Foraminifera of the Lodo Formation Central California

General Introduction and Part 1, Arenaceous Foraminifera

GEOLOGICAL SURVEY PROFESSIONAL PAPER 240-A

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By M. C. ISRAELSKY

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A study of the foraminiferal fauna of a Paleocene and Eocene formation of scientific and economic importance

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FORAMINIFERA OF THE LODO FORMATION, CENTRAL CALIFORNIA

By M. C. ISRAELSKY

GENERAL INTRODUCTION

ABSTRACT

The Lodo formation, of Paleocene and Eocene age, crops out on the western border of the San Joaquin Valley, in central California. In an area in the Tumey Hills, in northwestern Fresno County, where the formation has a thickness of about 1,200 feet, 110 foraminiferal samples were collected and studied.

PURPOSE AND SCOPE OF REPORT

During the last few decades Foraminifera have been extensively used in the study of the stratigraphy of actual and potential oil-producing formations of Paleocene and Eocene age in California. Until the publication of Laiming's notable papers (1940, 1941) the study of the Foraminifera was done chiefly by micropaleontologists—in commercial laboratories—using systems of zonation and of generic and specific designations based on their individual convenience. Despite the impetus of Laiming's valuable and widely used preliminary zoning of the foraminiferal faunas, little systematic work on the Paleocene and Eocene Foraminifera of California has been published. As a result, the current generic and specific nomenclature is confusing and misleading. The present report is a step in an attempt to remedy this deficiency in publication.

The Lodo formation was chosen for the detailed study because it includes a considerable time span—evidently part of the Paleocene, probably all of the lower Eocene, and part of the middle Eocene—represented almost wholly by claystone, but in small part by siltstone. The virtual uniformity of the rocks, and therefore of the depositional environment of the sediments, at least partly eliminates faunal facies differentiation, which is particularly troublesome in the correlation of fossil faunas. It is hoped that the faunas of the Lodo formation may serve as a standard for the comparison and correlation of the Foraminifera in less complete Paleocene and Eocene sections of comparable depositional environment.

Foraminifera from the Lodo formation in the area covered by the present report were described by Lois T. Martin (1943). Miss Martin studied 59 samples collected by R. T. White. Only a small part of the fauna was illustrated, and many of the names used were based on Foraminifera from other geographic provinces and probably should be replaced by new names.

The present report describes and illustrates the arenaceous Foraminifera of the Lodo formation. The calcareous Foraminifera are to be described in subsequent parts of this Professional Paper. The final part is planned to include a discussion of the age and other relations of the faunas.

LODO FORMATION

The Lodo formation crops out in the foothills of the Coast Ranges on the western border of the San Joaquin Valley. Anderson and Pack (1915, pp. 58-67) called the same beds the Martinez(?) formation. The Paleocene Martinez formation of the San Francisco Bay region is different lithologically and represents a shorter time span than the formation now designated the Lodo. A local formation name is preferable and the term "Lodo formation" has priority. R. T. White defined the name in a brief abstract (1938, pp. 256-257), and published a full definition and description of it in 1940 (pp. 1735-1745). Between the two dates another name, Arroyo Hondo formation, was proposed by H. E. Vokes for the same formation (1939, pp. 27-31). Although there is no unanimity of usage, most California geologists and paleontologists working with these rocks now use the name Lodo.

About three miles southeast of the area shown on the geologic map accompanying the present report (fig. 2), a sandstone lens appears in the Lodo formation. It thickens rapidly southeastward, then thins, and finally disappears. This sandstone lens is the Cantua sandstone member, a name proposed by Anderson and Pack (1915, pp. 61-62) as a member of their Martinez(?) formation. Contrary to

Vokes' (1939, table 1) and White's (1940, fig. 3) graphic representations, Anderson and Pack specified that the fine-grained strata, "about 100 feet thick" (White's Cerros shale member of the Lodo formation), underlying the sandstone lens, were included in the Cantua sandstone member. Though Anderson and Pack did not discuss the matter, presumably they took that action because the fine-grained strata were too thin to indicate on their geologic map, which was published on a scale of 1:125,000. It appears to be preferable to redefine the name Cantua sandstone member so as to exclude the fine-grained strata below the sandstone lens rather than to redefine the name to include the entire formation, although where it is thickest the sandstone lens constitutes about 80 per cent of the formation.

COLLECTION AND PREPARATION OF SAMPLES

The sections sampled for the present report are located in the northwestern part of the Tumey Hills, in northwestern Fresno County (fig. 1). A geologic map of an area of four land sections, reproduced as figure 2, shows the location of the sampled sections and the geology of the surrounding region. The geologic map is a small part of a map prepared by J. E. Schoellhamer, D. M. Kinney, and J. G. Vedder for publication in the Geological Survey's Oil and Gas Investigations series.

Where the samples were collected, the Lodo formation has a general strike of N. 25° W., dips northeastward 20° — 25°, and lies unconformably on the Moreno shale. Large fragments of the purplish claystone characteristic of the Moreno are incorporated

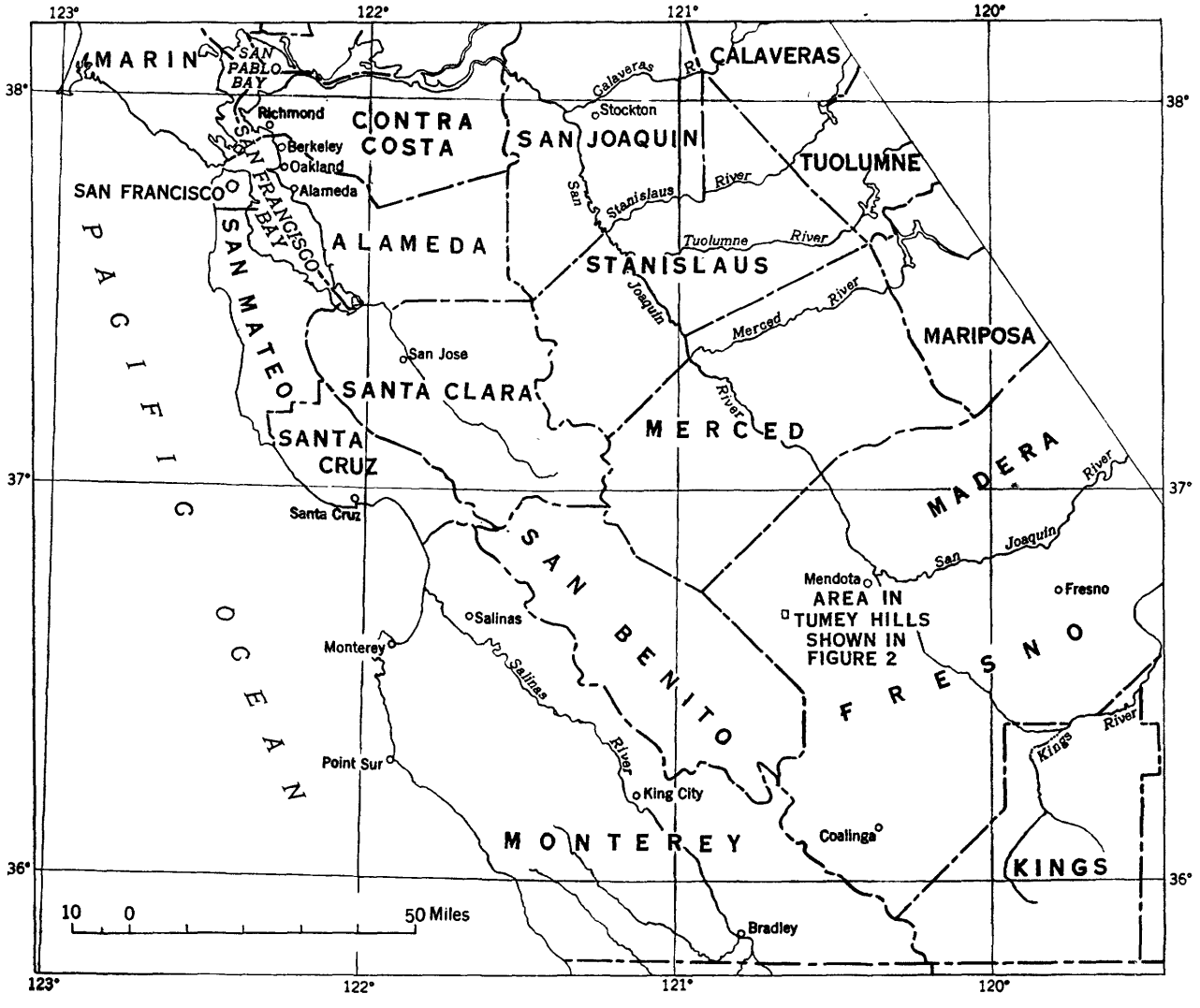

FIGURE 1.—Index map of central California, showing location of area studied.

in the basal sand of the Lodo at the exposed contact between the formations on the east side of the Panoche-Mendota road in sec. 29, T. 15 S., R. 12 E. The Moreno shale was assigned to the Upper Cretaceous by Anderson and Pack and the bulk of the formation certainly is of that age. The age of the uppermost part, however — above the dinosaur- and *Siphogenerinoides*-bearing strata — is somewhat doubtful. Just north of the area shown in figure 2, the uppermost part, which was included by Stewart, Popenoe, and Snavely (1944, column 1), in their lower member of the Martinez(?) formation, was found to contain eight species of mollusks, "most of which are recorded only from the Paleocene".

The Lodo formation is overlain unconformably by the Domengine formation, which is assigned to the middle Eocene. The lower part of the Domengine contains fragments of claystone derived from the Lodo.

Two incomplete but overlapping sections of the Lodo formation were measured by plane-table traverse and sampled with the assistance of Messrs. Schoellhamer and Kinney. The thickness of the sections and the stratigraphic position of the samples are shown in plate 1 (inside back cover). The shorter section (B), from which samples 3 to 26 were collected, is identical with Miss Martin's I-X section (1943, pp. 95-97). The longer section (A,

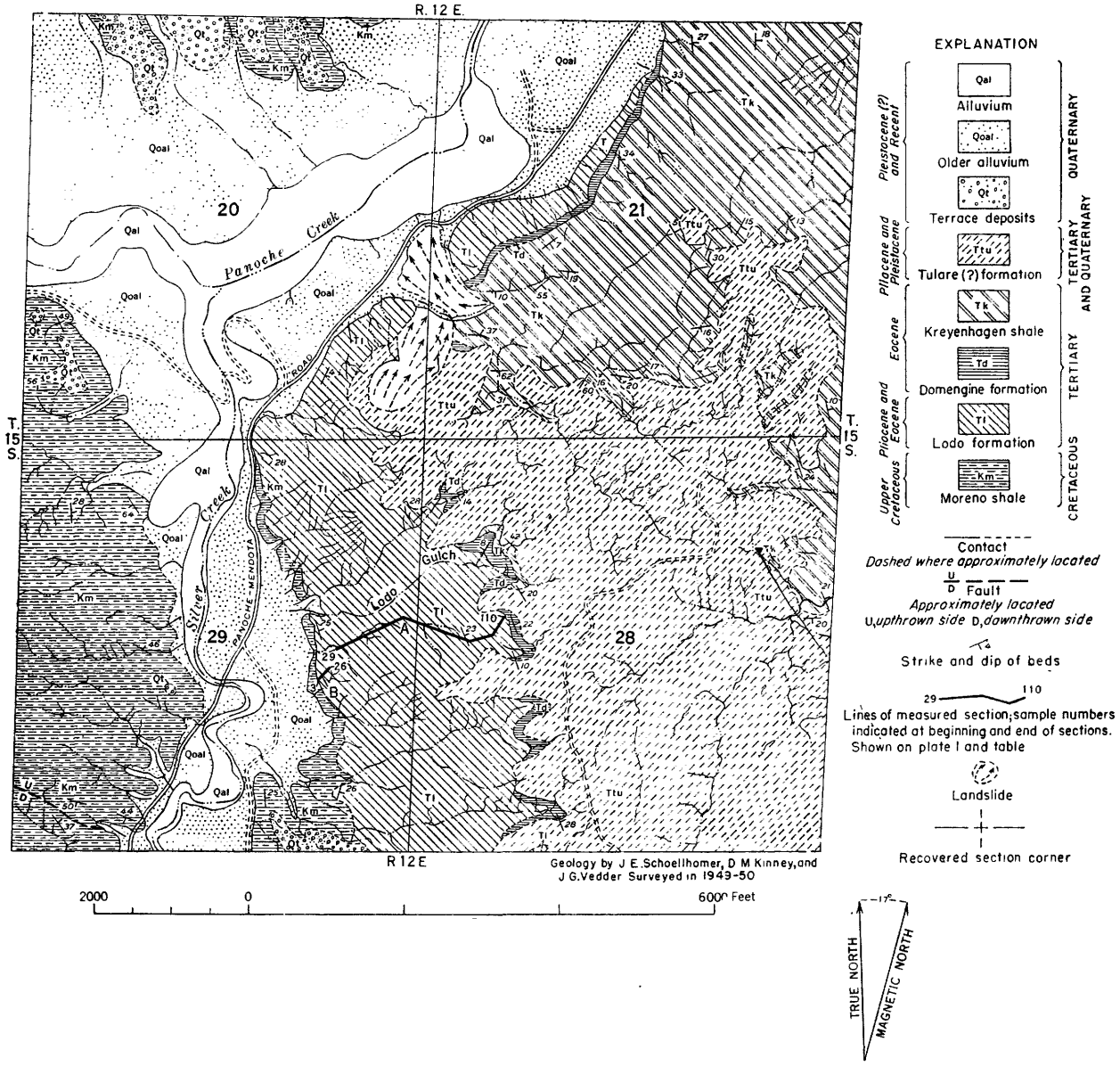

FIGURE 2.—Geologic map of northwestern Tumey Hills, Fresno County, California, showing location of sampled sections of Lodo formation.

samples 29 to 110) was measured along the first gulch south of Lodo Gulch. Her section I-S started in the same gulch and then crossed the ridge to the north and followed Lodo Gulch. The two sampled sections were correlated on the assumption that samples 23 and 33 are at the same stratigraphic level. The lithology fails to give a definite correlation, but the foraminiferal assemblages correspond fairly well.

The total thickness of the Lodo formation, as measured in the two sections, is about 1,200 feet. The basal part, a few feet thick, consists of sandstone. The remainder of the formation is made up of claystone, silty claystone, and minor units of siltstone, all mostly calcareous. A few thin sandstone streaks were noted at scattered intervals.

Very little soil is present in the outcrop area of the Lodo, but bedrock is mantled by as much as three feet of exfoliated rock, weathered to a varied degree. The samples were collected by digging down to bedrock. A total of 110 samples were prepared and studied. However, samples 27 and 28 are omitted as their Foraminifera do not fit the general faunal sequence. Possibly, they were collected from blocks that slid down the slope toward the gulch. The pits for the other samples along the longer section were located near the bottom of the gulch. One important faunule, which is represented in sample 6 + 1′, was missed in the original sampling but was called to the writer's attention by M. N. Bramlette.

One hundred cubic centimeters of each sample were washed on a 150-mesh screen and the residue was picked for microfossils. Except for a few samples of apparently barren hard calcareous sandstone from the basal sandstone, the samples readily broke down in water. Residues from claystone and siltstone were mostly foraminifera.

SUBSPECIFIC TERMS USED IN SYSTEMATIC DESCRIPTIONS

Subspecific terms, as used in the systematic descriptions, are defined as follows:

Variety.—The term variety is used for variations from the typical form of a species which are found only within the geographic and geologic ranges of the typical form. For example, *Gaudryina* (*Pseudogaudryina*) *coalingensis* Cushman and G. D. Hanna var. *alata* Israelsky, n. var., appears to be confined to the vertical range of the typical form of that species in the Lodo formation. (See table pp. 6–9).

Subspecies.—Subspecies is used to designate variations from the typical form of a species which have a different geographic or geologic range from that of the typical form. For example, *Glomospira charoides* (Jones and Parker) subsp. *corona* Cushman and Jarvis occurs in the Lodo formation, but the typical form, based on Recent specimens, is absent.

ARENACEOUS FORAMINIFERA

ABSTRACT

The present report describes and illustrates 66 species, varieties, and subspecies of arenaceous Foraminifera, 34 of which are new. *Bramlettia*, a new subgenus of *Silicosigmoilina*, is described. The stratigraphic distribution of the arenaceous forms is shown in a table.

STRATIGRAPHIC DISTRIBUTION OF ARENACEOUS FORAMINIFERA

The distribution of the 66 arenaceous forms in the sampled sections of the Lodo formation is shown by the table (pp. 6-9). The names of the Foraminifera are listed from left to right in order of their appearance downward from the top of the section.

ARRANGEMENT OF FAMILIES

In general Cushman's (1948) classification is used. Minor differences in the order of arrangement of the families are based on the author's preference. The only notable departure from Cushman's classification is the position of the Trochamminidae, which in his arrangement follows the calcareous Miliolidae. Whatever the taxonomic merits of a classification based on the constituents of the foraminiferal test may be, the arrangement adopted has the practical advantage of bringing together the arenaceous forms, thereby facilitating identification.

SYSTEMATIC DESCRIPTIONS

Family RHIZAMMINIDAE

Genus Bathysiphon M. Sars, 1872

Bathysiphon eocenicus Cushman and G. D. Hanna

Plate 2, figures 1-4

Bathysiphon eocenica Cushman and G. D. Hanna, California Acad. Sci. Proc., 4th ser., vol. 16, no. 8, p. 210, pl. 13, figs. 2, 3, 1927.

Test elongate, compressed cylindrical; wall made of fine white amorphous material and rather soft; wall thick but the tubular chamber several times as broad as the thickness of the wall; outer surface with traces of a reddish coating. Length of short pieces 1 mm., breadth 0.5 mm.—Cushman and Hanna, 1927.

The species was first described from the vicinity of Coalinga, California, 10 feet above the Eocene sandstone ledge, also 100 feet below. The ledge is believed to be Domengine. Other occurrences are recorded but as the determination depends largely on texture, and as comparative specimens are not at hand, no further synonymy is attempted.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	109	560485	1.54	0.81	0.49
Figured	109	560486	0.88	.38	.26

Bathysiphon sp. A
Plate 2, figures 5, 6

Collapsed subcylindrical tube made up of distinct sand grains, roughly cemented, walls thick, body cavity narrow, great range in size.

This species and *Bathysiphon sp.* B may not belong to this genus. They are figured as their ranges within this Lodo section differ from that of *Bathysiphon eocenicus*. The tubes appear distinctly saccharoidal, in marked contrast to *Bathysiphon eocenicus*. No intergrades were noted.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	67	560487	1.15	0.49	0.29

Bathysiphon sp. B
Plate 2, figures 7–9

Collapsed subcylindrical tube made up of coarse to medium sand grains, roughly cemented; walls thick, body cavity narrow. Specimens have a great range of size.

