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84. ARENACEOUS FORAMINIFERA
FROM THE OLIGO-MIOCENE OF TRINIDAD

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Habana, Cuba

The investigation of diagnostic arenaceous foraminifera from the Tertiary of Trinidad (Bonnimann, 1951) is continued in the present paper with the description of arenaceous species and genera from the Nariva formation (Oligocene), Karamat formation (Oligo-Miocene), and Cruse formation (Miocene) of Central and South Trinidad. Not much attention has been paid in the past to morphology and space-time distribution of these arenaceous foraminifera which apparently are of limited biostratigraphic significance compared with the pelagic species on which the biostratigraphic zones of arenaceous foraminifera are important markers of biofacies. The original samples, collected from the Tertiary of Trinidad (Bonnimann, 1951), are diagnostic for the biofacies of the non-calcareous clays of the Nariva formation of South Trinidad.

Test trochoid spiral, composed of 4-5 whorls, elongate, cone-like, pointed at initial end, greatest diameter at last whorl, rounded in transverse section. Spiral throughout quadriserial. Chambers inflated, interior not subdivided. Sutures well defined. Aperture a rounded opening at the base of the last chamber, apparently without tooth or toothlike growth. Walls thin, not alveolar, finely arenaceous. Surface smoothly finished.

Genotype. Gravellina narivaensis Bronnimann n. sp. Nariva formation, Oligocene, Trinidad, B.W.I.

Remarks. Gravellina is a new monotypic valvulirid genus characterised by a throughout quadriserial arrangement of the chambers. It is perhaps related to Makarikiana van Soest 1942, described from the Eocene of Dalmatia (Van Soest, 1942, p. 27, pl. I, figs. 22-25), generotype M. trochoidea van Soest. Makarikiana is 4 to 5 chambered in early and 3 to 4 chambered in late whorls and possesses an aperture with a short rounded tooth. The figures of M. trochoidea are not very clear, and therefore are not of much use for the interpretation of the generic definition. Gravellina occurs often abandantly and associated with Alveovalvulinella posonensis (Cushman and Renz) in the non-calcareous clays of the ?Upper to Lower Oligocene Nariva formation of South Trinidad.

The new genus is named for the late D. W. Gravell in recognition of his valuable contributions to the knowledge of orbitoidal foraminifera of the Caribbean region.

Gravellina narivaensis Bronnimann n. sp.

Plate 15, figure 9. Textfigure 1

Well preserved specimens are elongate, rounded in cross section, cone-like, with a pointed initial end. The greatest diameter is at the apertural end. The inflated and undivided chambers increase gradually in size and are arranged quadriserially throughout the 4 to 6 whorls. The sutures, especially the longitudinal ones, are distinct excepting at the initial portion. The aperture is a rounded opening at the base of the end chamber; no tooth or toothlike growth appears to be present. The walls are finely arenaceous, non-calcareous, not alveolar, and the surface is smoothly finished. The tests are as a rule laterally or axially compressed. Laterally compressed specimens are predominant. The species is easily recognizable on account of the 2 converging lines of longitudinal sutures on both sides of

1 Now with Gulf Oil Corporation.
the compressed test. Normal and compressed specimens are illustrated in textfigure 1. The pointed initial end is mostly damaged, and where preserved, appears to be quadriserial (textfigure 1, y). The length of laterally compressed individuals ranges from 0.57 mm to 0.9 mm.

The species is named after the Nariva area, South Trinidad.

**TEXTFIGURE 1**

*Holotype.*—*Gravellina narivaensis* n. sp. Plate 15, Figure 9, 110x. K.R. 23724; T.L.L. Cat. No. 165072.

Nariva formation, Oligocene, Trinidad, B.W.I. Length of test 0.63 mm, maximum diameter (final whorl) 0.48 mm.

*Occurrence.*—*G. narivaensis* occurs often abundantly in the non-calcareous clays of the Oligocene Nariva formation, associated with *Alveovalvulinella* pozonensis (Cushman and Renz), *Haplophragmoides carixensis* n. sp., *Cyclammina cancellata* Brady and others.

**Genus Jarvisella Bronnimann, n. gen.**

Test a trochoid spiral like *Alveovalvulina* with more than 3 chambers in the initial whorl and with 3 large chambers in the adult. Chambers increase rapidly in size and the adult whorl represents the larger portion of the test. Chambers of later whorls with 2-3 shallow basal pockets produced by inward folding of walls. Interior without alveoles or radiating partitions, not labyrinthic. Walls finely arenaceous, thin. Surface smoothly finished. Exterior irregular due to the undulating surface of the lower chamber walls. Aperture arcuate, with distinct neck, situated in umbilical depression at the base of the apertural face of the end chamber.

*Genotype.*—*Jarvisella karamatensis* Bronnimann n. sp. Karamat formation, Oligo-Miocene, Trinidad, B.W.I.

*Remarks.*—The arrangement of the chambers, and also the general appearance of the test resembles closely *Alveovalvulinella* Bronnimann (1951, p. 100, textfigs. 5-8, pl. 11, fig. 5), from which it differs by the absence of the peripheral alveoles and by the presence of the basal pockets and folds. The available material is not sufficiently well preserved for a detailed investigation of the early stages. Axial thin sections however (textfigure 3d) indicate that the early stage has more than 3 chambers in a whorl. With the exception of the basal folds the chambers of *Jarvisella* are not reinforced by interior structures and the upper portions of the thin chamber walls are therefore often compressed or crushed. *Jarvisella* is monotypic and occurs only in the non-calcareous clays of the Oligo-Miocene Karamat formation of South Trinidad.

The genus is named after P. W. Jarvis who in cooperation with J. A. Cushman started modern micropaleontologic work in Trinidad.

*Jarvisella karamatensis* Bronnimann, n. sp.

Plate 15, figure 7. Textfigures 2, 3

The 3 chambered last whorl represents the larger portion of the trochoid test. The chambers increase rapidly in size. The initial portion is rather pointed. The sutures are well defined in the adult, but indistinct in the early stages. The number of chambers in the whorls of the initial portion is therefore difficult to determine. The aperture is arcuate, with distinct neck and situated in the umbilical depression at the base of the apertural face of the end chamber. The chambers show 2 to 4 oblong basal depressions produced by the inward folding of the chamber walls (textfigure 2). These basal depressions create a characteristic undulated or ragged exterior which renders this species easily distinguishable from morphologically related forms. The apertural sides of the chambers, on the other hand, are not folded and they are not reinforced by folds, often compressed or crushed. The thin walls are very finely arenaceous, non-calcareous. The surface is smoothly finished. Deformed specimens are the rule.

**EXPLANATION OF TEXTFIGURE 1**

Textfigure 1. *Gravellina narivaensis* Bronnimann, n. sp. Nariva formation, Oligocene, South Trinidad, B.W.I. a-x, z — Same specimen, K.R. 23724; T.L.L. Cat. No. 165072. All × 80.
y — K.R. 11979; T.L.L. Cat. No. 6152. × 35.
and occasionally it is difficult to separate them from badly preserved specimens of *Alveovalvulina suteri* Bronnimann which in the general features of the test comes closely to *J. karamatensis*.

**TEXTFIGURE 2**

Broken up chambers (textfigure 2, g, h, i) exhibit the basal pockets produced by the inward folding of the lower chamber walls. The number of basal folds varies with the size of the chambers and appears to be 3 to 4 in the chambers of the final whorl. The pockets open widely into the chamber lumina which are only slightly restricted in the lower part. In cross section the basal pockets could be mistaken for alveoles as described in *Alveovalvulina suteri*, but no morphologic relationship seems to exist between the completely closed alveoles of *Alveovalvulina* and these structures. This type of internal subdivision is not labyrinthic.

The axial section of the initial portion (textfigure 3d) shows that the number of chambers in the early whorls must be greater than 3 and that basal folds probably do not yet occur at this stage. Adult chambers are much compressed toward the aperture. The interior of chambers and pockets is coated with a thin brown chitinous film. The length of tests varies from 0.325 to 0.65 mm., the maximum width from 0.225 to 0.48 mm. Sectioned specimen (textfigure 3d): Length 0.8 mm. Maximum width 0.51 mm. Diameter of initial chamber ±20μ. Thickness of outer wall in early stage ±10μ, in end chamber 30-50μ. Chamber lumina are compressed to 30-50μ.

The species is named after the Karamat area, South Trinidad.

*Holotype.* — *Jarvisella karamatensis* n. sp. Plate 15,

**TEXTFIGURE 3**

(EXPLANATION OF TEXTFIGURES 2 & 3)

Textfigure 2. *Jarvisella karamatensis* Bronnimann, n. sp. Karamat formation, Oligo-Miocene, South Trinidad, B.W.I.


c, h — Hg. 3891; T.L.L. Cat. No. 97964. × 35.

e, f — Hg. 2183; T.L.L. Cat. No. 89082. × 35.

g — W.J. 304; T.L.L. Cat. No. 961. × 35.

Textfigure 3.


b — Specimen opened obliquely to axis showing uniserial arrangement of chambers and subdivision into chamberlets.

c — End chamber of same specimen with radial partitions. Chamberlets connected with central cavity by rounded pores.

d — *Jarvisella karamatensis* Bronnimann, n. sp. Karamat formation, Oligo-Miocene, South Trinidad, B.W.I. Hg. 7353; T.L.L. Cat. No. 173043. Appr. × 40. Axial section showing the multiserial early stage and the compressed late chambers.

e — *Alveovalvulinella pozonensis* (Cushman and Renz), Nariva formation, Oligocene, South Trinidad. K.R. 23619; T.L.L. Cat. No. 163955. × 38. Apertural view of biserial stage. End chamber broken up exhibiting alveolar system.
Grand Lagon area, South Trinidad, B.W.I. Karamat formation, Oligo-Miocene. Length of test 0.63 mm., maximum width 0.48 mm. (laterally compressed specimen). Deposited in Cushman Collection, U. S. National Museum, Washington, D.C., U.S.A.

