The Foraminiferal Fauna of the Upper Cretaceous Arkadelphia Marl of Arkansas

GEOLOGICAL SURVEY PROFESSIONAL PAPER 221-A

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By JOSEPH A. CUSHMAN

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Illustrations and description of Foraminifera from the Deaderick Collections in the U. S. National Museum

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THE FORAMINIFERAL FAUNA OF THE UPPER CRETACEOUS ARKADELPHIA MARL OF ARKANSAS

By JOSEPH A. CUSHMAN

ABSTRACT

This paper records 116 species and varieties of Foraminifera from 11 localities of the Upper Cretaceous Arkadelphia marl of Arkansas. Sixty genera are represented. Many of the species have not previously been reported from the formation nor have specimens from it been figured.

GENERAL REMARKS

In a recent work on the Upper Cretaceous Foraminifera of the Gulf Coastal region of the United States and adjacent areas (U. S. Geol. Survey Prof. Paper 206, 1946) the faunas were described and figured from material then available. Since the publication of that paper a splendid collection of Foraminifera from the Arkansas region was bequeathed to the United States National Museum by the late Dr. William H. Deaderick, of Hot Springs, Arkansas. Dr. Deaderick had collected and studied the Foraminifera in his spare time as an interest outside his medical work. In his collections of mounted slides and washed material, now in the United States National Museum, are numerous excellently preserved Foraminifera from the Arkadelphia marl of Navarro age. A study of this material has added greatly to the recorded fauna of the Arkadelphia marl and extended the range of many known species, and has also filled gaps in the recorded faunas of the formations of the Navarro group and its equivalents.

References to the literature and descriptions of the species will be found in Professional Paper 206. Many of the species, however, were not there figured from the Arkadelphia marl. Illustrations of these are given here to complete the illustration of this fauna.

The earlier localities, those already studied in Professional Paper 206, are given as stations 1 to 4, and the new localities, those from the Deaderick Collection, as stations 5 to 11. The data for these are as follows:

ARKADELPHIA MARL.

1. Near base. Seven miles north by west of Hope, Hempstead County, Ark. U.S.G.S. 13411.
2. Small branch east of the Nashville road 4½ miles (air line) northwest of Hope, Hempstead County, Ark. L. W. Stephenson.
3. Branch east of road ½ mile north by west of Reed's store (SW¼ sec. 29, T. 11 S., R. 24 W.), 6 miles north by west of Hope, Hempstead County, Ark. L. W. Stephenson.
4. Lower part. 4.5 miles east of Washington in creek ½ mile north of Reed's store, Hempstead County, Ark. U.S.G.S. 8211.
5. Highway 29, between Hope and Blevins, 300 yards from Reid's (Harris') store, on side road to Washington, north side of road, Hempstead County, Ark. Collected by W. H. Deaderick, Nos. 148, 218, and 334.
6. Highway 4, 5 miles northwest of Hope, 100 yards east of airport beacon, Hempstead County, Ark. Collected by W. H. Deaderick, Nos. 155, 217, and 339.
7. Highway 67, roadside ditch, west side, 5.4 miles southwest of Missouri Pacific Railroad station in Arkadelphia, Clark County, Ark. Collected by W. H. Deaderick, No. 374.
8. Highway 67, roadside ditch, east side, 6.5 miles southwest of Missouri Pacific Railroad station in Arkadelphia, Clark County, Ark. Collected by W. H. Deaderick, No. 379.
9. Highway 67, roadside ditch, west side, 7.3 miles south of 10th and Pine Streets, Arkadelphia, Clark County, Ark. Collected by W. H. Deaderick, No. 315.
10. Highway 67, roadside ditch, east side, 4.7 miles south-southwest of railroad station in Arkadelphia, Clark County, Ark. Collected by W. H. Deaderick, Nos. 358 and 375.
11. Arkadelphia (?) marl; possibly Nacatoch sand. West bank of Ouachita River, 25 yards downstream from Missouri Pacific Railroad bridge at Arkadelphia, Clark County, Ark. (Prob-

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ably removed in construction of bridge.) Collected by W. H. Deaderick, No. 157.

SYSTEMATIC NOTES

Family SACCAMMINIDAE

Genus PROTEONINA Williamson, 1858

Proteonina difflugiformis (H. B. Brady) Rhumbler

Plate 1, figure 1

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 15, 1946.)

Rare specimens occurred at station 5. It has not previously been recorded from the Arkadelphia marl.

Family REOPHACIDAE

Genus REOPHAX Montfort, 1808

Reophax texanus Cushman and Waters

Plate 1, figure 2

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 16, 1946.)

This species was found at stations 3, 4, and 5; common at the last locality.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

Ammodiscus cretaceus (Reuss) Cushman

Plate 1, figure 3

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 17, 1946.)

Rare specimens from station 6 make the first record from the Arkadelphia marl.

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides calcula Cushman and Waters

Plate 1, figure 4

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 19, 1946.)

This species, not previously recorded from the Arkadelphia marl, was common at stations 5 and 6.

Haplophragmoides glabra Cushman and Waters

Plate 1, figure 5

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 20, 1946.)

This species, not previously recorded from the Arkadelphia marl, was found only at station 7.

Haplophragmoides rugosa Cushman and Waters

Plate 1, figure 6

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 20, 1946.)

Specimens occurred at stations 1, 3, 5, and 8.

Haplophragmoides excavata Cushman and Waters

Plate 1, figure 7

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 21, 1946.)

Specimens occurred at stations 4, 5, 7, 8, 9, and 10.

Genus AMMOBACULITES Cushman, 1910

Ammobaculites arenatus Cushman

Plate 1, figure 8

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 22, 1946.)

This species is known only from the Arkadelphia marl, occurring at station 3, the type locality, and station 5.

Ammobaculites coprolithiformis (Schwager) Cushman

Plate 1, figure 9

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 22, 1946.)

Specimens occurred at stations 1, 3, and 5.

Ammobaculites texanus Cushman

Plate 1, figure 10

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 23, 1946.)

Numerous typical specimens occur at station 5. This is the first record from the Arkadelphia marl. The only other record is from the Corsicana marl of Texas.

Family TEXTULARIIDAE

Genus SPIROPLECTAMMINA Cushman, 1927

Spiroplectammina semicomplanata (Carsey) Plummer

Plate 1, figure 11

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 28, 1946.)

This species has been recorded from several formations of the Navarro group but not previously from the Arkadelphia marl. Rare specimens occurred at station 5.

Family VERNEUILINIDAE

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina navarroana Cushman

Plate 1, figure 14

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 33, 1946.)

Already recorded from station 2, the species is very abundant at station 6 and rare at stations 7 and 10.

Gaudryina deadericki Cushman

Plate 1, figures 12, 13

Gaudryina deadericki Cushman, Cushman Lab. Foram. Research Contr., vol. 23, p. 56, pl. 13, figs. 8–10, 1947.