This species may be found to intergrade with *Bathysiphon sp.* A.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	45	560488	2.15	1.02	0.61
Figured	45	560489	1.30	.....	.....

Family ASTRORHIZIDAE
Rhabdammina spp. indet.

Rare fragments having a pellucid chalcedonic appearance may represent this genus.

Family SACCAMMINIDAE
Genus Saccammina M. Sars, 1869
Saccammina sp. aff. S. rhumbleri (Franke)
Plate 2, figures 10, 11

Nearly globular test with slightly produced neck containing small aperture; built of rather smoothly cemented fine sand.

Figured specimen, from sample 8, lost.

The original figure of *Orbulinaria rhumbleri* Franke (1925, pl. 1, fig. 2) is a poor one. The species is recorded as *Saccammina rhumbleri*(?) by Cushman and Jarvis (1932, p. 5) and *Saccammina rhumbleri*(?) (Franke) by Cushman (1946, p. 14) and Cushman and Renz, (1946, p. 13) from the Lizard Springs formation, Trinidad, B.W.I. Specimens from the Lizard Springs formation, in the Stanford University collections and labeled by Renz, are more smoothly cemented than the Lodo specimens but otherwise are similar.

Several figures of *S. sphaerica* M. Sars from the present oceans closely resemble our specimens, but differ in detail, especially in having broader necks and correspondingly larger apertures.

Family AMMODISCIDAE
Subfamily AMMODISCINAE
Genus Ammodiscus Reuss, 1861
Ammodiscus glabratus Cushman and Jarvis
Plate 2, figures 12, 13

Ammodiscus glabratus Cushman and Jarvis, Cushman Lab. Foram. Research Contr., vol. 4, p. 86, pl. 12, fig. 6, 1928. [Cret.]

Cushman and Jarvis, U. S. Nat. Museum. Proc., vol. 80, art. 14, p. 8, pl. 2, fig. 1, 1932. [Cret.]

Cushman, Jos. A., U. S. Geol. Survey Prof. Paper 206, p. 17, pl. 1, fig. 32, 1946. [Cret.]

Cushman and Renz, Cushman Lab. Foram. Research, Spec. Pub. no. 18, p. 14, pl. 1, fig. 26, 1946. [Cret.]

Test planispiral, much compressed, concave on both sides, periphery broadly curved; tubular chamber very gradually and uniformly increasing in size with succeeding coils; wall thin, composed almost entirely of cement, of a brownish color, very smooth and polished; aperture semi-circular, at the end of the tubular chamber. Diameter 0.65 mm.; thickness 0.12 mm.—Cushman and Jarvis, 1928.

Except that our specimens are white, the above description fits the Lodo specimens which were compared with specimens from the Lizard Springs formation, Trinidad, B.W.I., labeled by Renz and in the Stanford University collections.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Height
Figured	8	560490	0.42	0.12

Various figures referred to *A. cretaceus* (Reuss) are disturbingly close to *A. glabratus*. Reuss' original figures (1845, pt. 1, p. 35) are too minute for use. From Cushman's description (1946, p. 17) it is inferred that *A. cretaceus* lacks the distinct concavities of *A. glabratus*.

Ammodiscus pennyi Cushman and Jarvis
Plate 2, figures 14, 15

Ammodiscus pennyi Cushman and Jarvis, Cushman Lab. Foram. Research Contr., vol. 4, p. 87, pl. 12, figs. 4, 5, 1928; U. S. Nat. Museum. Proc., vol. 80, art. 14, p. 9, pl. 2, figs. 2, 3, 1932. [Cret.]

Cushman, U. S. Geol. Survey Prof. Paper 206, p. 17, pl. 1, figs. 33, 34, 1946. [Cret.]

Cushman and Renz, Cushman Lab. Foram. Research, Spec. Pub. no. 18, p. 14, pl. 1, fig. 27, 1946. [Cret.]

Stratigraphic distribution of arenaceous Foraminifera in the Lodo formation of northwestern Tumey Hills

Stratigraphic position (in feet) below Domengine formation	Sample number	1. *Bathysiphon eocenicus*	2. *Haplophragmoides protrulisatus*	3. *robustus*	4. *Trochammina* spp. indet.	5. *Haplophragmoides nonionelloides*	6. *longifissus*	7. *Ammodiscus pennyi*	8. *Pseudoclavulina copiosa*	9. *Schenckiella rugosa*	10. *Gaudryina (Pseudogaudryina) coalingensis*	11. *(Pseudogaudryina) coalingensis* var. *alata*	12. *Karreriella inflata*	13. *Goësella?* sp. A	14. *Haplophragmoides* spp. indet.	15. *Spiroplectammina* sp. A	16. *Saccammina* sp. aff. *S. rhumbleri*	17. *Trochammina* sp. A	18. *Ammosphaeroidina* sp. A	19. *Gaudryina (Gaudryina) expansa*	20. *Karreriella? lodoensis*	21. *Silicosigmoilina californica*	22. *Dorothia cubensis*	23. *Textularia* spp. indet.	24. *Spiroplectammina richardi*	25. *Gaudryina (Pseudogaudryina)* sp. A	26. *Spiroplectammina* sp. B	27. *Pseudoclavulina emaciata*	28. *Bathysiphon* sp. A	29. *Gaudryina (Pseudogaudryina) corrugata*	30. *Pseudoclavulina prismatica*	31. *Spiroplectammina praelaevis*	32. *perplexa*	33. *Bermudezina bramlettei*	34. *Clavulinoides* sp. A	35. *Dorothia excentrica*	36. *bulbosa*	37. *Spiroplectammina bolivinoides*	38. *Vulvulina fortelabiata*	39. *Rhabdammina* spp. indet.	40. *Verneuilina frustrata*	41. *Tritaxia mitrata*	42. *Marssonella lodoensis*	43. *Gaudryina (Gaudryina)* aff. *G. rudita*	44. *Bathysiphon* sp. B	45. *Frankeina* sp. A	46. *Pseudoclavulina variata*	47. *Dorothia* sp. A	48. *Glomospira charoides* subsp. *corona*	49. *Dorothia* sp. B	50. *Gaudryina (Gaudryina) inflata*	51. *Clavulinoides inflatus*
1	110-1′	X	X	X	X																																															
8	109	X	X	X	X	X	X																																													
10	108	X	X	X	X	X																																														
22	107	X	X	X																																																
29	106	X	X	X		X	X																																													
44	105	X	X	X	X	X	X	X																																												
68	104			X		X	X		X	?																																										
94	103	X		X																																																
104	102			X							X	X																																								
121	101+1′		X	X							X	X																																								
122	101																																																			
123	101−1′		X	X	X				X	X	X																																									
138	100		X	X	X	X			?																																											
158	99	X	X	X	X																																															
169	98	X	X	X	X								X																																							
186	97	X	X	X	X				?	?																																										
217	96	X	X	X	X						X			X																																						
231	95	X	X	X	X						X			X	X	?																																				
249	94	X			X												X	X	X																																	
267	93	X	X	X	X									X					X	X																																
287	92	X	X	X	X	X			?	?										X																																
298	91	X	X	X	X	X														X																																
310	90		X		X															X	X	X																														
320	89	X			X					?													X																													
334	88	X	X		X													X	X																																	
348	86	X			X										X																																					
350	87	X			X								X																																							
365	85	X			X		X		X	?																																										
388	84	X			X										X																																					
409	83	X			X				X				X		X				X		X	X		X																												
419	82	X	X	X	X									?																																						
434	81	X	X		X			X	X									X			X			X																												
448	80	X	X		X	?				?			X		X			X							X																											
449	79	X																							X	?																										
450	78	X	X	X	X								X		X			X			X		?	X			X																									
474	77	X			X		X								X												X																									
492	76	X			X				X	?			X								X		X		X		X	X																								
505	75				X			X	X															X			X																									
522	74	X			X				X						X				X					?	X																											
535	73	X			X				X	X				X															X																							
556	72	X			X				X					X	X								?	X					X																							
570	71	X							X	X				X										X																												
584	70	X	X		X		X		X	X				X				X			X			X																												
597	69	X			X				X	X				X							X	X		X						X																						
622	68	X			X				X					X								X			X				X	X	X	?																				
662	67	X			X		X	X		X				X	X			X		X		X	X		X			X	X		X	X	X																			
678	66				X		X		X					X	X			X		X		X			X			X		X				X	X																	
693	65				X		X		X	X										X		X	X	X	X				X			X				X																
708	64	X			X		X		X						X							X	X					X	X					X	X																	
730	63				X				X	X										X		X	X		X			X	X					X		X	X	X														
748	62				X				X					X	X							X		X	X				X						X																	
779	61	X			X				X	X				X	X			X		X		X			X		X	X	X	X			X						X													
796	60				X				X											X		X	X					X	X						X				X													
806	59	X			X				X					X	X					X		X		X					X			X			X					X												
821	58				X		X		X	X				X						X		X		X	X				X	X							X		X		X	X										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51

[Samples 3–26 are from section B, samples 29–110 from section A, on plate 1 and figure 2.]

52. *Spiroplectammina densa*	53. *Silicosigmoilina* (*Bramlettea*) *perplexa*	54. *Conotrochammina* sp. A	55. *Gaudryina* (*Pseudogaudryina*) *phenocrysta*	56. *Ammodiscus glabratus*	57. *Marssonella impendens*	58. *Verneuilina* sp. A	59. *Ammoglobigerina* sp. aff. *A. globigeriniformis*	60. *Ammobaculites* sp. A	61. *Gaudryina* (*Pseudogaudryina*) *pyramidata* subsp. *tumeyensis*	62. *Dorothia subretusa*	63. *altacamerata*	64. sp. C	65. *Marssonella angulata*	66. sp. A	Sample number	Lithologic descriptions Color symbols from "Rock Color Chart," published by National Research Council, 1948.	Per cent left on 150 mesh screen	Stratigraphic position (in feet) below Domengine formation
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	110−1′	Olive-gray (5Y5/1) claystone	< 1	1
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	109	Light olive-gray (5Y7/1) claystone	< 1	8
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	108	Same (5Y6/1)	< 1	10
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	107	Light olive-gray (5Y6/1) silty calcareous claystone	< 1	22
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	106	Light olive-gray (5Y7/1) slightly calcareous claystone	< 1	29
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	105	Greenish-gray (5G6/1) calcareous claystone	< 1	44
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	104	Olive-gray (5Y5/1) silty calcareous claystone	< 1	68
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	103	Greenish-gray (5GY6/1) calcareous claystone	< 1	94
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	102	Light olive-gray (5Y6/1) slightly silty calcareous claystone	< 1	104
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	101+1′	Light olive-gray (5Y6/1) slightly calcareous claystone	< 1	121
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	101	Yellowish-gray coarse grained calcareous sandstone		122
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	101−1′	Olive-gray (5Y5/1) calcareous slightly silty claystone	< 1	123
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	Same	< 1	138
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	99	Olive-gray (5Y5/1) calcareous claystone	< 1	158
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	98	Olive-gray (5Y5/1) slightly silty claystone	< 1	169
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	97	Olive-gray (5Y5/1) slightly silty calcareous claystone	< 1	186
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	96	Olive-gray (5Y5/1) claystone	< 1	217
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	95	Greenish-gray (5GY6/1) claystone	< 1	231
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	94	Olive-gray (5Y5/1) claystone	< 1	249
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	93	Light olive-gray (5Y6/1) claystone	< 1	267
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	92	Light olive-gray (5Y6/1) calcareous claystone	< 1	287
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	91	Same	< 1	298
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	Greenish-gray (5GY6/1) calcareous claystone	< 1	310
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	89	Light olive-gray (5Y6/1) calcareous claystone	< 1	320
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	88	Greenish-gray (5GY6/1) calcareous claystone	< 1	334
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	86	Same	< 1	348
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	87	Same	< 1	350
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	85	Same	< 1	365
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	84	Light olive-gray (5Y6/1) calcareous claystone	< 1	388
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	83	Greenish-gray (5GY6/1) calcareous claystone	< 1	409
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	82	Same	< 1	419
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	81	Same	< 1	434
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	Light olive-gray (5Y6/1) calcareous claystone	< 1	448
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	79	Light olive-gray (5Y7/1) friable very silty fine grained calcareous sandstone; varicolored micas		449
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	78			450
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	77			474
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	76			492
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	75			505
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	74			522
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	73			535
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	72			556
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	71			570
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70			584
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	69			597
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	68	Greenish gray (5GY6/1) calcareous claystone		622
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	67			662
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	66		< 1	678
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	65			693
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	64			708
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	63			730
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62			748
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	61			779
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60			796
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	59			806
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	58			821
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66				

Stratigraphic distribution of arenaceous Foraminifera in the Lodo formation of northwestern Tumey Hills (Continued)

Stratigraphic position (in feet) below Domengine formation	Sample number	1. *Bathysiphon eocenicus*	2. *Haplophragmoides protrullisatus*	3. *robustus*	4. *Trochammina* spp. indet.	5. *Haplophragmoides nonionelloides*	6. *longifissus*	7. *Ammodiscus pennyi*	8. *Pseudoclavulina copiosa*	9. *Schenckiella rugosa*	10. *Gaudryina (Pseudogaudryina) coalingensis*	11. *(Pseudogaudryina) coalingensis* var. *alata*	12. *Karreriella inflata*	13. *Goësella?* sp. A	14. *Haplophragmoides* spp. indet.	15. *Spiroplectammina* sp. A	16. *Saccammina* sp. aff. *S. rhumbleri*	17. *Trochammina* sp. A	18. *Ammosphaeroidina* sp. A	19. *Gaudryina (Gaudryina) expansa*	20. *Karreriella? lodoensis*	21. *Silicosigmoilina californica*	22. *Dorothia cubensis*	23. *Textularia* spp. indet.	24. *Spiroplectammina richardi*	25. *Gaudryina (Pseudogaudryina)* sp. A	26. *Spiroplectammina* sp. B	27. *Pseudoclavulina emaciata*	28. *Bathysiphon* sp. A	29. *Gaudryina (Pseudogaudryina) corrugata*	30. *Pseudoclavulina prismatica*	31. *Spiroplectammina praelaevis*	32. *perplexa*	33. *Bermudezina bramlettei*	34. *Clavulinoides* sp. A	35. *Dorothia excentrica*	36. *bulbosa*	37. *Spiroplectammina bolivinoides*	38. *Vulvulina fortelabiata*	39. *Rhabdammina* spp. indet.	40. *Verneuilina frustrata*	41. *Tritaxia mitrata*	42. *Marssonella lodoensis*	43. *Gaudryina (Gaudryina)* aff. *G. rudita*	44. *Bathysiphon* sp. B	45. *Frankeina* sp. A	46. *Pseudoclavulina variata*	47. *Dorothia* sp. A	48. *Glomospira charoides* subsp. *corona*	49. *Dorothia* sp. B	50. *Gaudryina (Gaudryina) inflata*	51. *Clavulinoides inflatus*
832	57	X			X				X					X	X		X					X	X				X		X						X				X			X										
844	56	X			X		X		X					X				X						?					X				X	X																		
852	55	X					X	X		X					X			X							X				X				X	X			X					X										
861	54		?		X		X	X							X			X							X			X	X		X			X																		
870	53	X			X			X		X					X			X				X		X	X				X		?		X	X		X						X										
880	52				X																	X	X		X				X		X		X	X																		
884	51																												X				X																			
891	50				X																								X		X		X				X						?									
899	49	X			X																	X																														
904	48				X						X			X		X		X	X			X																														
909	47	X	X		X																						?																									
917	46				X							X																	X							X				X												
925	45		?		X					X	X	X									X				X			X	X						X		X	X					?	?	X							
933	44											X						X			X							X	X					X	X		X								X							
943	43	X			X			X	?											X					X				X					X						X					X							
951	42		X	X				X		X								X				X			X			?	X					X																		
960	41				X			X		X	X														X			X	X		X			X			X									X	?					
968	40				X						X			X						X	X				X				X		X														X							
984	39						X	X		X				X				X		X					X				X			X	X	X		X	X										X	X				
993	38		X							X				X	X			X				X	X	X	X			X	X				?	X	X				X	X			X		X		X	X	X	X	X	X
1,001	37				X		X		X					X				X				X						X	X		X				X				X								X			X		
1,007	36						X									X									?				X		?																		X			
1,014	35				X		X							X	X			X				X							X																							
1,034	34																	X				X							X				X			X						X	X									?
1,043	33								X					X	X							X							X						X																	X
1,048	32																			X				X							X									X												X
1,054	31										X																																									
1,061	30										X																																									
1,076	29*		X					X							X			X				X							X				X							X									X			
1,014	26		X		X		X							X	X			X				X							X											X			X									
1,029	25						X							?	X							X							X											X												
1,036	24	X	X															X	X			X							X											X									X			
1,043	23				X						X			?								X			X				X				X						?		X								X			X
1,051	22										X							X								X															X											X
1,058	21				X																																			X	X											
1,068	20										X																														X											
1,073	19										X																														X											
1,082	18										X																														X											
1,087	17	X	X		X		X	X									X	X				X							X				X										X									
1,095	16		X		X		X	X									X	X				X							X				X							X									X			
1,104	15		X		X		X	X						X	X		X					X							X																							
1,108	14		?		X		X	X			X							X	X			X							X				X																			
1,122	13				X										X							X							X																							
1,133	12		X		X		X				X				X		X	X	X			X							X				X							X												
1,139	11		X		X		X											X				X							X				X																			
1,145	10		X		X		X				X							X				X							X																X							
1,154	9		X					X							X		X	X				X							X				X							X					X				X			
1,161	8		X		X			X								X	X	X				X							X														X						X			
1,168	7		X		X			X								X		X				X							X											X												
1,174	6+1′		X		X		?	X	X		X					X		X				X			X				X			X	X				X				X		X	X	X			X	X			
1,175	6																																																X			
1,186	5														X							X							X											X												
1,194	4																																																			
1,197	3																																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51

* Samples 27, 28 omitted—probably from slumped material.

[Samples 3–26 are from section B, samples 29–110 from section A, on plate 1 and figure 2.]