Occurrence.—Jarvisella karamatensis occurs commonly in the non-calcareous clays of the Oligo-Miocene Karamat formation (Globorotalia iohki Zone and Globorotalia mayeri Zone). It is associated with Valutulina flexilis Cushman and Renz, Eggerella karamatensis n. sp., Haplophragmoides narvaensis n. sp. and other less common arenaceous species.

Genus Alveovalvulinella Bonnimann, n. gen.

Test elongate, rounded in transverse section, rapidly tapering at base. Early stage a trochoid spiral with more than 3 chambers in a whorl, then reducing to 3 chambers, then to 2 and finally to one. Uniserial portion of well developed adults consists of about 3 to 4 chambers. Interior of chambers of later whorls peripherally subdivided into small alveoles arranged normal to the outer walls. Walls arenaceous, occasionally translucent showing the interior alveolar structure.

Surface smooth to fairly coarse. Sutures distinct in the uniserial but hardly discernible in the early portion. Aperture rounded, terminal, sunken, without lip or neck.

Genotype.—Liebusella pozonensis Cushman and Renz 1941.

Remarks.—Alveovalvulinella pozonensis was described by Cushman and Renz (1941, p. 9, pl. 2, figs. 1a, 1b, 2) from the Upper Oligocene to Middle Miocene, Agua Salada formation (zones 1-3), Eastern Falcon, Venezuela, as Liebusella pozonensis. The morphology of Liebusella soldanii (Jones and Parker) 1860, the genotype of Liebusella Cushman 1933, however differs considerably from that of L. pozonensis which must be attributed to a new monotypic valvulinid genus with interior peripheral alveoles and uniserial adult. The interior of the chambers of the uniserial portion of L. soldanii and of the variety intermedia (Vanden Broeck) is characterized by rather thick partitions converging from the periphery, thus producing radially arranged chamberlets which open into the central apertural cavities by rounded to oblong pores. The height of the chamberlets is identical with the height of the chambers, i.e. each chamber is developing one layer of chamberlets only. The straight radiating partitions — also called pillars — between the chamberlets connect roof and floor of each chamber. The original chamber lumina are therefore reduced by the development of secondary radial chamberlets and in the adult, the chamber is represented by the apertural cavity only. The chambers of the early stage of the test do not seem to be subdivided into chamberlets. This interesting arrangement is well exposed by the broken up specimen of L. soldanii, from off Key West, Florida, 78 fathoms, figured by Cushman (1937, pl. 20, fig. 5) and by recent specimens of L. soldanii and of L. soldanii var. intermedia from Atlantis Station No. 3474, Lat. 23° 18' N, Long. 80° 46' W, off Province Oriente, Cuba, 450 fathoms (textfigures 6, 8, 9) which were kindly donated by P. J. Bermudez, Caracas. The axial section of a recent specimen of L. soldanii, figured by Brady (1884, pl. 32, fig. 17) as Haplostichia soldanii, clearly shows the thick arenaceous walls, the low chambers and the straight and rather thick partitions of the chamberlets. L. goeici Höglund 1947, reported from the Gullmar Fjord and the Skagerak, shows a similar radial subdivision of the uniserial chambers (Höglund, 1947, pl. 14, fig. 8) and was termed "sublabyrinthic" by Höglund (p. 197). The aperture, in general, is placed in crater like depressions. The type of aperture is extremely variable.

In order to demonstrate the internal structure of L. soldanii and its variety intermedia the calcareous walls of recent specimens from Atlantis Station 3474 were etched in steps with HCl. The sections obtained after each application of HCl were drawn with an Abbé Mirror and compiled in textfigures 5, 6, 8, 9. L. soldanii (textfigure 8) is figured first from the outside showing the stout test and the rather indistinct sutures (a). In the following 4 steps (b-e) the radial chamberlets appear and the rounded openings into the central apertural cavities. Then the radial chamberlets of the 4 uniserial chambers and part of the chambers of the preceding stages are opened (f-i). It is of interest to note that the 2 radiating chamberlets of the end chamber are leading to a single opening in the apertural cavity, i.e. the partition does not reach the centre and the chamberlets are not completely separated. The 3 final stages (k-m) expose the initial portion, the apertural cavities and the passages between chamberlets and cavities (black spots). The end chamber of L. soldanii (textfigure 6) possesses a rather indistinct and irregularly shaped terminal aperture (a), which opens into the central apertural cavity (b). The following sections expose the apertural cavity and the radiating chamberlets (c) and the connections between chamberlets and cavity (d, e). The internal structure of L. soldanii var. intermedia is shown in textfigure 9. The variety is more slender and has more definite sutures than the parent species. The sections (a-g) reveal complete agreement in the internal structure with L. soldanii.

Vanden Broeck (1876, p. 76) described the internal structure of Liebusella soldanii var. intermedia v.d.B. from Barbados as follows: “... chacune des loges se trouve elle-même subdivisée en un certain nombre de compartiments au moyen de cloisons secondaires, dressées perpendiculairement sur le plancher des loges. C'est alors le type composé dans lequel l'ouverture devient dendirique ou multiple.” This description, illustrated by excellent sections (pl. 2, figs. 3, 4, and 6) is confirmed by the present investigation. The term
"labyrinthic," however, has not been used by vanden Broeck.

The chambers of the initial portion of *L. soldanii*, as far as it could be ascertained by the acid treatment (textfigure 5e) appear to be in a linear arrangement. The position of the apertures however suggest that the true arrangement is multiserial. The interior of *Liebusella* therefore, is not labyrinthic, although the impression of a labyrinthic arrangement could be created by tangential sections parallel or oblique to the axis of the test. The present author does not agree with whereby "clear that there are separated tiers of partitions which are not aligned and which are separated by irregular horizontal partitions parallel to the floors and ceilings of the chambers." The specimens described and figured in this paper (textfigures 5, 6, 8, 9), the broken specimen of Cushman and the axial section of Brady, however, do not show such an irregular structure, and also Palmer's axial section of a fossil specimen of *L. soldanii* from the Upper Oligocene Cojimar formation of Cuba (1938, pl. 22, fig. 21) exhibits a fairly regular arrangement of cavities in horizontal layers which correspond to the chamberlets of a chamber. No indication of a labyrinthic interior is to be seen.

Palmer (1938, p. 284) assigned specimens with "labyrinthic" chambers exemplified by recent specimens of *L. soldanii* to *Liebusella* Cushman, 1933, sensu stricto. On the other hand specimens with non-labyrinthic, but partitioned chambers were referred to the genus *Cubanina* Palmer 1936, typified by *C. alavensis* Palmer. As the chambers of recent specimens of *L. soldanii* are subdivided by radiating partitions into chamberlets, *Liebusella* and *Cubanina* cannot be distinguished and the latter becomes a synonym of *Liebusella*. According to Palmer's figures on pl. 22, the only remaining difference between *C. alavensis* and *L. soldanii* is the greater height of the chambers and the larger chamberlets in *C. alavensis* when compared with *L. soldanii*. Should these features be constant, the two forms are probably only different species. The number of chamberlets appears to be of the same order (about 10) in *C. alavensis* (Palmer, 1938, pl. 22, fig. 9) and in *L. soldanii* (see textfigure 6).

A recent specimen from the South Coast of Trinidad (textfigure 3b, c) (Br. 532-537; T.L.L. Cat. Nos. 132287-292) which from the exterior closely resembles *L. soldanii* was also opened with acid and revealed the same internal structure as typical representatives of *Liebusella*, with the exception of the much greater height and width of the chambers and the greater dimensions of the openings between chamberlets and central apertural cavity. In addition the number of radiating chamberlets is only 8 against 10 of the examined specimens of *Liebusella*. It is possible that specimens of this type were assigned by Palmer to *Cubanina*.

Thus *Liebusella* Cushman 1933, sensu stricto, as defined by Palmer 1938, differs considerably from *Alveovalvulinella*, which is characterized by numerous small alveoles covering the interior of the chambers. The chamber lumina are only slightly reduced by the development of alveoles which open widely into the chambers. *Alveovalvulinella*, on the other hand, is closely related to the adult triserial *Alveovalvulinella* Bronnimann 1951, from which it is distinguished by the uniserial adult test and the rounded terminal aperture. Early stages of *Alveovalvulinella* and of *Alveovalvulinella* are very similar, perhaps identical (Bonnimann 1951, textfigure 7a-7d, 8).

*Alveovalvulinella* is monotypic and occurs in the Oligocene of Trinidad, Venezuela, and Costa Rica.

**Alveovalvulinella pozonensis**

(Cushman and Renz), 1941

Plate 15, figure 3. Textfigures 3-7


**Liebusella pozonensis** Cushman and Renz var. *crassa*


Cushman and Renz's original description of the parent species is as follows:

"test of medium size, subcylindrical, rapidly tapering at the base, the adult with the sides nearly parallel, somewhat lobulate; chambers of the early portion indistinct, the triserial portion usually followed directly by the uniserial stage which consists of 3-4 chambers, interior labyrinthic; sutures of the earlier portion indistinct, in the uniserial portion distinct and depressed; wall finely arenaceous with much cement, somewhat translucent and showing the interior structure; aperture rounded, terminal. Length 0.95-1.30 mm., diameter 0.35-0.50 mm."

The Trinidad material corresponds perfectly with that from Venezuela, represented in the collections of Trinidad Leaseholds by the original samples H.S.R. 921, T.L.L. Cat. No. 19787 and L.P. 129, T.L.L. Cat. No. 22675.