Test with the very earliest chambers triserial, later entirely biserial, much compressed, periphery serrate, increasing fairly rapidly in width; chambers distinct, increasing rather rapidly but evenly in size as added, later ones slightly overlapping; sutures distinct, depressed, nearly straight, strongly oblique; wall finely arenaceous, smoothly finished; aperture at the base of the inner margin of the last-formed chamber, in the early stages a low opening but in the adult extending well into the apertural face. Length 0.60–0.85 mm.; breadth 0.25–0.40 mm.; thickness 0.12–0.15 mm.

Holotype (U.S.N.M. No. 104238) from the Upper Cretaceous, Arkadelphia marl, on Highway 4, 5 miles northwest of Hope, 100 yards east of airport beacon, Hempstead County, Ark.

This species is common at the type locality but was not noted at the other stations. It differs from *Gaudryina laevigata* Franke in the more numerous chambers, more compressed test, deeper sutures, and serrate periphery. It was named for Dr. William H. Deaderick who collected and mounted the material.

Gaudryina (Siphogaudryina) stephensoni Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 35, pl. 8, figs. 8–11, 1946.)

A single typical specimen from station 8 gives the first record of this species from the Arkadelphia marl.

Genus GAUDRYINELLA Plummer, 1931

Gaudryinella pseudoserrata Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 36, pl. 8, figs. 15–21, 1946.)

Specimens occurred at stations 2 and 3.

Gaudryinella pseudoserrata Cushman var. extensa Cushman, n. var.

Plate 1, figures 15–17

Variety differing from the typical form in the smaller size and much slenderer form with more uniserial chambers in the adult.

Holotype of variety (U.S.N.M. No. 104265) from the Upper Cretaceous, Arkadelphia marl, Highway 29, north side of road, between Hope and Blevins, 300 yards from Reid's (Harris') store, on side road to Washington, Hempstead County, Ark.

This variety is very common at the type locality, station 5, and also at station 6.

Genus PSEUDOCLAVULINA Cushman, 1936

Pseudoclavulina arenata (Cushman) Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 37, pl. 9, fig. 9, 1946.)

The species occurs at stations 3, 6, and 8.

Genus CLAVULINOIDES Cushman, 1936

Clavulinoides compressa Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 39, pl. 10, figs. 1–7, 1946.)

The only record for the Arkadelphia marl is from station 4.

Clavulinoides insignis (Plummer) Cushman

Plate 1, figures 18, 19

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 39, 1946.)

The species occurs at stations 1, 3, 4, and 5.

Family VALVULINIDAE

Genus DOROTHIA Plummer, 1931

Dorothia bulletta (Carsey) Plummer

Plate 1, figure 20

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 46, 1946.)

This widely ranging species occurs at stations 1, 3, 4, 5, and 6.

Genus PLECTINA Marsson, 1878

Plectina watersi Cushman

Plate 1, figure 21

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 47, 1946.)

The species occurs at stations 1, 3, 5, and 6.

Genus GOËSELLA Cushman, 1933

Goësella rugulosa Cushman

Plate 1, figure 23

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 47, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 6.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

Quinqueloculina antiqua Franke var. angusta Franke

Plate 1, figure 22

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 48, 1946.)

A single specimen from station 11, here figured, is not well preserved but seems to be the first record of this variety from the Arkadelphia marl.

Family TROCHAMMINIDAE

Genus TROCHAMMINA Parker and Jones, 1859

Trochammina texana Cushman and Waters

Plate 1, figure 24

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 50, 1946.)

This species, confined to formations of the Navarro group and its equivalents, has not previously been recorded from the Arkadelphia marl. It occurs at stations 5 and 8.

Trochammina gyroides Cushman and Waters

Plate 1, figure 25

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 50, 1946.)

Specimens occur at stations 1, 3, 5, 9, and 10.

Family LAGENIDAE

Genus ROBULUS Montfort, 1808

Robulus navarroensis (Plummer) Cushman

Plate 1, figure 26

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 51, 1946.)

This species typical of the Navarro group occurs at stations 1, 2, 3, 5, 6, and 10.

Robulus navarroensis (Plummer) Cushman var. extruatus Cushman

Plate 1, figure 27

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 52, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 6.

Robulus spisso-costatus Cushman

Plate 2, figure 1

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 52, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 6.

Robulus pondi Cushman

Plate 2, figures 2, 3

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 52, 1946.)

This species, not previously recorded from the Arkadelphia marl, is common at station 6.

Robulus münsteri (Roemer) Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 53, pl. 17, figs. 3–9, 1946.)

Specimens from stations 5 and 8 give the first record of the occurrence of this species in the Arkadelphia marl.

Genus LENTICULINA Lamarck, 1804

Lenticulina jonesi Sandidge

Plate 2, figure 4

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 55, 1946.)

Numerous specimens from station 5 seem to belong to this species, not previously recorded from the Arkadelphia marl.

Lenticulina cf. rotulata Lamarck

Plate 2, figure 8

Specimens from station 5 may be referred to this species with some doubt.

Genus PLANULARIA Defrance, 1824

Planularia dissona (Plummer) Cushman

Plate 2, figure 5

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 57, 1946.)

There are specimens from stations 1, 3, 4, and 6.

Planularia deadericki Cushman

Plate 2, figures 6, 7

Planularia deadericki Cushman, Cushman Lab. Foram. Research Contr., vol. 23, p. 56, pl. 13, figs. 11–13, 1947.

Test much compressed, early portion close coiled, later tending to uncoil in various degrees, periphery carinate with a narrow, transparent keel; chambers fairly distinct, little if at all inflated; sutures fairly distinct, curved, little if at all depressed; wall ornamented with longitudinal costae, curved, more or less in the curve of the dorsal margin of the test; aperture terminal, radiate. Length up to 1.40 mm.; breadth up to 0.55 mm.; thickness up to 0.25 mm.

Holotype (U.S.N.M. No. 104240) from the Upper Cretaceous, Arkadelphia marl, Highway 4, 5 miles northwest of Hope, 100 yards east of airport beacon, Hempstead County, Ark.

This species in some characters resembles *Planularia dissona* (Plummer) but is usually more compressed and has a very highly ornate surface. It is very common at the type locality, station 6.

Genus SARACENARIA Defrance, 1824

Saracenaria saratogana Howe and Wallace

Plate 2, figure 9

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 58, 1946.)

Specimens occur at stations 1, 4, 5, and 6.

Genus MARGINULINA d'Orbigny, 1826

Marginulina navarroana Cushman

Plate 2, figure 10

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 62, 1946.)

A few specimens from station 6 give the only record from the Arkadelphia marl.

Marginulina silicula (Plummer) Cushman

Plate 2, figure 11

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 62, 1946.)

