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Maastrichtian (Late Cretaceous) ammonites from the Owl Creek Formation in northeastern Mississippi, U.S.A.

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ABSTRACT:

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Ammonites are locally abundant in the Owl Creek Formation in northeastern Mississippi. The assemblage is dominated numerically by *Eubaculites carinatus* (MORTON, 1834), a widely distributed marker fossil for the Maastrichtian that also occurs in South America, southern Africa, Madagascar, western Australia, southern India, and western Europe. It is accompanied by *Sphenodiscus pleurisepta* (CONRAD, 1857), *Baculites* cf. *B. claviformis* STEPHENSON, 1941, *B.* cf. *B. undatus* STEPHENSON, 1941, *Discoscaphites iris* (CONRAD, 1858), *D. sphaeroidalis* sp. nov., and *D.* cf. *D. conradi* (MORTON, 1834).

Key words: Cretaceous, Maastrichtian, Ammonites, U.S.A., Mississipi.

INTRODUCTION

The Owl Creek Formation is the youngest unit of the Cretaceous sequence throughout its outcrop in northern Mississippi; it is bounded unconformably below by the Ripley Formation (Campanian and Maastrichtian) and unconformably above by the Palaeocene Clayton Formation. The Owl Creek consists of dark silty sand with subordinate clay that may be richly fossiliferous and is generally less than 12.2 m thick. The formation extends northward into Tennessee and Missouri (STEPHENSON 1955), but when traced southward in Mississippi, the Owl Creek passes into the Prairie Bluff Chalk (Maastrichtian). A general account of the formation and a review of previous literature were given by SOHL (1960, 1964).

The type locality of the formation is on Owl Creek about 4 km northeast of Ripley in Tippah County, Mississippi (Text-fig. 1, locality 12; HILGARD 1860). Details of the locality were given by SOHL (1960, p. 39), who measured 4.9 m of calcareous, argillaceous, micaceous, slightly glauconitic sand containing a rich fauna in which original aragonitic shells are preserved. CONRAD (1858), on the basis of specimens collected by W. SPILLMAN of Columbus, Mississippi, described 56 species of invertebrate fossils from this locality, including the new ammonites *Baculites tippaensis*, *B. spillmani*, and *Scaphites iris*. He also indicated the presence of *Scaphites conradi* (MORTON, 1834). Much later, PRYOR (1960, table 1) listed the ammonite *Turrilites alternatus* TUOMEY, 1854, from the Owl Creek, but locality details were not given.

SOHL (1960) reviewed the stratigraphy of the Owl Creek Formation and treated the gastropods, but no account of the ammonites of the Owl Creek in

Mississippi has been published since that of CONRAD (1858). STEPHENSON (1955), however, dealt with material from the Owl Creek Formation at Crowleys Ridge in southeastern Missouri in which he recorded *Baculites carinatus* MORTON (1834), *Discoscaphites iris* (CONRAD, 1858), *Discoscaphites* sp., and *Sphenodiscus pleurisepta* (CONRAD, 1857). Crowleys Ridge lies about 265 km north-northwest of the type locality of the Owl Creek Formation near Ripley, Tippah County, Mississippi. Additions to the ammonite fauna at Crowleys Ridge are two fragments of a pachydiscid ammonite that may be *Pachydiscus jacquoti* SEUNES, 1890, found by G.R. SCOTT, now retired from the U.S. Geological Survey. A single specimen of this rare ammonite was found by L.W. STEPHENSON in the Prairie Bluff Chalk in Noxubee County, Mississippi (COBBAN & KENNEDY 1995).

The Owl Creek Formation, of Maastrichtian age, has been referred to the *Exogyra costata* Zone of STEPHENSON (1914) and correlated by SOHL (1960) with the Prairie Bluff Chalk in the southern part of Mississippi, the upper part of the Corsicana Formation and Kemp Clay in northeastern Texas, the Providence Sand in the Chattahoochee River region in Alabama and Georgia, and the higher parts of the Severn Formation (Monmouth Formation of early workers) in Maryland. SMITH & MANCINI (1982) recorded a nannofossil assemblage from the type locality of the Owl Creek that indicates zone 25b of SISSINGH (1978), PERCH-NIELSEN (1985), and others. C.C. SMITH (*oral commun*., 1990) referred the Owl Creek Formation to the upper part of the *Globotruncana gansseri* planktonic foraminifer zone (*Racemiguembelina fructicosa* zonule). This assignment is compatible with the ammonite evidence, inasmuch as the commonest species in the Owl Creek fauna, *Eubaculites carinatus* (MORTON, 1834), is a good Maastrichtian marker fossil in many parts of the world.

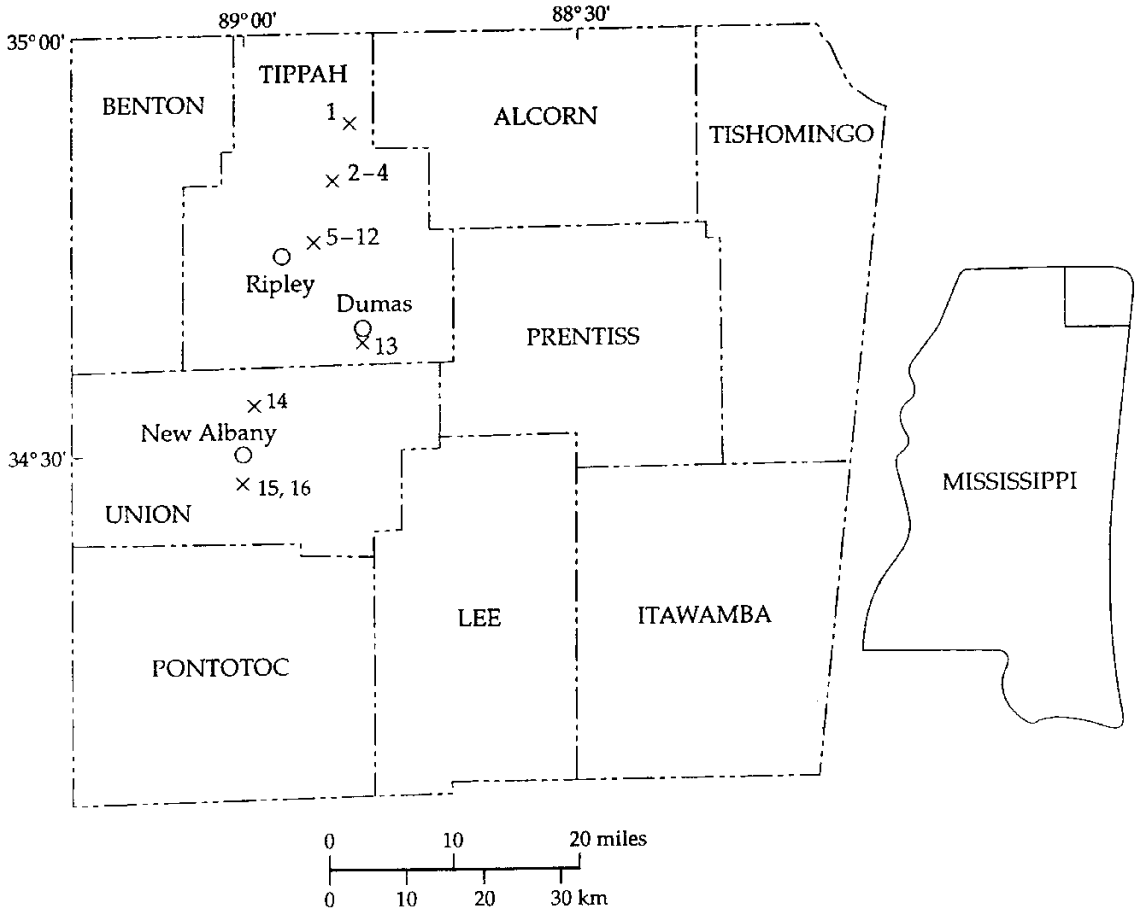

Fig. 1. Localities where ammonites were collected from the Owl Creek Formation in northeastern Mississippi; localities are described in Table 1

LOCALITIES WHERE AMMONITES WERE COLLECTED

U.S. Geological Survey (USGS) Mesozoic localities where ammonites were collected from the Owl Creek Formation in northeastern Mississippi are shown in Text-fig. 1. Data regarding the collector(s), year of collection, and locality are given in Table 1.

REPOSITORIES OF SPECIMENS

Specimens described in this report are in the Academy of Natural Sciences of Philadelphia (ANSP), Philadelphia, Pennsylvania, and the U.S. National Museum of Natural History (USNM), Washington, D.C. Casts of some of the specimens figured here are kept at the U.S. Geological Survey, Denver, Colorado.