52. *Spiroplectammina densa*	53. *Silicosigmoilina (Bramlettella) perplexa*	54. *Conotrochammina* sp. A	55. *Gaudryina (Pseudogaudryina) phenocrysta*	56. *Ammodiscus glabratus*	57. *Marssonella impendens*	58. *Verneuilina* sp. A	59. *Ammoglobigerina* sp. aff. *A. globigeriniformis*	60. *Ammobaculites* sp. A	61. *Gaudryina (Pseudogaudryina) pyramidata* subsp. *tumeyensis*	62. *Dorothia subretusa*	63. *altacamerata*	64. sp. C	65. *Marssonella angulata*	66. sp. A	Sample number	Lithologic descriptions Color symbols from "Rock Color Chart," published by National Research Council, 1948.	Per cent left on 150 mesh screen	Stratigraphic position (in feet) below Domengine formation
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	57	Greenish-gray (5GY6/1) calcareous claystone		832
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	56			844
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	55			852
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	54			861
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	53			870
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	52			880
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	51			884
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	Greenish-gray (5GY6/1) slightly calcareous claystone; glauconite	< 1	891
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	49	Olive-gray (5Y5/1) calcareous claystone		899
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	48	Greenish-gray (5GY6/1) slightly silty calcareous claystone	< 1	904
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	47	Same	< 1	909
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	46	Greenish-gray (5GY6/1) argillaceous calcareous siltstone; rare green mica	< 1	917
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	45	Same	< 1	925
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44	Same	< 1	933
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	43	Greenish-gray (5GY6/1) silty calcareous claystone	< 1	943
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	42	Same	< 1	951
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	41	Same	< 1	960
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	Greenish-gray (5GY6/1) argillaceous calcareous siltstone, rare green mica	< 1	968
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	39	Same; some glauconite	< 1	984
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	38	Greenish-gray (5GY6/1) calcareous claystone	9	993
X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	37	Same	< 1	1,001
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36	Light olive-gray (5Y6/1) slightly silty calcareous claystone	< 1	1,007
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	35	Same	< 1	1,014
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	34	Same	< 1	1,034
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33	Light olive-gray (5Y6/1) slightly silty claystone	< 1	1,043
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32	Light olive-gray (5Y6/1) argillaceous calcareous siltstone; rare glauconite	< 1	1,048
--	X	X	--	--	--	--	--	--	--	--	--	--	--	--	31	Same	< 1	1,054
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	Same	< 1	1,061
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29*	Light-olive gray (5Y6/1) silty claystone; glauconite	< 1	1,076
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	Greenish-gray (5GY6/1) claystone; glauconite, coarse sand	< 1	1,014
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25	Same	< 1	1,029
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	Olive-gray (5Y5/1) claystone; glauconite, green mica, coarse sand grains	< 1	1,036
--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	23	Light olive-gray (5Y6/1) clauconite calcareous claystone	10	1,043
--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	22	Light olive-gray (5Y6/1) silty calcareous claystone; glauconite	< 1	1,051
--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	21	Light olive-gray (5Y6/1) argillaceous calcareous siltstone	< 1	1,058
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	Same	< 1	1,068
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	Light olive-gray (5Y6/1) very silty calcareous claystone; green mica, glauconite	< 1	1,073
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	Pale yellowish-brown (10YR6/2) hard calcareous siltstone		1,082
--	X	--	--	--	--	X	--	--	--	--	--	--	--	--	17	Light olive-gray (5Y6/1) sandy siltstone; green mica, rare glauconite	1½	1,087
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	16	Pale to dark yellowish brown (10YR6/2-10YR4/2) friable sandy siltstone; green and olive brown mica	5	1,095
--	X	--	--	--	--	X	X	--	--	--	--	--	--	--	15	Same	4	1,104
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	14	Same	5	1,108
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	13	Same		1,122
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	12	Pale yellowish-brown (10YR6/2) friable sandy siltstone; green, olive brown, colorless mica		1,133
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	11	Same	8	1,139
--	X	--	--	--	X	--	--	--	--	--	--	--	--	--	10	Brownish-gray (5YR5/1) friable sandy siltstone; green mica	< 1	1,145
--	X	--	--	--	X	--	--	--	--	--	--	--	--	--	9	Olive-gray (5Y4/1) silty claystone; green mica, glauconite	< 1	1,154
--	X	--	--	--	X	--	X	--	--	--	--	--	--	--	8	Brownish-gray (5YR5/1) silty claystone; glauconite	< 1	1,161
--	X	--	--	--	X	--	X	--	--	--	--	--	--	--	7	Reddish-brown (10R4/4) glauconitic claystone	5	1,168
X	X	--	X	X	X	X	--	X	X	X	X	X	X	X	6+1′	Light olive-gray (5Y6/1) glauconitic silty calcareous claystone	20	1,174
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	6	Light olive-gray (5Y6/1) argillaceous greensand	60	1,175
--	X	--	--	--	--	--	--	--	--	--	--	--	--	--	5	Light brownish-gray (5YR6/1) friable sandstone and sandy siltstone; green mica, glauconite	12	1,186
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	Light-gray (N7-N6) medium-grained laminated crossbedded hard calcareous sandstone; green		1,194
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	mica, glauconite		1,197

52	53	54	55	56	57	58	59	60	61	62	63	64	65	66

* Samples 27, 28 omitted—probably from slumped material.

Test planispiral, comparatively large, periphery broadly rounded, of a few coils, the tubular chamber increasing gradually in diameter; suture deep and distinct; wall thick, conspicuously arenaceous but fairly smoothly finished; aperture semicircular at the end of the tube. Microspheric form up to 2 mm. in diameter.

. . . . . .

This is one of the largest species of the genus and is nearest *A. mestayeri* Cushman in size. — Cushman and Jarvis, 1928.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Height
Figured	29	560491	1.22	0.24

The Lodo specimen was compared with one from the Lizard Springs formation, Trinidad, B.W.I., labeled by Renz, in the Stanford University collections.

A. coombsi Beck (1943, p. 591) described from the Cowlitz formation of Washington, the holotype of which was seen at Stanford University, differs mainly in being more smoothly cemented. It is also not perfectly planispiral, as noted by Beck, one side being more concave than the other and suggesting *Ammodiscoides*. However, a number of Lodo specimens referred to *Ammodiscus pennyi* show this same eccentricity.

A. mestayeri Cushman (1919, p. 597) described from off New Zealand, is an even larger species and apparently its sutures are much more depressed than those of in *A. pennyi*. *A. grandis* Holland (1910, p. 2) from the Cretaceous of the South Shetland Islands, is more tightly coiled, has more depressed sutures and is much larger than *A. pennyi*.

Genus Glomospira Rzehak, 1888
Glomospira charoides (Jones and Parker) subspecies corona Cushman and Jarvis
Plate 2, figures 16–18

Glomospira charoides (Jones and Parker) var. *corona* Cushman and Jarvis, Cushman Lab. Foram. Research Contr., vol. 4, p. 89, pl. 12, figs. 9–11, 1928; U. S. Nat. Museum. Proc., vol. 80, art. 14, p. 10, pl. 2, figs. 8–10, 1932. [Cret.]

Cushman, U. S. Geol. Survey Prof. Paper 206, p. 19, pl. 2, figs. 1–3, 1946. [Cret.]

Cushman and Renz, Cushman Lab. Foram. Research, Spec. Pub. no. 18, p. 15, pl. 1, fig. 31, 1946. [Cret.]

Cuvillier, J. and Szakall, V., Foraminifères d'Aquitaine, pt. 1, Soc. Nat. des Pétroles d'Aquitaine, p. 6, pl. 2, fig. 13 (2 figs.), 1949. [Cret.]

Glomospira charoides White (not Jones and Parker), Jour. Paleontology vol. 2, p. 187, pl. 27, fig. 7, 1928. [Cret.]

Variety differing from the typical in having the irregularly coiled later portion in a sort of irregular crown at the end of the test instead of coiling about the whole test as in the typical form. — Cushman and Jarvis, 1928.

The holotype is from the Lizard Springs formation, Trinidad, B.W.I.

The Lodo specimens have rather smooth surfaces.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Height
Figured	8	560492	0.35	0.28

As this variation occurs without the typical species being present, it is considered a subspecies.

Family SILICINIDAE
Subfamily RZEHAKININAE
Genus Silicosigmoilina Cushman and Church, 1929
Silicosigmoilina californica Cushman and Church
Plate 2, figures 19–21, plate 10, figure 20

Silicosigmoilina californica Cushman and Church, California Acad. Sci. Proc., 4th ser., vol. 18, p. 502, pl. 36, figs. 10, 11, not 12, 1929 [Cret.]; Cushman, Cushman Lab. Foram. Research Contr., vol. 6, p. 80, pl. 10, fig. 17, not 18, 1930. [Cret.]

Test compressed, nearly circular or oval in side view, somewhat rhomboid in end view, periphery subacute, usually with a definitely marked portion in side view; chambers in the earliest stages planispiral, later sigmoid; sutures fairly well marked, not deeply depressed; wall finely arenaceous, firmly cemented with a siliceous cement, smoothly finished; aperture simple, oval, without a tooth; white or light gray in color. — Cushman and Church, 1929.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	6+1′	560493	0.59	0.38	0.21

A transverse section (pl. 10, fig. 20) seemingly shows a large proloculum, on either side of which opposed gently curved spiral rows of chambers arise. Only beyond the first two chambers can the structure be termed planispiral. The chambers were filled with calcite.

Laiming (1940a, p. 545) records but does not figure *Silicosigmoilina* cf. *S. californica* Cushman and Church (small variety) from near the base of his zone A-2, low in the Kreyenhagen (Eocene). Martin (1943, p. 102) records the species from the type Lodo.

Subgenus Bramletteia Israelsky n. subgenus
Type: Silicosigmoilina (Bramletteia) perplexa Israelsky, n. sp.

Test in early stages nearly planispiral, chambers a half coil in length, later ones added in various planes and weakly sigmoid in end view; in transverse section the chambers form two opposed spirals; wall very finely arenaceous with siliceous cement; aperture crescentiform with toothlike projection surrounded by weak rim.

The above description is modified from that of Cushman (1948, p. 174) for *Silicosigmoilina* Cushman and Church. The subgenus appears to differ from *Silicosigmoilina* s.s. only in the presence of the toothlike projection at the aperture. This projection resembles that found in *Miliammina* Heron-Aller and Earland, but the chamber plan of that genus is "triloculine or quinqueloculine," not sigmoid.

Silicosigmoilina (Bramletteia) perplexa Israelsky n. sp.
Plate 2, figures 22–25; plate 10, figure 21

Test ovoid, much thinner than wide; weakly rimmed, giving the illusion of three chambers being visible on the broad sides; end view crudely pentagonal, slightly sigmoid; aperture at end of terminal chamber crescentiform with toothlike projection, surrounded by weak collar; test smooth, composed of very fine sand particles with abundant siliceous cement.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	6+1′	560494	0.41	0.22	0.16

A transverse section shows a sigmoid plan of growth, the chambers being in two opposed spirals, six chambers forming the outer wall. The chambers of the sectioned specimens appeared to be in part hollow, in part filled with calcite.

Family LITUOLIDAE
Subfamily HAPLOPHRAGMIINAE
Genus Haplophragmoides Cushman, 1910
Haplophragmoides protrullisatus Israelsky n. sp.
Plate 2, figures 26, 27

Test planispiral, nautiloid, lenticular, slightly depressed at umbilici; the visible whorl showing ten chambers; sutures slightly depressed and sinuate, especially toward the margin; marginal portion of chambers compressed, producing a roundly flanged margin; aperture crescentiform, between the base of the terminal face and the rimmed portion of the previous whorl; fine textured, rather smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Thickness
Holotype	7	560495	0.93	0.39

Specimens are fairly plentiful, but none showed the multiple apertures. Three sections failed to reveal the cancellate interior typical of *Cyclammina*.

This species is perhaps closest to *Cyclammina bradyi* Cushman (1910, p. 113; Brady, 1884, pl. 40, fig. 13) but may be distinguished by the relatively greater compression, less rapid rate of flare and lack of the rim in Cushman's species. Brady's figures 14 and 15 (1884, pl. 40) are not Cushman's species, 14a exhibiting an aperture within the terminal face. *Cyclammina garcilassoi* Frizzell (1943, p. 338) has much the same lateral appearance but lacks the rimmed margin and is more tightly coiled. Frizzell noted a simple aperture. *Cyclammina samanica* Berry (1928, p. 394) is more compressed and has a better defined keel than *H. protrullissatus* n. sp.

Haplophragmoides nonionelloides Israelsky n. sp.
Plate 2, figures 28–31

Test weakly trochospiral, nautiloid, lenticular, no marked depression at the umbilici; the visible whorl showing eight chambers; sutures slightly depressed, slightly sinuate; aperture crescentiform, between the base of the terminal face and the peripheral portion of the previous whorl; terminal face fairly flat and cutting the peripheral plane at about forty-five degrees, resulting in the terminal face showing two unequally lengthened lobes extending to their respective umbilici; medium textured, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Thickness
Holotype	106	560496	0.99	0.47

Sections fail to show cancellate internal structures.

Cyclammina pacifica Beck, (1943, p. 591) shares the weakly trochospiral plan of growth but is relatively much thinner, more umbilicate, and less strongly trochoid than is *H. nonionelloides* n. sp. No multiple apertures were noted by Beck.

These weakly trochospiral *Haplophragmoides* and similar *Cyclammina* stand in relationship to their typical planispiral relatives as does *Nonionella* to *Nonion* and *Darbyella* to *Robulus*. It is hoped they may be permitted to remain in their respective genera, which contain closely related species. A "scientific" solution would be to place them in the *Trochamminidae*.

Haplophragmoides robustus Israelsky n. sp.
Plate 2, figures 32, 33

Test planispiral, nautiloid, lenticular; sutures indistinct, margins broadly rounded; aperture a narrow slit between the base of the rather flat terminal face and the periphery of the previous whorl; peripheral outline sinuate; test built of medium textured sand with occasional larger sand grains, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Thickness
Holotype	109	560497	1.28	0.63

Sections revealed no cancellate internal structure, and no supplementary apertures were apparent in the terminal face.

In general appearance *Cyclammina schencki* Cushman (1928, p. 70) is similar, but that species is much more compressed and Cushman noted "indications of small circular pores in the middle of the apertural face."

Haplophragmoides longifissus Israelsky n. sp.
Plate 2, figures 34, 35

Test nautiloid, subglobular, strongly involute; septal lines not visible, periphery broadly rounded; aperture a long broad slit between the base of the terminal septal face and the previous whorl; walls coarsely arenaceous, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Thickness
Holotype	12	560498	0.78	0.56

Haplophragmoides subglobosus (G. O. Sars) is even more gibbose and has clearly discernible sutures (Cushman, 1921, p. 81).

Haplophragmoides spp. indet.

Small, nondescript specimens, probably referable to this genus, grouped together for checklisting.

Genus Ammobaculites Cushman, 1910
Ammobaculites? sp. A
Plate 2, figures 36–38; plate 3, figures 1–4

Early stages planispiral, smallest specimen studied probably having six chambers in coiled portion; uncoiling in the adult, none of the available specimens showing more than one rectilinear chamber; thickness of coiled portion two-thirds of greatest diameter; wall of medium-grained sand, with a few coarse sand inclusions, fairly smoothly cemented. Aperture not discernible.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	6+1′	560499	1.30	0.96 (coiled portion)	0.61
				.72 (final chamber)	

In specimens with the uniserial portion broken off, the apertural slit appears like those in *Haplophragmoides.*

To one with Gulf Coast experience *Lituola taylorensis* Cushman and Waters (1929, p. 66), *Lituola erecta* Mellen and Gault, and *Lituola erecta* subsp. *distincta* Mellen and Gault (1939, p. 472) come to mind, but all are strongly constructed and are clearly *Lituola. Ammobaculites midwayensis* Cushman (1940, p. 52) is more strongly compressed.

Genus Frankeina Cushman and Alexander, 1929
Frankeina sp. A
Plate 3, figures 5–8

Test large, elongate, almost half as broad as long, thickness about one-third of length; early portion planispiral, uniserial portion with subparallel sides, and with less breadth than through planispiral portion, sutures obscure; end view roundly subtriangular with two matched sides excavate, the aperture a subcircular opening surrounded by a neck; built of medium-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	41	560500	1.52	0.77	0.55

Frankeina taylorensis Cushman and Waters (Cushman, 1946, p. 25) is closely related but has strongly winged ridges.

Family TEXTULARIIDAE
Subfamily SPIROPLECTAMMININAE
Genus Spiroplectammina Cushman, 1927
Spiroplectammina perplexa Israelsky n. sp.
Plate 3, figures 9–14

Spiroplectoides clotho Cushman and Jarvis (not Grzybowski), Cushman and Jarvis, Cushman Lab. Foram. Research Contr., vol. 4, p. 101, pl. 14, fig. 13 (not fig. 14), 1928 —U. S. Nat. Museum Proc., vol. 80, art. 14, p. 43, pl. 13, fig. 6 (not fig. 5), 1932. [Cret.]

S.(?) clotho Cushman (not Grzybowski), Cushman Lab. Foram. Research Contr., vol. 10, p. 42, pl. 6, figs. 20, 21 (not 19, 22, 23), 1934. [Cret.]

Bolivinopsis? clotho Cushman (not Grzybowski), U. S. Geol. Survey Prof. Paper 206, p. 103, pl. 44, figs. 10, 11 (not 12, 13), 1946. [Cret.]

Spiroplectammina grzybowskii Cushman and Renz (not Frizzell), Cushman Lab. Foram. Research, Spec. Pub. no. 18, p. 20, pl. 5, figs. 34, 37, 38 (not 35, 36), 1946. [Cret.]

Megalospheric form: Early portion rapidly flaring, planispiral, nautiloid, with raised umbo at center, chambers numerous, sutures flush; the succeeding biserial portion rapidly decreasing in breadth and thickness, sutures becoming limbate, glassy and sinuate comma-shaped, reflexed about forty-five degrees from a median line, noded terminally; final chambers greatly compressed resulting in an elongate diamond-shaped terminal view; elsewhere the periphery gently rounded; aperture in a notch between the ultimate and penultimate chambers; test smooth but apparently minutely granular; cement seemingly largely siliceous (pl. 3, figs. 9-11).

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	6+1′	560501	0.40	0.22	0.10

Microspheric form: Early portion tightly coiled, planispiral, nautiloid, with weak umbo at center, chambers but about half the number in the holotype, sutures flush; the succeeding biserial portion maintaining its width throughout and almost as thick at its termination as at its initiation, sutures weakly depressed, reflexed about forty-five degrees; terminal view compressed diamond-shaped, the aperture in a notch between the ultimate and penulti-

mate chambers; weakly keeled throughout; test minutely granular, but smooth and apparently consisting largely of siliceous cement (pl. 3, figs. 12-14).

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Paratype	6+1′	560502	0.38	0.17	0.07

Under the binocular microscope the texture resembles that of *Silicosigmoilina*.

