

Middle Permian (Late Guadalupian) foraminifers from Dark Canyon, Guadalupe Mountains, New Mexico

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ABSTRACT: Late Capitanian foraminifers are described from two cores taken by Amoco on the north side of the entrance of Dark Canyon. The Amoco #1 core (400ft) penetrates proximal forereef debris of the Tansill Formation and bottoms in massive Capitan reefal limestone. The Amoco #2 core (468ft) penetrates proximal backreef lagoonal deposits of the upper Yates Formation and the Tansill Formation.

Foraminifers are very diverse and abundant in these cores. Based on the fusulinid distribution, the *Codonofusiella extensa* (upper part of the Yates Formation), *Yabeina texana*, *Paradoxiella pratti* and *Reichelina lamarensis* zones (lower and middle Tansill Formation) are present in the Amoco #2 core. Among small foraminifers, the first appearance of the genera *Sengoerina* and *Crescentia* are recorded at the base of the *Y. texana* Zone and they disappear at the top of the *P. pratti* Zone. The genus *Baisalina* appears at the base of the *R. lamarensis* Zone and disappears at the top of that zone. The Ocotillo Silt Member and upper dolomitized part of the Tansill Formation do not contain foraminifers. The Ocotillo Silt Member is present in the Amoco #2 core at a depth of from 88 to 112ft and, because of its regional dip of approximately six degrees, would possibly project below the base of the Amoco #1 core, thus correlating the Capitan and Tansill formations in the Amoco #1 core with the upper Tansill Formation of the Amoco #2 core. The lower part of the Amoco #1 core (from 110 to 370ft) contains fusulinacean species of the *Paraboultonia splendens* Zone. The assemblage of small foraminifers is dominated by species of nodosariids and hemigordiopsids. Four new genera and sixteen new species of foraminifers are described from both cores.

INTRODUCTION AND STRATIGRAPHIC SETTING

The Guadalupe Mountains in southeastern New Mexico and West Texas is a northeasterly tilted tectonic block of Middle/Upper Permian strata exhumed in the Tertiary (Hayes 1964) and forms the classic shelf-to-basin exposures of the Middle Permian Capitan reef depositional system. The International Commission on Stratigraphy (ICS) recently published an International Standard for the Middle Permian Guadalupian Series consisting of the Roadian, Wordian and Capitanian stages, the stratotype sections of which were designated in the Guadalupe Mountains (Gradstein 2000, Gradstein et al. 2004, Wardlaw et al. 2004). The lower boundaries of these stages have been drawn based primarily on the first appearance of conodonts: for the Roadian - *Jinogondolella nankingensis*; the Wordian - *J. aserrata*; and the Capitanian - *J. postserrata* (Glenister et al. 1999, Wardlaw et al. 2004) (text-fig. 1). The boundary of the Guadalupian with the overlying Lopingian Series is based on the evolutionary transition of the conodont *Clarkina postbitteri hongshuiensis* into *C. postbitteri postbitteri* (Wardlaw et al. 2004). In a recent paper, Lambert et al. (2002) illustrated specimens of *C. p. hongshuiensis* from the western part of the Apache Mountains in West Texas that conclusively demonstrated that the Guadalupian Series is essentially complete in the type area.

Fusulinaceans are also present in abundance in Guadalupian strata of West Texas and have been used for many years in both regional and international correlations of the Permian System (Dunbar and Skinner 1937, Ross 1964, Wilde 1955, 1975, 1990, Skinner and Wilde 1954, 1955, Wilde and Rudine 2000, Yang and Yancey 2000). Large fusulinaceans of several genera, such as *Parafusulina*, *Skinnerina*, and *Polydiexodina*, are pres-

