudinal ornament is well developed and in rare cases becomes dominant as in the specimen illustrated in fig. 14e.

Discussion.—This species is interesting both in its variable ornament and in the fact that the microspheric generation is close coiled like *Lenticulina. Cristellaria multiformis* Franke shows a very similar range of variation to the Thanet species and would appear to be identical.

Range.—Paleocene, Sweden, Netherlands, Denmark, Northwest Germany.

Astacolus danvillensis (Howe and Wallace) var. **venetii** Haynes, n. var.

Plate 16, figures 1-1f

?1897, *Cristellaria gibba* Burrows and Holland (not d'Orbigny), Proc. Geol. Assoc., vol. 15, p. 44, pl. 2, figs. 5, 6.

Distinguishing features.—An umbonate variety of *Astacolus danvillensis* with up to thirteen chambers, the later ones becoming evolute and short.

Description.—(Pl. 16, figs. 1, 1a). Test planispiral, becoming evolute, compressed, becoming more compressed in the evolute part, carinate, umbilici filled with clear calcite bosses; 12 chambers visible, increasing in size slowly; sutures distinct, flush, backward curving; aperture at the peripheral angle with radial grooves; wall radiate; pores minute; surface clear and glossy.

Dimensions.—Length 1.3 mm.

Horizon.—P33, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42494. Additional specimens P42495.

Alternation of generations.—Proloculus diameters range about 0.1 mm. in diameter and possibly represent the megalospheric generation.

Variation.—There is variation in the uncoiling of the later chambers and also in the direction of relatively larger, shorter chambers, fig. 1d. The development of the keel is variable also.

Discussion.—This variety appears to fall midway between *A. danvillensis* and *A. danvillensis* var. *yazooensis* Berquist. It is midway in size with the smooth surface and keel of the former and with the umbilical bosses but not the raised sutures of the latter.

Derivation of name.—The varietal name commemorates the tribe of Venetii which monopolised trade between Brittany and Southern England in pre-Roman times.

Genus **Vaginulina** d'Orbigny, 1826

Vaginulina icenii Haynes, n. sp.

Plate 16, figures 4-4d

Distinguishing features.—A smooth species of *Vaginulina* with a straight series of short chambers slowly increasing in size. Both umbilical and peripheral edges tend to be straight.

Description.—(Pl. 16, fig. 4). Test elongate, slightly compressed, both edges straight and gradually diverging; 10 short chambers slowly increasing in size, the second chamber smaller than the proloculus; sutures distinct, flush, inclined; aperture terminal with radial grooves; wall radiate; pores minute; surface smooth.

Dimensions.—Length 0.87 mm.

Horizon.—P51, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42497. Additional specimens P42498.

Alternation of generations.—Two groups of proloculus sizes were discerned. In one, ranging about 0.08 mm. in diameter, up to ten chambers are developed, in the other, ranging about 0.13 mm. in diameter, up to five or six chambers are developed. These groups may represent phases of the megalospheric generation.

Variation.—The chambers are generally short but occasionally longer ones are developed.

Derivation of name.—The specific name commemorates the Icenii of Iron Age East Anglia.

Genus **Marginulina** d'Orbigny, 1826

Marginulina costifera Ten Dam

Plate 15, figure 16

1944, *Marginulina costifera* Ten Dam, Meded. Geol. Sticht, ser. C-V, no. 3, p. 97, pl. 2, fig. 22.

Distinguishing features.—A *Marginulina* with up to four or five chambers, produced excentric aperture and sparse, intermittent longitudinal costae.

Description.—Test elongate, becoming semi-inflated; chambers 4, slowly increasing in size; sutures distinct, flush, oblique; aperture excentric, produced, with radial grooves; wall radiate; pores minute; ornament of sparse intermittent costae.

Dimensions.—Length 0.42 mm.

Horizon.—P38, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42500.

Range.—Paleocene, Netherlands.

Marginulina cf. **M. densicostata** Thalmann

Plate 15, figures 17, 17a

Description.—Test evolute, becoming semi-inflated, with a keel; chambers 8, slowly increasing in size; sutures distinct, slightly impressed; aperture broken off; ornament of longitudinal costae showing slight clockwise twisting.

Dimensions.—Length 1.9 mm.

Horizon.—P21, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42499.

Discussion.—Four specimens were recovered all differing from each other in details of ornament.

Marginulina cf. **M. dorsata** Cushman

Plate 15, figure 18

Description.—Test with initial part broken off, becoming semi-inflated; peripheral edge straight, with a blunt, pinched off keel; chambers remaining 5, increasing in size rapidly; sutures impressed, oblique; aperture at the peripheral edge, with radial grooves.

Dimensions.—Length 1.8 mm.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42501.

Genus **Dentalina** d'Orbigny, 1826

Dentalina glaessneri Ten Dam

Plate 16, figures 3-3h

1897, *Dentalina communis* Burrows and Holland, Proc. Geol. Assoc., vol. 15, p. 35, pl. 2, figs. 7, 9.

1944, *Dentalina glaessneri* Ten Dam, Meded. Geol. Sticht, ser. C-V, no. 3, p. 92, pl. 2, fig. 11.

Distinguishing features.—A gently curved *Dentalina* with up to six, elongate chambers and impressed oblique sutures. In the microspheric generation there are up to six chambers gradually increasing in size from the pointed initial end. In the megalospheric generation there are from two to six chambers and the proloculus tends to be larger than the chamber following it.

Description.—(Pl. 16, fig. 3a). Test elongate with pointed initial end, gently curved and gradually increasing in size; chambers 6, elongate; sutures oblique, impressed; aperture broken (in other specimens terminal, excentric, with radial grooves); wall radiate; pores minute.

Dimensions.—Length 0.91 mm.; width increasing to 0.19 mm.

Horizon.—Pegwell Marls; Pegwell.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42502.

Alternation of generations.—Up to six chambers are developed in the slender microspheric form. Megalosphere sizes range from about 80 microns to 170 microns and show a definite relation to chamber number; up to six chambers being developed by specimens with the smaller megalospheres while only one or two chambers are developed by specimens with the larger megalospheres (Pl. 16, figs. 3b-3h).

Range.—Paleocene, Netherlands.

Dentalina ovoidea Marie

Plate 16, figures 7-7b

1941, *Dentalina ovoidea* Marie, Mus. Nat. Hist. Mem., vol. 12, p. 89, pl. 11, figs. 131-134.

Distinguishing features.—A *Dentalina* with a few semi-inflated elongate chambers and impressed almost straight sutures.

Description.—(Pl. 16, fig. 7b). Test semi-inflated, chambers 3, slowly increasing in size; sutures very slightly oblique, impressed; aperture broken off, foramen exposed, excentric (aperture in specimen with unbroken terminal chamber slightly excentric with radial grooves); pores minute.

Dimensions.—Length 0.9 mm.; width at last chamber 0.3 mm.

Horizon.—P34, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42503.

Range.—Upper Cretaceous, Paris Basin.

Dentalina cf. **D. antenna** Cornuel

Plate 16, figures 6, 6a

Description.—(Pl. 16, fig. 6a). Test slender, elongate; chambers eleven, short in initial part and becoming elongate, slowly increasing in size; sutures slightly oblique, becoming slightly impressed; aperture broken off (in specimen with undamaged terminal chamber, terminal with radial grooves); pores minute.

Dimensions.—Length 0.75 mm.; width at tenth chamber 0.11 mm.

Horizon.—P33, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42505.

Dentalina megapolitana Reuss

Plate 16, figure 8

1855, *Dentalina megapolitana* Reuss, Deutsch. Geol. Gesell., vol. 7, p. 267, pl. 8, fig. 10.

1931, *Dentalina megapolitana* Cushman, Journ. Paleontology, vol. 5, p. 304, pl. 34, fig. 17.

1931, *Dentalina megapolitana* Cushman, Tennessee Div. Geol. Bull., no. 41, p. 29, pl. 3, fig. 8.

1932, *Dentalina megapolitana* Cushman, Journ. Paleontology, vol. 6, p. 335.

1940, *Dentalina megapolitana* Cushman, Contr. Cushman Lab. Foram. Res., vol. 16, p. 80, pl. 13, figs. 26-28.

1944, *Dentalina megapolitana* Cushman and Deaderick, Journ. Paleontology, vol. 18, p. 332, pl. 51.

1946, *Dentalina megapolitana* Cushman, U. S. Geol. Surv. Prof. Paper, no. 206, p. 67, pl. 23.

Distinguishing features.—An elongate, gently curved *Dentalina* with short chambers. The sutures become impressed between the last few chambers which tend to be of equal size. The terminal chamber may be smaller than the chamber preceding it.

Description.—Test elongate, gently curved; chambers 9, short, slowly increasing in size in the initial part, the last three semi-inflated and of almost equal size; sutures almost straight, flush in initial part, impressed between the last few chambers; aperture terminal, excentric, with radial grooves; wall radiate; pores minute.

Dimensions.—Length 1.66 mm.; width at terminal chamber 0.33 mm.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42506.

Range.—Upper Cretaceous, N.W. Europe, California, Tennessee, Arkansas, Alabama; Velasco, Mexico; Paleocene, Alabama.

Dentalina fallax Franke

Plate 16, figures 13-13b

1928, *Dentalina fallax* FRANKE, Preuss. Geol. Landes, vol. 3, p. 27, pl. 2, fig. 18.

1940, *Dentalina fallax* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, p. 79, pl. 13, figs. 18-20.

1946, *Dentalina fallax* CUSHMAN, U. S. Geol. Surv. Prof. Paper, 206, p. 66, pl. 23, figs. 15-17.

Distinguishing features.—A *Dentalina* with inflated, round to ovate chambers, produced central aperture and impressed sutures almost at right angles to the vertical axis. The proloculus, presumably in the megalospheric generation, is larger than the chamber following it.

Description.—(Pl. 16, fig. 13). Test with initial portion broken off, inflated; 3 chambers remain, slowly increasing in size; sutures impressed; aperture terminal, central, produced, with radial grooves; pores minute.

Dimensions.—Length 1.1 mm.; width of terminal chamber 0.39 mm.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42507.