Locality in Text-fig. 1	USGS Mesozoic locality	Collector(s), year of collection, and description of locality
1	25422	N.F. SOHL, 1950. Roadcut in E1/2 sec. 27, T. 2 S., R. 4 E.; Tippah County, Mississippi.
2	713	T.W. STANTON, 1889. Braddock's farm on Walnut Creek 11.3 km northeast of Ripley, Tippah County, Mississippi.
3	6875	L.W. STEPHENSON, 1910. White Oak Creek 8.8 km northeast of Ripley, Tippah County, Mississippi.
4	25421	N.F. SOHL, 1950. Roadcut near Walnut Creek in east edge of the SE1/4 sec. 16,T. 3 S., R. 4 E., Tippah County, Mississippi.
5	546	L.C. JOHNSON, 1888. Owl Creek, Tippah County, Mississippi.
6	594	C.A. WHITE, 1888. Owl Creek near Ripley, Tippah County, Mississippi.
7	707	T.W. STANTON, 1889. Bluffs along Owl Creek 4 km northeast of Ripley, Tippah County, Mississippi
8	6464	L.W. STEPHENSON, 1909. Bluff on Owl Creek 4 km northeast of Ripley, Tippah County, Mississippi
9	6876	L.W. STEPHENSON, 1910. Owl Creek 4 km northeast of Ripley, Tippah County, Mississippi
10	8309	E.N. LOWE, 1912. Bluff on south side of Owl Creek 4 km northeast of Ripley, Tippah County, Mississippi
11	25423	N.F. SOHL, 1950. Bluffs along Owl Creek 4 km northeast of Ripley in secs. 7 and 8, T. 4 S., R. 4 E., Tippah County, Mississippi
12	30761	N.F. SOHL, C.C. Smith, and W. ROSS, 1974. Bluff on Owl Creek 4 km northeast of Ripley in the Nl/2SEl/4 sec. 7, T. 4 S., R. 3 E., Tippah County, Mississippi. Type locality of Owl Creek Formation
13	25488	L.W. STEPHENSON and N.F. SOHL, 1955. Along road ditch 1.2 km south of Dumas in the SE1/4 sec. 23, T. 5 S., R. 4 E., Tippah County, Mississippi
14	18077	W.H. MONROE, 1939. Roadcut in middle of sec. 16, T. 6 S., R. 3 E., Union County, Mississippi
15	6468	L.W. STEPHENSON, 1909. New Albany-Pontotoc road 4.8 km south of New Albany, Union County, Mississippi
16	29860	N.F. SOHL, 1951. Roadcut 4.8 km south of New Albany in sec. 29, T. 7 S., R. 3 E., Union County, Mississippi

Table 1. U.S. Geological Survey (USGS) localities where ammonites were collected from the Owl Creek Formation in northeastern Mississippi

SYSTEMATIC PALEONTOLOGY

Suture terminology is that of WEDEKIND (1916) (*see* KULLMANN & WIEDMANN 1970). E is external lobe, L is lateral lobe, U, U1, and U2 are umbilical lobes, I is internal lobe, E/L is saddle separating E from L, and L/U is saddle separating L and U.

Order Ammonoidea ZITTEL, 1884
Suborder Ammonitina HYATT, 1889
Superfamily Acanthocerataceae DE GROSSOUVRE, 1894
Family Sphenodiscidae HYATT, 1900
Genus *Sphenodiscus* MEEK, 1871

TYPE SPECIES: *Ammonites lenticularis* OWEN, 1852, p. 579 (*non* PHILLIPS, 1829, Pl. 6, Fig. 5), by original designation; = *Ammonites lobatus* TUOMEY, 1854, p. 168.

Sphenodiscus pleurisepta (CONRAD, 1857)
(Pl. 1, Figs 12-15; Text-fig. 2)

1857. *Ammonites pleurisepta* CONRAD, p. 159, Pl. 15, Fig. la-c.
1861. *Ammonites pedernalis* BINKHORST, p. 21 (*pars*), Pl. 5al, Fig. la, lb only.
?1898. *Sphenodiscus pleurisepta* (CONRAD); BÖHM, p. 193-197, Pl. 7, Fig. 1, la, lb.
1903. *Sphenodiscus pleurisepta* (CONRAD); HYATT, p. 59, Pl. 3, Figs 7-15; Pl. 4; Pl. 5, Figs 1-3; Pl. 6, Fig. 6.
?1904. *Sphenodiscus pleurisepta* (CONRAD); LASSWITZ, p. 231, Pl. 2, Fig. 3a, b.
1908. *Sphenodiscus pleurisepta* (CONRAD); DE GROSSOUVRE, p. 22, Pl. 1, Fig. 8.
1910. *Sphenodiscus pleurisepta* (CONRAD); GRABAU & SHIMER, p. 215, Fig. 1490a-d.
1921. *Sphenodiscus pleurisepta* (CONRAD); GRABAU, Text-fig. 1756e-h.
1924. *Sphenodiscus pleurisepta* (CONRAD); DEUSSEN, Pl. 12, Fig. 3, 3a.
1928. *Sphenodiscus pleurisepta* (CONRAD); BÖSE, p. 304, Pl. 17, Figs 2-5.
1938. *Sphenodiscus pleurisepta* (CONRAD); ROMAN, p. 503.
1940. *Sphenodiscus* aff. S. *pleurisepta* (CONRAD); STEPHENSON & MONROE, p. 286, Pl. 13, Fig. 6.
1941. *Sphenodiscus pleurisepta* (CONRAD); STEPHENSON, p. 436, Pl. 95, Figs 1-4.
1955. *Sphenodiscus pleurisepta* (CONRAD); STEPHENSON, p. 135, Pl. 24, Figs 1-4.
?1955. *Sphenodiscus* cf. *pleurisepta* (CONRAD); REYMENT, p. 89, Fig. 44b, c.
1960. *Sphenodiscus pleurisepta* (CONRAD); MÜLLER, Fig. 362.
1993. *Sphenodiscus pleurisepta* (CONRAD, 1857); KENNEDY & COBBAN, p. 48, Figs 1a-c, 2, 3t.
1994. *Sphenodiscus pleurisepta* (CONRAD, 1857); EMERSON & *al*., p. 256, 257, 384.
1995. *Sphenodiscus pleurisepta* (CONRAD, 1857); COBBAN & KENNEDY, p. 12, Fig. 8.5.
1996. *Sphenodiscus pleurisepta* (CONRAD, 1857); KENNEDY & al., p. 11, Figs 4a, 5-12.
1997. *Sphenodiscus pleurisepta* (CONRAD, 1857); KENNEDY & al., p. 9, Figs 9J, 11-14.

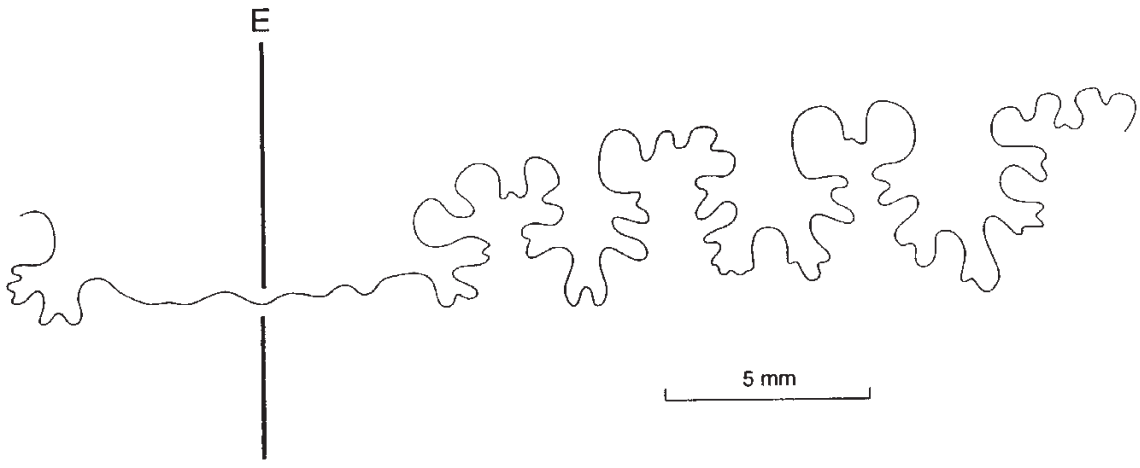

Fig. 2. Part of the sixth-from-last external suture of *Sphenodiscus pleurisepta* (CONRAD, 1857); USNM 465570, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7) (Pl. 1, Fig. 14); heavy, straight line marks middle of venter and middle of external lobe (E)

TYPES: CONRAD (1857, p. 159, Pl. 15, Figs 1a-c) figured one specimen but indicated that "it attains a much larger size than the specimen figured." It is not clear, however, whether he actually possessed more than one specimen; the original of his plate 15, figure 1 has, therefore, been regarded as the holotype. This specimen, USNM 9888, was said (CONRAD 1857, p. 159) to be from "Jacun, 3 miles below Laredo." As STEPHENSON (1941, 1955) noted, it is probably from the Escondido Formation of the Rio Grande region, probably in Maverick County, Texas.

MATERIAL: Figured specimens USNM 465569-465571 and 128183 are from the Owl Creek Formation of Tippah County Mississippi.

DESCRIPTION: Oxycone, with a tiny, occluded umbilicus. The umbilical wall is narrowly rounded; inner flanks are slightly concave, and outer flanks are broadly rounded and convergent. The venter is acute; it rounds on the adult body chamber. Shell surface, where well preserved, is covered by delicate growth lines and striae; these are prorsiradiate and straight to midflank, flexed back and convex over the midflank region, then flexed forward and concave on the outer flank.

There are about 15 small, rounded, midlateral tubercles per whorl connected by low ribs to about 18 somewhat larger outer lateral tubercles that are rounded at the smallest diameter seen but become crescentic as size increases. Suture (Text-fig. 2) is incompletely exposed; external lobes and saddles are moderately incised.