ent in the lower part of the Guadalupian, but not in the upper part. In the Guadalupe Mountains, the last appearance of the very large fusulinacean *Polydiexodina* appears to be in the middle part of the reefal Yates Formation (top of Yates B, middle Capitanian, Bebout and Kerans 1993) (text-fig. 1). The fusulinacean assemblage in the overlying upper part of the Yates Formation, Tansill (equivalent to basinal Lamar and "post-Lamar") Formation is dominated by small fusulinaceans such as *Codonofusiella*, *Yabeina*, *Reichelina*, and *Paraboultonia*. Wilde (1990) proposed a Zone of *Paraboultonia* for the last fusulinacean interval at the top of the Guadalupian. Recently, Wilde et al. (1999) formally introduced the name Reef Trail Member for the "post-Lamar" strata at the top of the Bell Canyon Formation and illustrated fusulinaceans from four successive fusulinacean zones: *Yabeina*, *Paradoxiella*, *Reichelina*, and *Paraboultonia*. Unfortunately, in this paper (Wilde et al. 1999, fig. 3), the Guadalupian/Lopingian boundary was drawn with question in the lower part of the Reef Trail Member with the implication that the *Paraboultonia* Zone was entirely of Lopingian age. Although Wilde et al. (1999) discussed the fusulinacean succession in this interval as support for this conclusion, it was premature for Wilde to suggest the placement of this boundary in the Guadalupian stratotype because the conodont succession in the type section of the Reef Trail Member had not been completely documented. In a recent paper, Lambert et al. (2002) clearly documented the upper boundary of the Capitanian in an undisturbed section in the western part of the Apache Mountains to the south of the Guadalupe Mountains. In this section (Lambert et al. 2002, fig. 3), the last appearance of *Paraboultonia* is in bed E1, about two meters below the first beds of the Castile Formation and in the same bed with the first appearance of the conodont *Clarkina postbitteri hongshuiensis*

Henderson, Mei and Wardlaw. The base of the Lopingian has since been defined at the first appearance of the conodont *Clarkina postbitteri postbitteri* (Wardlaw et al. 2004). Thus, the Zone of *Paraboultonia* is entirely Late Guadalupian in age and there are no known Lopingian fusulinaceans in the West Texas succession. No evidence was documented in this study of small foraminiferal species in the Dark Canyon succession to dispute this conclusion.

A number of well known canyons, among them McKittrick, Big, Slaughter, Rattlesnake, and Walnut, cut the east facing scarp of the Guadalupe Mountains and expose various facies of the forereef, reef and backreef deposits of the Guadalupian. Dark Canyon, the northernmost of these canyons, trends east-west, and is located about 10 miles (15km) southwest of Carlsbad, New Mexico in the SW ¼ of Sec. 24, T23E, R25E, Eddy County, New Mexico (text-fig. 2).

The two Amoco research cores were taken on the north side of Dark Canyon near the entrance (text-figs. 3, 4) in the shallow-water backreef Capitanian facies where the upper Guadalupian (Capitanian) has been subdivided into three formations (in ascending order): the Seven Rivers, Yates and Tansill formations. In this paper, small foraminifers and fusulinaceans from the *Yabeina*, *Paradoxiella*, *Reichelina* and *Paraboultonia* zones are described from these two cores. The Amoco #1 core (no. 4492) was taken near the mouth of the canyon and penetrates 398ft (121.3m) of proximal forereef debris of the Tansill Formation and bottoms in massive Capitan reef facies. The Amoco #2 core (no. 4518) was taken approximately 4000ft (1220m) to the west and penetrates 468ft (142.6m) of mostly backreef lagoonal shelf deposits of the Tansill Formation and bottoms in the upper part of the underlying Yates Formation (Tyrrell et al. 1978, Ward 1988). Over 750 large (2"x3") thin sections were made every 2 inches (5cm) throughout the fossiliferous strata of the cores. Algae and bryozoans are also common to abundant in the many intervals of the cores, but have not yet been studied.