Range.—Upper Cretaceous, N.W. Europe, North American (Taylor and Navarro), Mexico (Velasco).

Dentalina cf. **D. consobrina** d'Orbigny

Plate 16, figure 10

Description.—Test broken, elongate; 2 chambers remain, elongate, about four times as long as wide and slightly inflated; sutures slightly impressed; aperture produced with radial grooves; wall radiate hyaline; pores minute.

Dimensions.—Length 2.4 mm.; maximum width 0.4 mm.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42508.

Discussion.—The fragmentary test recovered is of large size with the chamber shape of *D. consobrina,* that is midway between *D. lorneiana* d'Orbigny, with semi-inflated chambers about half as long as wide, and *D. longiscata* d'Orbigny, with very long chambers.

Dentalina lorneiana d'Orbigny

Plate 16, figures 11, 11a

1840, *Dentalina lorneiana* D'ORBIGNY, Soc. Géol. France, Mém., vol. 4, p. 14, pl. 1, figs. 8, 9.

1897, *Nodosaria farcimen* BURROWS and HOLLAND (not SOLDANI), Proc. Geol. Assoc., vol. 15, p. 35, pl. 11, fig. 4.

1928, *Dentalina lorneiana* FRANKE, Preuss, Geol. Landes, vol. 3, p. 28, pl. 2, fig. 29.

1931, *Dentalina lorneiana* CUSHMAN, Tennessee Geol. Bull. 41, p. 28, pl. 3, figs. 4-7.

1940, *Dentalina lorneiana* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, p. 77, pl. 13, figs. 12-14.

1944, *Dentalina lorneiana* CUSHMAN, *ibid.,* vol. 20, p. 6, pl. 1, fig. 24.

1946, *Dentalina lorneiana* CUSHMAN, U. S. Geol. Surv. Prof. Paper, 206, p. 66, pl. 23, figs. 7-11.

Distinguishing features.—A large, slender, curved *Dentalina* with up to twelve elongate chambers about twice as long as wide.

Description.—(Pl. 16, fig. 11a). Test long and slender; chambers 9, slowly increasing in size, about twice as long as wide in the later part; sutures impressed, oblique; aperture terminal, excentric, with radial grooves; wall radiate hyaline; pores minute.

Dimensions.—Length 4.5 mm.; maximum width 0.5 mm.; proloculus diameter 250 microns.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42509.

Discussion.—The Thanet specimens appear to be almost identical with those described from the Upper Cretaceous of Europe and North America but are larger. The dentaline form with oblique sutures distinguishes this species from *Nodosaria farcimen* Soldani.

Range.—Upper Cretaceous, Paris Basin, North American (Navarro, Taylor, and Austin).

Dentalina lorneiana d'Orbigny var. **semisulcata** Haynes, n. var.

Plate 16, figures 12, 12a

Distinguishing features.—A variety of *D. lorneiana* with longitudinal sulci developed on some of the chambers.

Description.—(Pl. 16, fig. 12a). Test broken, elongate; 4 chambers remaining, twice as long as wide; sutures slightly oblique; aperture broken off (in other specimens terminal, slightly produced, with radial grooves); wall radiate hyaline; pores minute; sulci of various lengths developed on each chamber.

Dimensions.—Length 3.3 mm.; maximum width 0.6 mm.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42511.

Discussion.—This variety differs from *D. lorneiana* var. *spirans* Cushman in possessing sulci not costae. It is stouter than the typical *D. lorneiana* in the Thanet Beds.

Dentalina aff. **D. cognata** Reuss

Plate 16, figure 9

Description.—Test stout, elongate, gently curved; chambers semi-inflated, slowly increasing in size; su-

tures impressed; aperture terminal, excentric, with radial grooves; wall thick; pores minute.

Dimensions.—Length 3.3 mm.; maximum width 0.7 mm.; proloculus diameter about 500 microns.

Horizon.—P16, Pegwell Marls. (Possibly derived).

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42510.

Discussion.—The specimen described is almost the same size as the specimen described from the Senonian by Reuss, with the same number of chambers. The sutures differ in being much less impressed. This holds true in other incomplete and young Thanet specimens.

Dentalina bifurcata d'Orbigny

Plate 15, figures 15-15h

1846, *Dentalina bifurcata* d'Orbigny, Foram. Foss. du bassin Tert. Vienne, p. 56, pl. 11, figs. 38, 39.

1849, *Dentalina bifurcata* Reuss, Sitz. Akad. Wiss. Wien, vol. 1, p. 3, pl. 11, fig. 10.

1867, *Dentalina bifurcata* Reuss, *ibid.*, vol. 55, Abth. 1, p. 82.

1897, *Nodosaria obliqua* Burrows and Holland (not Linné), Proc. Geol. Assoc., vol. 15, p. 35, pl. 2, fig. 3.

1951, *Dentalina bifurcata* Marks, Contr. Cushman Found. Foram. Res., vol. 2, pt. 2, p. 45.

Distinguishing features.—A large, costate *Dentalina* with slender, curved, dentaline microspheric generation and straight, semi-inflated megalospheric generation with almost straight sutures. There are up to ten chambers with nine costae in the microspheric generation and up to six chambers with fifteen costae in the megalospheric generation. The costae anastomose and divaricate and the number developed shows a relation to the chamber size.

Description.—(Pl. 15, fig. 15). Test elongate, straight, chambers 5, semi-inflated, increasing slowly in size; sutures impressed, almost straight; aperture terminal, central, with radial grooves; wall radiate hyaline; pores minute; ornament of longitudinal costae, 11 on proloculus, increasing to 15 on the terminal chamber.

Dimensions.—Length 2.48 mm.; maximum width 0.44 mm.; proloculus diameter 360 microns.

Horizon.—P33, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42512 and P42513.

Alternation of generations.—Specimens presumed to represent the microspheric generation are slender with oblique sutures, with minute, elongate proloculi and have up to ten chambers. The first few chambers are often smooth. A maximum of nine costae were noted on the terminal chamber of one specimen. Megalospheric specimens show proloculus diameters ranging from 160 microns to 400 microns (possibly falling into two groups). Specimens with proloculus diameters at the lower end of the size range develop up to six chambers while specimens with proloculus diameters at the higher end of the size range develop up to three chambers.

Variation in the development of costae.—The first chambers may be smooth in microspheric specimens but about nine costae are generally attained when the chambers reach 0.24 mm. in diameter. As for example in the following specimens from the Pegwell Marls (P33)—

1) Initial chamber broken off, five costae commencing on the first of the remaining chambers, increasing to nine on the sixth chamber (diameter 0.24 mm.), smoothing out on the terminal chamber.
2) Complete specimen, costae twisted, reaching nine on the chamber below the terminal chamber (diameter 0.24 mm.).
3) Specimen broken at both ends, three chambers remaining, costae increasing from five to seven and to nine on the last chamber (diameter 0.34 mm., a sudden increase in size over the previous chamber).

Figure 2 shows the number of costae on the megalospheres and terminal chambers of certain megalospheric specimens.

The number of costae on the megalospheres ranges from 8 to 12. In general the larger megalospheres appear to carry the most costae although the smallest megalosphere has 10 and one of the largest megalospheres only bears 9. None of the megalospheres below 300 microns in diameter bear more than 10 costae, making an interesting correspondence with the microspheric specimens discussed, where chambers of about 250 microns diameter possessed about 9 costae.

The number of costae on later chambers is very generally related to size. The highest number counted, 15, being attained only where chamber diameters are near 500 microns. This simple relation to chamber size is complicated by the tendency for costae to decrease by anastomosing together where the chambers following the megalosphere are smaller, as in specimens 3 and 4. In specimens which increase little or very evenly in size, as in specimen 8, the costae tend to divaricate and anastomose evenly, maintaining the same number. As in the microspheric generation the most marked increases in number are noted where chamber size increase is abrupt.

In conclusion it may be stated that in the Thanet Sands population the number of costae appears to vary from zero on the initial chambers of microspheric forms to fifteen on the adult chambers of megalospheric forms. This presumably genetic character is related to size and is possibly modified by vigour of growth.

COSTAE NUMBER ON MEGALOSPHERE			COSTAE NUMBER ON TERMINAL CHAMBER		
	MEGALOSPHERE DIAMETER	COSTAE NUMBER	TOTAL CHAMBER NUMBER	DIAMETER OF TERMINAL CHAMBER	COSTAE NUMBER
1)	360 microns	11	5	440 microns	15
2)	260	10	4	380	14
3)	300	10	4	280	9
4)	400	10	3	380	9
5)	260	10	-	-	-
6)	280	9	4	320	11
7)	300	11	6	400	11
8)	380	9	4	370	9
9)	400	12	-	-	-
10)	240	8	5	300	9
11)	250	10	5	300	9
12)	160	10	4	200	10
13)	200	8	4	320	12
				540	10
				500	15
				380	8
				380	12
				480	15

FIGURE 2

Relation of costae number to chamber size in *Dentalina bifurcata* d'Orbigny

Discussion.—Burrows and Holland referred this species to *Nodosaria obliqua* Linné. This modern species differs from the Thanet species in its larger size, larger number of chambers and in its finer, more numerous, costae.

Range.—Eocene, Hungary; Miocene, Vienna Basin.

Dentalina sp.

Plate 16, figures 5, 5a

Description.—(Pl. 16, fig. 5). Test incomplete, slender, curving; chambers 2, semi-inflated, increasing rapidly in size; suture impressed; aperture produced, apparently with fine, radial grooves; wall radiate hyaline; pores minute.

Dimensions.—Length 0.81 mm.; maximum width 0.2 mm.

Horizon.—P31, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42504.

Family LAGENIDAE

According to Parr (1947) unilocular lagenids belong to one family, Lagenidae, and were derived from the same common ancestor as the multilocular lagenids, Nodosariidae. Some support is given to Parr's views by the character of the walls and pores in the Thanet lagenids. All the multilocular genera possess thick, radiate hyaline walls with minute, dense pores. In the unilocular genera discovered the walls and pores were found to be of a similar character (except in the ornamented species where striae and pits cause complication of the wall). Two species with internal tubes and possibly referable to *Oolina* show the same characters. If *Oolina* were derived from such a family as the Buliminidae in which large pores, often oval or of irregular size, are common (Haynes, 1954) this would not be expected.