Rare specimens from station 5 give the first record from the Arkadelphia marl for this species.

Marginulina plummerae Cushman

Plate 2, figure 12

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 62, 1946.)

Specimens occur at stations 3, 4, and 6.

Marginulina curvatura Cushman

Plate 2, figure 13

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 63, 1946.)

This species is known only from the Corsicana marl and the Arkadelphia marl, from the latter at stations 4 and 5.

Marginulina siliqua Cushman

Plate 2, figure 14

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 63, 1946.)

This species has previously been recorded only from the Kemp clay and Corsicana marl. It occurs at stations 5 and 6.

Genus DENTALINA d'Orbigny, 1826

Dentalina legumen Reuss

Plate 2, figure 15

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 65, 1946.)

Specimens occur at stations 1 and 6.

Dentalina gracilis d'Orbigny

Plate 2, figure 18

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 65, 1946.)

The only records from the Arkadelphia marl are from stations 2 and 6.

Dentalina lorneiana d'Orbigny

Plate 2, figure 16

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 66, 1946.)

Specimens from station 6 give the first record from the Arkadelphia marl.

Dentalina basiplanata Cushman

Plate 2, figure 17

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 68, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 6.

Dentalina crinita Plummer

Plate 2, figure 19

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 69, 1946.)

There are specimens from stations 1, 3, 4, 5, and 6.

Genus NODOSARIA Lamarck, 1812

Nodosaria affinis Reuss

Plate 2, figure 20

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 70, 1946.)

Typical specimens occur at stations 1, 3, 4, and 6.

Genus PSEUDOGLANDULINA Cushman, 1929

Pseudoglandulina manifesta (Reuss) Cushman

Plate 2, figure 21

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 76, 1946.)

Specimens occur at stations 1, 3, 4, and 5.

Pseudoglandulina lagenoides (Olszewski) Cushman and Hedberg

Plate 2, figure 22

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 76, 1946.)

The figured specimen from station 6 is the only occurrence of this species in the Arkadelphia marl.

Pseudoglandulina pygmaea (Reuss) Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 76, pl. 27, figs. 27, 28, 1946.)

This species has been recorded previously from station 4.

Genus VAGINULINA d'Orbigny, 1826

Vaginulina multicostata Cushman

Plate 2, figure 24

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 79, 1946.)

Specimens occur at stations 1, 4, 5, and 6.

Vaginulina simondsi Carsey

Plate 3, figure 2

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 80, 1946.)

There are specimens from stations 2, 4, and 6.

Vaginulina cretacea Plummer

Plate 3, figure 1

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 80, 1946.)

There are specimens from stations 1, 2, 3, 5, 6, and 9.

Vaginulina navarroana Cushman

Plate 2, figure 23

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 80, 1946.)

Numerous specimens from station 6 give the first record of this species from the Arkadelphia marl.

Vaginulina webbervillensis Carsey

Plate 3, figure 3

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 81, 1946.)

Specimens of this species typical of the Navarro group occur at stations 1, 3, 4, 5, and 6.

Genus PALMULA Lea, 1833

Palmula reticulata (Reuss) Cushman

Plate 3, figures 4, 5

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 84, 1946.)

Specimens occur at stations 1, 3, 4, and 5.

Genus FRONDICULARIA Defrance, 1826

Frondicularia lanceola Reuss

Plate 3, figure 6

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 85, 1946.)

A single specimen from station 6 gives the only record from the Arkadelphia marl.

Frondicularia inversa Reuss

Plate 3, figure 7

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 86, 1946.)

Rare specimens occur at station 6.

Frondicularia arkadelphiana Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 91, pl. 37, figs. 21, 22, 1946.)

The only record for this species from the Arkadelphia marl is from station 4.

Genus LAGENA Walker and Jacob, 1798

Lagena hispida Reuss

Plate 3, figure 8

Although recorded from most other formations of Navarro age, this species has not previously been recorded from the Arkadelphia marl. It occurs at station 6.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1839

Guttulina adhaerens (Olszewski) Cushman and Ozawa

Plate 3, figure 9

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 96, 1946.)

Specimens occur at stations 3, 4, and 5.

Genus GLOBULINA d'Orbigny, 1839

Globulina lacrima Reuss

Plate 3, figure 10

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 96, 1946.)

This species in its typical form has not previously been recorded from the Arkadelphia marl. It occurs at station 6.

Globulina lacrima Reuss var. subsphaerica (Berthelin) Cushman and Ozawa

Plate 3, figure 11

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 96, 1946.)

Specimens occur at stations 3 and 6.

Globulina lacrima Reuss var. horrida Reuss

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 97, pl. 40, fig. 14, 1946.)

The only record from the Arkadelphia marl is from station 1.

Globulina prisca Reuss

Plate 3, figure 12

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 97, 1946.)

This species has not previously been recorded from the Arkadelphia marl. It occurs at station 6 where fistulose specimens are common.

Genus **PYRULINA** d'Orbigny, 1839

Pyrulina cylindroides (Roemer) Cushman and Ozawa

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 97, pl. 40, figs. 18, 19, 1946.)

Specimens occur at station 3 and questionable ones at station 6.

Genus **PSEUDOPOLYMORPHINA** Cushman and Ozawa, 1928

Pseudopolymorphina cuyleri Plummer

Plate 3, figure 13

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 98, 1946.)

This species occurs at stations 1, 3, 4, 5, and 6, especially abundantly at the last two stations.

Genus **BULLOPORA** Quenstedt, 1856

Bullopora laevis (Sollas) Wickenden

Plate 3, figure 19

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 98, 1946.)

This species, not previously recorded from the Arkadelphia marl, occurs at station 6.

Genus **RAMULINA** Rupert Jones, 1875

Ramulina arkadelphiana Cushman

Plate 3, figures 14, 15

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 99, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 6, abundantly at the last two.

Family **NONIONIDAE**

Genus **NONIONELLA** Cushman, 1926

Nonionella robusta Plummer

Plate 3, figures 16, 17

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 100, 1946.)

This species, not previously recorded from the Arkadelphia marl, occurs at station 6.

Nonionella ansata Cushman

Plate 3, figure 18

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 101, 1946.)

Previously known only from the Prairie Bluff chalk of Navarro age from Alabama, this species occurs in considerable numbers in the Arkadelphia marl at station 6.

Family **HETEROHELICIDAE**

Genus **BOLIVINOPSIS** Yakovlev, 1891

Bolivinopsis rosula (Ehrenberg) Macfadyen

Plate 3, figure 20

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 101, 1946.)

A single specimen from station 6 is the first record for this species from the Arkadelphia marl.

Genus **GÜMBELINA** Egger, 1899

Gümbelina plummerae Loetterle

Plate 3, figures 21, 22

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 104, 1946.)