PREVIOUS WORKS ON FORAMINIFERS

Non-fusulinacean small foraminifers are not well known in the Guadalupian of West Texas, although a few have been illustrated. In the earliest paper known, two equatorial sections of the genus *Abadehella* Okimura and Ishii (in Okimura et al. 1975) are illustrated from the Delaware Mountain Formation of the Apache Mountains, but it was mistakenly assigned to the alga genus *Anthracoportella* Pia 1920 (Johnson 1951, pl. 7, fig. 6-7). Later, Toomey and Cys (1977) presented a small list and one image of small foraminifers from Tansill transitional facies B at the entrance of Dark Canyon, and noted the presence of representatives of the genera *Geinitzina* Spandel 1901, *Tetrataxis* Ehrenberg 1854 (mistaken identification of the genus *Abadehella*), *Globivalvulina* Schubert 1921 and *Hemigordius* Schubert 1908. Recently, Wilde et al. (1999) illustrated several sections of small foraminifers attributed to *Abadehella* cf. *A. coniformis* Okimura and Ishii, from the Bell Canyon Formation at Seven Heart Gap in the Apache Mountains. Recently, Nestell and Nestell (in Lambert et al. 2002) illustrated specimens of several genera of small foraminifers, including *Pseudoammodiscus*, *Hemigordius*, *Rectocornuspira*, *Multidiscus*, *Calcitornella*, *Nodosaria*, *Ichthyolaria*, and *Abadehella*. These forms were recovered from insoluble residues from late Middle Permian strata in the western part of the Apache Mountains containing the conodonts *Jinogondolella xuanhanensis*, *J. altudaensis*, and *J. granti* (Lambert et al. 2002).

Only a few genera and species of fusulinaceans have been described from the upper Guadalupian (upper Yates/Tansill or the equivalent Lamar/Reef Trail) strata in West Texas. Wilde et al. (1999) presented a thorough discussion of the history of the discovery of many of these forms. Two interesting and controversial occurrences are the Tethyan form *Yabeina texana*, first reported from the McKittrick Canyon area by Skinner and Wilde (1955), and *Paraboultonia splendens*, first described from Seven Heart Gap in the Apache Mountains (Skinner and Wilde 1954). *Yabeina texana* is the only true verbeekiniid found in North America, except for specimens from exotic terranes in the Pacific Northwest. Since its first discovery in the basal Lamar Limestone Member of the McKittrick Canyon area, *Yabeina texana* has also been reported from the Tansill Formation at the top of McKittrick Canyon (Tyrrell, personal communication, 2005) and near the entrance of Dark Canyon (Tyrrell 1962, 1969).

DISTRIBUTION OF FORAMINIFERS IN THE CORE HOLES

The Amoco #1 core has 220ft of Tansill, 70ft of alternating Tansill/Capitan lithologies, and 110ft of massive Capitan (text-fig. 5). Small foraminifers in the cored section consist of 38 species belonging to 25 genera. The following species appear in the massive Capitan facies: *Tuberitina variabilis* n. sp., *Vachardella longiuscula* n. gen., n. sp., *Agathammina* sp. 1, *Nodosaria* cf. *N. novizkiana* Sosnina, *N.* cf. *N. partisana* Sosnina, *Geinitzina* sp. 1, *G.* sp. 4, *Tauridia* sp. 4, *Ichthyolaria* sp. 1, *Calvezina* sp. 1, *Globivalvulina* sp. 1, *Abadehella* sp. 2, and *Deckerella* sp. Almost all species continue into the overlying backreef Tansill facies, except for *Nodosaria* cf. *N. partisana*, *Geinitzina* sp. 1 and *G.* sp. 4. Only 25 species occur in the Tansill Formation. The most characteristic species are *Tansillites anfractuusus* n. gen., n. sp., *Pseudohemigordius incredibilis* n. gen., n. sp., *Graecodiscus praecursor* n. sp., *Polarisella lingulae* n. sp., *Neoendothyranella wildei* n. gen., n. sp., and *Aschemonella* sp.

Fusulinaceans present in the Amoco #1 core are represented by the species *Paraboultonia splendens* Skinner and Wilde, *Reichelina* aff. *R. changhsingensis* Sheng and Chang, *R.* cf. *R. lamarensis* Skinner and Wilde, *Parareichelina* sp., *Codonofusiella* (*Lantschichites*) *altudaensis* Wilde and Rudine, *Pseudokahlerina capitanensis* n. sp., and *Rauserella erratica* Dunbar (text-fig. 5). These species belong to the *Paraboultonia splendens* zone established by Wilde (1990).