The variety *crassa* has been put in synonymy with the parent species, as the differences put forward by Cushman and Renz (1941, p. 10) appear to be due to slightly different preservation which does not warrant the establishment of a new variety. The occurrence of
A. pozonensis in H.S.R. 921 is possibly allochthonous. The sample L.P. 129 is homogeneous and contains *Orbulina suturalis* Bronnimann, *Globorotalia fohsi barisanensis* LeRoy, and *Globorotalia mayeri* Cushman and Ellisor, an association which indicates an Upper Oligocene, *Globorotalia fohsi barisanensis* age of the fauna.

The description of the exterior by Cushman and Renz does not need much amplification. It may be added that the sutures are frequently indented indicating the basal rows of interior alveoles. Undeveloped tests, usually of the biserial stage are common. The tests are occasionally more or less compressed. The aperture is textularia-like in the early biserial stage (textfigure 4, b, c), later it becomes partly enclosed and subterminal (textfigure 4, d, f), and finally terminal (textfigure 4, g, h) in the adult stage. The number of chambers of the early whorls cannot be determined due to the obscure sutures.

The term labyrinthic has to be replaced in the original description by alveolar. The presence of alveoles is occasionally suggested by subcircular depressions on the surface which is also observed in *Alveovalvulinella*. In worn specimens alveoles are often exposed. The alveoles are arranged normal to the walls and they open widely into the chamber lumina, which are not much reduced by the alveolar wall structure (textfigures 6g, h, 7). Early ontogenetic chambers apparently do not possess alveoles. The number of alveoles is increasing with the size of the chambers, and in axial sections of late ontogenetic chambers 5-9 alveoles have been counted. In well preserved specimens the inner walls of alveoles and chambers are coated with a thin, brown chitinous film. Axial sections of specimens from the Agua Salada formation of Venezuela (L.P. 190; T.L.L. Cat. No. 22620) exhibit the alveolar structure and uniserial adult typical for *Alveovalvulinella* (textfigure 7).

**Dimensions of sectioned specimens**

Specimen 1, L.P. 190, T.L.L. Cat. No. 22620, Agua Salada formation, Venezuela.
- Length of test 1.03 mm. (4 uniserial chambers)
- Maximum diameter of test 0.4 mm.
- Maximum diameter of initial chamber ±0.12 mm.
- Diameter of alveoles of end chamber ±50μm
- Thickness of walls of initial portion ±15μm
- Thickness of walls of end chamber ±25μm

Specimen 2, L.P. 190, T.L.L. Cat. No. 22620, Agua Salada formation, Venezuela.
- Length of test 1.33 mm.
- Maximum diameter of test 0.64 mm.
- Diameter of alveoles of early chambers 30-50μm
- Diameter of alveoles of late chambers 50-65μm
- Thickness of wall of end chamber ±25μm

Specimen G. 5160A, Nariva formation, Trinidad.
- Length of test 1.27 mm.
- Maximum diameter of test 0.496 mm.
- Diameter of initial chamber ±40μm
- Diameter of alveoles 30-65μm
- Thickness of walls of early chambers ±15μm
- Thickness of walls of end chamber ±30μm

Specimen K. R. 23619, T.L.L. Cat. No. 163955, Nariva formation, Trinidad. (Only fragment of initial portion).
- Diameter of initial chamber ±30μm
- Thickness of wall of early chambers ±15μm
- Diameter of alveoles 30-50μm


**Occurrence.**—*A. pozonensis* has been recorded from the Oligo-Miocene of Venezuela (Agua Salada formation, lower zone of Carapita shale), Trinidad (Brasso formation, Nariva formation), and from the Amoura shale of Costa Rica. It is diagnostic for the non-calcareous shales of the Nariva formation of South Trinidad, where it is associated with *Gravellina narivaensis* n. sp., *Haplophragmoides narivaensis* n. sp., and others.

**Genus Eggerella Cushman, 1933**

**Eggerella karamatensis** Bronnimann, n. sp.

Plate 15, figure 2. Textfigure 5f-i

The elongate, slightly tapering test is a trochoid

**EXPLANATION OF TEXTFIGURE 4**

Textfigure 4. *Alveovalvulinella pozonensis* (Cushman and Renz), Nariva formation, Oligocene, South Trinidad.
- K.R. 23783; T.L.L. Cat. No. 165498. × 25.
- a, d-f — Biserial stage, aperture tends to become terminal.
- b, c — Young individuals, tri-biserial.
- e — Adult individuals, uniserial, terminal aperture. g with broken up end chamber, alveoles.
EXPLANATION OF TEXTFIGURE 5

Textfigure 5.

a-d — *Alveovalvulina pozonensis* (Cushman and Renz), Nariva formation, Oligocene, South Trinidad.

a-c — K.R. 23534; T.L.L. Cat. No. 164033.

d — K.R. 23619; T.L.L. Cat. No. 163955.

All × 70.

Superficially eroded specimens showing alveolar system.

e — *Liebusella soldanii* (Jones and Parker). Atlantis Station 3474, Lat. 23° 18' N, Long. 80° 46' W, off Oriente Province, Cuba, 490 fathoms. × 55. Same specimen as in Textfigure 8. Initial portion slightly deeper eroded than stage m of Textfigure 8, showing initial chamber.

f-i — *Eggerella karamatensis* Bronnimann, n. sp. Karamat formation, Oligo-Miocene, South Trinidad, B.W.I. Hg. 7351; T.L.L. Cat. No. 173017. × 55.

f, g — Same specimen.

h, i — Same specimen.

spiral of about 4 to 5 whorls, rounded at the initial end and broadest at the apertural end. The initial whorl is composed of more than 3 chambers, the final 3 to 4 whorls are triserial. The rather high subglobular chambers increase gradually in size. The sutures are well defined. The aperture appears to be a rounded opening at the base of the apertural face of the end chamber. The non-calcareous walls are finely to coarsely arenaceous and the surface is smoothly finished. The tests are frequently deformed.

A maximum length of 0.32 mm. to 0.67 mm. and a maximum diameter of 0.22 mm. to 0.3 mm. was measured on slightly deformed specimens.

Holotype.—Eggerella karamatensis n. sp. Plate 15,

TEXTFIGURE 6

a-f — Liebusella soldanii (Jones and Parker).

a-e — Atlantis Station 3474, Lat. 23° 18' N, Long. 80° 46' W, off Oriente Province, Cuba, 490 fathoms. All x 9. Same specimen, seen from the apertural side, showing successive stages obtained by application of HCl.

f — Atlantis Station 1573, to Cape Cruz, Cuba, 305 fathoms. x 9.

g, h — Alveovalvulinella pozonensis (Cushman and Renz), Nariva formation, Oligocene, South Trinidad. All approx. x 40.

g — G. 5160A.

h — K.R. 23619; T.L.L. Cat. No. 163955. Axial sections of biserial microspheric individuals showing the internal alveolar structure.

TEXTFIGURE 7

A maximum length of 0.32 mm. to 0.67 mm. and a maximum diameter of 0.22 mm. to 0.3 mm. was measured on slightly deformed specimens.

EXPLANATION OF TEXTFIGURES 6 & 7

Textfigure 6.

Figs. 1. Valvulina flexilis (Cushman and Renz). Hg. 230; T.L.L. Cat. No. 65478 (17' augerhole), Cruse formation, Miocene. Morne Diablo Quarry Road, South Trinidad. x 110. .................................................. 95

2. Eggerella karamatensis Bronnimann, n. sp. Hg. 7351; T.L.L. Cat. No. 173017 (14' augerhole), Karamat formation, Oligo-Miocene. Rochard-Douglas area, South Trinidad. x 110. Holotype. ........................................... 92

3. Alveovalvulinella pozonensis (Cushman and Renz). K.R. 23703; T.L.L. Cat. No. 164867 (20' augerhole), Nariva formation, Oligocene. Watts Trace Line, South Trinidad. x 110.................................................. 91

4. Haplophragmoidea narivaensis Bronnimann, n. sp. K.R. 23735; T.L.L. Cat. No. 165500 (20' augerhole), Nariva formation, Oligocene. Stafford Road, South Trinidad. x 110. Holotype. ........................................... 96

5. Recurvoides higginsi Bronnimann, n. sp. Hg. 7318; T.L.L. Cat. No. 172604 (14' augerhole), Cruse formation, Miocene. Rochard-Douglas area, South Trinidad. x 110. Holotype. ........................................... 98

6. Recurvoides obsoletum (Goës). Hg. 7318; T.L.L. Cat. No. 172604 (14' augerhole), Cruse formation, Miocene. Rochard-Douglas area, South Trinidad. x 110. Holotype. ........................................... 97

7. Larvisella karamatensis Bronnimann, n. sp. Lz. 3786; T.L.L. Cat. No. 45075; Karamat formation, Oligo-Miocene. Grand Lagon area, South Trinidad. x 110. Holotype. ........................................... 88

8. Eggerella forestensis Bronnimann, n. sp. S.L. 6637; T.L.L. Cat. No. 5220. Cruse formation, Miocene. Morne Diablo Quarry Road, South Trinidad. x 110. Holotype. ........................................... 87

9. Gravellina narivaensis Bronnimann, n. sp. K.R. 23724; T.L.L. Cat. No. 165072 (20' augerhole), Nariva formation, Oligocene. Watts Trace, South Trinidad. x 110. Holotype. ........................................... 92
Bronnimann: Arenaceous Foraminifera, Oligo-Miocene, Trinidad
Mayne: Pseudocyclammina hedbergi, n. sp.
Eggerella forestensis Bronnimann, n. sp.

The test is a small trochoid spiral of about 4 whorls, pointed at the initial end and broadest at the apertural end. The initial whorl contains 4 or more chambers, and the following whorls are throughout triserial. The chambers increase rapidly in size so that the final whorl represents about half of the test. The sutures are well marked. The aperture is an indistinct opening at the base of the apertural face of the end chamber. The walls are finely to coarsely arenaceous depending on the type of environment, and the surface is smoothly compressed, indicating that the chambers are not subdivided and that the walls are thin.