Numerous specimens from station 6 give the first record from the Arkadelphia marl.

Gümbelina striata (Ehrenberg) Egger

Plate 3, figure 24

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 104, 1946.)

Although not previously recorded from the Arkadelphia marl, numerous specimens occur at stations 5 and 6.

Gümbelina globulosa (Ehrenberg) Egger

Plate 3, figure 23

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 105, 1946.)

Specimens occur at stations 1, 5, 6, and 9.

Gümbelina costulata Cushman

Plate 3, figure 25

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 108, 1946.)

Specimens from station 6 give the first record of this species from the Arkadelphia marl.

Gümbelina excolata Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 108, pl. 46, fig. 16, 1946.)

This species has been recorded from station 2.

Genus **RECTOGÜMBELINA** Cushman, 1932

Rectogümbelina cretacea Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 110, pl. 47, figs. 2, 3, 1946.)

This has been recorded from a station that is open to question as to whether it is Upper Cretaceous or Paleocene.

Genus PSEUDOTEXTULARIA Rzehak, 1886

Pseudotextularia varians Rzehak

Plate 3, figure 26

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 110, 1946.)

This species has been recorded from the Cretaceous of Texas, in the Kemp clay and Corsicana marl. A number of typical specimens were found at station 6 in the Arkadelphia marl.

Genus PLANOGLOBULINA Cushman, 1927

Planoglobulina acervulinoides (Egger) Cushman

Plate 3, figure 27

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 111, 1946.)

This species has been recorded from the Prairie Bluff chalk of Navarro age from Alabama. The first record for the Arkadelphia marl is from station 5.

Genus VENTILABRELLA Cushman, 1928

Ventilabrella carseyae Plummer

Plate 3, figure 28

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 112, 1946.)

Specimens occur at stations 1, 2, 3, 4, and 6.

Genus BOLIVINITA Cushman, 1927

Bolivinita costifera Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 115, pl. 49, fig. 3, 1946.)

This has been recorded from a station that may belong to the Arkadelphia marl or to the Paleocene series.

Genus PSEUDOUVIGERINA Cushman, 1927

Pseudouvigerina seligi (Cushman) Cushman and Todd

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 117, pl. 49, figs. 21–24, 1946.)

This species occurs at stations 3, 4, and 6.

Genus SIPHOGENERINOIDES Cushman, 1927

Siphogenerinoides plummeri (Cushman) Cushman

Plate 4, figure 1

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 117, 1946.)

Specimens occur at stations 2 and 6.

Siphogenerinoides brevispinosa Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 119, pl. 50, fig. 12, 1946.)

The only record for this species is from the type locality. It is somewhat doubtful whether the locality should be placed in the Arkadelphia marl or in the Paleocene series.

Family BULIMINIDAE

Genus BULIMINELLA Cushman, 1911

Buliminella cushmani Sandidge

Plate 4, figure 2

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 119, 1946.)

This species has been recorded from several formations of the Navarro group but not previously from the Arkadelphia marl. Specimens occur at station 6.

Genus BULIMINA d'Orbigny, 1826

Bulimina aspera Cushman and Parker

Plate 4, figure 3

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 121, 1946.)

The species occurs at stations 1, 2, 3, 4, 6, and 10.

Bulimina prolixa Cushman and Parker

Plate 4, figure 4

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 122, 1946.)

Rare specimens from stations 5 and 10 give the first record for this species from the Arkadelphia marl.

Bulimina arkadelphiana Cushman and Parker

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 124, pl. 52, figs. 3, 4, 1946.)

Specimens occur at stations 1, 3, 4, and 5, and are very common at the last station.

Genus VIRGULINA d'Orbigny, 1826

Virgulina navarroana Cushman

Plate 4, figure 5

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 126, 1946.)

This species has been recorded from numerous localities in the Kemp clay and Corsicana marl of the Navarro group. Abundant specimens from station 6 give the first record from the Arkadelphia marl.

Genus BOLIVINA d'Orbigny, 1839

Bolivina incrassata Reuss

Plate 4, figure 6

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 127, 1946.)

Although not previously recorded from the Arkadelphia marl, this species occurs very commonly at station 5.

Bolivina decurrens (Ehrenberg) Marsson

Plate 4, figure 7

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 127, 1946.)

Rare specimens from station 6 give the first record of this species from the Arkadelphia marl.

Genus LOXOSTOMUM Ehrenberg, 1854

Loxostomum gemmum (Cushman) Cushman

Plate 4, figure 8

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 129, 1946.)

Specimens occur at stations 1, 3, 4, 5, and 10.

Loxostomum plaitum (Carsey) Cushman

Plate 4, figure 9

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 130, 1946.)

Specimens occur at stations 2, 5, and 6.

Family ELLIPSOIDINIDAE

Genus ELLIPSONODOSARIA Silvestri, 1900

Ellipsonodosaria stephensoni Cushman

Plate 4, figure 10

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 134, 1946.)

Specimens occur at stations 1, 3, 4, and 5.

Ellipsonodosaria stephensoni Cushman var. speciosa Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 135, pl. 56, fig. 8, 1946.)

The types of this variety are from station 3.

Ellipsonodosaria alexanderi Cushman var. impensia Cushman

Plate 4, figure 11

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 136, 1946.)

Specimens occur at stations 1, 4, and 5.

Ellipsonodosaria? granti (Plummer) Cushman

(For references and figures, see U. S. Geol. Survey Prof. Paper 206, p. 136, pl. 56, figs. 24–26, 1946.)

The only record from the Arkadelphia marl is station 4.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

Valvulineria cretacea (Carsey) Cushman and Todd

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 138, pl. 57, fig. 8, 1946.)

The only record from the Arkadelphia marl is station 1.

Genus GYROIDINA d'Orbigny, 1826

Gyroidina depressa (Alth) Cushman and Church

Plate 4, figures 12, 13

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 139, 1946.)

Although recorded from numerous formations of the Navarro group, the first record from the Arkadelphia marl of Navarro age is station 6, where it is abundant.

Gyroidina arkadelphiana Cushman

Plate 4, figures 14–16

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 141, 1946.)

Specimens occur at stations 1, 4, 5, and 6.

Genus SIPHONINA Reuss, 1850

Siphonina prima Plummer

Plate 4, figure 17

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 143, 1946.)

Specimens occur at stations 1 and 5.

Family CASSIDULINIDAE

Genus PULVINULINELLA Cushman, 1926

Pulvinulinella glabrata Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 144, pl. 59, fig. 10, 1946.)

This species has previously been recorded from station 4.

Pulvinulinella navarroana Cushman

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 144, pl. 60, fig. 1, 1946.)

This species also has been recorded from station 4.

Family CHILOSTOMELLIDAE

Genus ALLOMORPHINA Reuss, 1850

Allomorphina navarroana Cushman

Plate 4, figure 18

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 145, 1946.)