REMARKS: The present material is all crushed to varying degrees but shows the characteristic binodose flank ornament of the species. This we take to be a more significant feature than variations in the suture, and we regard all the binodose oxycone North American *Sphenodiscus* as a single species. Presence of tubercles separates *S. pleurisepta* from the smooth or weakly ribbed forms referred to *S. siva* (FORBES, 1846, p. 110, Pl. 7, Fig. 6) in southern India, *S. binkhorsti* BÖHM, 1898 (see revision in KENNEDY, 1986a, p. 177, Pl. 16, Fig. 23; Pl. 17, Figs 1, 2; Pl. 18, Figs 1-4, 6, 7; Pl. 19, Figs 5, 6; Pl. 20, Figs 1, 6-8; Pl. 30, Figs 10-12; Text-fig. 8a-c) in Europe, and *S. lobatus* (TUOMEY, 1854) (see revision *in* ZABORSKI, 1982; KENNEDY & *al*., 1997) in the United States and west Africa.

OCCURRENCE: Owl Creek Formation in Missouri, Mississippi, and Tennessee; Prairie Bluff Chalk in Mississippi and Alabama; Corsicana Formation in northeastern Texas; Escondido Formation in Trans-Pecos Texas and northern Mexico; Severn Formation in Maryland; Pierre Shale (*Baculites clinolobatus* Zone) in Colorado and Wyoming; and Fox Hills Formation (*Hoploscaphites birkelundi* Zone) in Colorado and Wyoming.

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Turrilitaceae GILL, 1871
Family Baculitidae GILL, 1871
Genus *Baculites* LAMARCK, 1799

TYPE SPECIES: *Baculites vertebralis* LAMARCK, 1801, p. 103, by subsequent designation by MEEK (1876, p. 391).

Baculites cf. *B. claviformis* STEPHENSON, 1941
(Pl. 2, Figs 24-26)

Compare:

1941. *Baculites claviformis* STEPHENSON, p. 403, Pl. l; Pl. 77, Figs 6-8; Pl. 78, Figs 1-6.
1974. *Baculites claviformis* STEPHENSON; COBBAN, p. 5, Pl. 3, Figs 7, 8, 12-14.
1991. *Baculites claviformis* STEPHENSON, 1941; COBBAN & KENNEDY, p. E4, Pl. 3, Figs 1-9.
1994. *Baculites claviformis* STEPHENSON, 1941; COBBAN & KENNEDY, p. B8, Pl. 8, Figs 1-8; Pl. 10; Pl. 11; Text-fig. 3 (with additional synonymy).
1994. *Baculites claviformis* STEPHENSON, 1941; EMERSON & *al*., p. 322, 394.

TYPES: The holotype is USNM 77241; paratypes USNM 77242-77244, all from the Nacatoch Sand near Kaufman, Kaufman County, Texas.

MATERIAL: One figured specimen, USNM 465572, from the Owl Creek Formation of Tippah County, Mississippi, is compared to *B. claviformis*.

DESCRIPTION: USNM 465572 is part of an uncrushed body chamber that retains most of its nacreous shell material. The specimen has a length of 55.7 mm, a height of 24.8 mm, a width of 18.0 mm, and an angle of taper of 1°. The cross section is a moderately compressed oval; the venter is fairly narrowly rounded, the flanks are very broadly rounded, and the dorsum is a little less broadly rounded. Ornament is lacking except for fairly weak ventral ribs spaced at five or six in a distance equal to the whorl height.

REMARKS: USNM 465572 resembles comparable-sized juvenile stages of *B. claviformis* that have similar moderately compressed ovate sections and smooth flanks. Adults of *B. claviformis* have low, broad flank ribs.

OCCURRENCE: The specimen is from the Owl Creek Formation at USGS Mesozoic locality 707 (Text-fig. 1, loc. 7), Tippah County, Mississippi. *Baculites claviformis* is known from the Coon Creek Tongue of the Ripley Formation in Tennessee, from the Ripley Formation in Alabama, from the Neylandville Marl and Nacatoch Sand in Texas, and from the Navesink Formation in New Jersey.

Baculites cf. *B. undatus* STEPHENSON, 1941
(Pl. 2, Figs 29, 30)

Compare:

1941. *Baculites undatus* STEPHENSON, p. 405, Pl. 79, Figs 5-10.
1973. *Baculites undatus* STEPHENSON; COBBAN, p. 459, Figs 2-5.
1993. *Baculites undatus* STEPHENSON; KENNEDY & COBBAN, p. 424, Figs 12.2, 14.18, 14.19, 14.21, 15.13, 15.25-15.27.
1994. *Baculites undatus* STEPHENSON, 1941; EMERSON & *al*., p. 323, 394.
1994. *Baculites undatus* STEPHENSON, 1941; COBBAN & KENNEDY, p. B8, Pl. 8, Figs 9-11; Pl. 9, Figs 1-6 (with additional synonymy).
1995. *Baculites undatus* STEPHENSON, 1941; KENNEDY & al., Pl. 5, Figs 22, 23.

TYPES: The holotype is USNM 77245; paratypes USNM 77246, 77247; all from the Nacatoch Sand near Chatfield, Navarro County, Texas.

MATERIAL: A single figured specimen, USNM 465573, from the Owl Creek Formation of Tippah County, Mississippi is compared to *B. undatus*.

DESCRIPTION: USNM 465573 is part of an uncrushed body chamber 77 mm long that retains part of its original nacreous shell material. The specimen has a stout, ovate intercostal cross section that is 23 mm high and 17.4 mm wide at its larger end. The venter is fairly narrowly-rounded, the flanks are broadly rounded, the dorsum somewhat flattened. The angle of taper of the specimen is 4°. Ornament consists of broad, arcuate flank ribs spaced at one in a distance equal to the whorl height and weak ventral ribs spaced at five or six per whorl height.

REMARKS: The specimen resembles *B. undatus* STEPHENSON, 1941, in its stoutness, taper, and general appearance, but *B. undatus* has narrower ribs that tend to be a little more closely spaced. In its broad, widely spaced flank ribs, the Owl Creek specimen resembles *B. baculus* MEEK & HAYDEN, 1861 (p. 445; MEEK, 1876, p. 397, Figs 51, 52), but the latter has a nearly circular cross section.

OCCURRENCE: USNM 465573 is from the Owl Creek Formation at USGS Mesozoic locality 707 (Text-fig. 1, loc. 7), Tippah County, Mississippi. *Baculites undatus* is known from the Neylandville Marl and Nacatoch Sand in Texas, the Saratoga Chalk in Arkansas, the Coon Creek Tongue of the Ripley Formation in Tennessee, the Navesink Formation in New Jersey, and the Pierre Shale in Colorado and New Mexico.

Genus *Eubaculites* SPATH, 1926

TYPE SPECIES: *Baculites vagina* var. *ootacodensis* STOLICZKA, 1866, p. 199, Pl. 90, Fig. 14, by original designation.

Eubaculites carinatus (MORTON, 1834)
(Pl. 2, Figs 1-23, 27, 28; Text-figs 3, 4)

1834. *Baculites carinatus* MORTON, p. 44, Pl. 13, Fig. 1.
1847. *Baculites lyelli* D'ORBIGNY, Pl. 1, Figs 3-7.
1858. *Baculites tippaensis* CONRAD, p. 334, Pl. 35, Fig. 27.
1858. *Baculites spillmani* CONRAD, p. 335, Pl. 35, Fig. 24.
1923. *Baculites sheringomensis* CRICK, p. 139, Pl. 9, Figs 1-3.
1923. *B.* cf. *vagina* var. *ootacodensis* STOLICZKA; CRICK, p. 140, Pl. 9, Figs 4-5.
1923. *B.* cf. *vagina* var. *simplex* KOSSMAT; CRICK, p. 140, Pl. 9, Figs 6-7.
1940. *Eubaculites ootacodensis* (STOLICZKA); SPATH *pars*, p. 49, *non* Pl. 1, Figs 3a, b, Text-fig. lb.
1965. *Eubaculites* sp. ROSSI DE GARCIA & CAMACHO, p. 72, Pl. 1, Fig. 1.
1980. *Eubaculites ootacodensis* (STOLICZKA); RICCARDI, p. 11, Text-figs. 1, 2.
1986. *Eubaculites lyelli* (D'ORBIGNY); STINNESBECK, p. 207, Pl. 9, Figs 6-8; Text-fig. 24d.
1986a. *Eubaculites lyelli* (D'ORBIGNY, 1847); KENNEDY, p. 195, Pl. 27, Figs 5-8; Pl. 32, Figs 13, 14 (with synonymy).
1986b. *Eubaculites lyelli* (D'ORBIGNY, 1847); KENNEDY, Text-fig. 12c, d.
1986c. *Eubaculites lyelli* (D'ORBIGNY); KENNEDY *in* KENNEDY & *al*., p. 1016, Pl. 1, Figs 1-3; Pl. 2, Figs 3-8; Pl. 3, Figs 2-8, 13-21.

1992. *Eubaculites carinatus* (MORTON); HENDERSON & *al*., p. 150, Figs 6F, G, 14-16, 17A-C, G-J, 18, 19.
1992. *Eubaculites carinatus* (MORTON); KENNEDY & HENDERSON, p. 714, Text-fig. 5A-C.
1995. *Eubaculites carinatus* (MORTON); COBBAN & KENNEDY, p. 26, Figs 14.1, 14.5-14.7, 15.4, 15.6-15.8, 16.13-16.15, 16.23, 16.24, 16.28-16.30, 17.52-17.59, 18.1-18.44 (with additional synonymy).
1995. *Eubaculites carinatus* (MORTON); KENNEDY & al., Pl. 7, Figs 4-6.
1996. *Eubaculites carinatus* (MORTON, 1834); KENNEDY & COBBAN, p. 802, Fig. 13.1-13.3, 13.7.-13.12.