The length of the tests is from 0.25 mm. to 0.65 mm. and the maximum width from 0.25 mm. to 0.4 mm. These dimensions refer to compressed specimens.

Remarks.—E. karamatensis differs from E. forestensis n. sp. in the elongate, gradually tapering test, smaller final whorl in relation to the size of the test, and the larger chambers.

Occurrence.—E. karamatensis is a common species of the Oligo-Miocene Karamat faunas, associated with Jarroisella karamatensis n. sp., Haplophragmoides nari­vaensis n. sp., and others.

Genus Valvulina Orbigny, 1826

Valvulina flexilis Cushman and Renz, 1941

Plate 15, figure 8. Textfigure 15a-g

The test is a small trochoid spiral of about 4 whorls, pointed at the initial end and broadest at the apertural end. The initial whorl contains 4 or more chambers, and the following whorls are throughout triserial. The chambers increase rapidly in size so that the final whorl represents about half of the test. The sutures are well marked. The aperture is an indistinct opening at the base of the apertural face of the end chamber. The walls are finely to coarsely arenaceous depending on the type of environment, and the surface is smoothly compressed. The tests are laterally, occasionally axially subdivided and that the walls are thin.

The length of the tests is from 0.25 mm. to 0.65 mm. and the maximum width from 0.25 mm. to 0.4 mm. These dimensions refer to compressed specimens.

Remarks.—Eggerella forestensis differs from E. forestensis n. sp. in the elongate, gradually tapering test, smaller final whorl in relation to the size of the test, and the larger chambers.

Occurrence.—E. forestensis is a common species of the Oligo-Miocene Cruse faunas, associated with Clavularia n. sp., Haplophragmoides nari­vaensis n. sp., and others.

Valvulina flexilis Cushman and Renz, 1941

Plate 15, figure 8. Textfigure 15a-g

The test is a small trochoid spiral of about 4 whorls, pointed at the initial end and broadest at the apertural end. The initial whorl contains 4 or more chambers, and the following whorls are throughout triserial. The chambers increase rapidly in size so that the final whorl represents about half of the test. The sutures are well marked. The aperture is an indistinct opening at the base of the apertural face of the end chamber. The walls are finely to coarsely arenaceous depending on the type of environment, and the surface is smoothly compressed. The tests are laterally, occasionally axially subdivided and that the walls are thin.

The length of the tests is from 0.25 mm. to 0.65 mm. and the maximum width from 0.25 mm. to 0.4 mm. These dimensions refer to compressed specimens.

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Genus Valvulina Orbigny, 1826

Valvulina flexilis Cushman and Renz, 1941

Plate 15, figure 8. Textfigure 15a-g

The test is a small trochoid spiral of about 4 whorls, pointed at the initial end and broadest at the apertural end. The initial whorl contains 4 or more chambers, and the following whorls are throughout triserial. The chambers increase rapidly in size so that the final whorl represents about half of the test. The sutures are well marked. The aperture is an indistinct opening at the base of the apertural face of the end chamber. The walls are finely to coarsely arenaceous depending on the type of environment, and the surface is smoothly compressed. The tests are laterally, occasionally axially subdivided and that the walls are thin.

The length of the tests is from 0.25 mm. to 0.65 mm. and the maximum width from 0.25 mm. to 0.4 mm. These dimensions refer to compressed specimens.

Remarks.—Eggerella forestensis differs from E. forestensis n. sp. in the elongate, gradually tapering test, smaller final whorl in relation to the size of the test, and the larger chambers.

Occurrence.—E. forestensis is a common species of the Oligo-Miocene Cruse faunas, associated with Clavularia n. sp., Haplophragmoides nari­vaensis n. sp., and others.
Miocene clays of the Agua Salada formation of Venezuela. The specimens are as a rule much compressed or crushed. The amount of cement and the colour of the test is very variable. Sutures are occasionally less distinct than in the Venezuelan forms. The large flattened tooth referred to by Cushman was not observed.

**TEXTFIGURE 8**


*Occurrence.*—Valvulina flexilis has been recorded in Trinidad from the *Globorotalia fohsi* Zone and from the *Globigerina cl. concinna* Zone of the Cipero formation, and from the *Globigerinatella insueta* Zone of the Ste. Croix type locality. The species also occurs in the Nariva, Karamat, Lenga, and Cruse formations of Trinidad. In Venezuela it has only been reported from the Agua Salada formation.

**TEXTFIGURE 9**

*Remarks.*—*H. narivaensis* is as a rule strongly deformed. The aperture has only been observed in an equatorial section (textfigure 3a), where it appears to be interiomarginal. The proloculum is not known. *H. narivaensis* resembles in size *H. pusillum* Hoglund 1947 and *"H." glomeratum* (Brady). It is distinguished from *H. pusillum* by the deep and small umbilici and by the axial elongation of the chambers. *"H." glomeratum* with axially elongate chambers is now assigned to the genus *Adercotryma*; it is fully discussed in a recent paper by A. R. Loeblich and Helen Tappan (1953, p. 26). Representatives of this peculiar arena-
ceous species, collected by Captain Bartlett from off Clavering Island, N. E. Greenland, 50 to 51 fathoms, were very obligingly loaned for comparison by A. R. Loeblich, U. S. National Museum, and from the Heron-Allen and Earland collection of the British Museum by C. D. Ovey.

TEXTFIGURE 10

_H. narivaensis_ is smaller and more involute than _H. canariensis_ (Orbigny) and has in general a smaller number of chambers in the final whorl. The last chambers of _H. canariensis_ are not elongate in axial direction (Brady, p. 310, pl. 35, figs. 1-3).

Occurrence.—_H. narivaensis_ occurs commonly in the non-calcareous clays of the Oligocene Nariva formation and in the Oligo-Miocene Karamat formation of South Trinidad.

(?)_Haplophragmoides_ aff. _H. narivaensis_ Bronnimann

TEXTFIGURE 15

This 5 chambered planispiral species resembles _H. narivaensis_. It is invariably axially compressed. The aperture is not visible, and the generic position therefore is uncertain. The non-calcareous test is rather coarsely arenaceous, the surface is smoothly finished. The maximum diameter of the axially compressed figured specimens is from 0.38 to 0.45 mm.

TEXTFIGURE 11

_Occurrence._—(?)_H. aff. H. narivaensis_ is an important facies marker of the silts and silty clays of the Miocene Cruse formation. In general it occurs alone or associated with _Eggerella forestensis_ n. sp.

TEXTFIGURE 12

**Genus Recurvoides** Earland, 1934

_Recurvoides obsoletum_ (Goës), 1896

_Plate 15, figure 6. Textfigures 10-13_

_EXPLANATION OF TEXTFIGURES 10, 11 & 12_

Textfigure 10. _Recurvoides obsoletum_ (Goës). Cruse formation, Miocene, South Trinidad. Hg. 7330. T.L.L. Cat. No. 172616. All × 27.
a-c — Same specimen.
d-f — Same specimen.

Textfigure 11. _Recurvoides obsoletum_ (Goës). Cruse formation, Miocene, South Trinidad. All × 27.
a — Hg. 7337; T.L.L. Cat. No. 172623. Apertural view, 2 last chambers removed.
b — Hg. 7566; T.L.L. Cat. No. 174523. Early chambers of final volution broken up showing the interior of chamber and the apertures.

textfigure 12.
a, b — _Recurvoides obsoletum_ (Goës). Cruse formation, Miocene, South Trinidad. All × 27.
a — Hg. 7270; T.L.L. Cat. No. 172795.
b — Hg. 7330; T.L.L. Cat. No. 172616.
c-e — _Recurvoides higginsi_ Bronnimann, n. sp. Cruse formation, Miocene, South Trinidad. All × 27.
c — T.L.L. Cat. No. 2359.
d, e — Hg. 7260; T.L.L. Cat. No. 172785.
The chambered test is streptospiral. The outline is broad ellipsoid in umbilical and oblong in apertural view. The umbilical side is almost flat, the opposite side is slightly convex. The umbilicus is occasionally indicated by a faint depression. The earliest chambers of the streptospiral test are completely hidden and only those of the final whorl, occasionally one or two chambers of the preceding whorl are visible. The final volutions is about 7 chambered. The sutures, particularly of large specimens, are almost indiscernible. The slit like aperture is interioareal, above the base of the apertural face like that of Labrospira, and surrounded by a distinct collar. The shape of the aperture is variable. The apertural face is arcuate and forms an angle with the surface of the final whorl. The thick walls are finely to coarsely arenaceous, depending on the type of environment, and non-calcareous. The end chamber is rather coarsely textured. The surface is smooth, but not shining. The interior of the chambers is coated with a brown chitinous film.

The maximum diameter across the umbilical side ranges from 0.55 mm. to 1.35 mm., the average is from 0.9 to 1.25 mm.

**Holotype.**—*Haplophragmium obsoletum* Goës. Recent. Albatross Station 2140, Lat. 17° 36′ N, Long. 76° 46′ W, 966 fathoms, Caribbean sea, about 23 miles South South East from Port Royal, Jamaica.

**Remarks.**—The Trinidad specimens agree in structure and size perfectly with recent specimens of *R. obsoletum* from Atlantis Station 3474, Lat. 23° 18′ N, Long. 80° 46′ W, off Province Oriente, Cuba, 490 fathoms, kindly donated by P. J. Bermudez, Caracas. One of the Atlantis specimens, which have rather coarsely finished calcareous tests, has been etched with diluted HCl, and the successive steps have been illustrated in textfigure 23. The Atlantis specimens measure across the umbilical side 1.05 mm. to 1.3 mm. Goës figures of *R. obsoletum* (diameter 1-2 mm.) are not very clear (1896, pl. 3, figs. 14-16) but give the general character of the test. Trinidad specimens, although the chambers are fairly thick walled, are frequently compressed or otherwise deformed. The streptospiral arrangement of the Miocene specimens is illustrated in textfigures 11 and 12a, b. From the position of the aperture it can be seen, that the axis of coiling can shift through 90°.