Genus **Lagena** Walker and Jacob, 1798

Lagena (Oolina) apiculata Reuss

Plate 17, figures 9, 9a

1851, *Oolina apiculata* Reuss, Haidinger's Naturw., vol. 4, p. 22, pl. 1, fig. 1.

1862, *Oolina apiculata* var. *elliptica* Reuss, Sitz. Akad. Wiss., Wien., vol. 46, Abth. 1, p. 35, pl. 2, fig. 2.

1897, *Lagena apiculata* Burrows and Holland, Proc. Geol. Assoc., vol. 15, p. 33, *listed only.*

?1951, *Entosolenia* cf. *E. apiculata* Cushman, U. S. Geol. Surv. Prof. Paper 232, p. 42, pl. 9, fig. 7.

Distinguishing features.—An oval, smooth *Oolina* with a short initial spine and aperture with radial grooves.

Description.—(Pl. 17, fig. 9). Test elongate oval with greatest width about the middle; unilocular; aperture with radial grooves and short internal tube; wall radiate hyaline, translucent, thin, smooth; pores minute; ornament of a short basal spine.

Dimensions.—Length 0.26 mm.; maximum width 0.15 mm.

Horizon.—P39, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42514.

Range.—Upper Cretaceous, N.W. Europe; Paleocene, Venezuela, Alabama.

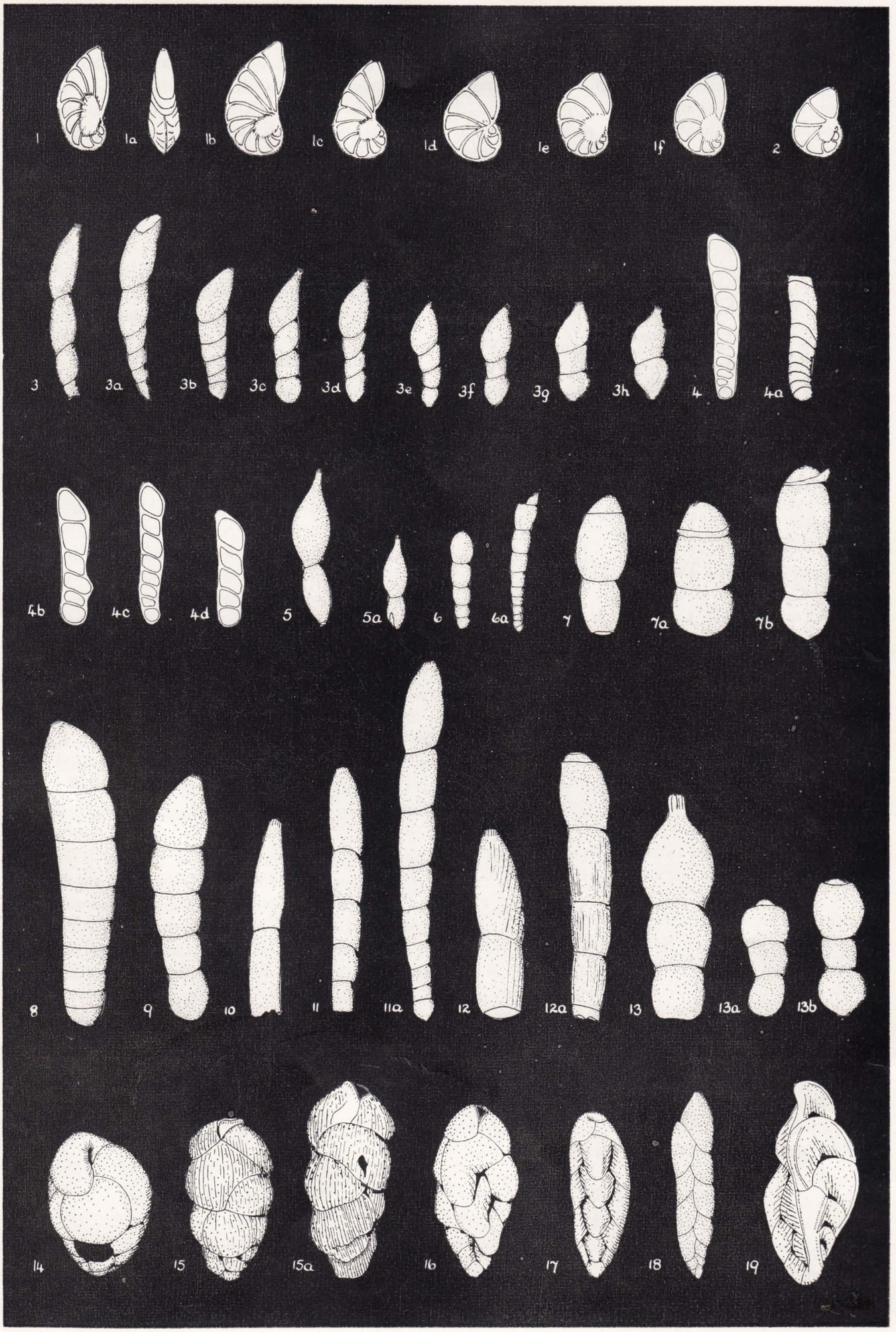
Lagena (Oolina) caudigera Wiesner var. **lemoni** Haynes, n. var.

Plate 17, figure 10

Distinguishing features.—A variety of *Oolina caudigera* that is smaller, bears a variable amount of small spines and possesses a wider external collar to the internal tube.

Description.—Test oval; unilocular; aperture with internal tube and low, wide collar, apparently with

EXPLANATION OF PLATE 16



Haynes: British Paleocene Foraminifera

faint radial grooves; wall radiate hyaline; pores minute; ornament includes an initial spine and scattered spines on the surface of the test.

Dimensions.—Length 0.23 mm.; maximum width 0.16 mm.

Horizon.—RB11, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42515.

Variation.—Other specimens were recovered completely covered in spinose ornament.

Derivation of name.—In honour of Roy H. Lemon.

Lagena hexagona (Williamson)

Plate 17, figures 8-8b

1848, *Entosolenia squammosa* var. *hexagona* Williamson, Ann. Mag. Nat. Hist., ser. 12, vol. 1, p. 20, pl. 2, fig. 23.

1897, *Lagena reticulata* Burrows and Holland, Proc. Geol. Assoc., vol. 15, p. 33.

1929, *Lagena hexagona* Cushman, Contr. Cushman Lab. Foram. Res., vol. 5, pt. 3, p. 72, pl. 11, fig. 8.

1935, *Lagena hexagona* Cushman, U. S. Geol. Surv. Prof. Paper 181, p. 23, pl. 9, fig. 10.

1944, *Lagena hexagona* Ten Dam, Med. Geol. Sticht., ser. C-V, no. 3, p. 103.

1946, *Lagena hexagona* Cushman, U. S. Geol. Surv. Prof. Paper 206, p. 95, pl. 39, fig. 16.

1951, *Lagena hexagona* Marks, Contr. Cushman Found. Foram. Res., vol. 2, p. 46.

Distinguishing features.—An oval *Lagena* with hexagonal ornament and a tubular, non-radiate aperture.

Description.—(Pl. 17, fig. 8a). Test oval; unilocular; aperture produced and tubular, equal in length to the rest of the test, without radial grooves, covered with minute spines; wall radiate hyaline; pores minute; ornament of raised ridges in hexagonal pattern.

Dimensions.—Length without apertural tube 0.25 mm.

Horizon.—P36, Pegwell Marls,

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42516.

Discussion.—It is uncertain whether differences in the size of the hexagons are of infraspecific value. In the type specimen they are very large, about five encompassing the length. In the specimen described here the hexagons are about a quarter this size. One specimen was also recovered in which the hexagons are much more minute.

Range.—Upper Cretaceous, N. America; Paleocene, Netherlands; Eocene, Australia; Recent, British Isles.

Lagena cayeuxi Marie

Plate 17, figures 11-11b

1941, *Lagena cayeuxi* Marie, Mus. Nat. Hist. Mem., tome 12, fasc. 1, p. 74.

Distinguishing features.—An oval *Lagena* with about twelve costae which continue up the tubular aperture with flange-like extensions.

Description.—(Pl. 17, fig. 11). Test oval with produced apertural end; unilocular; aperture produced, tubular, without radial grooves; wall radiate hyaline; pores minute; ornament of 12 costae which run with flange-like extensions up the tubular aperture.

Dimensions.—Length 0.38 mm.; maximum width 0.2 mm.

Horizon.—RB1, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42517.

Range.—Upper Cretaceous, Paris Basin.

Lagena striata (d'Orbigny)

Plate 17, figures 7, 7a

1839, *Oolina striata* d'Orbigny, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères," p. 21, pl. 5, fig. 12.

1847, *Oolina haidingeri* Czjzek, Haidinger's Naturw., vol. 2, p. 138, pl. 12, figs. 1, 2.

1863, *Lagena striata* Reuss, Sitz. Akad. Wiss. Wien., vol. 46, p. 327, pl. 3, figs. 44, 45.

1913, *Lagena striata* Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, figs. 42, 43.

1951, *Lagena striata* Marks, Contr. Cushman Found. Foram. Res., vol. 2, p. 46.

Distinguishing features.—An oval *Lagena* with about twenty-four fine striae which do not continue onto the tubular aperture.

Description.—(Pl. 17, fig. 7a). Test oval; unilocular; aperture tubular with short spines, not radiate; wall radiate; pores minute; ornament of about 24 longitudinal striae.

Dimensions.—Length 0.25 mm.; maximum width 0.16 mm.

Horizon.—P35, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42518.

Discussion.—Although the type figure shows an unornamented aperture many specimens have been assigned to the species with spiral and annular ridges on the aperture, as by Brady (1884) in the Challenger Report. On the other hand these features were used by Reuss as a basis for setting up new species, as was the occurrence of basal spines, as for example in *Lagena striata* var. *basisenta* Cushman and Stainforth. The taxonomic importance of these details is still uncertain.