TYPES: Holotype, by monotypy, is ANSP 72866, from the Prairie Bluff Chalk of Alabama, the original of MORTON, 1834, Pl. 13, Fig. 1.

MATERIAL: About 80 uncrushed and crushed specimens from the Owl Creek Formation in Tippah County, Mississippi (Fig. 1, locs 5-12); 45 uncrushed specimens from the Owl Creek Formation near Dumas, Tippah County (Text-fig. 1, loc. 13); and 54 uncrushed specimens from the Owl Creek near New Albany, Union County, Mississippi (Fig. 1, locs 15, 16).

DIAGNOSIS: A moderate-sized species characterized by a flat, ribbed keel and by weak to strong, arcuate lateral ribs.

DESCRIPTION: The holotype (MORTON 1834, Pl. 13, Fig. 1) is an internal phosphatic mold about 50 mm long that has end diameters of 15 and 18 mm according to STEPHENSON (1955, p. 134). MORTON's drawing shows three arcuate lateral ribs in a distance equal to the diameter.

The species was well described by STEPHENSON (1955, p. 134). A large specimen illustrated by STEPHENSON (1955, Pl. 24, Figs 5-7) from USGS Mesozoic locality 707 on Owl Creek, Tippah County (Text-fig. 1, loc. 7), shows the main features of the species. That specimen, about 180 mm long, has an ovate section 24.5 mm high and 17.5 mm wide, a flattened dorsum, a broadly rounded flank, and a flat venter bordered by a ventrolateral furrow to produce a distinct keel.

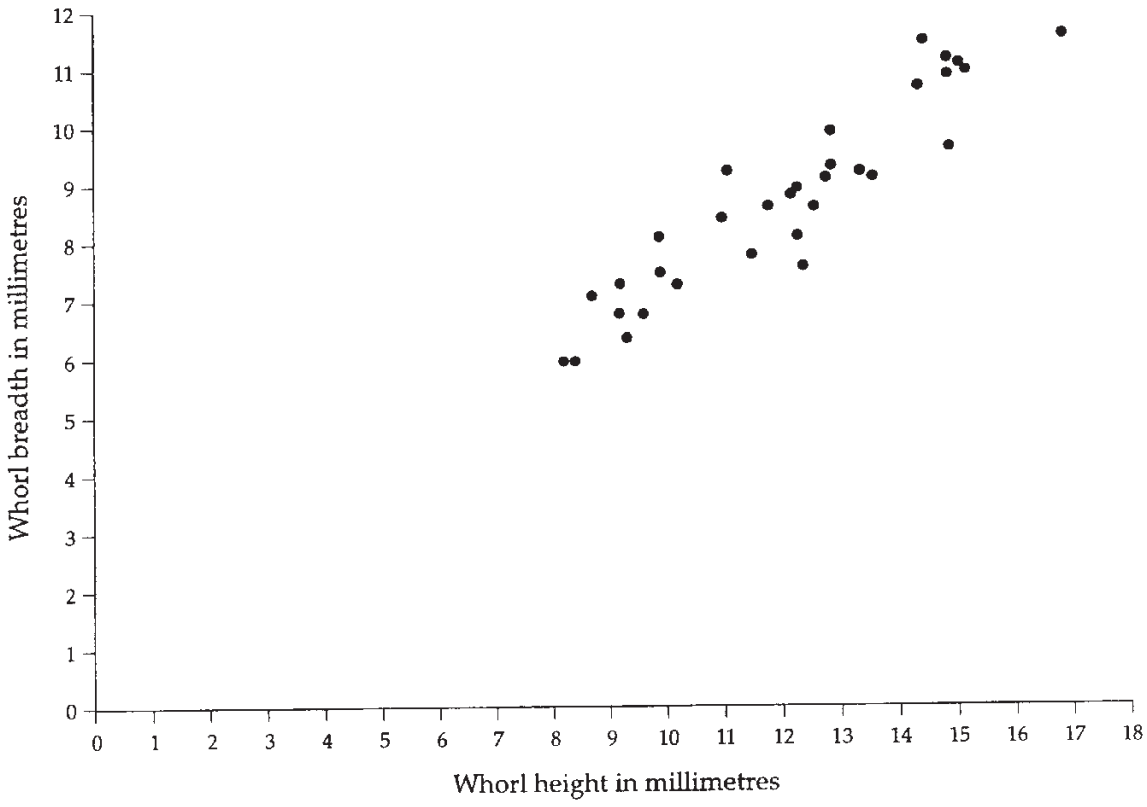

Fig. 3. Plot of whorl breadth and whorl height of 32 uncrushed specimens of *Eubaculites carinatus* (MORTON, 1834) from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

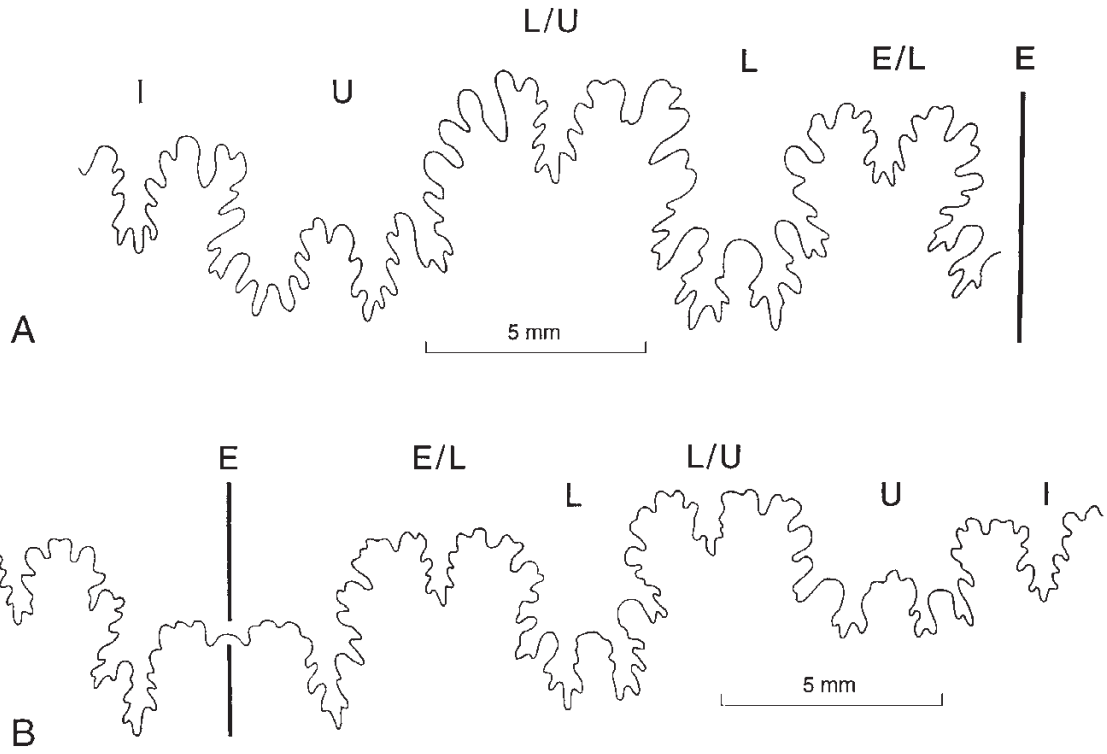

Fig. 4. Sutures of *Eubaculites carinatus* (MORTON, 1834) from USGS Mesozoic locality 6464 (Text-fig. 1, loc. 8); A, USNM 465586. B, USNM 465587; heavy, straight line marks middle of venter and middle of external lobe (E); L is lateral lobe, U is umbilical lobe, I is internal lobe, E/L is saddle separating E and L, and L/U is saddle separating L and U

Thirty-six specimens ranging from 8.5 to 23.2 mm in diameter are at hand from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7). Most are body chambers (some crushed) that retain much of their original nacreous shell material. Most specimens have angles of taper of 3° or 4°, but some individuals have angles as small as 2° or as large as 7°. Keels are developed at the smallest diameters observed. Ribbing on the keel may be obscure to distinct; ribs usually number 5 to 7 in a distance equal to the whorl height, but may be as low as 3 or as high as 10, as on the specimen illustrated by STEPHENSON (1955, Pl. 24, Fig. 5). Ribs arch forward slightly on crossing the keel and then slant backward and multiply before disappearing on crossing the lower part of the flank, where they form an angle of about 20° with the keel. Crescentic ribs on the dorsal half of the flank are present on most specimens from USGS Mesozoic locality 707. They follow the course of growth lines and range from weak to strong and from narrow to broad. Most specimens have about two ribs in a distance equal to the whorl height, but a few may have as many as three. Occasional specimens seem to lack flank ornament. Forwardly arched growth lines may be conspicuous on the dorsum, and, on some specimens, the growth lines may be raised into weak ribs. Apertures are not preserved.

A collection of 33 uncrushed internal moulds from the Owl Creek Formation at USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13) includes specimens as small as 8.4 mm in diameter (unfigured specimen USNM 465588). The ovate whorl sections have whorl breadth to height ratios from 0.6 to 0.8 (Text-fig. 3). Lateral ribs arise at diameters as small as 9 mm or at some diameter larger than 13 to 17 mm. These ribs range from barely discernible to strong and conspicuous and number one to three in a distance equal to the whorl height.