Whether or not this pairing is correct, certainly neither form belongs with the rapidly flaring forms illustrated by Cushman and Jarvis, Cushman, and Cushman and Renz, which are not included in the above synonymy of *Spiroplectammina perplexa*. The excluded forms did not appear in our Lodo samples, so the separation to that extent is sound.

In side view *S. mexiaensis* Lalicker (1935, p. 43) resembles the paratype of *S. perplexa*, especially in Lalicker's figure 6, but he notes sutures distinct, usually somewhat limbate because of depressed chambers, * * * in adult form the reëntrant tends to close, causing the aperture to be distinctly above the inner margin of the chamber.

The megalospheric form of *S. grzybowskii* Frizzell (1943, p. 339) resembles what is believed to be the microspheric form of *S. perplexa* n. sp. Frizzell's figure suggests a coarser texture, the sutures appear more distinct and there is a slight but noticeable widening from the initiation to the termination of the biserial portion.

Fortunately Frizzell (1948, p. 106) designated "as lectotype of *Spiroplectammina grzybowskii* the microspheric specimen from Trinidad illustrated as *Spiroplectoides clotho* (Grzybowski) by Cushman and Jarvis (1928, p. 101) on pl. 14, fig. 14." No form resembling it was found in our samples.

Spiroplectammina Sp. A

Plate 3, figures 17–19

Initial portion coiled, sutures indistinct; biserial portion maintaining width about equal to greatest diameter of coiled portion, sutures depressed and forming a scalloped outline on the outside margin, margins crudely flanged; aperture a short crescentic slit in a notch between the ultimate and penultimate chambers, end view roundly diamond-shaped; surface of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	6+1′	560503	0.58	0.27	0.16

No comparable species were noted.

Spiroplectammina sp. B

Plate 3, figures 15, 16

Initial portion planispiral, nautiloid, flanged, sutures not detectible externally; margins of biserial portion roughly parallel, with well-developed marginal flange, sutures depressed, slightly reflexed; the aperture small, semicircular, in a notch between the ultimate and penultimate chambers; test composed of smoothly cemented fine-grained sand.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	27	560504	0.64	0.12	0.22

This species is very close to *S. mexiaensis* Lalicker (1935, p. 43), but Lalicker's edge view (his pl. 6, fig. 5c) suggests a broken, rather than a continuous flange, and the aperture (his pl. 6, fig. 5b) is within the terminal face.

Spiroplectammina richardi L. Martin

Plate 4, figures 1–16

Spiroplectammina richardi L. Martin, Stanford Univ. Pub. Geol. Sci., vol. 3, no. 3, p. 104, pl. 5, fig. 3, 1943.

Test roughly triangular in side view, compressed laterally, about two-thirds as wide as long; in cross section flatly diamond-shaped; peripheral margin sharply keeled with wide serrated flange best developed about the middle of test; early chambers planispirally coiled, later becoming biserial, long, narrow, increasing slightly in length as added; sutures distinct, slanting obliquely toward initial end, very slightly if at all depressed; wall finely arenaceous with large amount of cement, giving surface a roughened appearance; aperture a crescentic depression at inner base of last-formed chamber. * * * *Remarks.* — This species is similar to *Spiroplectammina adamsi* Lalicker (1935), but the Lodo specimens have more distinct initial coils, more inflated chambers, and the sutures are more arched toward the apertural end of the tests — Martin, 1943.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	23	560505	0.58	0.48	0.22
Figured	38	560506	1.04	.78	.34
Figured	45	560507	0.57	.46	.21
Figured	68	560508	.49	.45	.21
Figured	80	560509	.70	.53	.23
Figured	80	560510	.35	.36	.16

An unsuccessful attempt was made to split this species. It is believed all the variants figured belong here, with the possible exception of the one illustrated by figures 4-6.

Textularia seligi Stuckey (1946, p. 164) is similar, but lacks the initial coil and is not so strongly flanged.

Spiroplectammina bolivinoides Israelsky n. sp.

Plate 3, figures 20–24

Test broadly rounded at initial end, margins nearly parallel, slightly diverging in adult portion, strongly keeled except in initial portion, chambers in early portion flush, later chambers distinctly inflated, sutures curved, nearly normal to a median line; aperture rounded, in re-entrant of final face,

between that face and the previous chamber, final two chambers compressed diamond-shaped and outline of earlier chambers compressed elliptical in end view; wall very finely arenaceous with smooth cement; probably a microspheric specimen.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	63	560511	0.87	0.43	0.22
Paratype	63	560512	0.55	0.43	0.25

Similar, but proportionally broader and thicker specimens, with more strongly curved sutures, probably represent the megalospheric form.

Textularia mississippiensis Cushman var. *alabamensis* Cushman (1923, p. 17) has a much more acutely pointed initial portion and the keel is less strongly developed.

Spiroplectammina praelaevis Israelsky n. sp.
Plate 3, figures 25, 26

Viewed from side crudely subtrigonal; early portion coiled, sutures not clearly discernible; later portion biserial, sutures flush, straight, reflexed at low angle, chambers relatively low; well-defined peripheral flange, appearing after the initial portion and not extending onto the terminal faces; end view compressed, roundly diamond-shaped, the aperture a slit in a re-entrant between the final and penultimate faces; most of test smoothly cemented, medium sized-grains apparent in the more translucent flange.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holoytpe	39	560513	0.58	0.42	0.19

S. laevis (Roemer) var. *cretosa* Cushman (1946, pp. 27-28), has "a raised zigzag line along the center of the test," a weaker apertural re-entrant and lacks the well defined peripheral flange.

Spiroplectammina densa Israelsky n. sp.
Plate 3, figures 27–31

Broadly triangular in side view; initial portion planispiral, sutures slightly depressed; biserial portion slowly expanding, sutures strongly depressed, gently arched, chambers broad and low, a narrow thick flange present, apertural end sharply truncated; apertural view a broad rounded diamond in outline, final surfaces slightly depressed medially, apertural re-entrant broad with median tongue, aperture a low opening between the tongue and the preceding chamber; wall finely arenaceous, smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	6+1′	560514	0.47	0.46	0.27
Paratype	6+1′	560515	0.30	.31	.18

The paratype is figured in end view (pl. 3, fig. 31) to show the weak medial groove and poor bilateral development.

Textularia tatumi Cushman and Ellisor (1939, p. 2) is similar, but lacks the initial coil and the well developed flange of *Spiroplectammina densa*. Except for the lack of coiling *T. tatumi* seems closer than any previously figured *Spiroplectammina*.

Subfamily TEXTULARIINAE
Genus Textularia Defrance, 1824
Textularia spp. indet.
Plate 3, figures 32–34

Various irregularly formed specimens are grouped here for checklisting purposes.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*
			Length
Figured	70	560517	0.43
Figured	71	560518	.35
Figured	71	560519	.44

Genus Vulvulina d'Orbigny, 1826
Vulvulina fortelabiata Israelsky n. sp.
Plate 4, figures 17–19

Broadly elliptical in side view, broadest at about midlength, initial portion probably biserial, chambers notably increasing in height at about midlength (measured medially), the last chamber uniserial, sutures flush, well flanged except for initial portion; edge view compressed subelliptical, thickest about one-third length from apertural end; apertural end truncate, formed by keel parting to form apertural collar; apertural view broadly subelliptical with projecting flanges, aperture an elongate subelliptical opening surrounded by labiate collar; very finely arenaceous, smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	46	560516	0.59	0.49	0.30

No specimens with more than one uniserial chamber were noted.

Vulvulina colei Cushman (1932, p. 84) is close, but the sutures are less strongly arched, it has a less well defined flange and possesses a projecting initial portion not present in *V. fortelabiata*. *V. bortonica* Finlay (1947, p. 263) has a similar outline and strongly reflexed sutures in the biserial portion, but has a projecting initial portion and the sutures are limbate. Only the lengths of the compared species were given by their describers, and only side views were shown.

Family TROCHAMMINIDAE
Subfamily TROCHAMMININAE
Genus Trochammina Parker and Jones, 1859
Trochammina sp. A
Plate 4, figures 20–28

Test low spired trochospiral, dorsal surface flattened, ventral surface strongly rounded, sutures

indistinct, chambers flush; apertures not seen, but apertural depressions appear medially at inner margin of final chamber; test composed of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Height
Figured	37	560520	0.52	0.37
Figured	37	560521	.48	.42
Figured	37	560522	.58	.44

This small form is highly varied. No figures of closely allied forms were noted.

Trochammina spp. indet.

The above designation is used on the check list to include numerous tentatively identified highly varied and distorted forms.

Genus Conotrochammina Finlay, 1940
Conotrochammina sp. A
Plate 5, figures 1–3

Test low spired trochospiral; chamber plan indiscernible on dorsal surface, six irregularly sized and variably inflated chambers visible ventrally; final face rather flat, aperture an oval opening lying within the apertural face and surrounded by a smoothed area; test composed of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Greatest diameter	Height
Figured	7	560523	0.70	0.66

This species, although very rare, is of interest because *Conotrochammina* has been recorded from the Cretaceous and Paleocene of New Zealand only.

Genus Ammoglobigerina Eimer and Fickert, 1899
Ammoglobigerina sp. aff. A. globigeriniformis (Parker and Jones)
Plate 5, figures 4–6

Test subglobose, low spired trochospiral, only the last volution of four chambers clearly seen, chambers somewhat inflated, increasing rapidly in size, sutures well marked; aperture central, at the inner face of the last chamber; test composed of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	7	560524	0.52	0.41	0.35

The Lodo specimens agree well with Cushman's figures (1910, figs. 193-195) from the North Pacific, except that the chambers of his specimens are more distinct in the early whorls, the height is relatively greater, the aperture apparently less open, and the test much larger.

The type figure (Parker and Jones, 1865 p. 407) is very poor. Numerous occurrences from Cretaceous to Recent have been recorded, but many seem dubious.

The type of *Trochammina* is *Discorbis*-like, the present form is *Globigerina*-like, and there seems no valid reason to suppress the name *Ammoglobigerina* (Eimer and Fickert, 1899, p. 704).

Subfamily AMMOSPHAEROIDININAE
Genus Ammosphaeroidina Cushman, 1910
Ammosphaeroidina? sp. A
Plate 4, figures 29–31

Outline oblate in dorsal and ventral views; edge outline club-shaped, constricted at final suture; three chambers visible, more inflated dorsally than ventrally; the final suture at right angles to the previous one; test made of medium-grained sand with calcareous cement, surface rough.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	83	560525	0.64	0.54	0.32

The few specimens available failed to show a definite aperture. Sectioning failed to show an early spiral portion. With these criteria absent it is only because of a general resemblance to *Ammosphaeroidina sphaeroidiniformis* that the species is considered as *Ammosphaeroidina?* (Cushman, 1910, p. 128).

Family VERNEUILINIDAE
Genus Verneuilina d'Orbigny, 1840
Verneuilina frustrata Israelsky n. sp.
Plate 5, figures 7–13

Test triserial throughout, the three lateral faces subequal, expanding from subacute initial end to greatest breadth previous to the last chamber; roundly but not conspicuously keeled; chambers flush, sutures flush to slightly depressed, almost straight except for sigmoid last suture; apertural view trigonal, with aperture between the final and penultimate chambers; composed of medium sand with some coarse inclusions, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width (lateral faces)
Holotype	22	560526	1.33	0.84
			.....	.88
			.....	.99
Paratype	22	560527	0.73	.69

The species tends toward a true biserial state but does not reach it in any of our specimens. This form is not the young of any of the associated *Gaudryina* species.

Verneuilina münsteri Reuss (Cushman, 1937a, p. 9) agrees best in general configuration, but has limbate sutures, which are much more strongly reflexed than in the present species.

Verneuilina? sp. A
Plate 5, figures 14–16

Test with crushed appearance, outlines from side roundly subtrigonal, sutures depressed, chambers somewhat inflated, two rows of chambers visible from one side, three from the other, apparently triserial throughout; test composed of coarse sand grains, roughly cemented. As associated species are uncrushed, it is believed the specimens grew in this shape.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	6+1′	560528	1.07	1.04	0.56

This species calls to mind similar crushed-appearing forms referred to *Eggerella scabra* Williamson, from the subsurface Miocene of Louisiana, and *Valvulina flexilis* Cushman and Renz (1941, p. 7) from the Oligocene of Venezuela.

I have seen no published figures of the distorted form of *Eggerella scabra*.

Genus Tritaxia Reuss, 1860
Tritaxia mitrata Israelsky n. sp.
Plate 5, figures 17–20

Test elongate; early portion triserial, tripyramidal, expanding rapidly, with faces marked by broad shallow grooves; the sides gently converging toward suddenly developing uniserial portion; sutures reflexed, weakly depressed; uniserial portion subcylindrical, narrowing toward broadly rounded apertural end; apertural view subelliptical, the aperture an elliptical opening surrounded by low rim; test made of medium sand grains fairly smoothly cemented, the apertural end quite smooth.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	(broadest face)
Holotype	34	560529	0.78	0.38	

In its early portion the present species closely resembles *T. pyramidata* Reuss (Cushman, 1937a, p. 22, especially pl. 2, fig. 24a) but the final chamber of that species retains its trigonal outline, and the triserial portion is relatively longer. In the hood-like final chamber, *T. mitrata* more closely resembles *T. plummerae* Cushman (1937a, p. 24), but that species expands more slowly and the triserial portion is relatively longer.

Genus Gaudryina d'Orbigny, 1839
Subgenus Gaudryina sensu stricto
Gaudryina (Gaudryina) expansa Israelsky n. sp.
Plate 5, figures 21–24

In edge or side views subtrigonal; early portion triserial, tripyramidal, slightly more than one-fifth of total length, expanding rapidly; biserial portion also expanding rapidly, but more on broad sides than on edges; faces rather flat, rounded at margins, sutures indistinct; outline as viewed from apertural end broadly subelliptical; aperture in notch between terminal and penultimate faces; pyramidal portion and apertural faces apparently composed of finer-grained sand or more smoothly cemented than the sides, which are of medium-grained sand with some coarser grains.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	39	560530	0.50	0.47	0.35

Superficially similar are *Textularia broussardi* Howe and Wallace (1932, p. 18) and *T. bundenensis* van Bellen (1946, p. 26).

Gaudryina (Gaudryina) inflata Israelsky n. sp.
Plate 6, figures 1–12

Viewed from side or edge roundly subtrigonal; early portion triserial, tripyramidal, about one-fifth of total length; biserial portion expanding gradually to the final two chambers which are strongly inflated and expanded; appearance of two sides different, one with the sutures strongly depressed, the other with sutures weakly depressed, making the chamber heights different for the two sides; apertural view broadly elliptical, aperture an elongate slit in re-entrant and lying between the final and penultimate chambers; test composed of fairly smoothly cemented medium-grained sand.

Figures 5-12 show appearance before addition of inflated chambers, with more rounded apertures and variation in apertural notch.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	38	560531	0.99	0.76	0.57
Paratype	38	560532	.84	.51	.35
Paratype	38	560533	.46	.36	.27

A series of *Gaudryina* (*Gaudryina*) *laevigata* Franke is figured by Cushman (1937a, p. 41). In his figures of a topotype (figs. 10a, b) the pyramidal portion appears proportionally much bigger and the sutures more nearly horizontal than in the present species. Cushman's figure 12 shows a notable expansion of the final chambers similar to that of *G. inflata*.

Toulmin (1941, p. 572)) figured as *G. laevigata* a specimen with expanded and inflated final chambers. His figure 5, however, shows a roundly triangular apertural view, and the sutures approach the horizontal.

Gaudryina (Gaudryina) aff. G. rudita Sandidge
Plate 6, figures 13–15

Test elongate, subtriangular in side or edge view, weakly compressed, initial end fairly sharp, terminal end rounded; triserial tripyramidal initial portion very short, followed by gently spreading biserial portion with sutures but slightly depressed; apertural view subcircular, aperture in rounded notch between the final and penultimate chambers; built of medium-grained sand with rare coarse grains, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Figured	6+1′	560534	0.89	0.48	0.42

The present figures are close to *G. rudita* Sandidge as figured by Cushman (1946, p. 34), especially to figure 23a in chamber plan and to 24b in end view. Cushman's two figured specimens are quite different in end view and the Lodo specimen is rounder than either of his figures indicate. His specimens have notably larger sand grains.

Subgenus Pseudogaudryina Cushman, 1936
Gaudryina (Pseudogaudryina) coalingensis Cushman and G. D. Hanna
Plate 6, figures 16–22

Gaudryina jacksonensis var. *coalingensis* Cushman and G. D. Hanna, California Acad. Sci. Proc., 4th ser., vol. 16, p. 212, pl. 13, fig. 7, 1927.

? Gaudryina (Pseudogaudryina) jacksonensis var. *coalingensis*, Cushman, Cushman Lab. Foram. Research, Spec. Paper 7, p. 89, pl. 13, figs. 5, 6, 1937.

Gaudryina rel. *atlantica* (Bailey), Israelsky, 6th Pacific Sci. Cong. 1939, Proc. vol. 2, p. 572, pl. 1, fig. 4, 1940.

Test triangular in cross section throughout, two sides about equal and slightly broader than the third; early portion large, triserial, tripyramidal, flaring rapidly; margins of biserial portion subparallel, then narrowing to rounded apertural end, sutures obscure; apertural view trigonal, the final face narrower than the previous one, aperture lying between final and penultimate chambers to rear of well-defined notch; made of medium-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Figured	19	560535	0.81	0.46 (narrow face) .53 (wide face)
Figured	19	560536	.88	.46 (narrow face) .58 (wide face)

The specimen shown on figures 20-22 is different in apertural aspect, having the final chamber on the broad rather than on the acute side of the test. The sinuous, strongly reflexed sutures are also visible. The species is rather varied but the specimen shown on figures 16-19 is typical.

The type of the species, seen at the California Academy of Sciences, is very similar but rougher than the Lodo specimens. Those figured from Marysville Buttes as *G.* rel. *atlantica* (Bailey) are smoother. If these textural variations should prove to have distinctive stratigraphic ranges they should be discriminated. Within this single Lodo section the texture appears consistent.

Gaudryina (*Pseudogaudryina*) *coalingensis* Cushman and G. D. Hanna seems closer to *G.* (*Pseudogaudryina*) *atlantica* (Bailey) from which it differs noticeably by being much blunter at both ends, than to *G.* (*Pseudogaudryina*) *jacksonensis* Cushman. (See Cushman, 1937, pl. 14, especially fig. 4, and Cushman 1933, p. 9).