The Amoco #2 core consists entirely of backreef facies, having 399ft of the Tansill Formation and 70ft of the underlying Yates Formation (text-fig. 6). Small foraminifers are very diverse and represented by 46 species belonging to 29 genera. *Tuberitina variabilis* n. sp., *Haplophragmina? infrequens* n. sp., *Vachardella longiuscula* n. gen., n. sp., *Palaeonubecularia marginata* n. sp., *Pseudohemigordius incredibilis* n. gen., n. sp., *Agathammina* sp. 1, *Graecodiscus* sp. 2, *Nodosaria capitanensis* n. sp., *Geinitzina aetheria* n. sp., *Howchinella* sp. 1, *Globivalvulina guadalupensis* n. sp., *Abadehella* ex gr. *A. coniformis* Okimura and Ishii, *Neoendothyranella wildei* n. gen., n. sp., and *Spireitlina* sp. appear in the upper part of the Yates Formation. Almost all species continue into the overlying Tansill Formation, except *Howchinella* sp. 1, and *Spireitlina* sp. The Tansill Formation is subdivided into four informal units: lower, middle, Ocotillo Silt Member, and upper (Tyrrell et al. 1978). In the lower Tansill, the species *Pseudolituotuba* (*Pseudospira*) sp. 1, *Agathammina pusilla* (Geinitz), *Nodosaria* cf. *N. novizkiana*

Standard chronostratigraphic scale				North America, Guadalupe Mountains (Glenister et al., 1992, 1999; Wardlaw, 2004)						Transcaucasia (this paper)		South China (Sheng and Jin, 1994)				
System	Series	Stage	FA of conodont species	Shelf			Margin			Basin			Stages		Series	Stages
PERMIAN	LOPINGIAN	Changhsingian	● <i>Clarkina wangi</i>											Dorashamian	Lopingian	Changhsingian
		Wuchiapingian	● <i>C. postbitteri</i>											Dzhulfian		Wuchiapingian
	GUADALUPIAN	Capitanian	● <i>Jinogondolella postserrata</i>	Tansill Fm			Capitan Fm	Bell Canyon Formation	Reef Trail mbr			Midian	Upper	Maokouan	Lengwuan	
				Yates Fm		C			Lamar mbr							
						B										“McKittrick Canyon mbr”
		A		McComb mbr												
		Seven Rivers Fm			Rader mbr											
	Wordian	Queen Fm	● <i>J. asserata</i>	Grayburg Fm				Goat Seep Fm	Cherry Canyon Fm	Pinery mbr			Lower	Murgabian	Kuhfengian	
										Hegler mbr						
	Roadian	San Andreas Fm	● <i>J. nankingsis</i>	Middle-Upper						Manzanita mbr						
										South Wells mbr						
								Getaway mbr								
								Br. C. Cutoff Fm			(N. craticulifera A. schencki)					
								Pipeline mbr								
								Williams Ranch mbr								
								El-Centro mbr								

TEXT-FIGURE 1

Correlation chart for Middle and Upper Permian strata in the West Texas, Transcaucasia, and South China.

Sosnina, *Polarisella lingulae* n. sp., *Rectoglandulina lepida* (Wang), *Eomarginulinella* sp. 1, *E.* sp. 3, *Tauridia* sp. 1, *Pachyphloia* sp., *Robustopachyphloia*? sp., *Globivalvulina* sp. 1, *Crescentia migrantis* n. sp., *Dagmarita* sp., *Abadehella* sp. 2, *Spireitlina* sp. 2, *S?* sp., and *Deckerella* sp. appear for the first time. All but eight species continue into the middle Tansill. Only *Nodosaria* cf. *N. novizkiana*, *Polarisella lingulae* n. sp., *Eomarginulinella* sp. 1, *Spireitlina*? sp., and *Deckerella* sp. are characteristic for the lower Tansill. In the middle Tansill, the species *Calcitornella* sp., *Calcivertella* sp., *Tansillites anfractuusus* n. gen., n. sp., *Baisalina americana* n. sp., *Agathammina* ex gr. *A. rosella* G. Pronina, *A.* sp. 4, *A.* sp. 7, *Graecodiscus praecursor* n. sp., *Nodosaria* sp. 8, *Lingulina*? sp., *Tauridia* sp. 4, *Globivalvulina* sp. 4, and *Endothyra* sp. 1 appear at the first time.