**Occurrence.**—This large and conspicuous species is commonly represented in the clays of the Miocene Cruse formation and Lenga formation, South Trinidad. It is associated with Discamminoides tobleri, Bronnimann, Valvulina flexilis Cushman and Renz, Alveovalvulina suteri n. sp., Cyclammina cancellata Brady, Glomospira charoides (Jones and Parker), Glo­mospira gordialis (Jones and Parker), Gymnospira mio­cenica (Cushman), Ammodiscus tenuis Brady, (?) Haplophragmoides aff. II. narivaensis n. sp., Recur­voides higginsi n. sp., and others.

**Recurvoides higginsi** Bronnimann, n. sp.
Plate 15, figure 5. Textfigures 12, 14

The streptospiral test is relatively small, subglobular and biumbilicate. The last whorl is 6 to 7 chambered. The sutures are indistinct. The small slit like aperture is interioareal, above the base of the apertural face, like Labrospira and surrounded by a collar. The thick walls are finely to coarsely arenaceous. The surface is smoothly finished and shining as if polished. The interior of the chambers is coated with a thin chitinous film.

**TEXTFIGURE 13**

**EXPLANATION OF TEXTFIGURE 13**

Textfigure 13. Recurvoides obsoletum (Goës). Atlantis Station 3474, Lat. 23° 18′ N, Long. 80° 46′ W, off Oriente Province, Cuba, 490 fathoms. × 9. Same specimen treated with HCl to show the streptospiral volutions.
The maximum diameter ranges from 0.27 to 0.65 mm., the average is from 0.35 mm. to 0.5 mm. The species is named for G. E. Higgins in recognition of his contributions to the geology of Trinidad.

It is noteworthy that H. scitulum most probably belongs to Labrospira Höglund. Brady's equatorial section (pl. 34, fig. 13) demonstrates clearly that the apertures are almost basal but still interioareal like those of Labrospira. R. contortus is larger (diameter 0.75 mm. to 0.9 mm. and thickness 0.375 mm. to 0.425 mm.), typically bilumbically compressed like Haplophragmoides thus can easily be distinguished from the subglobular R. higginsi. R. higginsi also differs from R. gillieparkeri Smith 1948, described from the Miocene Harang fauna of Louisiana. Specimens of R. gillieparkeri originating from wells of the same locality as the holotype (Bully Camp, Lafourche Parish, Louisiana), kindly put at the writer's disposal by D. J. Smith, were compared with the Trinidad material. R. gillieparkeri with its umbilically compressed test of about 9 chambers in the final whorl is closer to R. contortus than to R. higginsi. The specimens of R. gillieparkeri show invariably a portion of the preceding.

EXPLANATION OF TEXTFIGURES 14 & 15


Holotype.—Recurvoides higginsi n. sp. Plate 15, Figure 5. 110X. Hg. 7318; T.L.L. Cat. No. 172604. Cruse formation, Miocene, South Trinidad. Maximum diameter 0.525 mm., thickness of walls 0.035 mm. to 0.050 mm. Deposited in Cushman Collection, U. S. National Museum, Washington, D. C., U. S. A.

Remarks.—R. higginsi is a small, subglobular species which can easily be separated from the large oblong and compressed R. obsoletum (Goës). In order to ascertain the taxonomic position, R. higginsi was compared with topotypes of R. contortus Earland 1934, the generotype of Recurvoides Earland, from Station D. 170, Discovery Expedition 1925, off Clarence Island, depth 342 m., kindly donated by C. D. Ovey, British Museum, London. R. contortus is typically streptospiral, the final voluttion however is close to Haplophragmoides. Ovey stated (letter 10th January, 1952) that he met with considerable difficulties when trying to segregate R. contortus from Haplophragmoides scitulum Brady.
ing whorl. The last chambers are as a rule deformed and the apertures are not discernible. The maximum diameter of R. gillieparkeri ranges from 0.4 mm. to 0.525 mm., the thickness of the test from 0.25 mm. to 0.375 mm.

Recent specimens of R. trochamminiforme Höglund 1947 and of R. laevigatum Höglund 1947 both from the Koster Channel, Skagerak, collected 24-7-46, kindly donated by H. Höglund, Lysekil, Sweden, have also been compared with R. higginsi and found to be different from the Trinidad species. R. trochamminiforme has rather deeply incised sutures and R. laevigatum resembles somewhat R. contortus Earland, but is much smaller (0.16 mm. - 0.26 mm.) and in the adult retains the asymmetric form of the streptospiral test.

In broken up individuals of R. higginsi (textfigure 12, c, d, e), the streptospiral arrangement of the volutions is well recognizable by the changes in the position of the aperture during ontogeny. Textfigure 12c shows the equatorial section of the early volution with the initial chamber and the basal apertures. The slit like aperture of the penultimate chamber is distinctly interioreal.

Occurrence.—R. higginsi is associated with R. obsolatum (Goës). It is common in the clays of the Miocene Cruse formation and Lengua formation.

LITERATURE


———, 1947, A supplement to the monograph of the foraminiferal family Valvulinidae: Cushman Lab. Foram. Research, Special Pub. No. 8A.


ABSTRACT—Pseudocyclammina hedbergi n. sp. from Urgonian to Middle Albian beds of Venezuela is described and figured. This species belongs to the coarsely labyrinthic Litus type but with fewer and relatively large chambers in the last whorl. In this respect it shows morphological similarities with the small Upper Jurassic species P. virguliana Koechlin as well as with the large-sized Cenomanian form P. rugosa (Orb.).

Pseudocyclammina hedbergi n. sp. was also observed in Lower Cretaceous beds of Florida. An identical or at least closely related form occurs in Aptian limestones of southwestern France.

Another representative of Pseudocyclammina is listed as Pseudocyclammina sp. This small form is possibly a variety of P. litus (Yokoyama); it occurs in Upper Aptian Choffatella-bearing limestones from Cuba and in Aptian strata from East Venezuela and Florida.

The occurrence of Pseudocyclammina litus (Yokoyama) and Pseudocyclammina n. sp. in the Lower Cretaceous of the Caribbean region was previously recorded by the writer (Maync, 1949, pp. 529 ff.). Studies of additional specimens appear to indicate that the above-mentioned forms belong to the same specific unit within its scope of variability for which the name Pseudocyclammina hedbergi n. sp. is proposed. This species is named in honor of Hollis D. Hedberg in recognition of his outstanding contributions to the stratigraphy of Venezuela.

Unfortunately, no free specimens of this new species are available, hence the diagnosis is entirely based on thin-section studies.

DESCRIPTION OF SPECIES

Pseudocyclammina hedbergi, n. sp.

Plate 16, figures 1-8


Pseudocyclammina n. sp., Maync, 1949 (ibid.)


Pseudocyclammina n. sp. Maync, 1952 (ibid.).

Holotype: U. S. Nat. Mus. (Cushman Collection) 64541.

Paratypes: U. S. Nat. Mus. (Cushman Collection) 64542-64547.

Description.—Pseudocyclammina hedbergi, n. sp. shows a coarsely labyrinthic interior structure; its test sometimes contains incorporated small foraminifers (see Pl. 16, fig. 2). Structurally, it closely resembles Pseudocyclammina litus (Yokoyama) Yabe and Han­zawa to which it had been referred by the writer (Maync, 1949, 1952). In P. hedbergi, however, the cancellous walls and septa are not as thick as those of the typical litus (compare, Yabe and Hanzawa, 1926, Pl. II, figs. 3-6; Pflender, 1938, Pl. XIII, figs. 1-5; Henson, 1948, Pl. IX, figs. 2-3, Pl. XIII, fig. 7). Moreover, this Venezuelan species contains only 5 chambers in the last whorl whereas numerous narrow chambers make up the last whorl in P. litus. The labyrinthic structural elements of the large litus type usually are exuberantly developed at the expense of the chamber cavities. In P. hedbergi, on the other hand, the lumina are clearly outlined and relatively large and inflated. In this respect, P. hedbergi approaches Pseudocyclammina virguliana Koechlin (compare Koechlin, 1942, Pl. VI, figs. 1-2, 5-6; see Pl. 16, figs. 13-15 of the present paper) or Pseudocyclammina rugosa (Orb.) (compare Maync, 1952, Pl. 12, figs. 9-10). The new species differs from the Upper Jurassic P. virguliana in having a) fewer chambers in the last whorl, b) a coarser, litus-like structure of walls and septa, and c) a larger size (greatest diameter of 1.7-2.2 mm. in P. hedbergi, of 0.8-2 mm. in P. virguliana Koechlin).

Pseudocyclammina hedbergi differs from the Cenomanian form P. rugosa (Orb.) in its coarse labyrinthic interior structure (litus type) and in showing a much less rounded, often even sub-acute periphery. The spiral portion of the test, furthermore, attains a diameter of more than 3 mm. in P. rugosa and is, therefore, more than twice as large as in the new Venezuelan species.

With respect to its morphology and internal structure, P. hedbergi occupies an intermediate position between the Jurassic species (P. litus, P. virguliana) and the Cenomanian P. rugosa. This interrelation is also manifest in the intermediate stratigraphic occurrence of the new Venezuelan species (Lower Aptian to Middle Albian).