Gaudryina (Pseudogaudryina) coalingensis Cushman and G. D. Hanna var. alata Israelsky, n. var.
Plate 6, figures 23–27

The variety differs from the typical form by having strongly marked depressions in the paired faces, resulting in alate projections of the margins formed by those faces and the appearance of a Y with flattened wings in apertural view.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	45	560537	0.77	0.53 (narrow face) .65 (wide face)

The variety seems to grade into the typical form, and occurs within its range. A few specimens are much more compressed than the holotype and have strong resemblance to *G. soldadoensis* Cushman and Renz (1942, p. 4).

Gaudryina (Pseudogaudryina) sp. A
Plate 6, figures 28–32

Matched faces elongate subtriangular, terminal end rounded; unmatched face subquadrate, sides nearly parallel, rounded at both ends; early portion short, triserial, tripyramidal with a shallow groove on each face; sutures of biserial portion strongly reflexed and somewhat grooved on paired sides resulting in a serrated ridge at their juncture; final chamber inflated, apertural view suboblate, nearly straight at one end, rounded at the other; aperture an elliptical opening in shallow notch lying between the final and penultimate chambers; made up of roughly cemented coarse sand grains.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Figured	22	560538	1.16	0.60 (narrow face) .73 (wide face)

No species comparable to this form, which is rare at this and other localities, were noted.

Gaudryina (Pseudogaudryina) phenocrysta Israelsky n. sp.
Plate 7, figures 1–4

Outline subtrigonal in side view; early portion triserial, tripyramidal, forming about half the length; margins of biserial portion subparallel, anterior margin rounded however viewed; on the unmatched face and one of the paired faces sutures strongly depressed giving an inflated appearance to the chambers, the remaining face with but slightly depressed sutures; apertural view quadrate-oblate, aperture elongate, lying in notch between the final and penultimate chambers; test of coarse sand with phenocryst-like larger grains, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	6+1′	560539	0.92	0.57 (narrow face) .63 (wide face)

Apparently the closest figured specimen is one from the Velasco shale of Mexico, called *Gaudryina* sp. by Cushman (1926, p. 588). However, his specimen is much smaller, the chambers are not inflated, and the apertural face is less rounded.

Gaudryina (Pseudogaudryina) pyramidata (Cushman) subsp. tumeyensis Israelsky n. subsp.
Plate 7, figures 5–12

Outline trigonal however specimen is viewed, the two matched lateral faces broader than the third face; early portion triserial, pyramidal, about one-third of length, two sides strongly grooved, the other not; biserial portion with sutures curved, more depressed on one matched face than on the other, resulting in chambers being more inflated on one matched face than on the other; end view roundly subtrigonal; aperture in a gentle notch, between the final and penultimate chambers; test built of medium-grained sand, fairly smoothly cemented. In contrast to the holotype, the paratype has the final chamber at the broad rather than the narrow side and exhibits a more pronounced apertural notch. The paratype is also much shorter at the same stage of growth.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	6+1′	560540	0.94	0.56 (narrow face) .70 (paired faces)
Paratype	6+1′	560541	0.61	.31 (narrow face) .40 (paired faces)

Cushman's type figure (1926, pl. 16, fig. 8) of *G. (Pseudogaudryina) pyramidata* Cushman shows a triserial portion of about two-thirds the test's length, the sutures are more reflexed, the chambers appear less inflated, and the apertural view outline is quadrate. White's side view (1928, pl. 42, fig. 7) shows little in common with either Cushman's view of the holotype or with our figures, but is very similar to the present subspecies in apertural view. No other apertural views of similar species were found in the literature.

Gaudryina (Pseudogaudryina) corrugata Israelsky n. sp.
Plate 7, figures 13–17

Viewed on broad matched side, broadly subtrigonal, outline of initial portion rounded; initial portion short triserial, tripyramidal, two faces slightly broader than the third; chambers of biserial portion low, inflated; sutures strongly depressed on broad faces; viewed on narrow unmatched side narrowly subtrigonal, surface slightly depressed medially except for final two chambers; apertural view oblately subtriangular, final face broadly rounded, penultimate face with subangular outline; aperture rounded, notched, lying between the final and penultimate faces; test made of fine sand with a few larger grains, rather smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	61	560542	0.64	0.35 (narrow face) .58 (wide face)
Paratype	61	560543	.46	.35 (narrow face) .52 (wide face)

The paratype (pl. 7, fig. 17) is oriented to show apertural appearance with final chamber at unmatched side. Other specimens show a pointed initial end in broadside view. This variation in outline seems due to the varied position of the pyramidal portion in relation to the biserial portion.

Gaudryina (Pseudogaudryina) rutteni Cushman and Bermudez is related, but has more strongly curved sutures, is relatively more compressed, and has a subquadrangular outline as viewed aperturally (Cushman, 1937a, p. 90).

Genus Bermudezina Cushman, 1937

Either a new genus must be erected for the species described below or the conception of the genus *Bermudezina* slightly modified to accommodate it. The latter seems preferable. The diagnosis, formed by adding the words "rounded rim or" to Cushman's description (1937a, p. 102), would then become

Test similar to *Gaudryina* in general structural characters, especially the subgenus *Pseudogaudryina*, but differing in

the apertural characters which consist of a [rounded rim or] rounded, tubular neck in a terminal position on the last-formed chamber, the aperture circular.

Bermudezina bramlettei Israelsky n. sp.

Plate 7, figures 18–24

Viewed on broad faces outline crudely oblate, breadth increasing from initial end, then narrowing through final chamber, sutures depressed; viewed on narrow face outline subrectangular, sides nearly straight, ends rounded; apertural view subtrigonal, aperture an elliptical opening in the final face surrounded by weak rim; initial portion triserial, pyramidal, all faces slightly concave, the juncture of the two matched faces forming a serrated ridge; test of medium-grained sand fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	39	560544	1.05	0.48 (narrow face)
				.59 (wide face)
				.63 (wide face)
Paratype	39	560545	0.90	.49 (narrow face)
				.58 (wide face)

The paratype is figured to show appearance of apertural view with final chamber on the acute margin, also large included sand grains.

There is some resemblance to *B. pleionensis* (Cushman) but that species is relatively narrow and lacks the serrated ridge (Cushman, 1937, p. 103). Two forms probably referable to *Bermudezina* are *Gaudryina*(?) sp. 1 and *Gaudryina*(?) sp. 2 of Cuvillier and Szakall (1949, pp. 21, 22), both of which are relatively narrower, with lower chambers and in *Gaudryina*(?) sp. 2 apparently with all marginal angles serrate. Except for the terminal aperture *B. bramlettei* would fit in *Gaudryina* (*Pseudogaudryina*).

Genus Pseudoclavulina Cushman, 1936

Pseudoclavulina variata Israelsky n. sp.

Plate 7, figures 25–29

Test elongate, earliest portion triserial, tripyramidal; followed by a triserial, triangular, prism-like section of about twice the length of the pyramidal portion; then a uniserial portion about equal in length to the triserial portion, with first three chambers oblate-spheroidal, variably compressed in direction of length, the final chamber juglike, produced at the apertural end to form a poorly defined rim about the aperture, which is an irregularly elongate opening in the final face; test built of fine-grained sand with very smooth cement.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	37	560546	2.67	0.69	.....
Paratype	37	560547	.54	.....	.....

The paratype shows the early pyramidal portion and is of interest because of the narrow comma-like aperture extending from the base of the apertural face into that face rather than being along the interface.

Pseudoclavulina eggeri Cushman (1937, p. 111) has less compressed uniserial chambers and a proportionally greater length of the uniserial portion. portionately greater length of the uniserial portion. *P. humilis* (H. B. Brady) also lacks the high degree of compression in the uniserial chambers and is more coarsely textured (Cushman, 1937a, p. 116).

Pseudoclavulina emaciata Israelsky n. sp.

Plate 7, figures 30–33

Test elongate, earliest portion triserial, tripyramidal, with distinctly rounded edges; followed by triserial triangular prismlike section slightly longer than the pyramidal portion; then a uniserial portion about one and one-third times as long as the triserial portions, the first two chambers oblate spheroidal, compressed in direction of length, the final chamber juglike and produced at the apertural end forming a poorly defined rim about the aperture, which is an irregular dewdroplike opening in the final face; test built of fine-grained sand, fairly smoothly cemented, grains coarser on final than on initial end.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	37	560548	1.35	0.32	.....

The character most clearly distinguishing this species from *P. variata* is the conspicuous roundness of edges in the pyramidal portion.

Pseudoclavulina prismatica Israelsky n. sp.

Plate 8, figures 5–8

Test elongate, earliest portion triserial, tripyramidal with rounded edges and slightly excavated faces; followed by triangular prismlike section about twice the length of the pyramidal portion, composed of uniserial chambers; final chamber inflated, juglike, slightly produced, forming a weak rim about the cruciform aperture; apertural view roundly subtrigonal; test made of medium-grained roughly cemented sand with distinctly sugary appearance.

A sectioned specimen showed five uniserial chambers.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	37	560550	1.70	0.50	.....

This species somewhat resembles *Clavulinoides trilatera* (Cushman) but that species has a much more definitely trigonal outline of the apertural face, the edges tend to be ridged, and the sutures are strongly depressed (Cushman, 1937a, p. 121).

Pseudoclavulina copiosa Israelsky n. sp.
Plate 7, figures 34–36; plate 8, figures 1–4

Test elongate, earliest portion triserial, tripyramidal with rounded edges; followed by subcylindrical uniserial section of five chambers, the last two more inflated and higher than the previous three; apertural view circular; test made of medium-grained roughly cemented sand, giving distinctly sugary appearance.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	6+1′	560549	1.74	0.53	.....

The aperture of the holotype is not detectible, but another specimen (lost) is figured (pl. 7, figs. 34-36) to show comma-like aperture in the final face.

Under the name *Clavulina(?) parisensis* d'Orbigny, Schwager (1883, p. 116) figures a similar form, but the pyramidal portion is more acute than in *P. copiosa*. Schwager's figure, the closest noted, appears to represent a *Pseudoclavulina*.

Genus Clavulinoides Cushman, 1936
Clavulinoides inflatus Israelsky n. sp.
Plate 8, figures 9–15

Test crudely subcylindrical, pointed at initial end, truncate at apertural end; initial portion short, triserial, tripyramidal, faces furrowed; followed by a swollen, somewhat compressed biserial portion, which together with the triserial portion forms half the length of the test; final portion uniserial with a constriction between it and the biserial portion, sutures indistinct; apertural view subcircular, aperture a three-quarter moonlike opening in the final face. Paratype U.S.N.M.no. 560552 (pl. 8, figs. 14, 15) shows biserial portion in accidental cross section.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Holotype	22	560551	0.77	0.32 shortest .34 greatest

This species fits poorly in the genus *Clavulinoides*, lacking triangular cross section in the short initial portion. No comparable species have been placed in the genus. Some *Pseudoclavulina* have superficial resemblances. In general appearance this species closely resembles several species of *Schenckiella*.

Clavulinoides sp. A
Plate 8, figures 16–23

Specimens of the general nature of the figured individual are included here. They are rare in this section of Lodo formation.

The figured specimen shows relationships to *C. trilatera* var. *concava* (Cushman) and *C. cubensis* Cushman and Bermudez, (Cushman, 1946, pl. 9, figs. 18, 19; 1937a, p. 130, pl. 18, figs. 18-20) but until a suite of this type of *Clavulinoides* is available, its relationships must remain hazy.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width (lateral faces)
Figured	45	560553	0.75	0.32 .33 .31

Family VALVULINIDAE
Subfamily EGGERELLINAE
Genus Marssonella Cushman, 1933
Marssonella sp. A
Plate 8, figures 24–31; plate 10, figures 22–25

Test broadly subconical, with length slightly greater than maximum diameter; initial end broadly rounded, terminal end truncated, early chambers obscure but probably five-chambered for about one-third of the length, final chambers biserial; apertural face subrounded, contact between final two faces four-lobed; test composed of fine sand roughly cemented except the penultimate face which is smoothly cemented, final face either coarser grained or more poorly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	6+1′	560554	1.19	0.99
Figured	6+1′	560555	0.41	.58

A specimen that reached the triserial stage is figured on plate 8, figs. 29-31; this specimen subsequently was used for sectioning (pl. 10, figs. 22-25). The eroded initial end of this specimen exposed what appeared to be 5 chambers and 5-, 4-, and three-chambered whorls were found. Specimen U.S.N.M. 560555, taken to be the young form, shows six chambers. Only one biserial, one triserial and four six-chambered specimens were found, all in sample 6+1′.

Because this species has comparatively flat apertural faces it is placed in *Marssonella* rather than *Dorothia*. Though it superficially resembles *Textulariella* this species lacks the internal complexity

of that genus. Its stoutness seems to make it unique among both *Marssonella* and *Dorothia.*

Marssonella lodoensis Israelsky n. sp.
Plate 9, figures 1–6; plate 10, figures 26, 27

Test subconical, elongate, tending toward subcylindrical in last third of length, cross sections subcircular; earliest chambers not distinctly seen, final chambers biserial, later sutures somewhat depressed; walls made up of medium-grained sand, roughly cemented; apertural and penultimate faces rather flat; aperture a narrow elongate opening below base of the inner margin of the last chamber.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Holotype	6+1′	560556	1.10	0.63
Paratype	6+1′	560557	.87	.55
Paratype	6+1′	560558	.61	.52

One paratype, U.S.N.M. 560557, is similar to the holotype but the subcylindrical form of the paratype was developed earlier and the triserial and four-chambered portions are indistinctly visible. The specimen is rounder in apertural view than the holotype. A second paratype, U.S.N.M. 560558, is a young specimen with conical test. In apertural view, three fully developed chambers, and part of a fourth, can be seen. The sutures are indistinct. Sectioning of one specimen (pl. 10, figs. 26, 27) revealed the four- and five-chambered portions. The chambers seemed to be filled with calcite.

This species belongs to the *M. oxycona* (Reuss) group. Cushman (1937b, p. 56) permits that species great latitude. Reuss' original figure (reproduced by Cushman) shows much more compression and a sharper apical angle than does *M. lodoensis* n. sp. Views of *M. indentata* (Cushman and Jarvis), are quite similar (Cushman, 1937b, pl. 6, figs. 21, 22), but are described as "smoothly finished" and as having indented sutures.

Marssonella angulata Israelsky n. sp.
Plate 9, figures 7–9; plate 10, figures 28–29

Test elongate, tapering early portion subconical, becoming subcylindrical, rounded in transverse section, greatest diameter about one-third distance from apertural end; early portion obscure, biserial portion forming about seven-tenths of length, sutures gently depressed, earliest sutures horizontal, later concave toward terminal end, chambers comparatively high; final face at nearly forty-five degree angle to long axis; apertural view subcircular, contact of final two faces sinuous, weakly trilobate, aperture not clearly seen; test composed of fine-grained sand, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Holotype	6+1′	560559	1.12	0.62

A sectioned specimen was filled with calcite, so chambers nearer the apex than the illustrated four-chambered section could not be detected (pl. 10, figs. 28, 29). It is believed the three-chambered stage was hazily seen. The biserial portion forms a greater part of the test than is common in the genus.

Textulariella paalzowi Cushman (1937, p. 62) strongly resembles *M. angulata* Israelsky n. sp., but has comparatively lower chambers and according to Cushman the chambers are divided by radial partitions.

Marssonella impendens Israelsky n. sp.
Plate 9, figures 10–12; plate 10, figures 30–34

Test elongate, tapering, early portion subconical, becoming subcylindrical, rounded in transverse section, greatest diameter before final chamber; early portion obscure; early half of subcylindrical portion triserial with some chambers overlapping toward apical end, last half biserial, sutures through triserial portion convex apically, nearly straight in biserial portion; final face at about sixty degree angle to long axis; apertural view subcircular, contact of final two faces sinuous, bilobate, aperture in the sinus between the final two chambers; test composed of fine-grained sand roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Holotype	6+1′	560560	0.83	0.38

A sectioned specimen showed two-, three-, and four-chambered whorls (pl. 10, figs. 30-32).

Marssonella impendens n. sp. is distinguished from *M. lodoensis* n. sp. by the much less elongate four-chambered stage and perhaps by the lack of initial five-chambered stage. It lacks the smooth finish and indented sutures of *M. indentata* (Cushman and Jarvis) as described by Cushman (1937b, p. 59).

Genus Dorothia Plummer, 1931

Dorothia cubensis (Cushman and Bermudez)
Plate 9, figures 13–15; plate 10, figures 35–39

Tritaxilina cubensis Cushman and Bermudez, Cushman Lab. Foram. Research Contr., vol. 12, pl. 10, figs. 25, 26, 1936; vol. 13, p. 7, 1937. [Eocene]
Cushman, Jos. A., Cushman Lab. Foram. Research, Spec. Pub. 8, p. 156, pl. 18, figs. 4, 5, 1937. [Eocene]
Cushman, Jos. A., Cushman Lab. Foram. Research Contr., vol. 16, p. 54, pl. 9, fig. 9, 1940. [Paleocene (Midway)]

T. cubensis Cuvillier, J. and Szakall, V., Foraminifères d'Aquitaine, pt. 1: Soc. Nat. des Pétroles d'Aquitaine, p. 34, pl. 12, fig. 3, 1949. [Eocene]

Test elongate, fusiform, about twice as long as broad, greatest breadth at or a little above the middle, apertural end rounded, initial end pointed; chambers fairly distinct, with deep excavation at the base at either side, middle of chambers extending downward; sutures fairly distinct, depressed; wall coarsely arenaceous, rather smoothly finished; aperture small, narrow, at right angles to the inner margin, in a distinct depression. Length up to 1.50 mm.; diameter 0.75 mm. — Cushman and Bermudez, 1937.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	63	560561	1.04	0.58

A specimen in the triserial stage was sectioned and revealed six, five-, and four-chambered whorls (pl. 10, figs. 35-39), and the triserial portion was recognized externally. The sections revealed no suggestion of labyrinthine structure, and the specimens from the Lodo certainly are not *Tritaxilina*. The four references cited do not take note of the internal structure.

If the Lodo specimens are correctly referred to *Tritaxilina cubensis* Cushman and Bermudez, the species must be removed from *Tritaxalina*. The short biserial portion is rare in *Dorothia* but seemingly the species must be placed in that genus.

This species differs from *T. hantkeni* Cushman in the very deep depressions at the sides of the base of the chambers, and the depressed sutures. — Cushman and Bermudez, 1937.

Dorothia sp. A

Plate 9, figures 16–21; plate 11, figure 29

Test elongate, fusiform, about three times as long as broad, greatest breadth near the middle, apertural and apical ends rounded; chambers fairly distinct except for smooth initial portion, sutures slightly depressed, transverse sutures nearly perpendicular to length, earliest number of visible chambers per whorl four, followed by triserial and biserial portions; apertural view subcircular, aperture between final and penultimate chambers in sinus between lobes; test composed of roughly cemented fine-grained sand.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	38	560562	1.06	0.50
Figured	38	560563	1.02	.50

The specimen shown on plate 9, figures 19-21 has a smoother surface and a final suture at a higher angle than the one shown on figures 16-18, but is tentatively considered the same. A roughly cemented specimen sectioned revealed only the biserial portion clearly, as it is filled with cemented sand much like the shell wall. The biserial chambers (pl. 11, fig. 29) show simple structure. The species is not named as it is rare, and was found in but three samples.