A collection of 38 uncrushed internal molds from the Owl Creek Formation at USGS Mesozoic locality 29860 (Text-fig. 1, loc. 16) includes specimens 6.0 (unfigured specimen USNM 465589) to 19.3

mm in diameter. Lateral ribs arise at diameters as small as 7.5 mm, but the largest specimen is still smooth at 19.3 mm (unfigured specimen USNM 465590).

The suture (Text-fig. 4) has broad, plump, bifid E/L and L/U; narrow, moderately incised and bifid L; very broad and bifid U; and narrow I.

REMARKS: Small specimens differ in no significant respects from the holotype (MORTON, 1834, p. 44, Pl. 13, Fig. 1). Like the Owl Creek Formation, the Prairie Bluff Chalk in Mississippi and Alabama contains individuals having closely spaced ribs and those having widely spaced ribs. A similar range of variation is seen in material from Quiriquina Island, Chile, and we regard *Baculites lyelli* D'ORBIGNY, 1847 (Pl. 1, Figs 3-7) as a synonym (*see* STINNESBECK 1986, p. 207, Pl. 9, Figs 6-8; Text-fig. 24d). The types of *Baculites tippaensis* CONRAD (1858, p. 334, Pl. 35, Fig. 27) and *B. spillmani* CONRAD (1858, p. 335, Pl. 35, Fig. 24), from the Owl Creek Formation of Tippah County, Mississippi, are lost. *Baculites tippaensis* was based on a variant of the species having widely spaced, strong ribs; although it was shown with a circular cross section, the description speaks of the front being "slightly contracted, or with depressed lines on the submargin" or "obtusely carinated," showing it to be a *Eubaculites*. *Baculites spillmani* was based upon a weakly ornamented variant of the species; the whorl section is shown as a compressed oval, but the description mentions the front being "a little raised or carinated," indicating that it too was a *Eubaculites*. Other synonyms were discussed by KENNEDY (1986a) and COBBAN & KENNEDY (1995).

OCCURRENCE: Owl Creek Formation in Missouri, Mississippi, and Tennessee; Prairie Bluff Chalk in Mississippi and Alabama; Corsicana Formation in northeastern Texas; and reworked fauna at base of Brightseat Formation in New Jersey. The species ranges from lower to upper Maastrichtian elsewhere in the world, with records from The Netherlands, southeastern France, Austria, Mozambique, Zululand, Madagascar, southern India, western Australia, Argentina, Chile, and California.

Superfamily Scaphitaceae GILL, 1871
Family Scaphitidae GILL, 1871
Subfamily Scaphitinae GILL, 1871
Genus *Discoscaphites* MEEK, 1870

TYPE SPECIES: *Ammonites conradi* MORTON, 1834, p. 39, Pl. 16, Fig. 3, by original designation.

Discoscaphites iris (CONRAD, 1858)
(Pl. 3, Figs 3-35; Text-fig. 5)

1858. *Scaphites iris* CONRAD, p. 335, Pl. 35, Fig. 23.
1892. *Scaphites iris* CONRAD; WHITFIELD, p. 265, Pl. 44, Figs 4-7.
1955. *Discoscaphites iris* (CONRAD); STEPHENSON, p. 134, Pl. 23, Figs 23-30.

TYPES: Holotype is the original of CONRAD, 1858, p. 335, Pl. 35, Fig. 23, in the collection of the Academy of Natural Sciences of Philadelphia, from the bluffs of Owl Creek in Tippah County, Mississippi, probably at USGS Mesozoic locality 707 (Text-fig. 1, loc. 7). Figured specimens are USNM 128218, 445208, 465591-465614.

MATERIAL: About 140 specimens are at hand from the Owl Creek Formation near its type locality on Owl Creek, Tippah County, Mississippi (USGS Mesozoic localities 546, 707, 6464, 6876, 25423), 17 specimens from the Owl Creek Formation near Dumas, Tippah County (USGS Mesozoic locality 25488), and 34 specimens from the New Albany area, Union County, Mississippi (USGS Mesozoic localities 6468 and 29860).

DESCRIPTION: *Discoscaphites iris* is a moderate-sized species characterized by its stout form and ornament of four rows of tubercles on each flank. Ribs are either absent or poorly developed on the body chamber except near the aperture. Like all scaphites, the species is dimorphic. The holotype and the specimens figured by STEPHENSON (1955, Pl. 23, Figs 23-30) are macroconchs. Macroconchs are characterized by adult body chambers that have cross sections considerably higher than wide and have a swollen umbilical wall (Pl. 3, Figs 21-35). Most adult microconchs are smaller than macroconchs and have body chambers only a little higher than wide and lack a swollen umbilical wall (Pl. 3, Figs 3-20).

Although beautifully preserved with nacreous shell material, most specimens from the type locality of the species on Owl Creek are incomplete and have crushed, unfilled phragmocones. The largest collection, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7), made by T.W. STANTON in 1889, consists of 38 specimens, of which 12 are macroconchs, 10 are microconchs, and the rest are too incomplete

for determination. Macroconchs from locality 707 range in length from 32 to 52 mm. Body chambers occupy a full half whorl or slightly more. None of the specimens has a phragmocone that is well enough preserved for description.

A fairly small macroconch (Pl. 3, Figs 32, 33) from the Owl Creek locality 770 was figured by STEPHENSON (1955, Pl. 23, Figs 23-25) and has an uncrushed phragmocone that is compressed and quite involute; it has a whorl breadth to whorl height ratio of 0.64 and a ratio of umbilical diameter to shell diameter of 0.13. Ornament on the last half of the phragmocone consists of 14 prorsiradiate ribs (5 primaries separated by 1 or 2 secondaries) and umbilical bullae, weaker midflank bullae, slightly larger nodate inner ventrolateral tubercles, and smaller nodate outer ventrolateral tubercles. Umbilical and midflank bullae are on the primary ribs. Inner ventrolateral tubercles, which number 10, are present on the primary ribs and on some secondary ribs. Outer ventrolateral tubercles number 20 and are present on every rib. Ribs, although weakened, cross the venter transversly.

Macroconch body chambers from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7) have their greatest whorl height and breadth at the middle of the flank. The swollen umbilical wall, which lies just above the umbilicus, has a convex inner margin and a sloping outer wall. In contrast, the venter of the body chamber has a uniform curvature in side view. Although the body chamber straightens a little, there appears to be no gap between the aperture and the phragmocone. The younger part of the body chamber tapers in height and breadth toward the aperture, which is a little broader than high and is marked by a conspicuous constriction. The aperture has a slight ventral projection and a lesser dorsal projection; its lateral margin is nearly straight.

Tubercles dominate the ornament of the macroconch body chamber; ribs are lacking except for one to four weak, prorsiradiate ones at the apertural end. Four or five umbilical tubercles are located on the inner part of the flank. The two middle umbilical tubercles are large and nodate; the rest are small and bullate (Pl. 3, Fig. 35). Midflank tubercles are small-

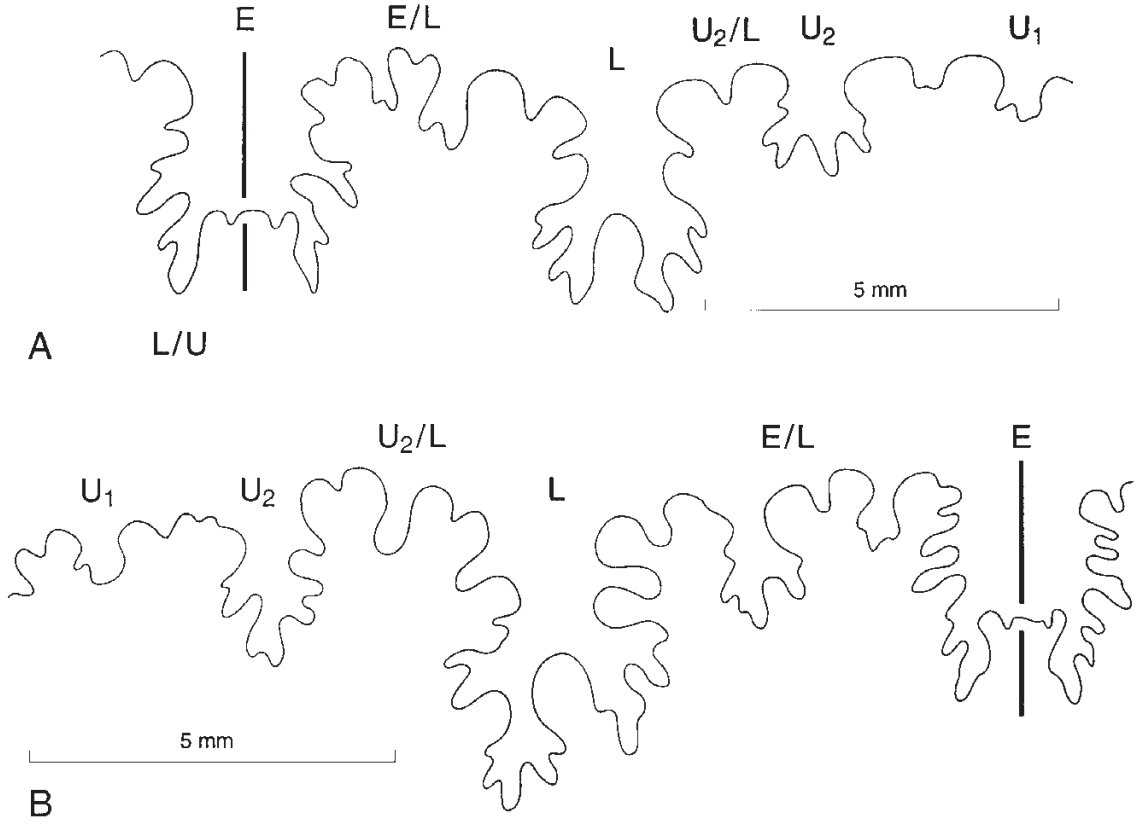

Fig. 5. External sutures of *Discoscaphites iris* (CONRAD, 1858) from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13); A – USNM 465594; B – USNM 445208. Heavy, straight line marks middle of venter and middle of external lobe (E); L is lateral lobe, U1 and U2 are umbilical lobes, E/L is saddle separating E and L, U2/L is saddle separating L and U2

er, mostly nodate, and number 6 to 8. Inner ventrolateral tubercles are nodate, larger than the midflank tubercles, and number 9 to 14. The umbilical, midflank, and inner ventrolateral rows are about equally spaced. An outer row of ventrolateral tubercles may be equally spaced from the other rows, or it may be a little nearer the inner ventrolateral row. The outer ventrolateral tubercles are nodate, equal to or slightly smaller than the inner ventrolateral ones, and number 13 to 19. Tubercles of the outer row are usually matched across the venter, but occasional tubercles may be arranged alternately on part of the body chamber and matched on another part. Tubercles in all the rows decline in size as they approach the aperture.