This species, known previously only from the Kemp clay and Corsicana marl, occurs commonly in the Arkadelphia marl at station 6.

Genus PULLENIA Parker and Jones, 1862

Pullenia minuta Cushman

Plate 4, figure 19

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 147, 1946.)

A very few specimens from stations 5 and 10 make the first record of this species from the Arkadelphia marl.

Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman, 1927

Globotruncana canaliculata (Reuss) Cushman

Plate 4, figures 20, 21

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 149, 1946.)

Specimens from station 6 give the first record from the Arkadelphia marl.

Globotruncana arca (Cushman) Cushman

Plate 4, figures 22, 23

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 150, 1946.)

Specimens occur at stations 5 and 6, giving the first record of this species from the Arkadelphia marl.

Globotruncana cretacea Cushman

Plate 4, figures 24, 25

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 151, 1946.)

This is a widely ranging species but not previously recorded from the Arkadelphia marl. It occurs at station 6.

Genus GLOBOROTALIA Cushman, 1927

Globorotalia membranacea (Ehrenberg) White

(For references and figure, see U. S. Geol. Survey Prof. Paper 206, p. 152, pl. 63, fig. 5, 1946.)

A single specimen from station 9 gives the first record for this species from the Arkadelphia marl.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

Anomalina nelsoni W. Berry

Plate 4, figure 26

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 154, 1946.)

Specimens occur at stations 4 and 5.

Anomalina pseudopapillosa Carsey

Plate 4, figures 27, 28

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 154, 1946.)

Specimens occur at stations 1, 2, 3, 4, 5, 6, and 10.

Anomalina pinguis Jennings

Plate 4, figures 29, 30

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 156, 1946.)

Specimens from station 6 give the first record of this species from the Arkadelphia marl.

Genus PLANULINA d'Orbigny, 1826

Planulina correcta (Carsey) Cushman

Plate 4, figures 31, 32

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 158, 1946.)

Specimens of this typically Navarro species occur at stations 1, 2, 3, 4, and 6.

Genus CIBICIDES Montfort, 1808

Cibicides harperi (Sandidge) Cushman

Plate 4, figures 33, 34

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 159, 1946.)

Specimens from stations 5, 6, and 8 give the first record from the Arkadelphia marl of this typically Navarro species.

Cibicides subcarinatus Cushman and Deaderick

Plate 4, figures 35, 36

(For references, see U. S. Geol. Survey Prof. Paper 206, p. 159, 1946.)

This species, occurring commonly at station 5 and rarely at station 9, gives the first record from the Arkadelphia marl.

Cibicides beaumontianus (d'Orbigny) Brotzen

Plate 4, figures 37, 38

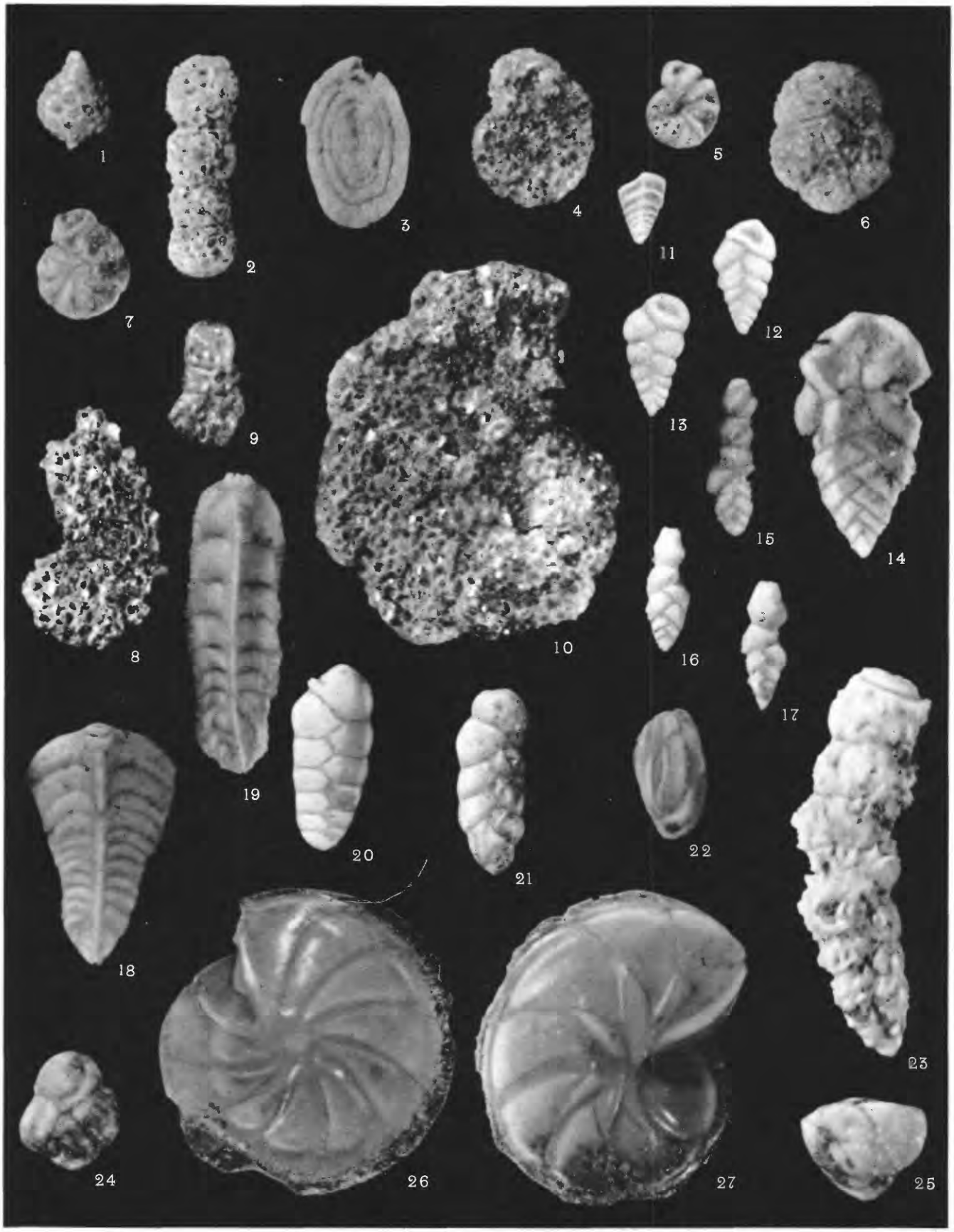
(For references, see U. S. Geol. Survey Prof. Paper 206, p. 160, 1946.)

Specimens are common at station 6, giving the first record from the Arkadelphia marl.