It is externally most like *Tritaxilina colei* Cushman and Siegfus as figured from the Eocene of California (Cushman, 1937b, p. 155) but is more gently tapered and has a shorter four-chambered stage.

Dorothia excentrica Israelsky n. sp.

Plate 9, figures 22–26; plate 11, figures 18–24

Test somewhat ovoid, side view very roundly trigonal, edge view subelliptical, more pointed at the initial than at the apertural end, sutures indistinct except last, final chamber somewhat inflated; traces of the four-chambered and triserial portions visible; apertural view broadly elliptical, the comma-shaped aperture in sinus between the final and penultimate faces, the sinus excentric; the test composed of fine-grained sand very smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Holotype	63	560564	0.47	0.26
Paratype	63	560565	.24	.22

Paratype U.S.N.M. 560565 reaches a four-chambered stage and resembles *Eggerella*.

Sections, some of which were poorly oriented, of two specimens from sample 63 reveal the 5-4-3-2 chamber plan (pl. 11, figs. 18-24). Chambers were hollow. None of a large suite of specimens showed the apertural sinus in a central position.

In general form similar to *D. inflata* Colom (1945, p. 292) but with relatively lower final and penultimate chambers and having biserial portion developed much later.

Dorothia sp. B

Plate 9, figures 27–29

Test elongate, side view subtrigonal, edge view roundly subquadrangular, earliest chambers not visible, four-chambered whorl definitely present, short triserial section, biserial portion forming about three-quarters of length, last three chambers inflated and final chamber produced toward outer margin, sutures flush through triserial portion, depressed in biserial portion; apertural view subrounded, aperture in sinus between final and penultimate faces; test composed of fine sand grains, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Width
Figured	37	560566	0.44	0.29 greatest .27 least

A sectioned specimen from sample 38 failed to reveal clearly the wall outlines of the chambers because of the similarity of the filling material to the shell wall. A few specimens of this species were found in two samples.

In general appearance this species is much like *Textulariella paalzowi* Cushman (1937, p. 62) but the latter has partitioned chambers. *Marssonella angulata* n. sp., is more pointed, its sutures are more angular, its final faces are flat rather than inflated, and the suture between the final two chambers as seen in the apertural view is trilobate rather than bilobate.

Dorothia sp. C

Plate 9, figures 30–32; plate 11, figures 25–28

Test elongate, somewhat fusiform, greatest breadth about central, initial end rounded, followed by short portion with pentagonal cross section, the rest of test subcircular in cross section, chambers fairly distinct, five-, four-, three- and two-chambered stages externally discernible, almost half of length formed by biserial chambers; sutures fairly distinct, depressed, in part of the five-chambered stage strongly excavated; apertural view subcircular, aperture between final two faces in a shallow notch whose inner margin is sinuous; test composed of fine sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	6+1′	560567	1.34	0.69

The species is rare, and has been found only in sample 6+1′.

A sectioned specimen (pl. 11, figs. 25-28) shows chamber outlines through the five- and four-chambered stages. The three- and two-chambered stages were indistinct. The five-chambered stage has about the same length as the four- and three-chambered stages combined.

In external view this species most closely resembles *Tritaxalina hantkeni* Cushman (1937b, p. 157) but the latter, besides having a relatively longer taper, has relatively shorter biserial and five-chambered stages, and Cushman remarks that the periphery is subdivided.

Dorothia bulbosa Israelsky n. sp.

Plate 9, figures 33–35; plate 11, figure 17

Test elongate, side view subelliptical, edge view subquadrate, ends broadly rounded, cross sections subcircular; earliest chambers not visible, a short triserial and four-chambered phase discernible, about the final six-tenths biserial; height increasing rapidly in the last three chambers; sutures flush except those bounding final two chambers which are swollen, sutures approaching the horizontal; apertural view subrounded, the final suture three-lobed, the middle lobe extending over the aperture which lies between the final two chambers; test made of very fine sand very smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	6+1′	560568	1.00	0.51

A sectioned specimen, apparently filled with calcite, failed to show chamber form clearly except in the biserial portion (pl. 11, fig. 17). Another specimen was etched with acid and it is believed five chambers surrounding a larger initial chamber were detected.

The species is very similar to *D. bulletta* (Carsey) and *D. plummeri* Brotzen (see Cushman, 1937b, p. 84, and Brotzen, 1936, p. 36). It is relatively greater in diameter and has less depressed sutures than either of these species and is also readily distinguished by the apertural lobe.

Dorothia subretusa Israelsky n. sp.

Plate 9, figures 36–38; plate 11, figures 4, 5

Test stout, broadly elliptical in cross section, slightly wider than thick, outline from side roundly trigonal, from edge roundly subquadrate; early chambers not visible, triserial section terminated about three-sevenths of axial distance from apical end, last triserial chamber swollen, sutures of biserial portion distinct, slightly depressed, final chamber truncate; apertural view broadly subelliptical, the terminal suture trilobate, the medial lobe overhanging the aperture which lies at the interface of the final two chambers; test composed of fine-grained sand, very smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Diameters
Holotype	6+1′	560569	0.85	0.63 greatest .54 least

A sectioned specimen (pl. 11, figs. 4, 5) showed an early five-chambered stage and a fairly distinct biserial stage. The chambers were filled with calcite.

Dorothia retusa (Cushman) as figured by Cushman (1937b, pl. 8, figs. 33-36) from Trinidad has the closest resemblance to the present species. In the Trinidad species, however, the width is proportionally much less and apertural views show a simple bilobed overlap of the final chamber onto the penultimate chamber. The Trinidad figures but poorly resemble the original illustrations (Cushman, 1926, pl. 16, fig. 10).

Dorothia altacamerata Israelsky n. sp.
Plate 10, figures 3–6; plate 11, figures 1–3

Test stout, outline from side roundly subtrigonal, expanding rapidly from initial end; viewed on edge roundly subquadrate, early chambers not distinguishable, triserial portion terminating about three-tenths of axial distance from apical end, sutures of biserial portion distinct, somewhat depressed; subelliptical in apertural view, somewhat compressed, the terminal suture trilobate, the medial lobe overhanging the aperture which lies at the interface of the final two chambers; test composed of fine-grained sand, very smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
				Diameter	
			Length	Greatest	Least
Holotype	6+1′	560570	0.66	0.47	0.38

Five-, three-, and two-chambered portions were seen in a sectioned specimen (pl. 11, figs. 1-3). Chambers were filled with calcite and appear to have simple walls.

This species may be distinguished from *D. subretusa* n. sp. by its greater compression, shorter multiserial portion and lack of notable truncation of the final chamber.

Genus Goësella Cushman, 1933
Goësella? sp. A
Plate 9, figures 39, 40; plate 10, figures 1, 2

Test elongate, length about three times greatest diameter; earliest chambers not distinguishable, four- and three-chambered whorls apparently present, with flush sutures; biserial portion with sutures depressed, median suture visible only in one view, other sides apparently uniserial; two truly uniserial chambers present; aperture probably terminal but not clearly seen; test of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*
			Length
Figured	37	560571	0.52
Figured	37	560572	.41

One specimen (pl. 10, figs. 1, 2) failed to reveal the early chambers, but showed triserial and biserial chambers.

The specimens grouped under this heading are very erratic in growth.

Genus Karreriella Cushman, 1933
Karreriella inflata Israelsky n. sp.
Plate 10, figures 7–9; plate 11, figures 14–16

Length of test about 1½ times breadth, side view subtrigonal, edge view subquadrate; earliest chambers not detectible, triserial portion terminating about one-quarter of length from apical end; chambers in triserial and biserial portions strongly inflated with correspondingly depressed sutures; end view roundly subelliptical with marked constriction at interface of final two chambers; aperture an elongate opening in final face, enclosed by a distinct collar, elongation of aperture at angle to terminal suture; test composed of very fine sand, very smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	83	560573	0.45	0.30	0.22

In a sectioned specimen (pl. 11, figs. 14-16) the earliest clearly discerned chamber plan was the four-chambered one; triserial and biserial sections were also clearly seen. The position of the aperture is greatly varied in this genus.

Of the various figured *Karreriella, K. chilostoma* (Reuss) seems closest (Cushman, 1937b, p. 126). The present form appears more inflated and its sutures more curved than in Reuss' species.

Karreriella? lodoensis Israelsky n. sp.
Plate 10, figures 10–14; plate 11, figures 6–9

Test about twice so long as broad, outline subtrigonal in side view, edge view subquadrate; earliest chambers not detectible, triserial portion terminating about two-fifths of the distance from apical end; sutures of biserial portion only plainly discernible, somewhat depressed; apertural end view roundly subelliptical with slight constriction at interface of the final two chambers, aperture an elongate opening in the final face surrounded by a distinct collar, elongation of aperture at angle to terminal suture; test composed of fine sand, fairly smoothly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*		
			Length	Width	Thickness
Holotype	44	560574	0.58	0.29	**0.24**
Paratype	44	560575	.39	.23	.17

Paratype length nearly twice the breadth, test expanding more rapidly at the apical end than does the holotype. The apertural end view reveals that it is less twisted than the holotype.

A sectioned specimen from sample 40 failed to show chambers clearly earlier than the triserial portion (pl. 11, figs. 6-9). It will be necessary to section more specimens to confirm the assignment to *Karreriella.*

Bermudezina danica (Franke) as figured by Brotzen (1948, p. 37) is similar, but more compressed and with distinctly inflated triserial chambers.

Textularia lajollaensis Lalicker (1935, p. 46) is more pointed and apparently biserial throughout.

Reexamination of the specimen figured as *?Textularia labiata* Reuss from the Marysville formation (Israelsky, 1939, p. 571) strongly suggests that the initial portion is planispiral.

Genus Schenckiella Thalmann, 1942
Schenckiella rugosa Israelsky n. sp.
Plate 10, figures 15–19; plate 11, figures 10–13

Length of test slightly more than three times the width; early portion ovoid, slightly compressed with suggestion of biserial sutures; followed by two uniserial inflated chambers, the final with attenuated neck; test composed of fine-grained sand, roughly cemented.

Specimen	Sample	U.S.N.M.no.	*Dimensions in millimeters*	
			Length	Greatest diameter
Figured	61	560576	0.70	0.22
Paratype	39	560577	.44	.17

The paratype (U.S.N.M.no. 560577) shows a longer multichambered stage than the holotype, and the simple aperture within the attenuated neck is clearly visible.

A sectioned specimen (pl. 11, figs. 10-13) from sample 39, in the uniserial stage shows simple wall structure; biserial, triserial and four-chambered stages were also recognized.

Schenckiella weymouthi (Finlay) most closely resembles *S. rugosa* n. sp. in the form of its multiserial portion but the uniserial chambers are more numerous and relatively shorter and the apertural neck is much more sharply differentiated from the rest of the final chamber (Cushman, 1947, p. 53). *S. cubana* Cushman and Bermudez (in Cushman, 1937b, p. 139, as *Listerella cubana*) is also similar

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PLATE 2

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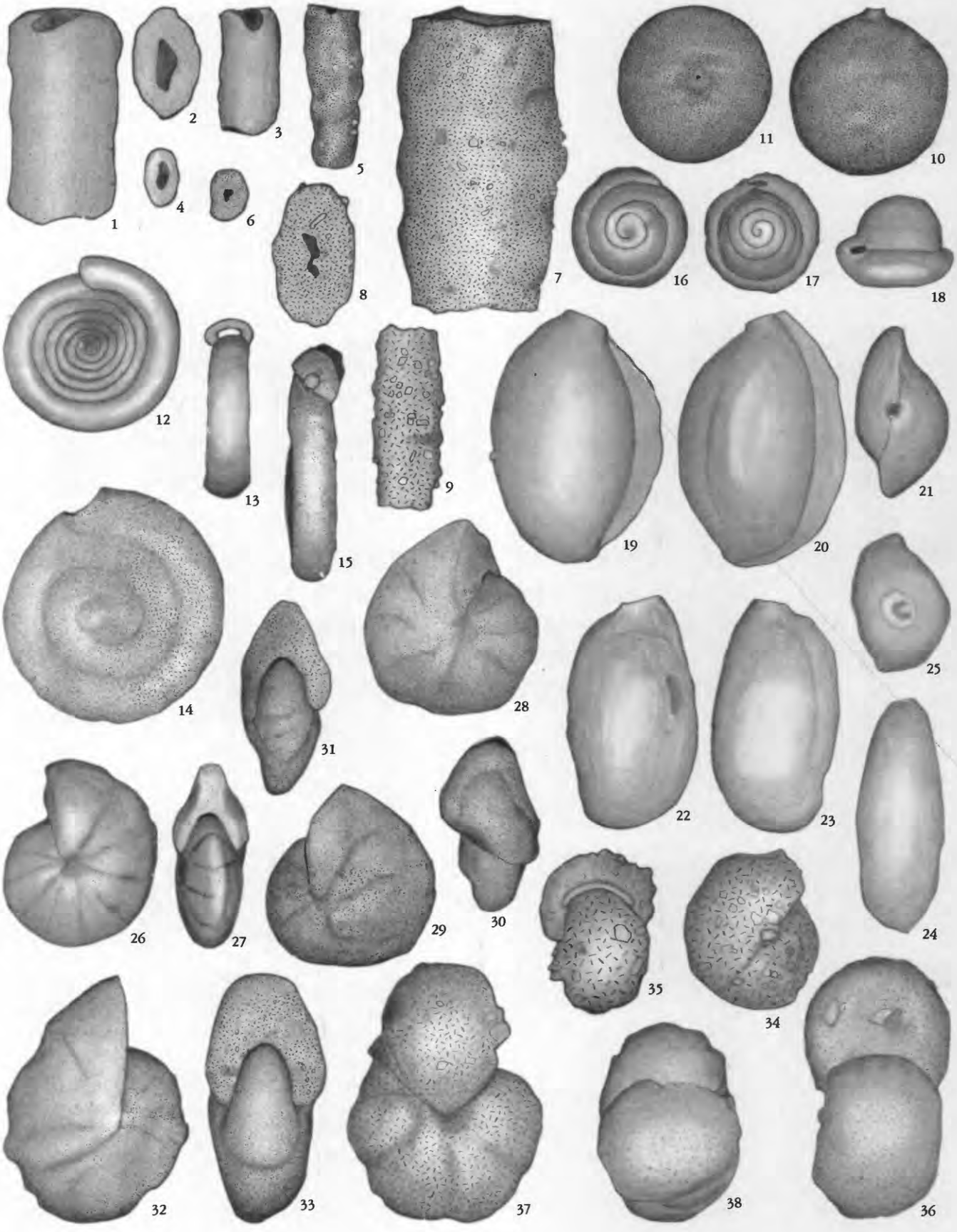

RHIZAMMINIDAE, SACCAMMINIDAE, AMMODISCIDAE, SILICINIDAE, LITUOLIDAE

PLATE 3

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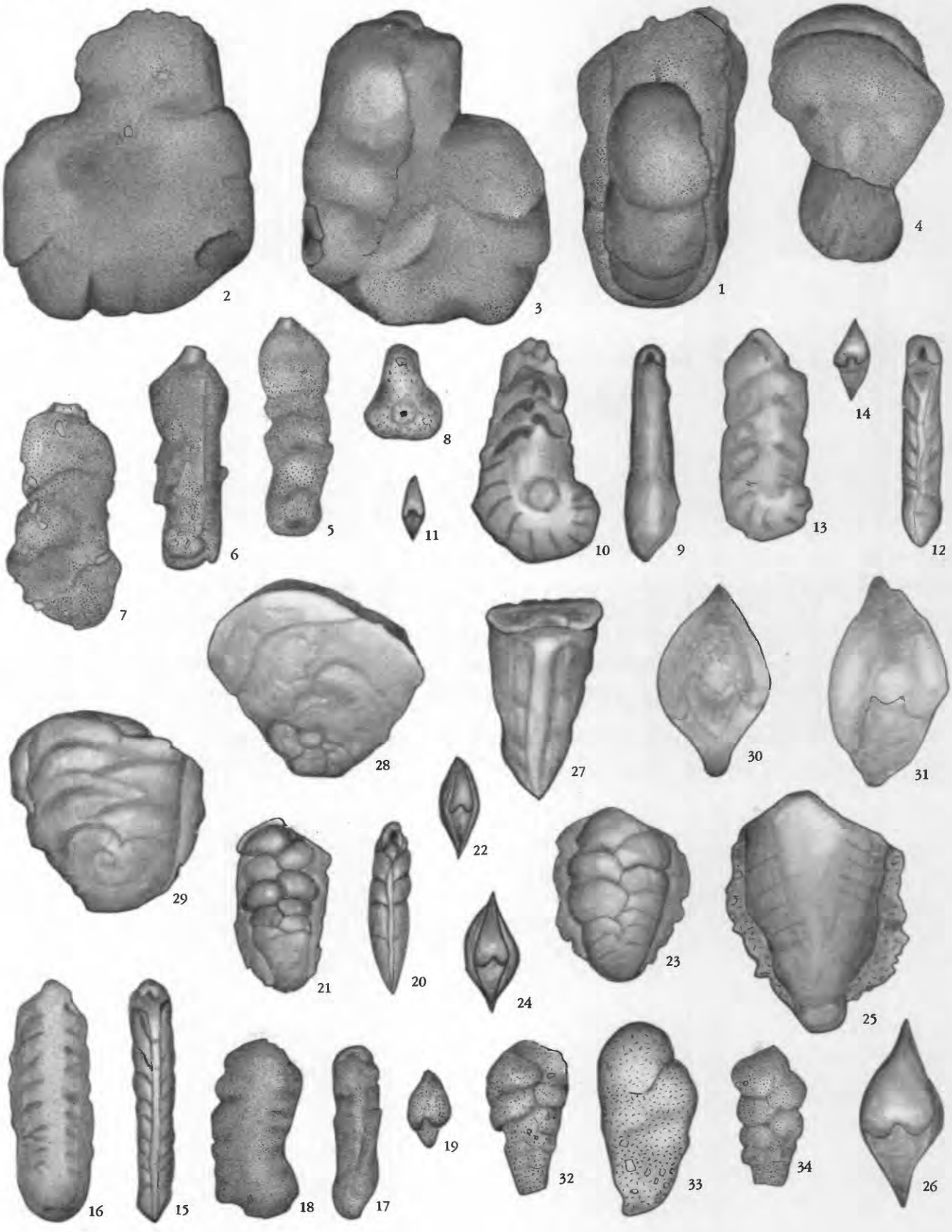