Microconchs from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7) have lengths from 26 to 39 mm (Pl. 3, Figs 3-6, 12, 13, 20). Most phragmocones are badly crushed but appear to be compressed and have whorls much higher than wide. Ratios of umbilical diameter to shell diameter are greater than those of macroconchs. The complete microconch shown in Pl. 3, Figs 3, 4, has an umbilical ratio of 0.17. Ornament of microconch phragmocones is similar to that of macroconchs. Body chambers from USGS Mesozoic locality 707 occupy one-half a whorl or slightly less. The inner margin of the umbilical wall is concave when viewed from the side, and the whorl height of the body chamber is fairly uniform throughout. The aperture is like that of the macroconch.

Ornament on microconch body chambers consists of four rows of tubercles and narrow, prorsiradiate ribs. Five or six bullate to nodate umbilical tubercles are located on the umbilical shoulder, where they are perched on arcuate ribs that arise at the umbilical seam. Nine to 13 smaller nodate midflank tubercles are present that usually arise on ribs. Twelve to 17 nodate inner ventrolateral tubercles are present that are a little larger than the midflank ones. Outer ventrolateral tubercles are nodate and slightly smaller than the inner ventrolateral ones; they number 12 to 18. As with macroconchs, the three inner rows are equally spaced, but the fourth row is slightly nearer the third row.

The suture is moderately complex and typical of Late Cretaceous scaphitids in having the E/L saddle asymmetrically bifid (Text-fig. 5).

Uncrushed internal molds of microconch body chambers from the Owl Creek Formation south of USGS Mesozoic locality 707 reveal a considerable range in stoutness. Eleven body chambers (USNM 465593, 465594, 465597, 465607-465614) from USGS Mesozoic locality 25488 near Dumas in Tippah County (Text-fig. 1, loc. 13) have the following intercostal breadth:height ratios; 0.72, 0.86, 0.88, 0.90, 0.93, 0.94, 0.97, 0.97, 1.00, 1.10, and 1.30.

REMARKS: *Discoscaphites iris* differs from the type species, *D. conradi* (MORTON, 1834)(see revision *in* JELETZKY & WAAGE 1978, LANDMAN & WAAGE 1993, COBBAN & KENNEDY 1995), in its constant number of tubercles, four on each side, versus up to six in *D. conradi*, which also develops siphonal tubercles on some specimens.

OCCURRENCE: Owl Creek Formation in Missouri and Mississippi; Corsicana Formation in northeastern Texas.

Discoscaphites sphaeroidalis sp. nov.
(Pl. 1, Figs 1-11; Text-fig. 6)

1955. *Discoscaphites* sp. STEPHENSON, p. 135, Pl. 23, Figs 20-22.

ETYMOLOGY: From sphaira (Greek), ball.

TYPES: Holotype is USNM 465615, from the Owl Creek Formation at the type locality at USGS Mesozoic locality 30761 (Text-Fig. 1, loc. 12). Paratypes USMN 465616 and 465617 (unfigured) are from the Owl Creek Formation on White Oak Creek, at USGS Mesozoic locality 6875, 8.8 km northeast of Ripley, Tippah County, Mississippi (Text-fig. 1, loc. 3). Paratype USNM 465618 is from USGS Mesozoic locality 594, Owl Creek Formation on Owl Creek, Tippah County, Mississippi (Text-fig. 1, loc. 6). Paratype USNM 20861 (STEPHENSON, 1955, Pl. 23, Fig. 20) is from USGS Mesozoic locality 707, Owl Creek Formation, Tippah County, Mississippi (Text-fig. 1, loc. 7). Paratype USNM 465619 is from USGS Mesozoic locality 29860, Owl Creek Formation, Union County, Mississippi (Text-fig. 1, loc. 16). Paratypes USNM 128219 (figured by STEPHENSON, 1955, Pl. 23, Figs 21, 22) and 465620 are from the Owl Creek Formation at USGS Mesozoic locality 16429, Crowleys Ridge, Stoddard County, Missouri.

DIAGNOSIS: A moderate-sized species characterized by inflated whorls, very small umbilicus, narrow venter, and ornament of strong ribs on the phragmocone and four rows of tubercles on the body chamber.

DESCRIPTION: The holotype (Pl. 1, Figs 1-4) is a nearly complete adult macroconch 46.2 mm in length that lacks parts of the adapertural end of the body chamber. Most of the specimen retains its original nacreous shell material. The body chamber occupies the last half whorl. The outer half whorl of the phragmocone has a diameter of 31.6 mm and an umbilical diameter of only 2 mm (ratio to phragmocone diameter of 0.06). Inner whorls are not visible, but the outer septate whorl is inflated and has broadly rounded flanks and a narrow, flat venter. Ornament on the whorl consists of rather closely spaced, strong, slightly flexuous, rectiradiate ribs. Five of the ribs are primaries that begin in the umbilicus and strengthen into bullae on the umbilical shoulder from which one or two ribs arise and cross the flank. Other ribs arise low or high on the flank to give a total of about 23 ribs on the last half of the phragmocone. All ribs have barely discernible midlateral tubercles and slightly stronger inner ventrolateral tubercles. A conspicuous row of larger, nodate outer ventrolateral tubercles borders the venter; these number 18 on the last half whorl of the phragmocone.

The body chamber is very inflated in its middle part and then tapers in height and breadth to the aperture. A low umbilical swelling lies just above the umbilicus; otherwise, the inner umbilical margin would be straight for part of its course. The venter of the body chamber has a uniform curvature when viewed from the side. A small part of the constricted aperture is preserved, and there is no gap between it and the phragmocone. Ornament on the body chamber consists of four rows of tubercles aligned along poorly defined, low, broad ribs. Five fairly large, nodate umbilical tubercles lie well out on the lower part of the flank. Seven or eight smaller nodate tubercles lie at midflank. Nine or more larger nodate inner ventrolateral tubercles are present, and probably a few more slightly smaller nodate tubercles border the narrow, flattened venter. The inner three rows are equally spaced, but the two ventrolateral rows are closer together.

A paratype (USNM 465616) from USGS Mesozoic locality 6875 (Text-fig. 1, loc. 3) is comparable in size to the holotype but is considerably more inflated (Pl. 1, Figs 5-7). The paratype consists of a phragmocone 31.5 mm in diameter and the adapical half of the body chamber. The specimen, a macroconch, has a tiny umbilicus of only 1.8 mm (ratio to phragmocone diameter of 0.06). Ornament is much like that of the holotype except for the outer row of ventrolateral tubercles, which are arranged alternately on the later part of the phragmocone. Most of the external suture is visible; it is typical of Maastrichtian scaphites (Text-fig. 6) in its moderate simplicity.

A single somewhat distorted phragmocone 28.5 mm in diameter may represent the microconch of the species (Pl. 1, Figs. 10, 11). The last half whorl has 18 strong, narrow, rectiradiate to prorsiradiate ribs, of which 6 or 7 are primaries that begin in the umbilicus and rise into low, narrow umbilical bullae on the umbilical shoulder. Secondary ribs arise low or high on the flank. Midflank tubercles are absent, but every rib supports small, nodate inner and outer ventrolateral tubercles of about equal size. Opposite outer ventrolateral tubercles are connected across the venter by a pair of weak ribs.