PLATES 1–4

PLATE 1

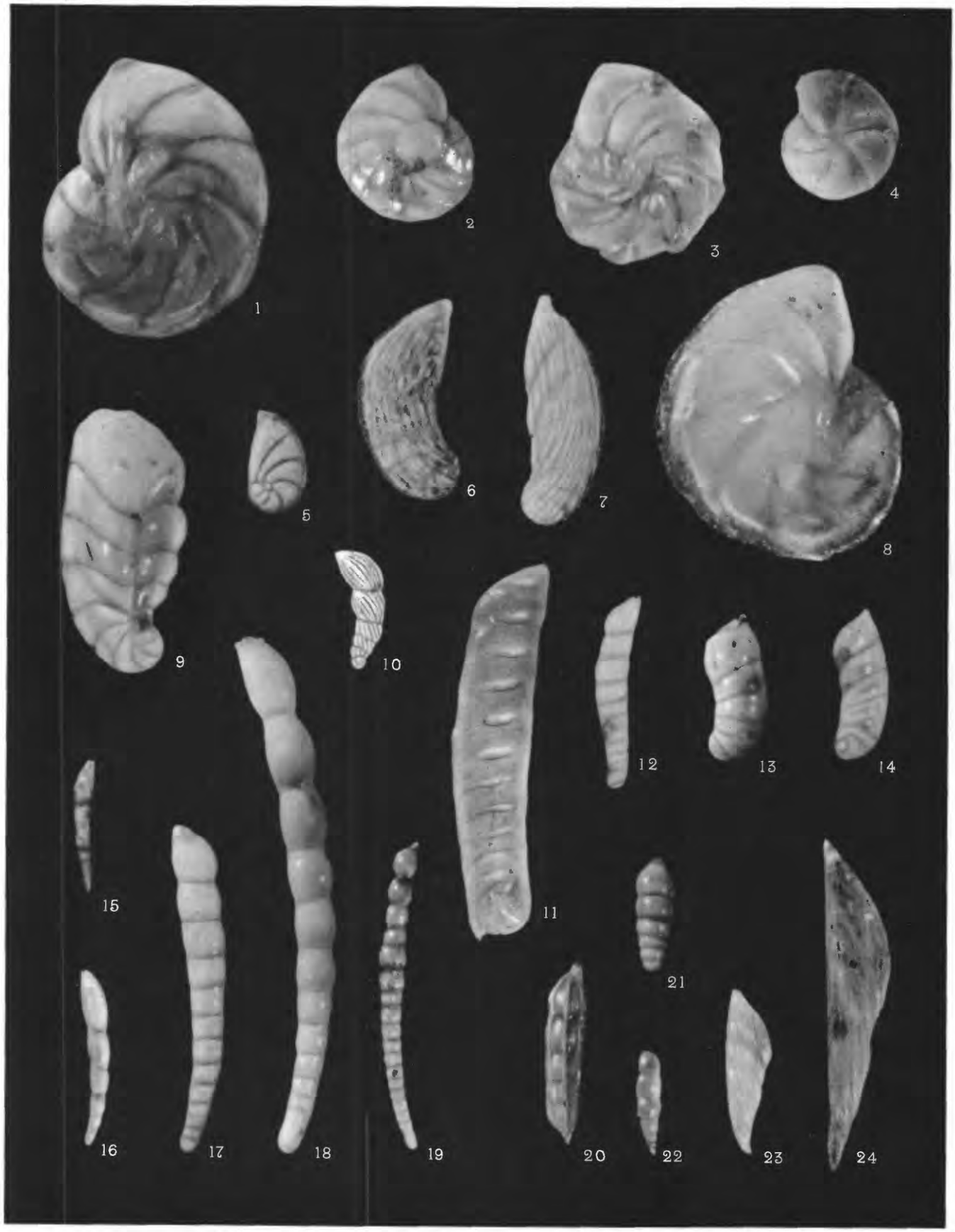
Figure 1. *Proteonina difflugiformis* (H. B. Brady) Rhumbler. Station 5. × 35.
2. *Reophax texanus* Cushman and Waters. Station 5. × 35.
3. *Ammodiscus cretaceus* (Reuss) Cushman. Station 6. × 35.
4. *Haplophragmoides calcula* Cushman and Waters. Station 5. × 35.
5. *Haplophragmoides glabra* Cushman and Waters. Station 7. × 35.
6. *Haplophragmoides rugosa* Cushman and Waters. Station 5. × 35.
7. *Haplophragmoides excavata* Cushman and Waters. Station 7. × 35.
8. *Ammobaculites arenatus* Cushman. Station 5. × 35.
9. *Ammobaculites coprolithiformis* (Schwager) Cushman. Station 5. × 35.
10. *Ammobaculites texanus* Cushman. Station 5. × 35.
11. *Spiroplectammina semicomplanata* (Carsey) Plummer. Station 5. × 35.
12, 13. *Gaudryina deadericki* Cushman. Station 6. × 35.
14. *Gaudryina navarroana* Cushman. Station 6. × 35.
15–17. *Gaudryinella pseudoserrata* Cushman var. *extensa* Cushman, n. var. Station 5. × 35. 15, Holotype. 16, 17, Paratypes.
18, 19. *Clavulinoides insignis* (Plummer) Cushman. Station 5. × 35. 18, Microspheric form. 19, Megalospheric form.
20. *Dorothia bulletta* (Carsey) Plummer. Station 6. × 35.
21. *Plectina watersi* Cushman. Station 5. × 35.
22. *Quinqueloculina antiqua* Franke var. *angusta* Franke. Station 11. × 35.
23. *Goësella rugulosa* Cushman. Station 6. × 35.
24. *Trochammina texana* Cushman and Waters. Station 5. × 35.
25. *Trochammina gyroides* Cushman and Waters. Station 5. × 35.
26. *Robulus navarroensis* (Plummer) Cushman. Station 6. × 35.
27. *Robulus navarroensis* (Plummer) Cushman var. *extruatus* Cushman. Station 6. × 35.