Type level.—Urgo-Aptian to Middle Albian of Venezuela, P. hedbergi occurs in limestone ledges interbedded in the Upper Barranquin formation and also in biothermal limestones of the Lower and Middle Chimana formation ("El Cantil limestone" auct., pars).

In the late Barranquin formation (?Barremian-Lower Aptian) it is associated with Choffatella decipiens Schlumberger, and in the higher formations of largely Middle Albian age with Orbitolina concavata (Roemer), Dictyoconus walnutensis (Casey), Textularia roicensis Casey, etc.

P. hedbergi is also found in the Aptian Lower Colorado limestone ("Tomon" auct.) of West Venezuela (Maync, 1949, p. 530) and in the Choffatella- and Orbitolina-bearing subsurface strata (Trinity) of Florida (ibid.). [Compare Pseudocyclammina litus (Yokoyama) and P. n. sp. in Maync, 1949, p. 529 ff.; Pseudocyclammina litus (Yokoyama) in Jordan and Ap-
Pseudocyclammina sp.

Plate 16, figures 9-12


A small species of Pseudocyclammina with the typical labyrinthic character of the inner structural elements was found in the fossiliferous Upper Aptian limestone from the Sierra de Jatabonico, Santa Clara Province, Cuba (see Maync, 1949, p. 541), where it is associated with Choffatella decipiens Schlumberger, Textularia rioensis Carsey, etc. These forms which occur in limestones of Middle and Upper Aptian age of southwestern France show a rather coarse labyrinthic wall and septal structure and large loculi with distinct contours. Five or four chambers make up the last-formed whorl. They are so similar to Pseudocyclammina hedbergi that they are tentatively considered as being in affinity with Pseudocyclammina hedbergi.

This form differs from all other described species in its small size (greatest diameter 0.6-1.3 mm.). Its broadly rounded periphery and thick labyrinthic walls and septa resemble the original Litus type which, however, attains several times the dimensions of the Cuban form. There is, however, no other known species with which the present form, with is usually well developed uncoiled adult stage, could be compared. Since numerous specimens of Choffatella decipiens Schlumberger ("Choffatelloid Pseudocyclammina," see: Maync, 1949, p. 541, footnote 24) in the same formation are dwarfed forms, not much emphasis should be laid upon the small size of this Pseudocyclammina species which might be a mere variety of P. lituus (Yokoyama).

Owing to the fact that no conclusive median sections could hitherto be observed in the available material, a nomenclatura aperta seems to be advisable until more samples are at hand.

Specimens of Pseudocyclammina with a broadly rounded periphery (see Pl. 16, fig. 12) also occur in the Chishima formation of Venezuela, associated with Pseudocyclammina hedbergi. In all probability, they may be identical with Pseudocyclammina sp. from Cuba. (see Pl. 16, figs. 9-11).

The same form is present in the Trinity samples from Florida.

REFERENCES


Yabe, H. and Hanzawa, Sh., 1926, Choffatella Schlum-
McLean: New Foraminifera from Lower Tertiary of New Jersey
Nyholm: Recent Nemogullmia longevariabilis, n. gen., n. sp.

86. FOUR NEW SPECIES OF FORAMINIFERA FROM THE LOWER TERTIARY OF NEW JERSEY

JAMES D. McLEAN, JR.

INTRODUCTION

In material donated by Horace G. Richards of the Academy of Natural Sciences of Philadelphia, the author has found four species of Foraminifera which do not seem to belong to any known form. They are, therefore, here described as new.

The new species apparently have quite decided stratigraphic ranges and seem to serve well in separating two units in the New Jersey stratigraphic sequences: Two species are from the type locality of the Paleocene Vincentown Formation; the other two come from a bed of different lithologic characteristics than the type Vincentown. There is as yet no clear-cut evidence to indicate whether or not the Vincentown is contemporaneous with this bed; in the opinion of the author, the bed containing *Eponides beaberleae* n. sp. and *Marginulina conrathi* n. sp. is younger than the Vincentown formation, although other workers have classified it as Vincentown in age.

Holotypes are deposited with the Academy of Natural Sciences of Philadelphia (A.N.S.P.); figured paratypes (better designated as cotypes) are deposited in the U. S. National Museum (U.S.N.M.) and the American Museum of Natural History (A.M.N.H.). It is realized that there might be some objection to such a separation of type specimens. There are, however, two reasons for this separation: First, such a separation will better insure survival of specimens upon which an original species is based in the event of natural or other catastrophe, and Second, such a dispersal of specimens makes comparison material more readily available to a larger number of workers. The history of past losses of important types is a strong argument in favor of reviving the descriptive practice of designating cotypes instead of single holotypes. Another reason in favor of cotypic material (at least in the Foraminiferida) is that adoption of this practice will allow the original description to cover some of the variations within the species.

ACKNOWLEDGMENTS

In addition to Horace G. Richards, who donated material upon which this paper is written, the author wishes to acknowledge the assistance of Mrs. Sally Lee, Scientific Illustrator, who kindly executed the drawings of type specimens.

DESCRIPTIONS OF THE NEW SPECIES

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus *Marginulina* Orbigny, 1826

*Marginulina conrathi* McLean, n. sp.

Plate 17, figures 1-3

Test elongate, round in transverse section, slightly if at all compressed in early portion; later portion very slightly coiled, later portion linear or with a slight curve toward peripheral area: 11 chambers visible in the holotype, fewer in most specimens, chambers very gradually increase in size as added; sutures show as rather broad bands of dark glassy material, flush in early part of test, depressed in later part; final chambers slightly inflated; wall smooth, glassy, ornamented with plate-like costae, some discontinuous, others traversing entirely the test, costae oblique to axis of test, definitely curved in direction of coiling in early portion, 6 to 8 costae visible to a side; aperture well developed, protruding, at the peripheral angle, radiate. Dimensions of holotype: length 1.66 mm.; breadth 0.37 mm.

Remarks.—This form resembles *Marginulina navarvroana* Cushman, but is much less lobate, has a flatter apertural face and more regular plate-like costae. It is less compressed than *Marginulina cocoensis* Cushman and the costae are inclined more to terminate without

EXPLANATION OF PLATE 18

<table>
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<th>Figs.</th>
<th>Description</th>
<th>Nat. size</th>
<th>Cond. d.</th>
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<tr>
<td>1-2.</td>
<td><em>Nemogullinia longevariabilis</em>, n. gen., n. sp. Nat. size 5 and 8 mm.</td>
<td>cr constriction, d detritus</td>
<td>105</td>
<td></td>
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<tr>
<td>3-4.</td>
<td>Sections of <em>Nemogullinia</em>-threads in a phase with small nuclei (<em>n</em>&lt;sub&gt;2&lt;/sub&gt;), <em>va</em> vacuoles.</td>
<td>Ca × 150</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Section of the end of a thread (<em>ed</em>) with only one large nucleus (<em>n</em>&lt;sub&gt;1&lt;/sub&gt;) situated there.</td>
<td>Ca × 250</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>
traversing entire test. The coil is smaller than in _M. cocoaemis_, which is inclined to slanted sutures.

Named in honor of Theodore Barthel Conrath, Jr., of Alexandria, Virginia.

*Types and Occurrences.*—All types are from a well sample interval from 573 to 583 feet, well in Penn State Forest, one-half mile north of Bear Swamp Hill, Atlantic County, New Jersey. Samples collected by Horace G. Richards.

Holotype A.N.S.P. No. 19673; Paratype A.M.N.H. No. FT-1117; Paratype U.S.N.M. No. 548850.

*Age and Ecology.*—Wilcox Eocene (Vincentown? formation); ecology unknown, probably moderately deep waters.

**Family ROTALIIDAE**

**Subfamily DISCORBISINAE**

*Genus Discorbis_ Lamarck, 1804*

*Discorbis toulmini_ McLean, n. sp.*

_Plate 17, figures 4-6_

_Discorbis_ sp. A. Toulmin, 1941, Jour. Pal. Vol. 15, p. 600, pl. 80, fig. 37, textfigure 4, H. I.

Test subcircular, convex on dorsal side, concave on ventral side, compressed; periphery rounded or slightly angulate, lobulate; 10 or more chambers to final whorl, chambers increase rather rapidly in size as added; sutures curved and somewhat limbate on both sides, flush or slightly raised in early portion, depressed in later portion of test; sutures merge into small umbilical cavity on ventral side; about 3 whorls visible on dorsal side in good specimens; wall perforate, glassy, ornamented with quantities of small spines whose amounts vary from specimen to specimen; aperture a thin slit under an overlapping flap between the periphery and umbilicus on ventral side. Dimensions of holotype: Diameter 0.44 mm.; thickness about 0.15 mm.

*Remarks.*—This form resembles _Discorbis neumannei_ Plummer but is generally larger, has spines and the sutures of the dorsal side are more tangential to the whorl sutures. The umbilicus seems less well developed than in _D. neumannei_.

Named in honor of Lyman D. Toulmin of Florida State University, Tallahassee, Florida, who first encountered the form.

*Types and Occurrences.*—Holotypes and figured paratypes are all from a sample collected by Horace G. Richards at the type locality of the Vincentown formation, 0.3 to 0.5 miles northwest of the town of Vincentown, New Jersey, along the north bluff of Rancocas Creek in Burlington County.


*Age and Ecology.*—Paleocene (Vincentown formation); ecology considered to be lagoonal or reefal by describer. The associated fauna indicated a deep to moderate depth series.

**Subfamily ROTALIIDAE**

*Genus Eponides_ Montfort, 1808*

_Eponides beaberleae_ McLean, n. sp.*

_Plate 17, figures 7-9_

Dorsal side slightly convex, ventral side highly convex and becoming a flange toward the periphery; periphery a distinctive thick flange, lobulate and with a clear glassy border which is part of the glassy limbate sutures; 9 to 10 chambers in the final whorl of ventral side, chambers gradually increasing in size as added and bordered with limbate, slightly raised, glassy sutures; dorsal sutures straight to slightly curved and tangential to the periphery of the whorls; ventral sutures sinuous, merging into an indistinct glassy umbo; wall glassy and coarsely perforate; aperture a low opening at the base of the final chamber between the umbo and periphery on ventral side. Dimensions of holotype: diameter 0.76 mm.; thickness 0.37 mm.