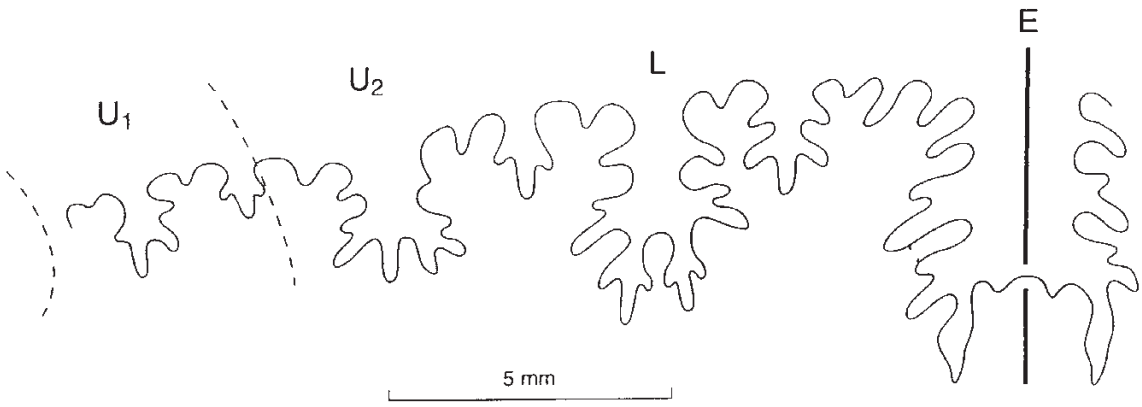

Fig. 6. Fourth-from-last external suture of *Discoscaphites sphaeroidalis* KENNEDY & COBBAN, sp. nov. Paratype USNM 465616, from USGS Mesozoic locality 6875 (Text-fig. 1, loc. 3); heavy, straight line marks middle of venter and middle of external lobe (E); longer dashed line marks umbilical shoulder; shorter dashed line marks umbilical seam; L is lateral lobe, Ul and U2 are umbilical lobes

REMARKS: *Discoscaphites sphaeroidalis* is closely related to *D. iris*, from which it differs in its globose form and strongly ribbed phragmocone.

OCCURRENCE: *Discoscaphites sphaeroidalis* sp. nov. is known only from the Owl Creek Formation in Tippah County in northern Mississippi and from the Owl Creek in southeastern Missouri.

Discoscaphites cf. *D. conradi* (MORTON, 1834)
(Pl. 3, Figs 1, 2)

Compare:

1834. *Ammonites conradi* MORTON, p. 39, Pl. 16, Fig. 3.
1978. *Discoscaphites conradi* (MORTON); JELETZKY & WAAGE, p. 1125, Pl. 1, Figs 1-20; Pl. 2, Figs 1-19; Pl. 3, Figs 1-17 (with full synonymy).
1993. *Discoscaphites conradi* (MORTON, 1834); LANDMAN & WAAGE, p. 194, Figs 149-166.
1995. *Discoscaphites conradi* (MORTON, 1834); COBBAN & KENNEDY, p. 29, Figs 10.2, 12.4, 12.5, 12.12-12.14, 19.1-19.19, 20.3-20.7, 20.21, 20.22, 22.1-22.4.

MATERIAL: One figured specimen, USNM 420319, from the Owl Creek Formation of Tippah County, Mississippi.

DESCRIPTION: A single uncrushed specimen differs from all the other scaphites at hand from the Owl Creek Formation in possessing five rows of tubercles. The specimen, a microconch, consists of a partly damaged phragmocone and a nearly complete body chamber. Whorls are compressed. Dimensions in millimeters and ratios to the diameter at the end of the phragmocone are as follows: diameter, 27.3; whorl breadth, 8.5 (0.31); whorl height, 13.7 (0.50); umbilicus, 5.1 (0.19). In the side view, the body chamber straightens slightly, but it has a concave umbilical margin and a uniformly curved venter. The specimen has a steep, narrowly rounded umbilical wall, narrow umbilical shoulder, and flattened flanks that merge into a narrow, flattened venter.

Ornament consists of conspicuous, very narrow, nodose, prorsiradiate primary ribs that rise from narrow umbilical bullae and become separated on the outer part of the flank by weak secondary ribs. Each primary rib bears a small, sharp bulla on the inner part of the flank, a similar bulla farther out on the flank, and larger, nodate inner and outer ventrolateral tubercles. All secondary ribs have nodate outer ventrolateral tubercles, and some have inner ones as well. Outer ventrolateral tubercles are connected across the narrow venter by low, broad, transverse ribs that greatly weaken on the body chamber.

REMARKS: The specimen resembles *D. conradi* in its compressed whorls and five rows of tubercles. Microconch specimens of *D. conradi* at hand from the Prairie Bluff Chalk of Alabama have weaker flank ornament but stronger ventral ribbing. The Owl Creek specimen retains much of its original nacreous shell material, whereas the Prairie Bluff specimens are internal moulds, and that difference may exaggerate the differences in flank ornament.

OCCURRENCE: Owl Creek Formation at USGS Mesozoic locality 713 on Walnut Creek northeast of Ripley, Tippah County, Mississippi (Text-fig. 1, loc. 2).

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PLATE 1

1-11 – *Discoscaphites sphaeroidalis* KENNEDY & COBBAN, sp. nov.
- 1-4 – Holotype USNM 465615, from USGS Mesozoic locality 30761 (Text-fig. 1, loc. 12)
- 5-7 – Paratype USNM 465616, from USGS Mesozoic locality 6875 (Text-fig. 1, loc. 3)
- 8-9 – Paratype USNM 465619, from USGS Mesozoic locality 29860 (Text-fig. 1, loc. 16)
- 10-11 – Paratype USNM 465618, from USGS Mesozoic locality 594 (Text-fig. 1, loc. 6)

12-15 – *Sphenodiscus pleurisepta* (CONRAD, 1857)
- 12 – USNM 128183, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)
- 13 – USNM 455569, from USGS Mesozoic locality 6875 (Text-fig. 1, loc. 3)
- 14 – USNM 465570, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)
- 15 – USNM 465571, from USGS Mesozoic locality 6464 (Text-fig. 1, loc. 8)

All figures are × 1

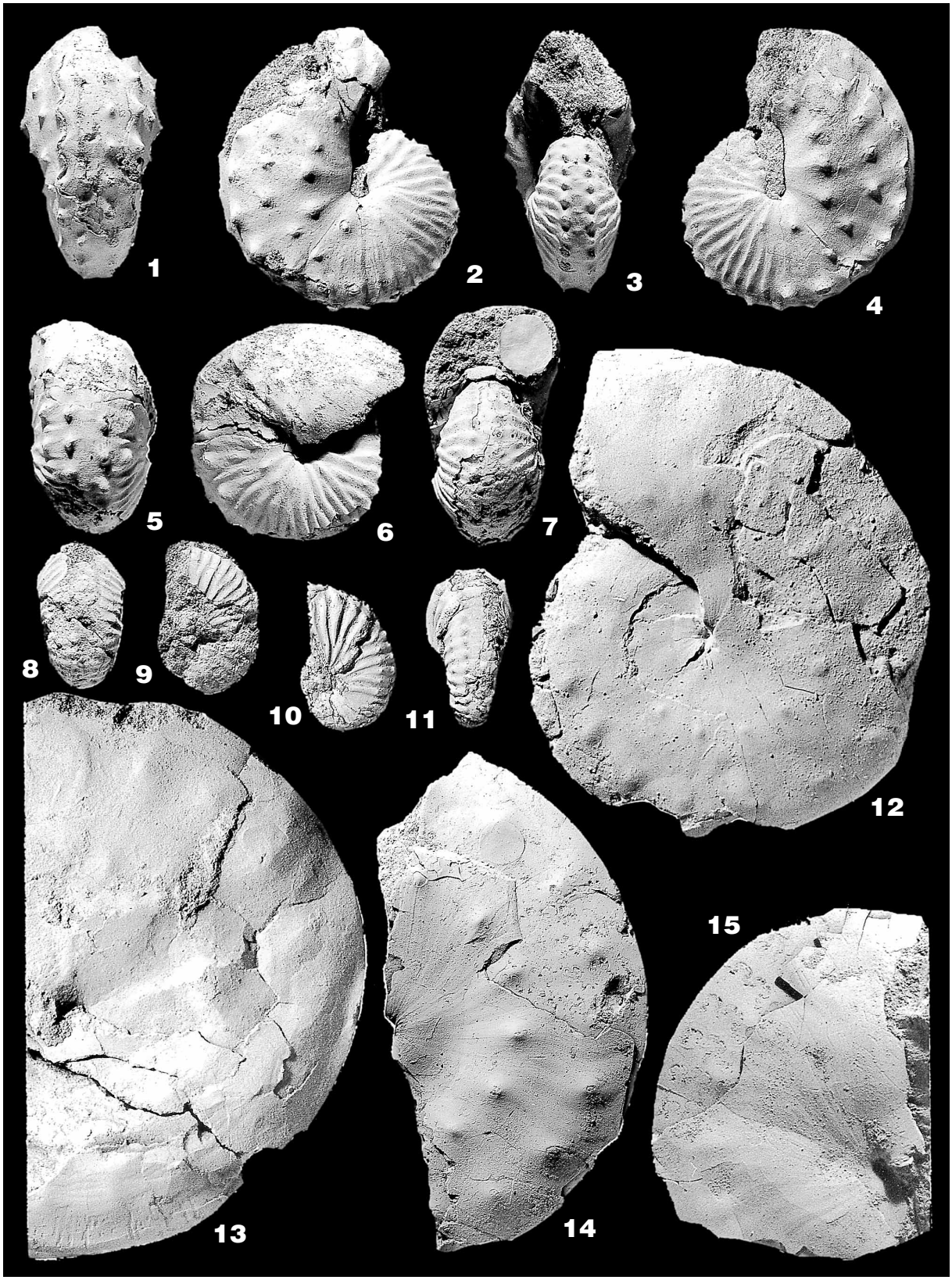
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PLATE 2

1-23, 27-28 – *Eubaculites carinatus* (MORTON, 1834)
Specimens shown in Figs 1-3, 12, 16-18, and 27-28 from USGS Mesozoic locality 6464 (Text-fig. 1, loc. 8); specimens shown in Figs 4-11, 13-15, and 19-23 from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)
1-3 – USNM 465574; 4-6 – USNM 465575; 7-9 – USNM 465576; 10 – USNM 465577; 11 – USNM 465578; 12 – USNM 465579; 13; 14 – USNM 465580; 15 – USNM 465581; 16-18 – USNM 465582; 19, 20 – USNM 465583; 21-23 – USNM 465584; 27-28 – USNM 465585