Range.—Tertiary, N.W. Europe, N. America, Australia.

Lagena gracilicosta Reuss

Plate 17, figures 5, 5a

1863, *Lagena gracilicosta* Reuss, Sitz. Akad. Wiss. Wien., vol. 46, p. 327, pl. 3, figs. 42, 43.

Distinguishing features.—An elongate-ovate *Lagena*

with complex ornament of striae with rows of minute pits between them and a produced tubular aperture.

Description.—(Pl. 17, fig. 5a). Test elongate-ovate with produced apertural end; unilocular; aperture produced, tubular, no radial grooves; wall radiate hyaline; pores minute; ornament of striae with rows of minute pits between them.

Dimensions.—Length 0.36 mm.; maximum width 0.11 mm.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42519.

Range.—Oligocene, Germany.

Lagena inornata (d'Orbigny) var. **spinescens** Haynes, n. var.

Plate 17, figure 4

Distinguishing features.—A variety of *Lagena inornata* with short scattered spines and a long, tubular aperture.

Description.—Test elongate-ovate; unilocular; aperture stoutly tubular, possibly with faint radial grooves; wall thick, radiate hyaline; pores minute; ornament of short scattered spines, surface dull white.

Dimensions.—Length 0.36 mm.; maximum width 0.16 mm.

Horizon.—RB4, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42520.

Lagena simplex (Reuss) var. **lacrima** (White)

Plate 17, figure 6

1928, *Oolina simplex* Reuss var. *lacrima* White, Journ. Paleontology, vol. 2, p. 211, pl. 29, fig. 10.

Distinguishing features.—A smooth, pear-shaped *Lagena* with radiate aperture.

Description.—Test pear-shaped with greatest width near the base and tapering towards the apertural end; unilocular; aperture terminal with radial grooves; wall radiate hyaline; pores dense, minute, oblique to the wall near the aperture; surface smooth, milky white.

Dimensions.—Length 0.40 mm.; maximum width 0.21 mm.

Horizon.—P35, Pegwell Marls (possibly derived).

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42521.

Range.—Upper Cretaceous, (Tampico) Mexico.

Lagena amphora Reuss

Plate 17, figure 2

1863, *Lagena amphora* Reuss, Sitz. Akad. Wiss. Wien., vol. 46, p. 330, pl. 4, fig. 57.

Distinguishing features.—An elongate-ovate *Lagena* with about twelve strong costae running onto the produced, tubular aperture.

Description.—Test elongate-ovate with the greatest width near the base and tapering towards the apertural end; unilocular; aperture terminal, tubular; wall radiate hyaline; pores minute; ornament of about 12 longitudinal costae which continue onto the produced apertural end.

Dimensions.—Length 0.4 mm.; maximum width 0.15 mm.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42522.

Range.—Oligocene, (Pietzpuhl) Germany.

Lagena ellipsoidalis Schwager

Plate 17, figure 1

1878, *Lagena ellipsoidalis* Schwager, Geol. Boll. Roma, vol. 9, p. 519, pl. 1, fig. 1.

1936, *Lagena ellipsoidalis* Brotzen, Sver. Geol. Undersök, Ars. 30, no. 3, p. 110, pl. 17, fig. 4.

Distinguishing features.—A large, globose *Lagena* with produced tubular aperture.

Description.—Test globose with greatest width just below the middle and produced apertural end; unilocular; aperture tubular with a suspicion of radial grooves at its tip; wall thick, milky white with minute pores; ornament of initial spine.

Dimensions.—Length 0.55 mm.; greatest width 0.36 mm.

Horizon.—P16, Pegwell Marls (possibly derived).

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42523.

Range.—Upper Cretaceous, Paris Basin, Sweden.

Lagena aff. **L. jacobi** Marie

Plate 17, figure 3

Description.—Test elongate-ovate, semi-inflated; unilocular; aperture terminal with radial grooves; wall radiate hyaline; pores minute; ornament of fine striae covers the lower half of the test.

Dimensions.—Length 0.25 mm.; maximum width 0.17 mm.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42524.

Discussion.—Only one specimen was recovered. It differs from those figured by Marie in the smoothly acuminate, not produced apertural end.

Family BULIMINIDAE

Genus **Buliminella** Cushman, 1911

Buliminella sp.

Plate 16, figure 14

Description.—Test minute, globose, ovate; chambers about 12, inflated, the last 4 making up two thirds of the test; sutures distinct, impressed; aperture a slit extending into the apertural face from the basal suture of the last chamber; wall radiate hyaline; pores minute.

Dimensions.—Length 0.23 mm.; maximum width 0.16 mm.

Horizon.—Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42560.

Discussion.—The specimen described is near in form to *B. obtusa* var. *inflata* Marie but is squat with a narrow aperture. *B. parvula* Brotzen is less inflated with higher chambers.

Genus **Bulimina** d'Orbigny, 1826

Bulimina paleocenica Brotzen

Plate 16, figure 17

1948, *Bulimina paleocenica* Brotzen, Sver. Geol. Undersök., ser. C, no. 493, p. 61, pl. 6, figs. 5, 6.

Distinguishing features.—An elongate *Bulimina,* triangular in section with up to seven or eight whorls of chambers slowly increasing in size.

Description.—Test elongate, triserial, triangular in section; chambers about 15, sutures distinct, flush, spiral sutures obsolete; aperture comma shaped, extending from the basal suture into the apertural face, free border with a lip; wall radiate hyaline; pores large.

Dimensions.—Length 0.26 mm.

Horizon.—RB3, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42565.

Range.—Paleocene, Sweden.

Family UVIGERINIDAE

Genus **Uvigerinella** Cushman, 1926

Uvigerinella europea (Cushman and Edwards)

Plate 16, figure 16

1937, *Angulogerina europea* Cushman and Edwards (part), Contr. Cushman Lab. Foram. Res., vol. 13, pt. 2, p. 61, pl. 8, fig. 18.

Distinguishing features.—A small trigonal *Uvigerinella* with up to six whorls of chambers slowly increasing in size.

Description.—Test trigonal, elongate with greatest width towards the apertural end; chambers 14, triserial, slowly increasing in size, arranged in an anticlockwise spiral; sutures distinct, impressed, spiral sutures marked; aperture terminal with a raised collar on both borders and connected by a suture to the base of the chamber; wall radiate hyaline; pores large, scattered.

Dimensions.—Length 0.27 mm.; maximum width 0.13 mm.

Horizon.—RB19, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42569.

Discussion.—The Thanet specimens resemble the holotype of Cushman and Edwards in possessing the apertural characters of *Uvigerinella.* The paratype figured by these authors shows a different form in which the aperture is terminal without a suture connecting it to the base of the chamber. The specimens ascribed to *A. europea* by Brotzen resemble this paratype.

Brotzen has erected the new genus *Pyramidina* to include triangular forms with *Uvigerinella*-like aperture connected to the base of the chamber by a suture but without raised collars. It is uncertain whether this form is generically distinct from *Uvigerinella* or from *Praeuvigerina* Hofker.

Range.—Paleocene, (Montian and Thanetian) Paris Basin.

Uvigerinella oveyi Haynes, n. sp.

Plate 16, figures 15, 15a

Distinguishing features.—An elongate, striated *Uvigerinella* with up to five whorls of low chambers without marked spiral sutures.

Description.—(Pl. 16, fig. 15). Test elongate, inflated, round in section; chambers about 12, in four whorls, triserial, the last 6 making up three quarters of the test, low, little embracing; sutures impressed; aperture terminal, large, with raised collars on each border and joined to the base of the chamber by a suture; wall radiate hyaline; pores large, scattered.

Dimensions.—Length 0.25 mm.; maximum width 0.13 mm.

Horizon.—RB1, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42567. Additional specimens P42568.

EXPLANATION OF PLATE 17

Discussion.—This species is distinguished from *Uvigerinella sparsicosta* Cushman and Laiming by its small size and proportions and in the possession of striae not costae.

Genus **Angulogerina** Cushman, 1927

Angulogerina cf. **A. wilcoxensis** Cushman and Ponton

Plate 16, figure 19

Description.—Test elongate, triangular, greatest width above the middle; chambers 12, increasing steadily in size, triserial in the initial part, the last two apparently uniserial; sutures distinct, not impressed; wall radiate hyaline, pores large, scattered; aperture broken off; ornament of two keels running unbroken down each angle of the test, the last few chambers excavated at the base.

Dimensions.—Length 0.32 mm.; maximum width 0.15 mm.

Horizon.—Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42570.

Discussion.—Only one specimen was recovered. The shape, chambering and ornament are the same as in *A. wilcoxensis,* a zonal guide fossil in the Midway of Alabama.

Family VIRGULINIDAE

Genus **Virgulina** d'Orbigny, 1826

Virgulina dibollensis Cushman and Applin

Plate 16, figure 18

1926, *Virgulina dibollensis* Cushman and Applin, Bull. Amer. Assoc. Petr. Geol., vol. 10, p. 168, pl. 7, figs. 7a-c.

1932, *Virgulina dibollensis* Howe and Wallace, Louisiana Dept. Cons. Geol. Bull. no. 2, p. 66, pl. 11, fig. 1.

1932, *Virgulina dibollensis* Cushman, Contr. Cushman Lab. Foram. Res., vol. 8, p. 21, pl. 3, fig. 14.

1937, *Virgulina dibollensis* Cushman, *ibid.*, Spec. Pub. 9, p. 7, pl. 1, fig. 20.

1944, *Virgulina dibollensis* Bandy, Journ. Paleontology, vol. 18, no. 4, p. 136, pl. 26, figs. 9a-b.

Distinguishing features.—A slender, elongate *Virgulina* with up to thirteen chambers arranged in a spiral or almost regular biserial series.

Description.—Test elongate, slender, slightly compressed; chambers 13, high, slowly increasing in size, arranged in an almost regular biserial series; sutures distinct, flush; aperture at the peripheral edge of the last chamber, running from the basal suture to the apex; wall granular; pores dense, minute, round.

Dimensions.—Length 0.58 mm.; maximum width 0.13 mm.

Horizon.—RB12, Reculver Silts.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42571.