FORAMINIFERA FROM THE ARKADELPHIA MARL OF ARKANSAS

PLATE 2

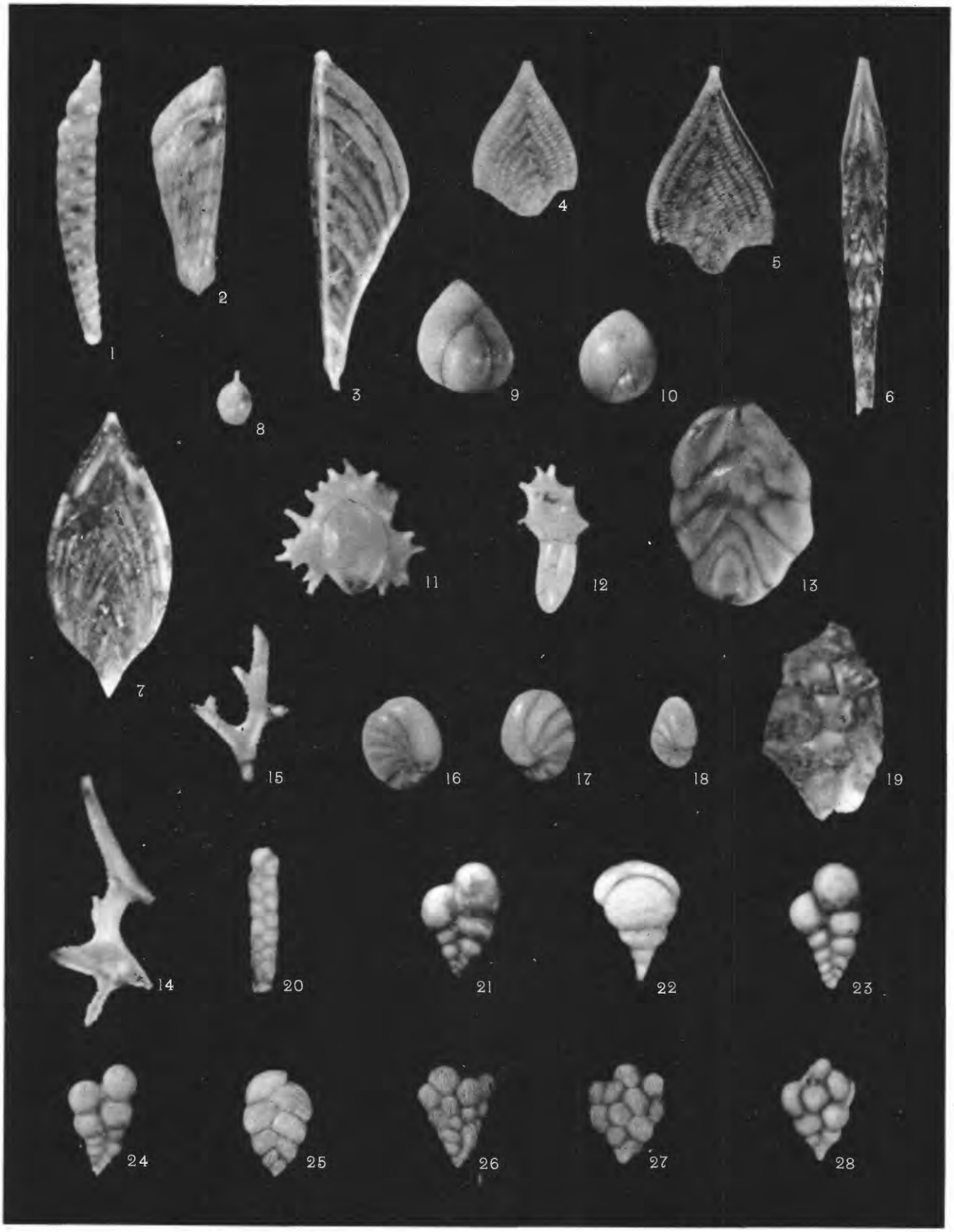
Figure 1. *Robulus spisso-costatus* Cushman. Station 6. × 35.
2, 3. *Robulus pondi* Cushman. Station 6. × 35.
4. *Lenticulina jonesi* Sandidge. Station 5. × 35.
5. *Planularia dissona* (Plummer) Cushman. Station 6. × 35.
6, 7. *Planularia deadericki* Cushman. Station 6. × 35.
8. *Lenticulina* cf. *rotulata* Lamarck. Station 5. × 35.
9. *Saracenaria saratogana* Howe and Wallace. Station 5. × 35.
10. *Marginulina navarroana* Cushman. Station 6. × 35.
11. *Marginulina silicula* (Plummer) Cushman. Station 5. × 20.
12. *Marginulina plummerae* Cushman. Station 6. × 35.
13. *Marginulina curvatura* Cushman. Station 5. × 35.
14. *Marginulina siliqua* Cushman. Station 6. × 35.
15. *Dentalina legumen* Reuss. Station 6. × 35.
16. *Dentalina lorneiana* d'Orbigny. Station 6. × 35.
17. *Dentalina basiplanata* Cushman. Station 5. × 35.
18. *Dentalina gracilis* d'Orbigny. Station 6. × 35.
19. *Dentalina crinita* Plummer. Station 6. × 20.
20. *Nodosaria affinis* Reuss. Station 6. × 35.
21. *Pseudoglandulina manifesta* (Reuss) Cushman. Station 5. × 35.
22. *Pseudoglandulina lagenoides* (Olszewski) Cushman and Hedberg. Station 6. × 35.
23. *Vaginulina navarroana* Cushman. Station 6. × 35.
24. *Vaginulina multicostata* Cushman. Station 5. × 35.