24-26 – *Baculites* cf. *B. claviformis* STEPHENSON, 1941; USNM 465572, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

29-30 – *Baculites* cf. *B. undatus* STEPHENSON, 1941; USNM 465573, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

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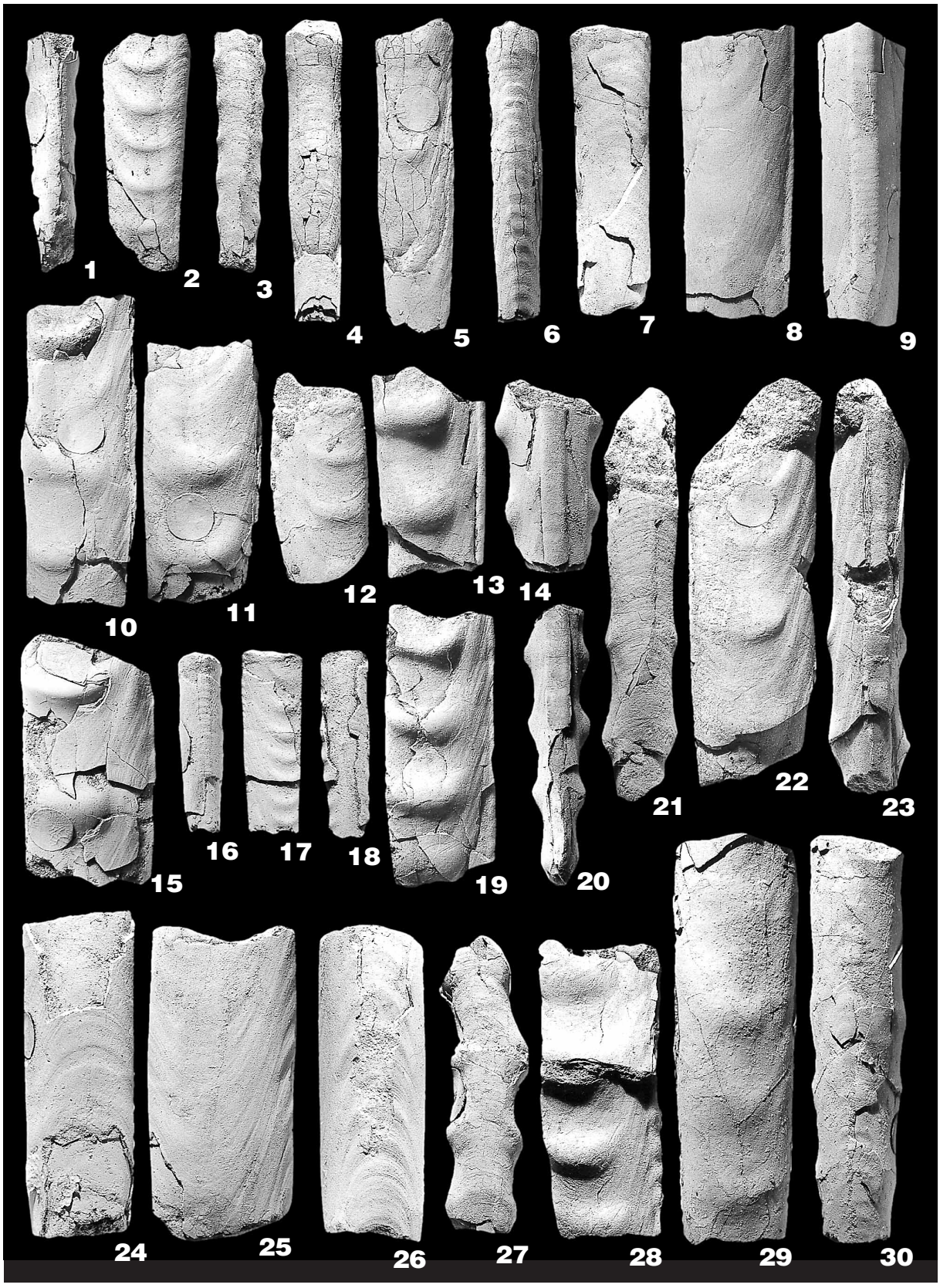
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PLATE 3

1-2 – *Discoscaphites* cf. *D. conradi* (MORTON, 1834); USNM 420319, from USGS Mesozoic locality 713 (Text-fig. 1, loc. 2)

3-35 – *Discoscaphites iris* (CONRAD, 1858); Specimens shown in figs 3-20 are adult microconchs; those shown in figs 21-35 are adult macroconchs

3-4 – USNM 465591, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

5-6 – USNM 465592, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

7-8 – USNM 465593, from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

9-11 – USNM 465594, from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

12 – USNM 465595, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

13-15 – USNM 465596, from USGS Mesozoic locality 6876 (Text-fig. 1, loc. 9)

16, 17 – USNM 465597, from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

18, 19 – USNM 465598, from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

20 – USNM 465599, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

21 – USNM 465600, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

22-24 – USNM 465601, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

25-26 – USNM 465602, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

27-28 – USNM 465603, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

29-30 – USNM 465604, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

31 – USNM 465605, from USGS Mesozoic locality 25488 (Text-fig. 1, loc. 13)

32-33 – USNM 128218, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

34-35 – USNM 465606, from USGS Mesozoic locality 707 (Text-fig. 1, loc. 7)

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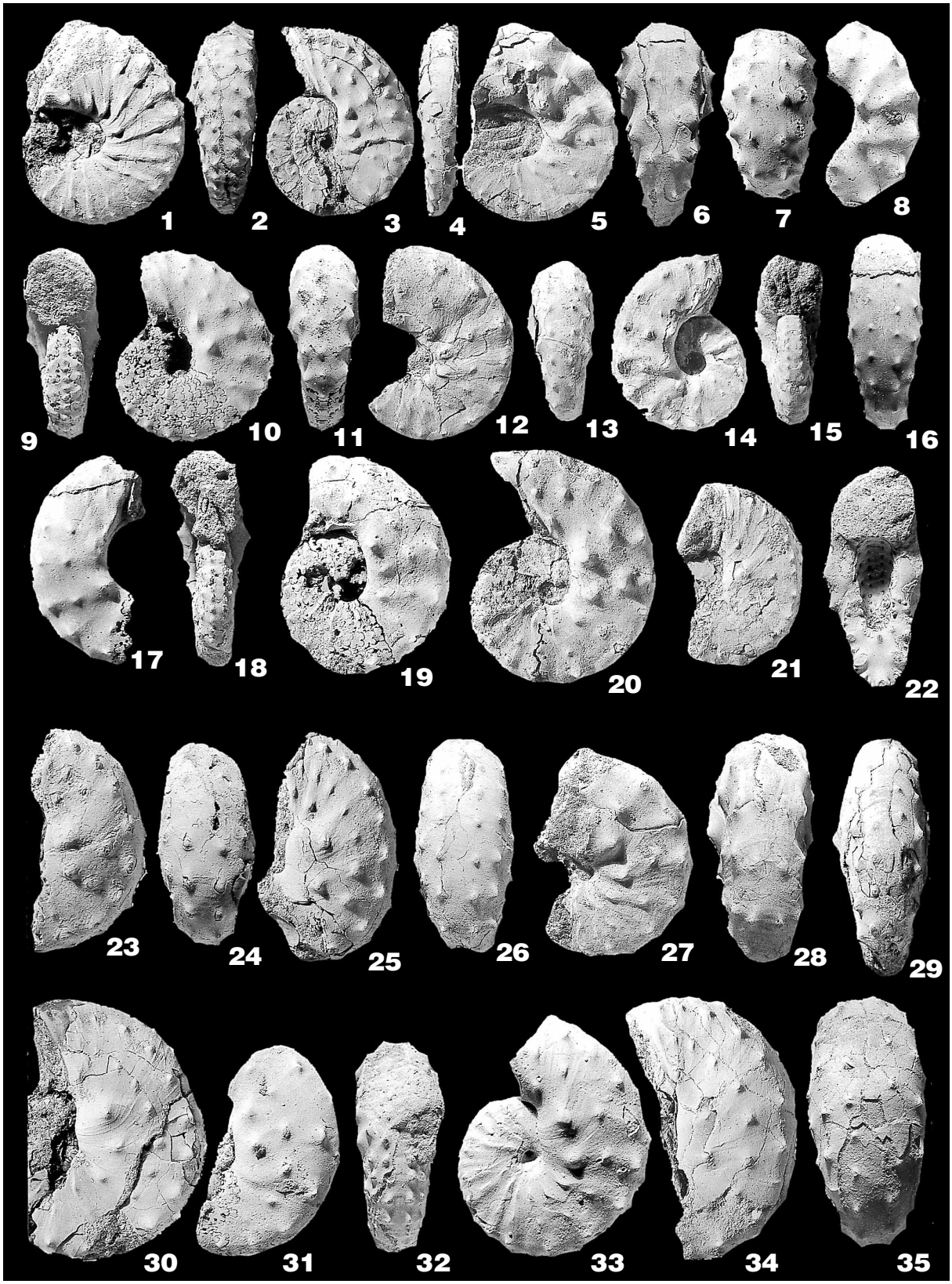
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