*Remarks.*—This form greatly resembles _Eponides crebbsi_ Hedberg but differs in being consistently larger, in having a more compressed dorsal side and a more distinctive flange. The umbo of _E. beaberleae_ is more indistinct than that of _E. crebbsi_ and the sutures are considerably thicker.

Named in honor of Mrs. Beatrice Conrath Berle, of Alexandria, Virginia.

*Types and Occurrences.*—All figured types are from a depth of 280 feet in a well at Point Pleasant, New Jersey; sample collected by Horace G. Richards.

Holotype A.N.S.P. No. 19674; Paratype U.S.N.M. No. 548851; Paratype A.M.N.H. No. FT-1118.

*Age and Ecology.*—Wilcox (?) Eocene (Vincentown? formation) of New Jersey: ecology unknown; probably moderately deep waters.

**Family ANOMALINIDAE**

**Subfamily ANOMALININAE**

*Genus Anomalina_ Orbigny, 1826*

_Anomalina pseudoammonoides_ McLean, n. sp.*

_Plate 17, figures 10-13_

Test about normal size for the genus, slightly trochosoid, periphery lobulate, rounded, with a thick but not highly-raised peripheral keel; 9 to 12 chambers in final whorl. Chambers distinct and inflated, sutures deeply incised in final whorl; final chamber usually large, others increasing gradually in size as added; a large open umbilicus on ventral side; dorsal side shows two whorls; wall uniformly and coarsely perforate; apertural face variable but generally triangulate and inflated; aperture a well-defined arch extending over the periphery and towards the umbilicus, aperture lipped. Dimension of holotype: diameter 0.58 mm.; thickness 0.35 mm. at thickest portion.

*Remarks.*—This interesting form has apparently been confused with _Anomalina ammonoides_ (Reuss). It differs from it in having an excavated umbilicus, a keel or rim, and non-limbate, unraised sutures.
Types and Occurrences.—Holotype and paratypes are all from a sample collected by Horace G. Richards at the type locality of the Vincentown formation, 0.3 to 0.5 miles northwest of the town of Vincentown, New Jersey, along the north bluff of Rancocas Creek in Burlington County.

87. STUDIES ON RECENT ALLOGROMIIDAE (2): NEMOGULLMIA LONGEVARIABILIS N. G., N. SP. FROM THE GULLMAR FJORD

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Studies of the microfaunal content of soft sediments in the Gullmar Fjord (Sweden) have brought to light the presence of a new genus of Foraminifera, which is herewith described.

Nemogullmia longevariabilis Nyholm, n. gen., n. sp.

Plate 18, figures 1-5. Textfigures 1-5

Description.—Single straight, bent or twisted threads with form-constant, transparent, non-striated, chitinoid test; plasma opaque with or without wrinkles; temporary narrow apertures at both ends of test; pseudopodia when first extruded cordiform, finally filireticulous. Agglutination of detritus on test can occur, depending on interapertural extrusion of plasma. One or more nuclei present.

Size.—1.6 to 19.0 mm. in length (not extended specimens).

Habitat.—Marine.

Occurrence.—Detritus-layer on top of soft bottoms at depth of 100 to 118 meters in Gullmar Fjord, Sweden.

Depositary of Types.—Department of Zoology, University of Uppsala.

Remarks.—When studying the recent microfauna of soft sediments in the Gullmar Fjord short usually white threads were found, the nature of which was difficult to make out at first. The threads consists of living plasma. Since all early cultures were unsuccessful, attempts to interpret these organisms failed until it became possible to keep the threads alive for months during autumn and winter time when the changes in temperature at different layers were less pronounced. It was observed in cultures that these filamentous organisms were indeed monothalamous Foraminifera feeding on detritus and increasing considerably in growth.

Remarks.—It has not been possible to obtain specimens of Nemogullmia with core samplers; they are obtainable primarily with a sledge net. The species seems to be about equally common in summer and in winter. During the summer they are easily damaged owing to the high temperature in the upper water layer. If suitable cooling arrangements cannot be used directly after dredging, it is preferable to study this material in the winter. Culture is necessary to obtain an idea of the changing form, the type of pseudopodia and the ingestion of food. Cultures can now be made repeatedly at temperatures of 6-9° C, in detritus taken at a depth of about 100 m, from the locality where the species is found, and it has been possible to observe amongst other things the type of pseudopodia in detail (Text Fig. 4). When the pseudopodial plasma appeared in the form of a long single string, which did not develop any further, the specimens proved to have been damaged by the action of light. The pseudopodia finally formed are filireticulous (Text Figs. 4, 5). The extent of the whole pseudopodial net in the cultures depends largely on the supply of detritus. When culturing on a glass slide with a thin layer of detritus a specimen with a maximum length of 2.5 cm. between the distal apertures was observed to have a maximum plasma net outside the apertures of about 2 cm². Detritus accumulation on the chitinoid test appear in a number of specimens in the preserved material (Pl. 18, Fig. 2, Text Figs. 1-3). Such an accumulation of detritus on cultured material is apparently caused by contraction of the more or less well-developed plasma net. This can occur also between the apertures of the thread when the thread is bent and the interapertural plasma net appears more frequent, resulting in a rich agglutination of detritus especially on the points of the thread. The colour of the test is usually white. In some cases pale red specimens were observed. According to our observations the tests are found free in the detritus. On two occasions a specimen of Nemogullmia was found in empty worm-tubes (Text Fig. 3), and several times twisted forms were observed (Text Fig. 1).

Discussion.—It is difficult to determine the exact taxonomic position of Nemogullmia. This is not surprising as the position of many monothalamous forms, which have been known for a long time, is still uncertain.

Shepheardella taeniformis described by Siddall (1880) is placed by Rhumbler among the Allogromiidae. This
allocation shows that Rhumbler (1904) does not assign a decisive role to one of the characteristics he himself gave for Allogromiidae, namely that the pseudopodial plasma does not emerge from any other place than the apertures. In Shepheardella, which has been studied alive, the pseudopodial plasma also emerges from the chitinoid test between the apertures. As several of the Allogromiidae have not been investigated alive it is impossible to state definitely that interapertural pseudopodia are always lacking. Until the information needed for a taxonomic revision of the Monothalamia has been obtained it is, therefore, not unreasonable to include Nemogullmia in the Allogromiidae for the time being. There are, however, certain resemblances in morphology between part of the preserved material of Nemogullmia and the genera Dendrotuba and Ophiotuba described by Rhumbler from preserved material only. Both these genera have been classed as Rhizamminae types (Rhumbler 1904, p. 251). Although these forms are relatively small (0.7-5 mm.) and known only from the empty shells of larger foraminifers, much new information would probably be obtained from a culture of these forms, i.e. facts explaining the relations to Allogromiidae in general and also certain phases of the life-cycle of Nemogullmia where many small nuclei may appear as is the case in Ophiotuba (Pl. 18, Figs. 3-5).

REFERENCES


Text Fig. 1: Twisted specimen of Nemogullmia. d: detritus
Text Fig. 2: Bent specimen of Nemogullmia. (preserved material) d: detritus
Text Fig. 3: Nemogullmia in an empty worm-tube.
Text Fig. 4: Extended specimen of Nemogullmia with pseudopodia (ps); ap: aperture
Text Fig. 5: A part of a specimen of Nemogullmia in the detritus-layer

RECENT LITERATURE ON THE FORAMINIFERA

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


Foraminiferi pelagici e facies in Italia.—Atti VII Conv. Naz. Met. e Petr., April 1952, pp. 1-34, plis. 1-5.—Geographic and quantitative distribution in Recent Mediterranean sediments are recorded and stratigraphic ranges of 57 planktonic species and varieties in the Cretaceous and Tertiary of Italy are plotted.


ASANO, KIYOSHI. Paleogene Foraminifera from the Ishikari and Kushiro Coal-Fields, Hokkaido.—Short Papers from the Institute of Geology and Paleontology, Tohoku Univ., Sendai, No. 4, June 17, 1952, pp. 23-46, pls. 3-5, text fig. 1 (map), tables 1, 2.—Twenty-seven species 3 new, are recorded and illustrated from the Poronai shale.

Foraminifera from the Miocene Takinoue formation near Momijiyama, Hokkaido.—Short Papers from the Institute of Geology and Paleontology, Tohoku Univ.,
Sendal. No. 4. June 17, 1952, pp. 47-51, pl. 6.—Seven species, 2 new and 3 undetermined, are recorded and figured.

BANDY, ORVILLE L. Ecology and paleoecology of some California Foraminifera. Part I. The frequency distribution of Recent Foraminifera off California.—Journ. Pal., vol. 27, No. 2, March 1952, pp. 161-182, pls. 21-25, text figs. 1-4, table 1.—Five zones are recognized in 3 profiles. The dominant bentonic species are recorded and illustrated, and their occurrence represented graphically. Four new species and 3 new varieties are described.

Part II. Foraminiferal evidence of subsidence rates in the Ventura Basin.—L. c., pp. 200-203, text figs. 1-3.—Dominance of Foraminifera species gives evidence for water depths during deposition.


Taxonomische Bemerkungen zu den Ammobaculites, Haplophragmium, Lituola und verwandten Gattungen (For.).—Senckenbergiana, vol. 33, No. 4/6, Nov. 15, 1952, pp. 313-342, pls. 1-7, text figs. 1, 2, table 1.—Ten species and subspecies of the three genera are discussed and illustrated. A new name is proposed and 2 new subspecies are described. A chart shows ranges and evolutionary relationships of the various species in the Dogger, Malm, and Lower Cretaceous.