LITUOLIDAE AND TEXTULARIIDAE

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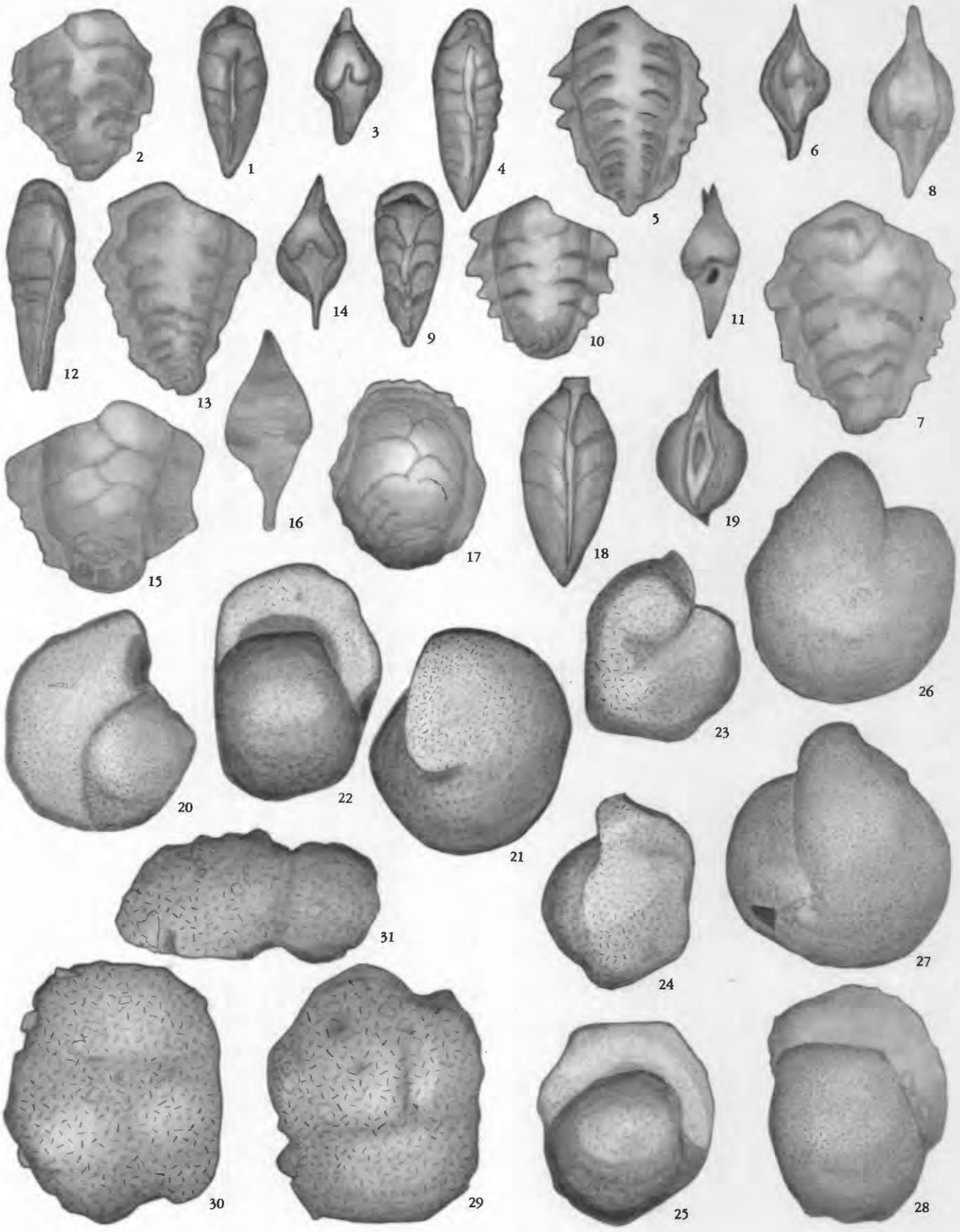

TEXTULARIIDAE, TROCHAMMINIDAE, AND AMMOSPHAEROIDINIDAE

PLATE 5

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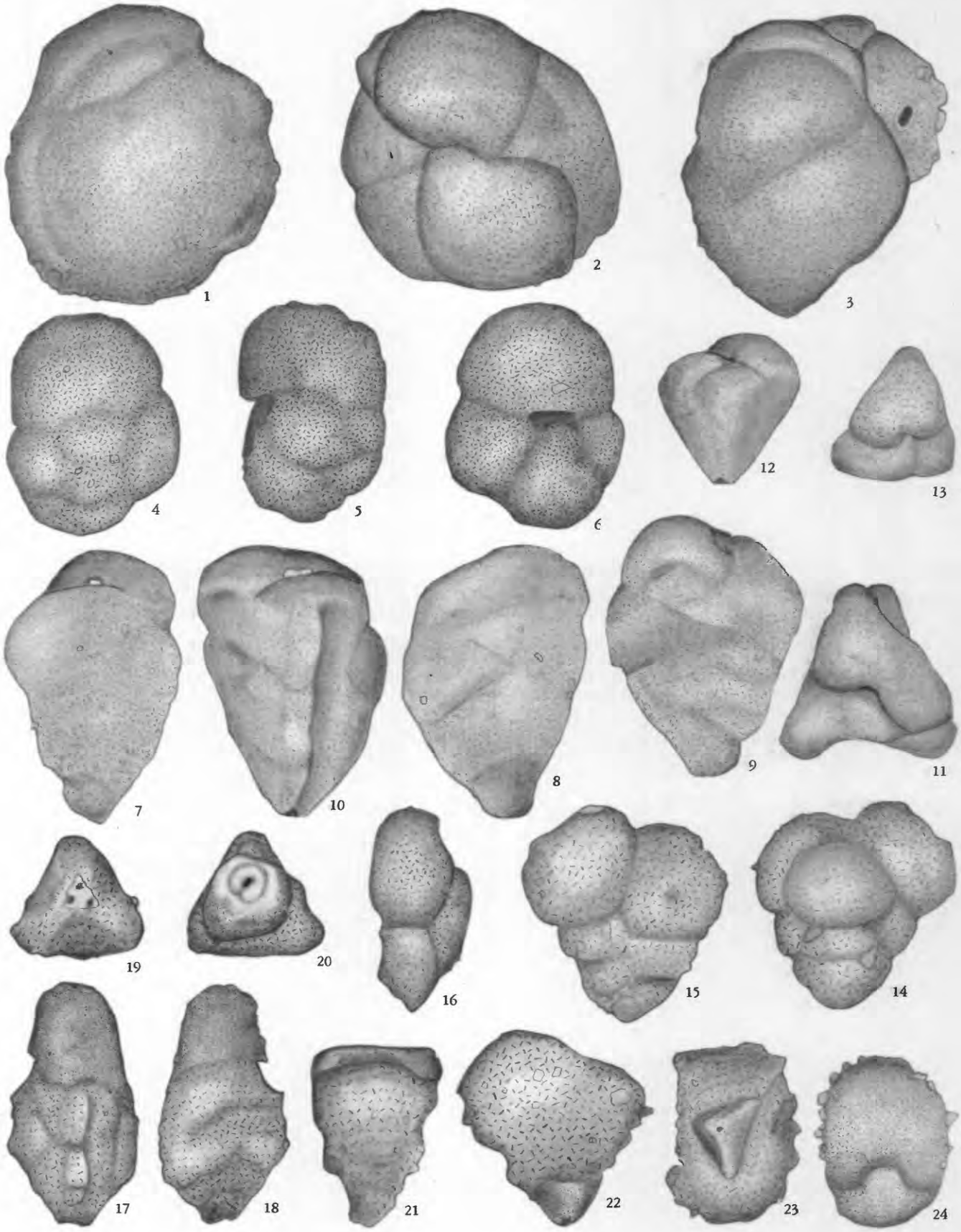

VERNEUILINIDAE

PLATE 6

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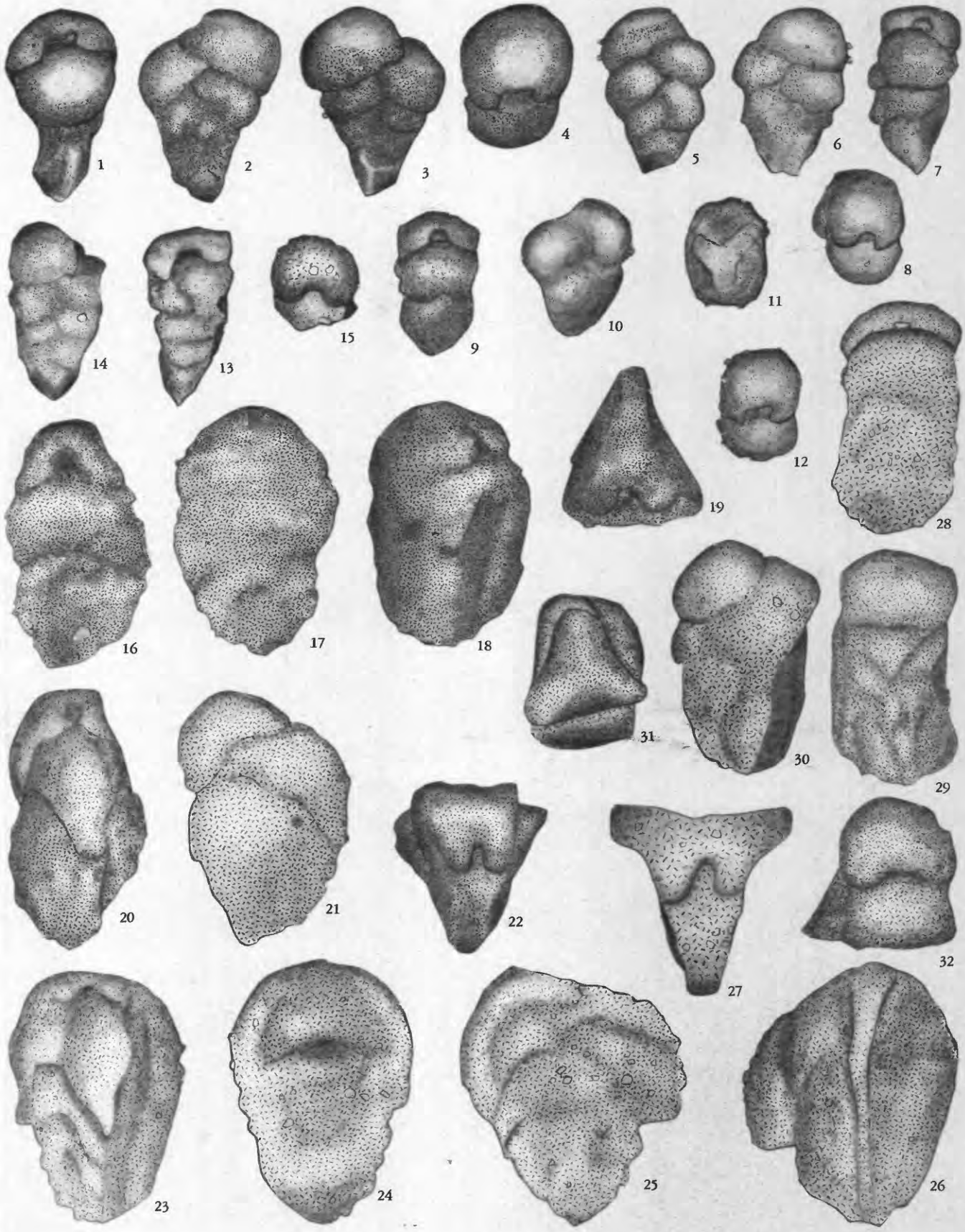

VERNEUILINIDAE

PLATE 7

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13–17. *Gaudryina (Pseudogaudryina) corrugata* Israelsky, n. sp. Holotype, narrow face, broad face, initial end and terminal end views, × 77, U.S.N.M. 560542; Paratype, 17, terminal end view, × 78, U.S.N.M. 560543. (p. 18)

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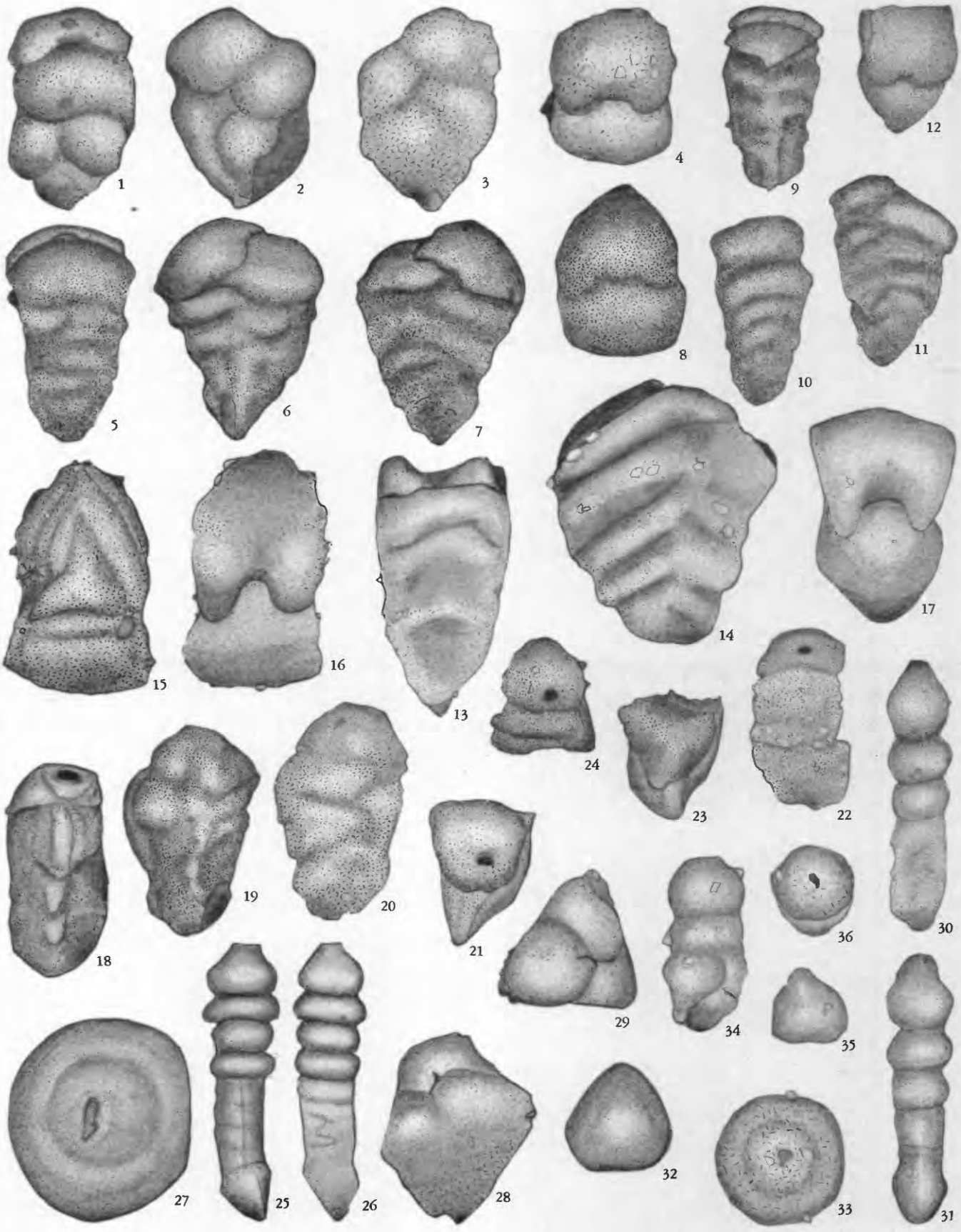
30–33. *Pseudoclavulina emaciata* Israelsky, n. sp. Holotype, side, edge, initial end, and terminal end views, 30, 31 × 38; 32 and 33 × 78, U.S.N.M. 560548. (p. 19)

34–36. *Pseudoclavulina copiosa* Israelsky, n. sp. Side, initial end, and terminal end views. Specimen lost. (p. 20)



VERNEUILINIDAE

PLATE 8

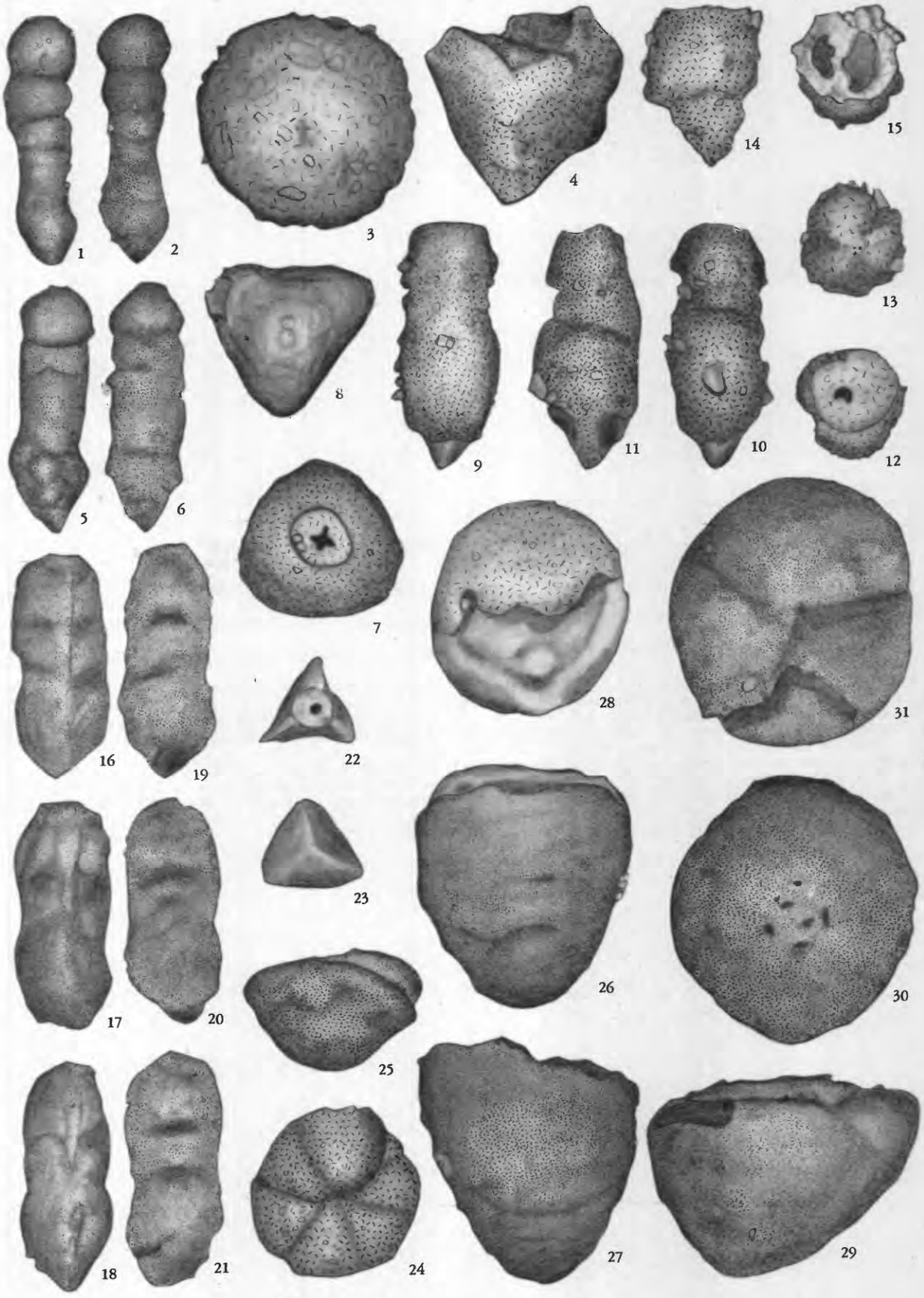
FIGURES 1–4. *Pseudoclavulina copiosa* Israelsky, n. sp. Holotype, edge, side, terminal end, and initial end views, 1, 2 × 26; 3, 4 × 74, U.S.N.M. 560549. (p. 20)