Discussion.—The majority of the specimens recovered are broken and an exact examination of the tongue could not be made but in external characters the Thanet specimens appear to be indistinguishable from *V. dibollensis.*

Range.—Eocene, N. America.

Family CHILOSTOMELLIDAE

Genus **Pullenia** Parker and Jones, 1862

Pullenia quinqueloba (Reuss)

Plate 17, figures 16-21a

1851, *Nonionina quinqueloba* Reuss, Zeitschr. Deutsch. Geol. Ges., vol. 3, p. 71, pl. 5, fig. 31.

1884, *Pullenia quinqueloba* Brady, Sci. Rep. *Challenger* Exped., p. 617, pl. 84, figs. 14, 15.

1885, *Pullenia quinqueloba* Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, p. 348, pl. 12, fig. 29.

1889, *Pullenia quinqueloba* Sherborn and Chapman, Journ. Roy. Micr. Soc., ser. 2, vol. 6, p. 5, pl. 11, fig. 29.

1897, *Pullenia quinqueloba* Burrows and Holland, Proc. Geol. Assoc., vol. 15, p. 47, pl. 2, fig. 21.

1926, *Pullenia quinqueloba* Plummer, Texas Univ. Bull., no. 2644, p. 136, pl. 8, fig. 12.

1939, *Pullenia quinqueloba* Cushman, Contr. Cushman Lab. Foram. Res., vol. 15, p. 73, pl. 12, fig. 17.

1940, *Pullenia quinqueloba* Cushman, *ibid.*, vol. 16, p. 72, pl. 12, figs. 13, 14.

1941, *Pullenia quinqueloba* Toulmin, Journ. Paleontology, vol. 15, p. 607, pl. 81, fig. 24.

1942, *Pullenia quinqueloba* Cushman and Todd, Contr. Cushman Lab. Foram. Res., vol. 18, p. 42, pl. 7, fig. 15.

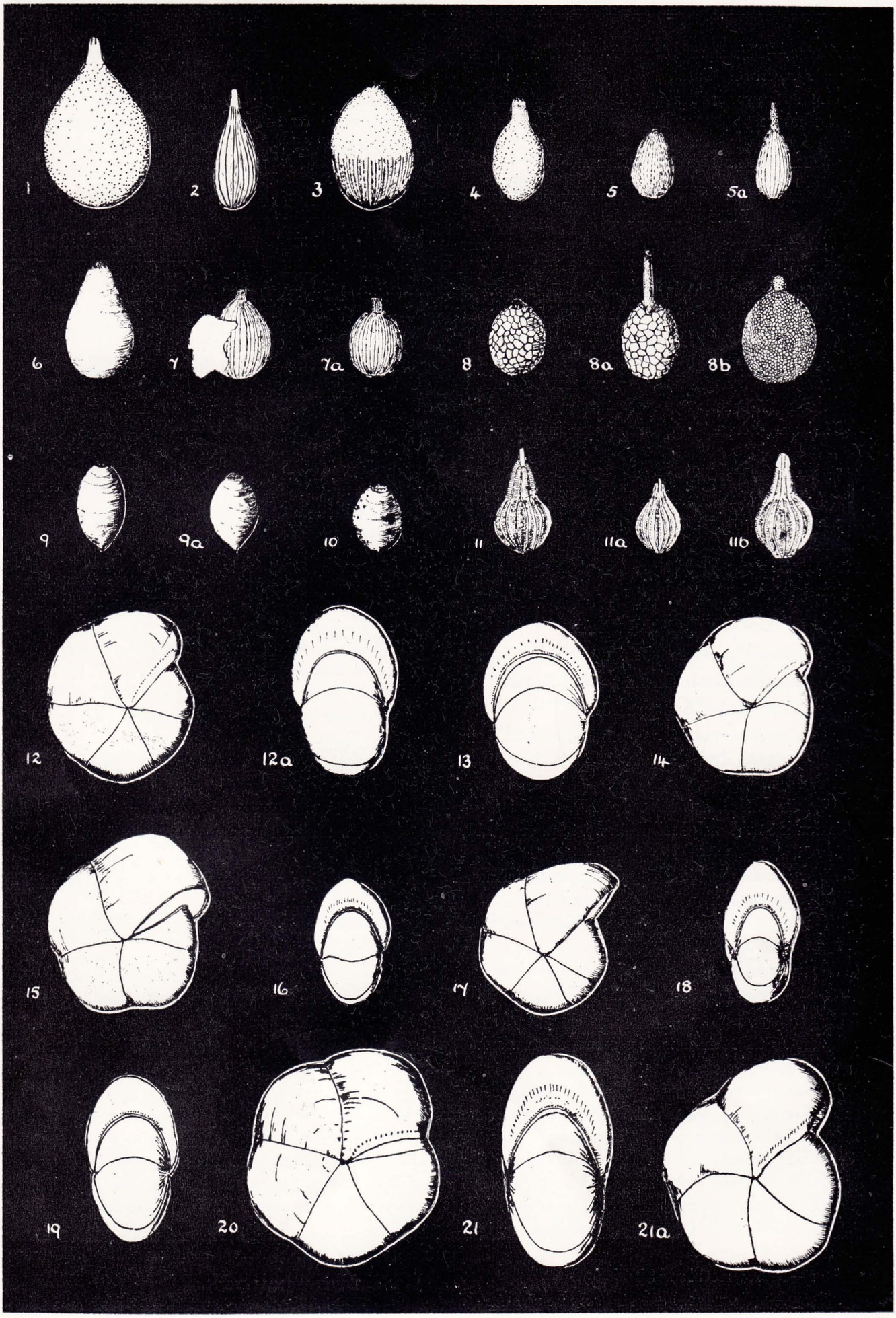
1943, *Pullenia quinqueloba* Cushman and Todd, *ibid.*, vol. 19, p. 10, pl. 2, fig. 5.

1946, *Pullenia quinqueloba* Cushman, *ibid.*, Spec. Pub. 16, p. 37, pl. 7, fig. 11.

Distinguishing features.—A semi-compressed *Pullenia* with five chambers visible at the periphery. The apertural face is high, one third to one half the total height of the last chamber, and the diameter of the test is twice the width from umbilicus to umbilicus.

Description.—(Pl. 17, figs. 20, 21). Test planispiral, involute, semi-compressed, periphery semi-lobate and broadly rounded; 5 chambers visible at the periphery; sutures distinct, slightly impressed, almost radial; aperture low, with a lip, extending along the basal suture from umbilicus to umbilicus; wall granular; pores not observed.

Dimensions.—Diameter 0.44 mm.; width 0.20 mm.; height of apertural face 0.12 mm.; height of last chamber 0.25 mm.; angle between sutures about 70°.



Haynes: British Paleocene Foraminifera

Horizon.—P42, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42572.

Alternation of generations.—About twenty specimens were sectioned and proloculus sizes were found to range about 25 microns in diameter. It is therefore possible that only one generation is represented in the specimens recovered. All stages of growth occur up to specimens with four whorls and about 0.6 mm. in diameter. Sectioned specimens of the size of that described were found to possess about three whorls of chambers.

Variation.—There is variation towards the six chambered species with high apertural face, *P. salisburyi* Stewart and Stewart, and in the other direction towards the more globose *P. quaternaria* (Reuss) with four chambers visible and low apertural face. Some of the specimens show an angular periphery.

Discussion.—Cushman and Todd (1943) distinguished compressed specimens of *P. quinqueloba* as a variety, *P. quinqueloba* var. *angusta;* their definition being based on a population from the Midway of Texas. It must be pointed out that their variety is, however, less compressed than Reuss' figure of *P. quinqueloba* and less compressed than their own figure of a topotype from the Septarian Clays.

Range.—Tertiary, N.W. Europe, Mid-East, N. America.

Pullenia quaternaria (Reuss)

Plate 17, figures 13-15

1851, *Nonionina quaternaria* Reuss, Haidinger's Naturw., vol. 4, pt. 1, p. 34, pl. 2.

1936, *Pullenia quaternaria* Cushman, Contr. Cushman Lab. Foram. Res., vol. 12, p. 74.

Distinguishing features.—A sub-globular *Pullenia* with four and a half chambers visible at the periphery. The apertural face is a third or less of the height of the last chamber and the height of the test is less than twice the width from umbilicus to umbilicus.

Description.—(Pl. 17, figs. 13, 14). Test planispiral, sub-globular, involute; periphery rounded, semi-lobate; 4½ chambers visible; sutures almost radial, slightly impressed; aperture low, with a lip, running from umbilicus to umbilicus at the basal suture; wall granular; pores not observed.

Dimensions.—Diameter 0.33 mm.; width 0.22 mm. Angle between sutures 80°.

Horizon.—P22, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42573.

Variation.—There is variation towards *P. quinqueloba* (Reuss) but the specimens do not seem to show a continuous morphological series. Reuss' specimen from the Limburg Chalk shows four chambers only so the Thanet forms may have shifted in mode.

Range.—Upper Cretaceous, Germany.

Pullenia salisburyi Stewart and Stewart

Plate 17, figures 12, 12a

1930, *Pullenia salisburyi* Stewart and Stewart, Journ. Paleontology, vol. 4, p. 72, pl. 8, fig. 2.

1931, *Pullenia salisburyi* Cushman and Laiming, *ibid.*, vol. 5, p. 117, pl. 14, fig. 2.

1943, *Pullenia salisburyi* Cushman and Todd, Contr. Cushman Lab. Foram. Res., vol. 19, pt. 1, p. 20, pl. 3, figs. 10, 11.

Distinguishing features.—A semi-compressed *Pullenia* with six chambers visible. The apertural face is greater than one third of the total height of the last chamber.

Description.—Test planispiral, involute, semi-compressed; periphery rounded; 6 chambers visible; sutures almost radial, impressed; aperture low, with a lip, running from umbilicus to umbilicus at the basal suture; wall granular; pores not observed.

Dimensions.—Diameter 0.35 mm.; width 0.17 mm.; height of last chamber 0.20 mm.; height of apertural face 0.09 mm.; angle between sutures about 60°.