BERMUDIZ, PESDRÓ J. Estudio sistemático de los Foraminíferos rotaliformes.—Ministerio de Minas e Hidrocarburos Boletín de Geología, vol. 2, No. 4, 1952, pp. 1-230, pls. 1-35.—Following Glaser’s classification of the superfamilia Rotalidae, 289 genera are included, most of them illustrated by one or more species. Fifteen new genera are erected: Planispirillina (genotype Spirillina limbata Brady var. papillosa Cushman 1915), Pleoliona (genotype Valvulina pleolus O. Orbigny 1839), Bronnmannia (genotype Discorbis palmaris Bermudes 1935), Lammellodiscorbis (genotype Discorbis dimidiata Parker and Jones 1962), Planodiscorbis (genotype Discorbis rarescens Brady 1884), Praeglabrotuncana (genotype Glabrotula delrioensis Plummer 1931), Asterigerinoides (genotype Discorbis gillrichi Franke 1912), Roloshaunia (genotype Rotalia rolshauseni Cushman and Bermudes 1945), Charlotina (genotype Pseudoparrella madrugaensis Cushman and Bermudes 1945), Hoferinella (genotype Nautilus balthicus Schroeter 1783), Noreotalia (genotype Rotalia mexicana Nuttall 1928), Thalmanitina (genotype Rotalia madrucoensis Cushman and Bermudes 1947), Caribeana (genotype C. polystoma n. sp.), Plano­gypsina (genotype Gypsinia vesicularis var. squamiformis Chapman 1901), Hemigypsina (genotype Gypsinia masticodens Bursch 1947).

El genere Asterigerinata (Foraminíferos) y sus especies. —Mem. Soc. Ciencias Nat. La Salle, vol. 12, No. 32, May-August 1952, pp. 201-210, pls. 1-8.—Nine species, 2 new, and one new variety, are illustrated and included in the genus.

BETTENSTAEDT, FRANZ. Stratigraphisch wichtige Foraminiferen-Arten aus dem Barrême vorwiegend Nordwest-Deutschlands.—Senckenbergiana, vol. 33, No. 4/6, Nov. 15, 1952, pp. 263-295, pls. 1-4, distribution and abundance chart.—Seven new species and three new subspecies are described. The variation and evolutionary development of one species and its subspecies are illustrated.

BULLARD, FREDDA JEAN. Polymorphinidae of the Cretaceous (Cenomanian) Del Rio Shale.—Journ. Pal., vol. 27, No. 3, May 1953, pp. 313-346, pls. 45, 46, text fig. 1.—Nineteen species. 6 new, are described and their occurrence and abundance plotted.


CLOUD, PRESTON E. JR., and COLE, W. STORRS. Eocene Foraminiferas from Guam, and their implications.—Science, vol. 117, No. 3039, March 27, 1953, pp. 323, 324.—Larger Foraminiferas are listed and indicate correlation with Tertiary b.

COLE, W. STORRS. Eocene and Oligocene Larger Foraminiferas from the Panama Canal Zone and vicinity.—U. S. Geol. Survey Prof. Paper 244, 1953 (March 11, 1953), pp. 1-41, pls. 1-25, text figs. 1, 2.—Descriptions and illustrations of 40 species, 1 new, and 2 varieties are included. Correlations of formations are made.

Some Late Oligocene larger Foraminiferas from Panama.—Journ. Pal., vol. 27, No. 3, May 1953, pp. 323-327, pls. 43, 44.—Four species, none new.

COLOM, G. Foraminíferos de las costas de Galicia (Campañas del "Xazou" en 1949 y 1950).—Bol. Inst. Español Oceanografía, No. 51, June 7, 1952, pp. 1-59, pls. 1-8, text figs. 1-5, map, distribution chart.—A fauna of about 125 species and varieties, 2 new, is recorded and illustrated, and distribution and abundance plotted against depth. The fauna falls into four associations.

Los caracteres micropaleontológicos de algunas formaciones del Segundario de España.—Bol. Instit. Geol. Min. España, vol. 64. 1952, pp. 1-88, pls. 1-14, text figs. 1-3 (stratigraphic section and distribution tables).—Smaller Foraminiferas from several sections and one well in Spain, mostly Cretaceous but including some Lias, are recorded and illustrated. One species is new.

CUVILLIER, JEAN. Étude stratigraphique du grand forage de Bastemmes-Gaujacq (Landes).—Geol. Appliquée et Prospection Minière, vol. 3, No. 4, 1950, pp. 5-14, pls. 1-4.—The well cuts lower Lutetian to Aptian strata. Foraminiferas are listed and a few illustrated in thin sections.

La notion de "microfacies" et ses applications.—Atti VII Conv. Naz. Met. e Petr., April 1952, pp. 1-5, pls. 1-4 (text figs.).


DROOGER, C. W. Late Eocene smaller Foraminiferas


EMILIANI, C., and EPSTEIN, S. Temperature variations in the lower Paleocene of southern California.—Journ. Geol., vol. 61, No. 2, March 1953, pp. 171-181, text figs. 1-6.—Three genera of Foraminifera used in isotope analysis give similar but not identical indications of paleotemperatures and thermic variations. Possible causes of differences and variations are discussed.


HAGN, HERBERT. Zur Kenntnis von Helvetikum und dem Unteren Obercampans (Zone der Bellinmites helvetica) der Innersalzburger Alpen.—Neues Jahrb. fur Geol. Pal., Abhandl., vol. 96, February 1953, pp. 204-238, pl. 8.—Includes distribution table.


Zur Kenntnis von Helvetikum und dem Unteren Obercampans (Zone der Bellinmites helvetica) der Innersalzburger Alpen.—Neues Jahrb. fur Geol. Pal., Abhandl., vol. 96, February 1953, pp. 204-238, pl. 8.—Includes distribution table.

HAMILTON, EDWIN L. Upper Cretaceous, Tertiary, and Recent planktonic Foraminifera from mid-Pacific flat-topped seamounts.—Journ. Pal., vol. 27, No. 2, March 1953, pp. 294-237, pls. 29-32, text figs. 1-6b.—Dredgings and cores from 5 guyots yielded fossil planktonic faunas that permit dating of events in geologic history and interpretation of sedimentation in the mid-Pacific region. Eighty-seven species and varieties, one species new, are recorded and most of them illustrated.

HARRIS, R. W., and JOBE, BILLYE IRENE. Microfauna of basal Midway outcrops near Hope, Arkansas.—The Transcript Press, Norman, Oklahoma, October 1951, pp. 1-112, pls. 1-14, tables 1-5.—One hundred fifty species and varieties of Foraminifera, 31 new, are recorded and illustrated from 58 samples from 5 localities.

ISHIZAKI, KAZUHIKO. Six new fossil species of Streblus from eastern Asia.—Acta Geol. Taiwanica, vol. 2, No. 1, July 1948, pp. 55-66, pl. 1.—All from the Pliocene of Taiwan and Japan.

JOELBLICH, ALFRED R. JR., and TAPPAN, HELEN. Studies of Arctic Foraminifera.—Smithsonian Misc. Coll., vol. 121, No. 7, April 2, 1953, pp. 1-150, pls. 1-24, text fig. 1.—A taxonomic study, including 110 species, of which 21 are new, and one new name proposed. Six new genera are erected: Ammomotus (genotype Litula cassis Parker), Scutulorhinus (genotype S. terminis n. sp.), Patexinos (genotype Quinquelineculina subbandata [Mountaza] forma hauereinoides Rhumbler), Larvaeoschisma (genotype L. hypalascida n. sp.), Esobyrix (genotype Pseudopolymorphina curta Cushman and Ozawa 1936), Trichohyalus (genotype Discorbis bartlettii Cushman 1933),

LOVE, J. D., HENBEST, L. G., and DENSON, N. M. Stratigraphy and Paleontology of Paleozoic Rocks, Hariville area, eastern Wyoming.—U. S. Geol. Survey Oil and Gas Investigations Chart OC 44 (in 2 sheets), 1953.—Numerous fusulinids are listed, some are illustrated, and their occurrence indicated on stratigraphic sections, and in a check list.

MURATA, SHIGEO. On the paleo-ecological investigation of the fossil foraminiferal fauna in the Miocene group with description of new species.—Bull. Fukuoka Kyushu Instit. Tech., No. 1, March 1951, pp. 91-104, pl. 1, text fig. 1 (map), tables 1-6 (range charts).—A quantitative study of five sections across an area including four Miocene formations indicates ecological change from north to south of inland sea to open sea conditions. Three new species are described.


TOMIC-DZODZO, RADOJKA. A paleontological treatise of microfauna from the well drilling Tusanji III: Donja Tuzla (Bosnia).—Zbornik Radova, vol. 23, No. 3, May 1952, pp. 243-267, pls. 1-6, text fig. 1 (map). (English summary pp. 262-266).—Smaller Foraminifera are recorded and illustrated from Eocene and Miocene strata.

TORIYAMA, RYUZO. New peculiar fusulinid genus from the Akiyosh limestone of southwestern Japan.—Journ. Pal., vol. 27, No. 2, March 1953, pp. 251-258, pls. 35, 36.—Akiyoshinella n. gen. (genotype A. ozawai n. sp.).


ZELLER, DORIS E. NODINE. Endothoid Foraminifera and ancestral fusulinids from the type Chesteran (Upper Mississippian).—Journ. Pal., vol. 27, No. 2, March 1953, pp. 183-199, pls. 26-28, text figs. 1-9, chart 1, tables 1-2.—Three species of Millereilla and 7 of Plectogyra, all new, are described.

Ruth Todd