5–8. *Pseudoclavulina prismatica* Israelsky, n. sp. Holotype, edge, side, terminal end, and initial end views; 5, 6 × 26; 7, 8 × 56, U.S.N.M. 560550. (p. 19)

9–15. *Clavulinoides inflatus* Israelsky, n. sp. Holotype, 9–13, edge, side, terminal end, and initial end views, × 57, U.S.N.M. 560551; Paratype, 14, 15, side and terminal end views, × 57, U.S.N.M. 560552 (p. 20)

16–23. *Clavulinoides* sp. A. Edge, side, terminal end, and initial end views, × 59, U.S.N.M. 560553. (p. 20)

24–31. *Marssonella* sp. A. Terminal end and side views, × 53, U.S.N.M. 560555; Edge, side, and terminal end views, × 40, U.S.N.M. 560554; Side, initial end, and terminal end views, × 60, Specimen used for section (pl. 10, fig. 22–25). (p. 20)



VERNEUILINIDAE AND VALVULINIDAE

PLATE 9

FIGURES 1–6. *Marssonella lodoensis* Israelsky, n. sp. Holotype, 1, 2, side and terminal end views, × 37, U.S.N.M. 560556; Paratype, 3, 4, side and terminal end views, × 39, U.S.N.M. 560557; Paratype, 5, 6, side and terminal end views, × 37, U.S.N.M. 560558. (p. 21)

7–9. *Marssonella angulata* Israelsky, n. sp. Holotype, edge, side, and terminal end views, × 40, U.S.N.M. 560559. (p. 21)

10–12. *Marssonella impendens* Israelsky, n. sp. Holotype, edge, side, and terminal end views, × 56, U.S.N.M. 560560. (p. 21)

13–15. *Dorothia cubensis* (Cushman and Bermudez). Edge, side, and terminal end views, × 38, U.S.N.M. 560561. (p. 21)

16–21. *Dorothia* sp. A. 16–18, Edge, side, and terminal end views, × 36, U.S.N.M. 560562; 19–21, Edge, side, and terminal end views, × 38, U.S.N.M. 560563. (p. 22)

22–26. *Dorothia excentrica* Israelsky, n. sp. Holotype, 22–24, edge, side, and terminal end views, × 77, U.S.N.M. 560564; Paratype, 25, 26, Edge and terminal end views, × 82, U.S.N.M. 560565 (p. 22)

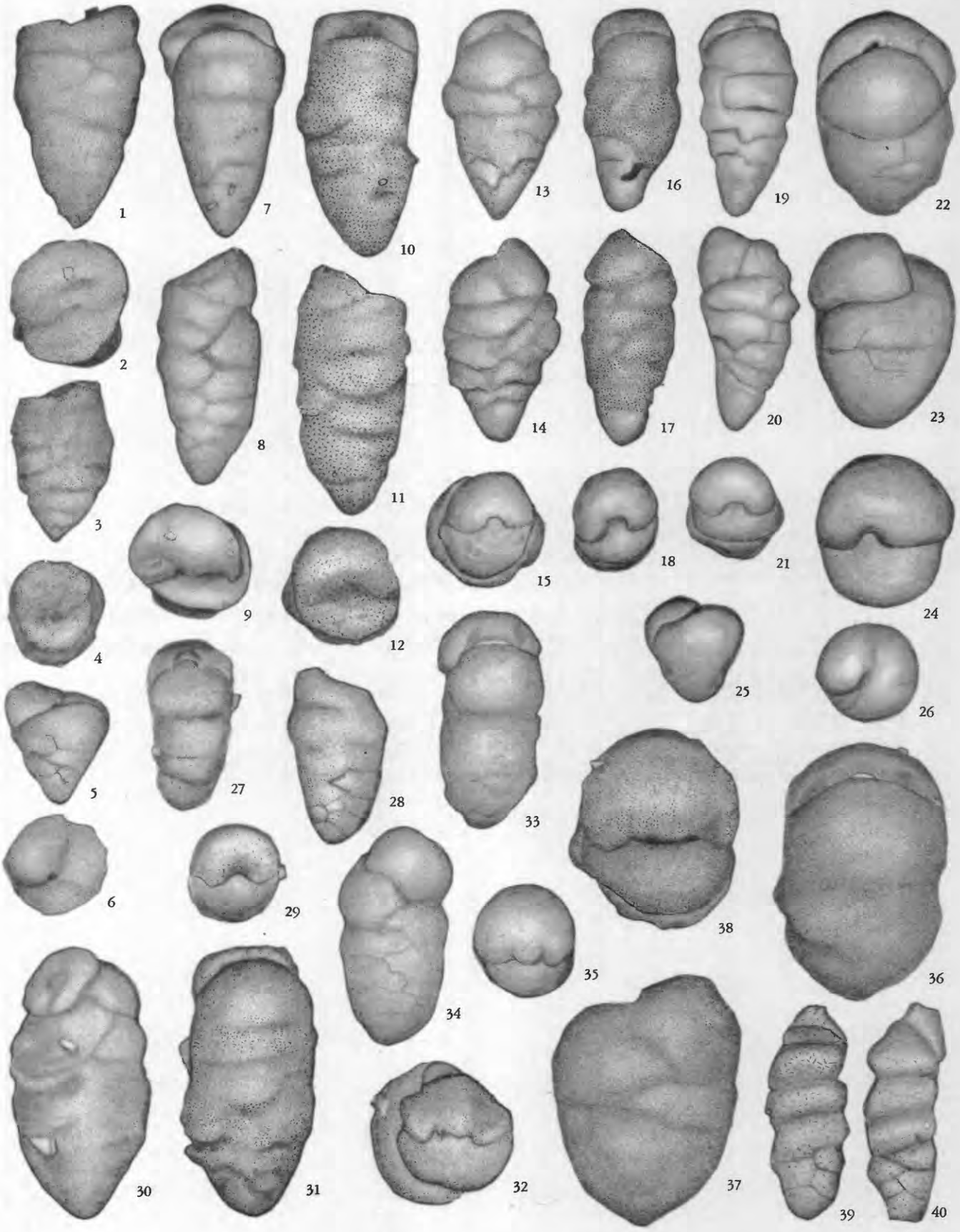
27–29. *Dorothia* sp. B. Edge, side, and terminal end views, × 75, U.S.N.M. 560566. (p. 22)

30–32. *Dorothia* sp. C. Side, edge, and terminal end views, × 38, U.S.N.M. 560567. (p. 23)

33–35. *Dorothia bulbosa* Israelsky, n. sp. Holotype, edge, side, and terminal end views, × 41, U.S.N.M. 560568. (p. 23)

36–38. *Dorothia subretusa* Israelsky, n. sp. Holotype, edge, side, and terminal end views, × 55, U.S.N.M. 560569. (p. 23)

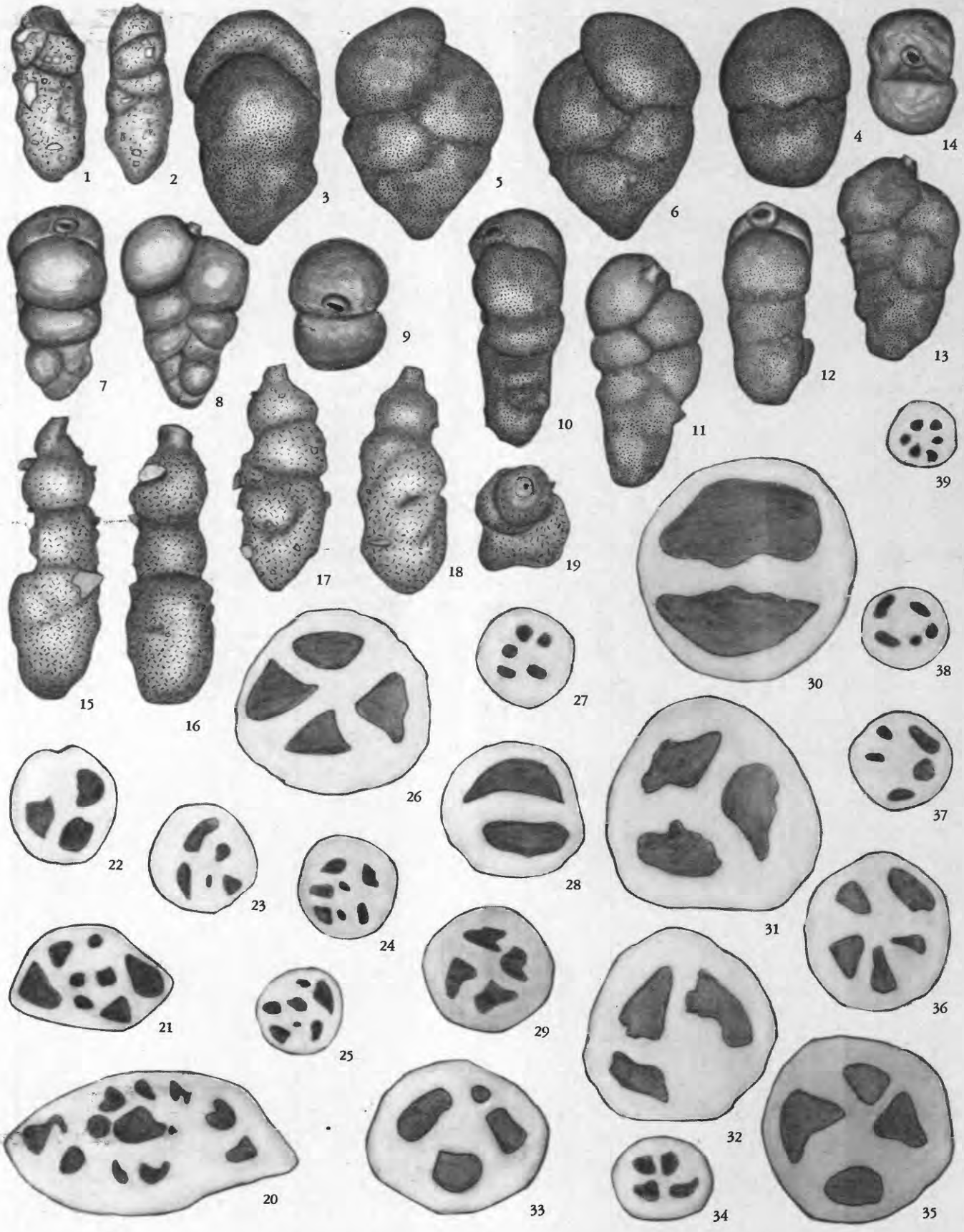
39, 40. *Goesella?* sp. A. Side and edge views, × 79, U.S.N.M. 560571. (p. 24)



VALVULINIDAE

PLATE 10

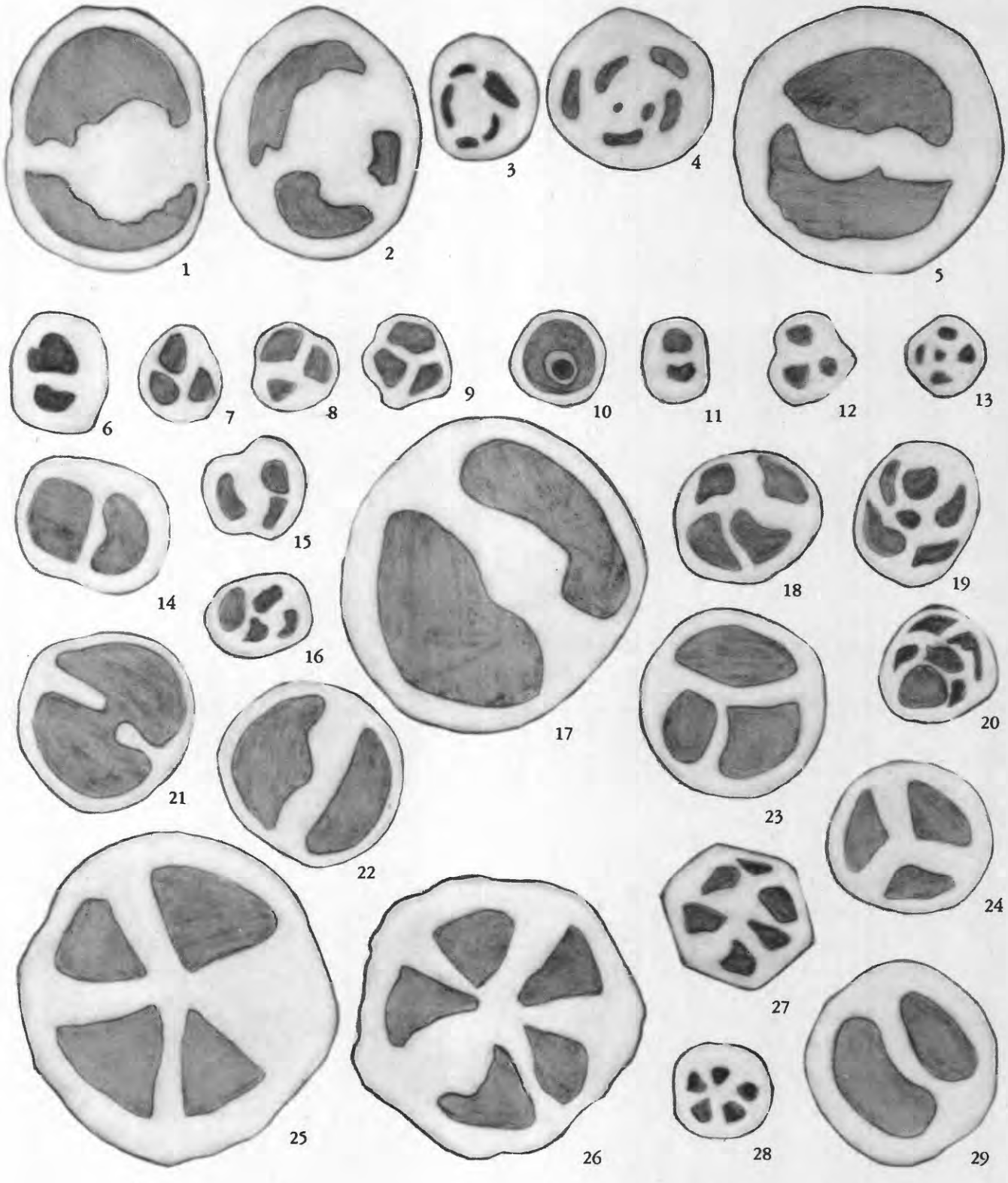
FIGURES 1, 2. *Goesella?* sp. A. Side and edge views, × 82, U.S.N.M. 560572. (p. 24)
3–6. *Dorothia altacamerata* Israelsky, n. sp. Holotype, edge and side views, × 65, U.S.N.M. 560570. (p. 24)
7–9. *Karreriella inflata* Israelsky, n sp. Holotype, edge, side, and terminal end views, × 80, U.S.N.M. 560573. (p. 24)
10–14. *Karreriella? lodoensis* Israelsky, n. sp. Holotype, 10, 11, Edge and side views, × 75, U.S.N.M. 560574; Paratype, 12–14, edge, side, and terminal end views, × 97, U.S.N.M. 560575. (p. 24)
15–19. *Schenckiella rugosa* Israelsky, n. sp. Holotype, 15, 16, Side and edge views, × 75, U.S.N.M. 560576; Paratype, 17–19, side, edge, and terminal end views, × 96, U.S.N.M. 560577. (p. 25)
20. *Silicosigmoilina californica* Cushman and Church. Transverse section, × 114. (p. 10)
21. *Silicosigmoilina (Bramletteia) perplexa* Israelsky, n. sp. Transverse section, × 114. (p. 11)
22–25. *Marssonella* sp. A. Transverse sections, × 28. (p. 20)
26, 27. *Marssonella lodoensis* Israelsky, n. sp. Transverse sections, × 78. (p. 21)
28, 29. *Marssonella angulata* Israelsky, n. sp. Transverse sections, × 78. (p. 21)
30–34. *Marssonella impendens* Israelsky, n. sp. Transverse sections, × 78. (p. 21)
35–39. *Dorothia cubensis* (Cushman and Bermudez). Transverse sections, × 78. (p. 21)



VALVULINIDAE

PLATE 11

FIGURES 1–3. *Dorothia altacamerata* Israelsky, n. sp. Transverse sections, × 100. (p. 24)
4–5. *Dorothia subretusa* Israelsky, n. sp. Transverse sections, × 100. (p. 23)
6–9. *Karreriella? lodoensis* Israelsky, n. sp. Transverse sections, × 132. (p. 24)
10–13. *Schenckiella rugosa* Israelsky, n. sp. Transverse sections, × 132. (p. 25)
14–16. *Karreriella inflata* Israelsky, n. sp. Transverse sections, × 132. (p. 24)
17. *Dorothia bulbosa* Israelsky, n. sp. Transverse section, × 100. (p. 23)
18–24. *Dorothia excentrica* Israelsky, n. sp. Transverse sections, × 100. (p. 22)
25–28. *Dorothia* sp. C. Transverse sections, × 100. (p. 23)
29. *Dorothia* sp. A. Transverse section, × 100. (p. 22)



VALVULINIDAE