Horizon.—P16, Pegwell Marls.

Depository.—Brit. Mus. Nat. Hist. Cat. no. P42574.

Range.—Miocene, California.

REFERENCES

Brady, H. B., 1884, Report on the Foraminifera dredged by H. M. S. *Challenger* during the years 1873-1876: Rept. Voy. *Challenger,* Zool., vol. 9, 814 pp., pls. 1-115.

Burrows, H., and Holland, R, 1897, The Foraminifera of the Thanet Beds of Pegwell Bay: Proc. Geol. Assoc., vol. 15, pts. 1 and 2, pp. 19-52, 5 plates.

Cushman, J. A., 1948, Foraminifera, their classification and economic use: ed. 4, 605 pages, 9 text figs., 31 text plates, 55 key plates. Harvard Univ. Press, Cambridge, Mass.

Glaessner, M. F., 1945, Principles of micropalaeontology: 296 pages, 64 text figs., 14 plates. Melbourne Univ. Press, Victoria, Australia.

Haynes, J., 1954, Taxonomic position of some British Paleocene Buliminidae: Contr. Cushman Found. Foram. Res., vol. 5, pt. 4, pp. 185-191, 3 text figs., 1 plate.

———, 1956, Certain smaller British Paleocene Foraminifera. Part I. Nonionidae, Chilostomellidae, Epistominidae, Discorbidae, Amphisteginidae, Globigerinidae, Globorotaliidae, and Gümbelinidae: Contr. Cushman Found. Foram. Res., vol. 7, pt. 3, pp. 79-101, pls. 16-18.

Parr, W. J., 1947, The lagenid Foraminifera and their relationships: Proc. Roy. Soc. Vict., n.s., vol. 58, pp. 116-130, pls. 6-7.

CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION
FOR FORAMINIFERAL RESEARCH
VOLUME IX, PART 3, JULY, 1958

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the Foraminifera that have come to hand.

AGIP MINERARIA. Foraminiferi Padani (Terziario e Quaternario). Atlante Iconografico e Distribuzione Stratigrafica.—AGIP Mineraria, 1957, 52 pls. (quarto). —An invaluable compilation presented in convenient form. Over 500 species and varieties are illustrated by excellent photographs (several views each). As a part of each plate explanation, a chart showing range and abundance of each species faces every plate.

ALEXANDROWICZ, STEFAN. L'âge des marnes crétacées de Puszcza Bukowa près de Szczecin (French résumé of Polish text).—Ann. Soc. Géol. Pologne, v. 26, fasc. 2, Ann. 1956 (1957), p. 91-105, text figs. 1-4. —Lower Maestrichtian age based on Foraminifera. Numerous species listed.

Pyroclastic quartzes in the Tortonian of the Cracow region (in Polish with English and Russian summaries).—Instyt. Geol. (Warsaw), Bull. 115, 1957, p. 27-61, pls. 1, 2, text figs. 1-8, tables 1, 2.—Lower Tortonian Foraminifera in intercalated clays are used in correlation.

ARNOLD, ZACH H. A precision sectioning instrument for microfossils.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 103-112, text figs. 1-3.—Whereby one may watch the sectioning process through the microscope.

AUROUZE, GERMAINE, and YAPAUDJIAN, LOUDFIG. Présence du genre **Hemigordius**(?) dans le Trias de Lorraine.—C. R. S. Soc. Géol. France, No. 14, Nov. 18, 1957, p. 322-325, text figs. 1-3.

BARTENSTEIN, HELMUT. Ein bisher unbekanntes Tertiär-Vorkommen (Mittel-Oligozän) auf Messtischblatt Lauenau (3722).—Geol. Jahrb., v. 73, Dec. 1957, p. 295-299, text figs. 1, 2 (map, microphotographs).—Thirty-three species recorded, some illustrated.

BECKER, LEROY E., and DUSENBURY, A. N., JR. Mio-Oligocene (Aquitanian) Foraminifera from the Goajira Peninsula, Colombia.—Cushman Found. Foram. Res., Spec. Publ. No. 4, Febr. 15, 1958, p. 1-48, pls. 1-7, tables 1-3, map.—One hundred thirty-seven species and varieties, 7 species new, from 2 areas (5 samples).

BIEDA, F. Contribution à la connaissance des grands Foraminifères de l'Éocène supérieur des Karpates (French résumé of Polish text).—Ann. Soc. Géol. Pologne, v. 25, fasc. 3, Ann. 1955 (1957), p. 203-230, pls. 11-13, table 1.—Two species each of **Grzybowskia, Spiroclypeus,** and **Operculinoides.**

BIELECKA, WANDA. Investigations of microfauna of the Lower Malm in the vicinity of Trzebinia (Upper Silesia) (in Polish with English summary).—Instyt. Geol. (Warsaw), Biul. 102, 1956, p. 59-80, pl. 4 (distribution and abundance chart), text fig. 1 (columnar sections).—Seven zones based on Foraminifera are distinguished.

Note on Triassic foraminifers of the north-west periphery of the Swiety Krzyz Mountains (in Polish with English summary).—Instyt. Geol. (Warsaw), Biul. 102, 1956, p. 81-95, pl. 5 (columnar section), text figs. 1, 2 (Ostracoda).—Presence of arenaceous forms, mainly **Haplophragmoides,** is recorded.

BIELECKA, WANDA, and POZARYSKI, WLADYSLAW. Micropalaeontological stratigraphy of the Upper Malm in central Poland (in Polish with English and Russian summaries).—Instyt. Geol., Prace, Warsaw, tom 12, 1954, p. 1-206, pls. 1-12, tables 1, 2, text figs. 1-4.—Sixty-one species and varieties of Foraminifera, 12 species and 4 varieties new, are described and illustrated. Twelve local zones are based on short-lived species of Foraminifera.

BOLTOVSKOY, ESTEBAN. Contribucion al conocimiento de las Tecamebas del Rio de la Plata.—Acta Geol. Lilloana, v. 1, 1956, p. 299-314, 1 pl., map.—Eleven species of Thecamoebina, none new, from fresh-water environments.

On the cyclical occurrence of Foraminifera.—Dusenia, v. 7, pt. 4, Sept. 30, 1956, p. 211-218.—Using as example the records of **Buccella frigida** on the Argentine shelf and adjacent waters during the past century, the author discusses the probability of cyclical fluctuations, and some problems of their recognition.

Los Foraminiferos del estuario del Rio de la Plata y su zona de influencia.—Rev. Instit. Nac. Invest. Ciencias Nat., Museo Argentino Ciencias Nat. "Bernardino Rivadavia," Ciencias Geol., v. 6, No. 1, 1957, p. 1-77, pls. 1-11, map, table 1 (distrib. and abund.).—Quantitative and qualitative study of 123 bottom samples ranging between 7 and 95 meters depth, with interpretations based on comparisons with other areas. One hundred and forty-three species and subspecies recorded; one new species described; most are illustrated.

BONNET, A., JULLIAN, YVES, LYS, M., and VATAN, ANDRÉ. Etudes dans le Néogène du Bas-Rhône. Etude micropaléontologique, by M. LYS. Etude mineralogique, by A. VATAN. Diagrammes électriques, calcimétriques et "Gamma Rays," by Y. JULLIAN and A. BONNET.—Atti VII Conv. Naz. Met. Petrol. 21-24 Apr. 1952, 16 p., pls. 1-4, tables 1, 2, map, graph.—Range and relative abundance of about 265 species of Foraminifera recorded from lower Aquitanian to Recent, with a few species indicated as distinctive of the several subdivisions of the Tertiary in this area.

BRONNIMANN, PAUL, and BROWN, NOEL K., JR. **Hedbergella,** a new name for a Cretaceous planktonic foraminiferal genus.—Journ. Washington Acad. Sci., v. 48, No. 1, Jan. 1958, p. 15-17, text fig. 1.—**Hedbergella** (type species **Anomalina lorneiana** var. **trocoidea** Gandolfi), a new name for **Hedbergina.**

BUCHANAN, JOHN B. The bottom fauna communities across the continental shelf off Accra, Ghana (Gold

Coast).—Proc. Zool. Soc. London, v. 130, pt. 1, Jan. 1958, p. 1-56, pl. 1, text figs. 1-10 (sketch maps, graphs).—A silty sand community at 20-25 fathoms is dominated by two large species of arenaceous Foraminifera: **Jullienella foetida** and **Schizammina** sp.

BUKOWY, STANISLAW, and GEROCH, STANISLAW. On the age of exotic conglomerates at Kruhel Wielki near Przemysl (Carpathians) (English summary of Polish text).—Ann. Soc. Géol. Pologne, v. 26, fasc. 4, Ann. 1956 (1957), p. 297-329, pls. 28-31, text figs. 1-5 (maps, sections, diagrams).—Maestrichtian Foraminifera used to date the conglomerates. Numerous species illustrated, none new.

BUTTERLIN, JACQUES. Les formations Éocènes, sédimentaires et ignées, des Montagnes Noires (République d'Haïti) et leur importance pour l'histoire géologique des Antilles.—Soc. géol. France Bull., ser. 6, tome 7, fasc. 4-5, Dec. 1957, p. 505-517, fig. 1 (geol. map).—Large and small Foraminifera are listed.

CITA, MARIA BIANCA. Guida allo studio della Micropaleontologia.—Milano, Nov. 1956, 384 pp., 214 text figs.—A textbook in which the section on small and large Foraminifera, with the collaboration of FLORIANO VILLA, comprises about half the volume.

COLE, W. STORRS. Larger Foraminifera from Eniwetok Atoll drill holes.—U. S. Geol. Survey Prof. Paper 260-V, 1957 (Febr. 12, 1958), p. 743-784, pls. 231-249, text fig. 254 (map), tables 1-6.—Fifty-nine species and 1 variety, 11 species new, described and illustrated from Recent, Pleistocene and Pliocene, Miocene (Tertiary **g**, **f**, and **e**), and upper Eocene beds. Stratigraphic divisions are compared with those at Bikini, and correlation is made with surface outcrops of Saipan and other Pacific localities. Paleoecologic interpretation is included.