FORAMINIFERA FROM THE ARKADELPHIA MARL OF ARKANSAS

PLATE 3

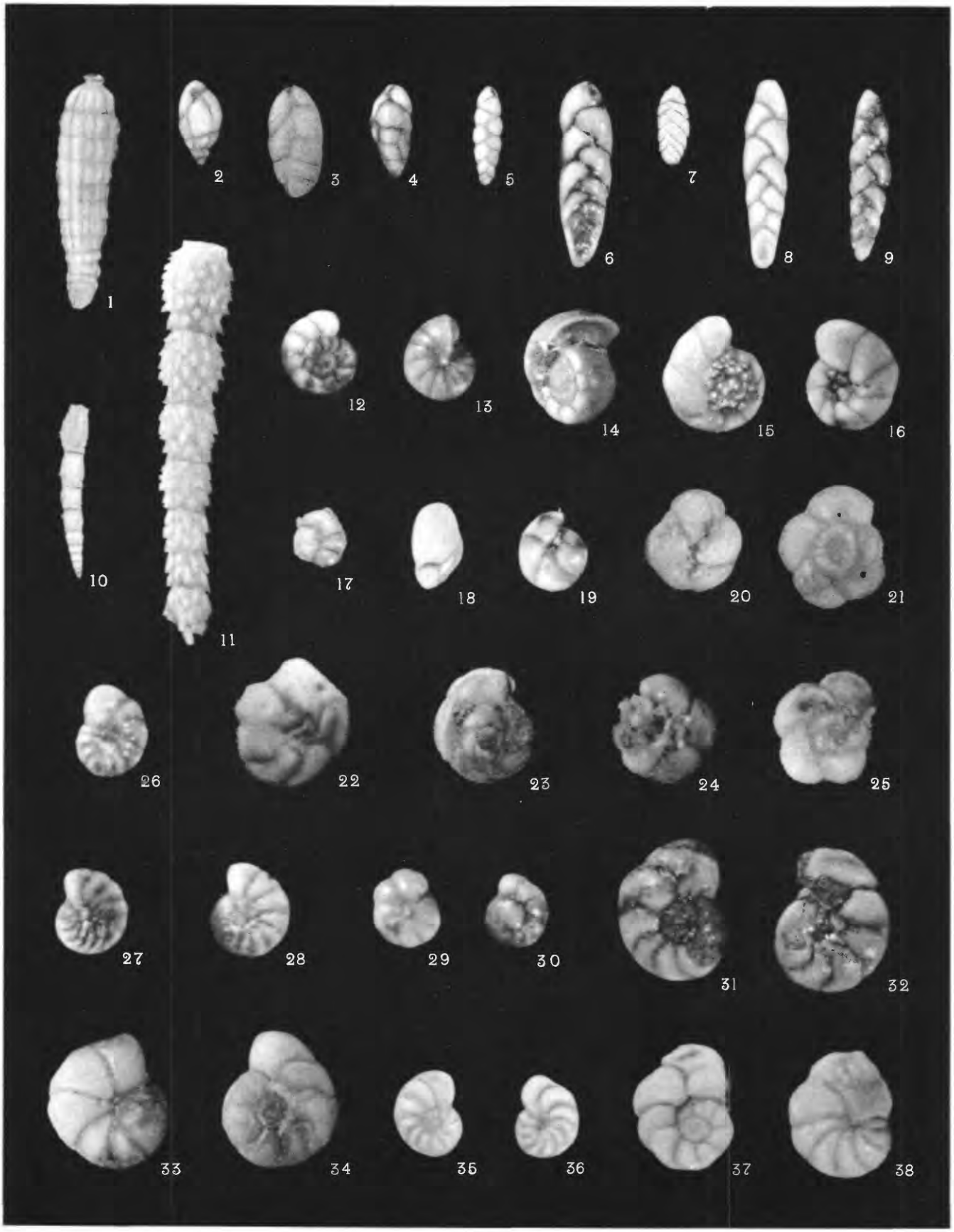
Figure 1. *Vaginulina cretacea* Plummer. Station 6. × 20.
2. *Vaginulina simondsi* Carsey. Station 6. × 20.
3. *Vaginulina webbervillensis* Carsey. Station 5. × 20.
4, 5. *Palmula reticulata* (Reuss) Cushman. Station 5. × 35.
6. *Frondicularia lanceola* Reuss. Station 6. × 35.
7. *Frondicularia inversa* Ruess. Station 6. × 20.
8. *Lagena hispida* Reuss. Station 6. × 35.
9. *Guttulina adhaerens* (Olszewski) Cushman and Ozawa. Station 5. × 35.
10. *Globulina lacrima* Reuss. Station 6. × 35.
11. *Globulina lacrima* Reuss var. *subsphaerica* (Berthelin) Cushman and Ozawa. Station 6. × 35.
12. *Globulina prisca* Reuss. Station 6. × 35.
13. *Pseudopolymorphina cuyleri* Plummer. Station 6. × 20.
14, 15. *Ramulina arkadelphiana* Cushman. Station 5. × 35.
16, 17. *Nonionella robusta* Plummer. Station 6. × 35.
18. *Nonionella ansata* Cushman. Station 6. × 35.
19. *Bullopora laevis* (Sollas) Wickenden. Station 6. × 35.
20. *Bolivinopsis rosula* (Ehrenberg) Macfadyen. Station 6. × 35.
21, 22. *Gümbelina plummerae* Loetterle. Station 6. × 35. 21, Side view; 22, Apertural view.
23. *Gümbelina globulosa* (Ehrenberg) Egger. Station 6. × 35.
24. *Gümbelina striata* (Ehrenberg) Egger. Station 6. × 35.
25. *Gümbelina costulata* Cushman. Station 6. × 35.
26. *Pseudotextularia varians* Rzehak. Station 6. × 35.
27. *Planoglobulina acervulinoides* (Egger) Cushman. Station 5. × 35.
28. *Ventilabrella carseyae* Plummer. Station 6. × 35.



FORAMINIFERA FROM THE ARKADELPHIA MARL OF ARKANSAS

PLATE 4

Figure 1. *Siphogenerinoides plummeri* (Cushman) Cushman. Station 6. × 45.
2. *Buliminella cushmani* Sandidge. Station 6. × 45.
3. *Bulimina aspera* Cushman and Parker. Station 6. × 45.
4. *Bulimina prolixa* Cushman and Parker. Station 5. × 45.
5. *Virgulina navarroana* Cushman. Station 6. × 45.
6. *Bolivina incrassata* Reuss. Station 5. × 45.
7. *Bolivina decurrens* (Ehrenberg) Marsson. Station 6. × 45.
8. *Loxostomum gemmum* (Cushman) Cushman. Station 5. × 45.
9. *Loxostomum plaitum* (Carsey) Cushman. Station 6. × 45.
10. *Ellipsonodosaria stephensoni* Cushman. Station 5. × 45.
11. *Ellipsonodosaria alexanderi* Cushman var. *impensia* Cushman. Station 5. × 45.
12, 13. *Gyroidina depressa* (Alth) Cushman and Church. Station 6. × 45. 12, Dorsal view. 13, Ventral view.
14–16. *Gyroidina arkadelphiana* Cushman. Station 5. × 45. 14, Peripheral view. 15, Dorsal view. 16, Ventral view.
17. *Siphonina prima* Plummer. Station 5. × 45.
18. *Allomorphina navarroana* Cushman. Station 6. × 45.
19. *Pullenia minuta* Cushman. Station 5. × 45.
20, 21. *Globotruncana canaliculata* (Reuss) Cushman. Station 6. × 35. 20, Ventral view. 21, Dorsal view.
22, 23. *Globotruncana arca* (Cushman) Cushman. Station 6. × 35. 22, Ventral view. 23, Dorsal view.
24, 25. *Globotruncana cretacea* Cushman. Station 6. × 35. 24, Ventral view. 25, Dorsal view.
26. *Anomalina nelsoni* W. Berry. Station 5. × 45.
27, 28. *Anomalina pseudopapillosa* Carsey. Station 5. × 45. 27, Ventral view. 28, Dorsal view.
29, 30. *Anomalina pinguis* Jennings. Station 6. × 35. 29, Ventral view. 30, Dorsal view.
31, 32. *Planulina correcta* (Carsey) Cushman. Station 6. 31, Dorsal view. 32, Ventral view.
33, 34. *Cibicides harperi* (Sandidge) Cushman. Station 6. × 35. 33, Ventral view. 34, Dorsal view.
35, 36. *Cibicides subcarinatus* Cushman and Deaderick. Station 5. 35, Dorsal view. 36, Ventral view.
37, 38. *Cibicides beaumontianus* (d'Orbigny) Brotzen. Station 6. 37, Dorsal view. 38, Ventral view.



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