COOGAN, ALAN H. Russian fusulinid genera.—Journ. Pal., v. 32, No. 2, March 1958, p. 304-311, text figs. 1, 2.—Compilation of paraphrased diagnoses and illustrations of type species of 11 genera and 1 subgenus. Also, brief notes on a few other genera.

CUMMINGS, ROBERT H. The faunal analysis and stratigraphic application of Upper Palaeozoic smaller Foraminifera.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 1-24, pl. 1, text figs. 1-6.—Recommended procedure of analysis combining study of free specimens from soft rocks with thin sections from hard rocks of the same sequence. Ten types of oriented thin sections each of 8 different genera are illustrated.

DALBIEZ, F. **Cuneolina hensoni,** a new lowermost Cretaceous marker in southwestern France.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 97-101, pls. 1, 2.

FERREIRA, J. MARTINS, and ROCHA, A. TAVARES. Foraminíferos do Senoniano de Catumbela (Angola) (with English summary).—Garcia de Orta (Lisboa), v. 5, No. 3, 1957, p. 517-545, tables 1-3.—Fifty-six species, none new, are recorded and discussed; none are illustrated. Planktonics are abundant. Ecology interpreted as medium to deep cool waters.

FEYLING-HANSSEN, ROLF W. Stratigrafi og skjaerfasthet et Geoteknisk Problem Geologisk Belyst (in Norwegian).—Naturen, Univ. Bergen, v. 82, No. 1, 1958, p. 5-19, 1 pl., text figs. 1-5 (graphs).—Pleistocene Foraminifera illustrated and discussed.

GEROCH, S. **Uvigerinammina jankoi** Majzon (Foraminifera) in the Carpathian Flysch (English summary of Polish text).—Ann. Soc. Géol. Pologne, v. 25, fasc. 3, Ann. 1955 (1957), p. 231-244, pls. 14, 15.—Detailed description and illustrations of this species of the Verneuilinidae from Upper Cretaceous and Paleocene sediments.

GLAESSNER, M. F., and WOODWARD, G. D. The micropalaeontological examination of the Willunga Bore.—Geol. Survey So. Australia, Rept. Invest. No. 8, 1956, p. 11-14 (distrib. table).—Occurrence in the bore of about 145 species of smaller Foraminifera is recorded. The age of the upper fauna is interpreted as upper Oligocene to lower Miocene and that of the lower strata as upper Eocene to Oligocene.

GRADER, P., and MOSER, F. A type composite log of the Upper Cretaceous and Lower Tertiary formations.—Israel Geol. Survey Bull. No. 15, Sept. 1957, p. 1-6, map, diagram.—Foraminifera, identified by Z. REISS, listed from 6 cores, 1 Eocene, 1 Paleocene, 2 Maestrichtian, and 2 Campanian, from a 300 meter section.

GRADER, P., and REISS, Z. On the Lower Cretaceous of the Heletz area.—Israel Geol. Survey Bull. No. 16, Jan. 1958, p. 1-14, pls. 1-17, map, composite log.—A composite section of about 1300 meters from the Jurassic (Kimmeridgian) to the Vraconian is subdivided into 10 rock-units. Their faunal characteristics (large and small Foraminifera and other groups) are illustrated by thin section photographs and plotted on the composite log.

GRELL, K. G. Studien zum Differenzierungsproblem an Foraminiferen.—Naturwissenschaften, 45 Jahrgang, heft 2, 1958, p. 25-32, text figs. 1-12.—Reproductive cycles in **Myxotheca arenilega, Patellina corrugata, Rotaliella heterocaryotica, R. roscoffensis, Rubratella intermedia,** and **Glabratella sulcata.**

HOFKER, JAN. Foraminiferen der Oberkreide von Nordwestdeutschland und Holland.—Beih. Geol. Jahrb., Heft 27, December 1957, p. 1-464, text figs. 1-495.—Over 200 species and varieties described and illustrated, 30 species new, and 2 new genera: **Valvoreussella** (genotype **Verneuilina bronni** Reuss) in the Valvulinidae, and **Angulogavelinella** (genotype **Rosalina lorneiana** d'Orbigny) in the Gavelinellidae. Eggerellidae is proposed as a new family.

HORNIBROOK, N. de B. New Zealand Upper Cretaceous and Tertiary foraminiferal zones and some overseas correlations.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 25-38, pl. 1, tables 1, 2 (correlation chart, range chart).—The twenty-five New Zealand stages are approximately correlated with the international time scale, and notes are included on their diagnostic Foraminifera. New Zealand ranges of 84 species or genera are shown. Six of Finlay's species are re-illustrated with 2 others, 1 new.

IGO, HISAYOSHI. Fusulinids of Fukuji, southeastern part of the Hida Massif, Central Japan.—Sci. Repts. Tokyo Kyoiku Daigaku, sec. C, v. 5, No. 47, March 20, 1957, p. 153-246, pls. 1-15, text figs. 1, 2.—Forty-three species (19 new and 6 indeterminate) and 3 varieties (all new) are described and illustrated from 2 formations in which 6 zones based on fusulinids are recognized.

ISHII, KEN-ICHI. On the so-called **Fusulina.**—Proc. Japan Acad., v. 33, No. 10, Dec. 1957, p. 652-656,

text figs. 1, 2.—**Fusulina** is polygenetic, one group descended from primitive **Fusulinella** and the other directly from **Profusulinella.** The two groups constitute an example of parallel evolution and convergence. **Beedeina** Galloway, 1933 (type species **Fusulinella girtyi** Dunbar and Condra, 1927) is emended and **Fusulina** is restricted to the group of **F. cylindrica.**

KANMERA, KAMETOSHI. Revised classification of **Cancellina** and **Neoschwagerina,** and evolution of Sumatrininae and Neoschwagerininae.—Mem. Fac. Sci., Kyushu Univ., ser. D, Geol., v. 6, No. 1, Febr. 1957, p. 47-64, pls. 19, 20, text fig. 1 (range chart).

KHALILOV, D. M. Novye Vidy Fauny **Nonion** Paleogenovykh Otlozhenij Azerbajdzhana (in Russian).—Akad. Nauk Azerbaidz. SSR, **Baku,** Instit. geol., Trudy, tom 18, 1956, p. 5-31, pls. 1-3, evolution diagram.—Twenty species, 18 new, and 7 varieties, all new.

Novye Vidy **Bolivina** Paleogenovykh Otlozhenij Azerbajdzhana (in Russian).—Akad. Nauk Azerbaidz. SSR, **Baku,** Instit. geol., Trudy, tom 18, 1956, p. 181-227, pls. 1-4, evolution diagram.—Thirty species and 19 varieties, all new.

KOBAYASHI, MANABU. Paleontological study of the Ibukiyama Limestone, Shiga Prefecture, Central Japan.—Sci. Repts. Tokyo Kyoiku Daigaku, sec. C, v. 5, No. 48, March 20, 1957, p. 247-311, pls. 1-10, text figs. 1, 2 (map, range chart), table 1.—From this Permian formation 41 species (7 new and 7 indeterminate) and 1 variety are described and illustrated and their local ranges indicated. Four zones, two of which are further subdivided into 2 subzones, are based on fusulinids.

KOPIK, JANUSZ. Stratigraphy and microfauna of the Jurassic in the "Borucice" deep bore-hole near Leczyca (district of Lodz) (in Polish with English summary).—Instyt. Geol. (Warsaw), Biul. 102, 1956, p. 31-58, pls. 2, 3 (distribution and abundance chart, columnar section).—Occurrence and abundance of 45 species of Foraminifera in the lower Dogger are recorded.

KRISTAN, EDITH. Ophthalmidiidae und Tetrataxinae (Foraminifera) aus dem Rhät der Hohen Wand in Nieder-Österreich.—Jahrb. Austria Geol. Bundes., Jahrg. 1957, Band 100, heft 2, p. 269-298, pls. 22-27, text figs. 1-4.—Twenty-one species, 16 new and 2 indeterminate, in 11 genera, 5 new. **Semiinvoluta** (genotype **S. clari** n. sp.), **Angulodiscus** (genotype **A. communis** n. sp.), **Coronella** (genotype **C. austriaca** n. sp.), and **Galea** (genotype **G. tollmanni** n. sp.) in the Ophthalmidiidae; and **Duotaxis** (genotype **D. metula** n. sp.) in the Trochamminidae. Also, **Trochonella** (subgenotype **T. (T.) crassa** n. sp.) new subgenus of **Trocholina.**

LISZKA, S. Microfauna of the Upper Eocene from Grabno (English summary of Polish text).—Ann. Soc. Géol. Pologne, v. 25, fasc. 3, Ann. 1955 (1957), p. 161-202, pls. 8-10.—About 100 species, 3 new, are recorded and many illustrated.

LISZKOWA, JANINA. Microfauna of the sub-Silesian series (in Polish).—Przeglad Geol., 1956, zeszyt 10, p. 463-469, text figs. 1-3 (columnar sections).—Many Foraminifera mentioned.

LUCZKOWSKA, E. Stratigraphy of the Lower Tortonian Clays from Benczyn near Wadowice on the Basis of Microfauna (English summary of Polish text).—Ann. Soc. Géol. Pologne, v. 25, fasc. 3, Ann. 1955 (1957), p. 305-336.—Numerous Foraminifera are listed.

MACAROVICI, NEC., PAGHIDA, NAT., and CEHANIONESI, BICA. La microfaune miocène du fondement du Plateau central moldave (French résumé of Rumanian text).—Anal. Stiint. Univ. "Al. I. Cuza," Jassy (n. ser.), Sect. II (Stiinte Nat.-Geogr.), Tom. III, Anul 1957, fasc. 1-2, p. 336-345, pl. 1.—Numerous Foraminifera listed, 2 new: **Sphaeridia moldavica** and **Miliolina buglovensis.**

MARIE, PIERRE, and MONGIN, DENISE. Le Valanginien du Mont-Rose de la Madrague (massif de Marseilleveyre, Bouches-du-Rhône).—Soc. géol. France Bull., ser. 6, tome 7, fasc. 4-5, Dec. 1957, p. 401-424, pl. 27, text figs. 1-4, table 1.—In the section by P. MARIE seven species of Foraminifera, none new, are recorded and illustrated by sections.

MATSUDA, TOKIHIKO. Bathyal sediments of Toyama Bay (in Japanese with English abstract).—Journ. Geol. Soc. Japan, v. 63, No. 746, Nov. 1957, p. 619-635, text figs. 1-9 (maps, graphs), tables 1-3.—Quantitative analysis of Foraminifera from depths of about 200 to 1100 meters.

McGUGAN, ALAN. A sorting device for smaller Foraminifera.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 113, 114.

OBERHAUSER, RUDOLF. Ein Vorkommen von **Trocholina** und **Paratrocholina** in der ostalpinen Trias.—Jahrb. Austria Geol. Bundes., Jahrg. 1957, Band 100, heft 2, p. 257-267, pls. 20, 21, text figs. 1-7.—Four new species and 2 new subspecies.

POZARYSKI, WLADYSLAW, and WITWICKA, EMILIA. **Globotruncana** of the Upper Cretaceous in central Poland (in Polish with English summary).—Instyt. Geol. (Warsaw), Biul. 102, 1956, p. 5-30, pl. 1 (range chart).—Ranges of 18 species shown between Cenomanian and Maestrichtian. In the Santonian and later, the faunas indicate probable limitation of connections with the Alpine geosyncline.

PURI, HARBANS S. Stratigraphy and zonation of the Ocala group.—Florida Geol. Survey, Geol. Bull. No. 38, Nov. 1, 1957, Part I, Stratigraphy: p. 13-89, pls. 1-3, text figs. 1-30, tables 1-3; Part II, Foraminifera: p. 91-184, pls. 1-15, table 1; Part III, Ostracoda: p. 185-244, pls. 1-15, table 1.—Eight faunizones, based mostly on Foraminifera, are recognized in the 3 formations of the Ocala group. Illustrations and descriptions or notes on 145 species of larger and smaller Foraminifera, 17 species of smaller Foraminifera new. Two new genera: **Neoclavulina** (type species **Valvulina intermedia** Applin and Jordan) and **Vernonina** (type species **V. tuberculata** n. sp.).

RAMA RAO, L. Recent contributions to our knowledge of the Cretaceous rocks of South India.—Proc. Indian Acad. Sci., sec. B, v. 44, No. 4, Oct. 1956, p. 185-245, pls. 14-18, text figs. 1-7 (maps, correlation chart, seafloor reconstruction).—Smaller and larger Foraminifera mentioned and orbitoids illustrated in thin section.

Fossil Foraminifera from the Cretaceous rocks of South India. Part I. Ariyalur Area Orbitoids.—Proc. Indian Acad. Sci., sec. B, v. 45, No. 6, June 1957, p. 263-281, pls. 27-29, text figs. 1, 2 (section, map).—Illustrations and notes.

RAUZER-CHERNOUSOVA, D. M., and REITLINGER, E. A. Razvitie Foraminifer V Paleozojskoe Vremja

I Ikh Stratigraficheskoe Znachenie.—Izvestija Akad. Nauk SSSR, ser. geol., no. 11, 1957, p. 103-124, text figs. 1-3 (evolution diagrams), table 1.

REISS, Z. Notes on Foraminifera from Israel. 4. Occurrence and stratigraphical significance of **Cuvillierina eocenica** Debourle.—Israel Geol. Survey Bull. 10, Febr. 1956, p. 1-12, pls. A, B.—Accompanying species are listed, and notes on the systematic position of the genus are included. **C. eocenica** subsequently corrected to **C. vallensis** (Ruiz de Gaona and Colom).

Notes on Foraminifera from Israel. 5. Studies on Victoriellidae. 6. Stratigraphical distribution of some Mesozoic and Cainozoic Foraminifera from Israel.—Israel Geol. Survey Bull. 11, May 1957, p. 1-9, text fig. 1, pls. A, B, p. 1-5, range chart.—**Eorupertia magna** (Le Calvez) and accompanying species recorded from Middle Eocene of Israel. Descriptions and illustrations show bilamellar wall structure. **Gyroidinella** a junior synonym of **Eorupertia.** Range chart of 158 genera, subgenera, and species-groups from Late Jurassic to late Pliocene.

Classification of lamellar Foraminifera.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 51-70, pls. 1-5, table 1.—Lamellar Foraminifera are included in 2 suborders, 6 superfamilies, and 42 families. Numerous thin-section photographs illustrate both lamellar and non-lamellar species.

SAID, RUSHDY, and KAMEL, TOSSON. Recent littoral Foraminifera from the Egyptian Mediterranean Coast between Rosetta and Saloum.—Bull. Instit. Egypte, v. 37, fasc. 2, Sess. 1954-55, 1956, p. 341-372, pls. 1, 2, text fig. 1 (map).—Eighty species, none new but 2 given new names, are recorded and illustrated. Notes are included on probable origins of the various elements of the fauna.

SAUNDERS, J. B. Emendation of the foraminiferal genus **Palmerinella** Bermudez, 1934, and erection of the foraminiferal genus **Helenia.**—Journ. Washington Acad. Sci., v. 47, No. 11, November 1957, p. 370-374, pl. (figs. 1-7).—**Helenia** (type species **Pseudoeponides anderseni** Warren), with supplementary apertures along sutures of both spiral and umbilical sides, and a new subspecies of **Palmerinella,** both from brackish environments of Trinidad.

Recent Foraminifera of mangrove swamps and river estuaries and their fossil counterparts in Trinidad.—Micropaleontology, v. 4, No. 1, Jan. 1958, p. 79-92, pls. 1, 2, text figs. 1-3 (map, distrib. table, correlation table).—Eight species, 2 new, described and illustrated from brackish-water deposits and Miocene and Pliocene deposits of similar ecology.

SHUKRI, N. M., PHILIP, G., and SAID, R. The Geology of the Mediterranean Coast between Rosetta and Bardia. Part II. Pleistocene sediments: Geomorphology and microfacies.—Bull. Instit. Egypte, v. 37, fasc. 2, Sess. 1954-55, 1956, p. 395-427, pls. 1-6 (photographs, thin sections), text figs. 1-11 (maps, sections).—Foraminifera are listed from the several bars.

SKOLNICK, HERBERT. Lower Cretaceous Foraminifera of the Black Hills area.—Journ. Pal., v. 32, No. 2, March 1958, p. 275-285, pls. 36-38, text fig. 1 (map).—Fifteen arenaceous species (families Lituolidae and Trochamminidae), 9 new, comprise an assemblage similar to those of Fredericksburg and Washita age. Environment interpreted as near-shore, brackish, shallow-water lagoonal deposits.

SMIGIELSKA, T. The Miocene Foraminifera from Gliwice Stare (English summary of Polish text).—Ann. Soc. Géol. Pologne, v. 25, fasc. 3, Ann. 1955 (1957), p. 245-304, pls. 16-18.—Forty-one species and varieties, 8 species and 1 variety new, described and illustrated from beds of presumed middle Tortonian age. Over 100 additional species listed.

SOCIN, COSTANTINO. Considerazioni su alcune microfaune oligoceniche presso Brusasco (Torino).—Pubbl. Istit. Geol. Univ. Torino, fasc. III, 1954, p. 1-6.—Foraminifera listed.

Microfaune terziarie del Monferrato.—Pubbl. Istit. Geol. Univ. Torino, fasc. III, 1954, p. 25-50.—Lists of Foraminifera from numerous Tertiary samples.

Il cetaceo fossile di Valmontasca (Vigliano d'Asti) e breve elenco dei vertebrati fossili recentemente trovate nell' Astigiano.—Pubbl. Istit. Geol. Univ. Torino, fasc. III, 1954, p. 83-86.—Foraminifera mentioned.

ST. JEAN, JOSEPH, JR. A Middle Pennsylvanian foraminiferal fauna from Dubois County, Indiana.—Indiana Geol. Survey Bull. No. 10, Febr. 1957, p. 1-66, pls. 1-5, text figs. 1-3 (map, columnar section, phylogeny diagram), table 1.—Descriptions and illustrations of 23 species, 4 new, from a single outcrop, and interpretation of its paleoecology. Families Endothyridae and Fusulinidae include most of the fauna. **Plectogyra** is suppressed as a synonym of **Endothyra.** Species are illustrated both as free specimens and as thin sections, the latter indicating that the granular appearance is due to recrystallization of the original wall, not agglutination of the test. Notes on sectioning techniques and a glossary of terms are included.

TASMAN, MEHLIKA. Correlation of Adana wells by means of quantitative analysis of Foraminifera.—Bull. Min. Res. Explor. Instit. Turkey, Foreign Ed., No. 49, 1957, p. 56-59, text fig. 1 (map), diagram.—**Globigerina helicina** used for correlation in thick Helvetian sections.

TEDESCHI, D., and ZANMATTI, C., II. Diagnosi de forme nuove.—Riv. Ital. Pal. Stratig., v. 63, no. 4, 1957, p. 247-254, text figs. 1-8.—Four new species and four new varieties described and illustrated by excellent photographs from Miocene and Pliocene of Italy.

THOMPSON, M. L., DODGE, H. W., and YOUNGQUIST, WALTER. Fusulinids from the Sublett Range, Idaho.—Journ. Pal., v. 32, No. 1, Jan. 1958, p. 113-125, pls. 17-20, text fig. 1 (map), tables 1-4.—Ten species, 2 new and 3 indeterminate, from Pennsylvanian and Permian rocks.

WOOD, ALAN. The "Devonian Foraminifera" from Tamworth, New South Wales.—Mem. Nat. Mus. Victoria, No. 22, pt. 5, June 14, 1957, p. 1-4, pl. 1 (thin section photographs).—The supposed Foraminifera are oolite grains.

ZANMATTI-SCARPA, C. Studio su alcune "Microfacies" del Bresciano.—Boll. Serv. Geol. Italia, v. 78, fasc. 4-5, Anno 1956 (1957), p. 585-607, pls. 1-3 (microphotographs of rock sections), 1 map, 1 columnar section.—Foraminifera and other microfossils from a Jurassic-Cretaceous section.

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