In the upper part of the Yates Formation in the Amoco #2 core, fusulinaceans are represented by the species *Reichelina*? sp., *Codonofusiella extensa* Skinner and Wilde, and *Rauserella bengeensis* Wilde and Rudine (text-fig. 6). The first two noted species continue into the lower Tansill; *R. bengeensis* also extends into the middle Tansill. The first appearance of the distinctive species *Yabeina texana* Skinner and Wilde marks the base of the Tansill Formation. Abundant specimens of *Y. texana* are also present throughout several meters of the basal part of the Tansill Formation in a *Mizzia* grainstone in a surface outcrop at the base of the north wall of Dark Canyon about 250 meters to the southwest from the site of the Amoco #2 core and about 1500 meters from the mouth of Dark Canyon. *Codonofusiella* sp. and *Paradoxiella pratti* Skinner and Wilde appear above the last occurrence of *Y. texana* in the core, and

Reichelina lamarensis Skinner and Wilde marks approximately the base of the middle Tansill (text-fig. 6). No foraminifers were found in the Amoco #2 core in the Ocotillo Silt Member and the overlying dolomitic upper Tansill. The fusulinacean assemblages present in the Amoco #2 core follow Wilde (1990), Wilde et al. (1999), and Wilde and Rudine's (2000) proposed zonation of *Codonofusiella*, *Yabeina*, *Paradoxiella*, *Reichelina* for Late Capitanian age strata in the Guadalupe Mountains (text-figs. 6, 7).

The upper part of the Capitan and basal part of the Tansill formations in the Amoco #1 core can probably be correlated with the upper Tansill of the Amoco #2 core by the stratigraphic position and regional dip of the Ocotillo Silt Member. Parsley (1988, p. 35, fig. 15) showed the Ocotillo Silt Member as "pinching out" to the east in the direction of the position of Amoco #1 core. It is present in the Amoco #2 core at a depth of from 88ft to 112ft and, because of its regional dip of approximately six degrees, would project just below the base of the Amoco #1 core. Mazzullo (1999, p.108, fig. 2) noted the presence of the Ocotillo Silt Member (thickness about 33ft) as "commonly brecciated siltstones, silty dolomites and micritic limestones" and poorly exposed in the south wall of Dark Canyon just back from the entrance.

ANALYSIS AND AGE OF FORAMINIFERAL ASSEMBLAGE

The assemblages of small foraminifers in both cores are very rich and diverse, but mostly only endemic species are represented. Only seven species are known from other regions, mostly in the Tethyan realm: *Rectoglandulina lepida* (Wang), *Nodosaria novizkiana* Sosnina, *N. grandecamerata* Sosnina, *N. partisana* Sosnina, *Agathammina pusilla* (Geinitz), *Agathammina rosella* G. Pronina, and *Abadehella coniformis* Okimura and Ishii. *Rectoglandulina lepida* is known in the Xizang Formation of Xizang, China that has been correlated with the Maokou Formation of South China (Wang 1986), and also in the *Pseudoammodiscus baissalensis* - *Reitlingeria vediensis* Zone of the lower Midian (= Wordian) of Transcaucasia (Pronina 1990). *Nodosaria novizkiana*, *N. grandecamerata* and *N. partisana* occur in the *Metadoliolina lepida* Zone of the Chandalaz Group of the upper Midian (= Capitanian) of South Primorye (Sosnina 1965, 1980). *Agathammina pusilla* is present in the lower Zechstein of Poland (Wolanska 1959), the Naujoji Akmene Formation of the Baltic area (Miklukho-Maklay and Ukharskaya 1975), the Khachik Formation of the upper Midian (= Capitanian) of Transcaucasia (Pronina 1990), and many other regions of the Tethyan realm. It is also reported from the Mantuan Productus Bed of the Peawaddy Formation of the Bowen Basin of Australia (Palmieri 1994). *Agathammina rosella* was described from the Khachik Formation of the upper Midian (= Capitanian) of Transcaucasia (Pronina 1988a). *Abadehella coniformis* is known from many regions of the Tethys.

We consider the genus *Pseudohemigordius* to be present in the lower Zechstein of Poland (Jurkiewicz 1966), but mistakenly identified there as *Glomospira* sp.

For the first time, representatives of the Tethyan genera *Graecodiscus* Vachard (in Vachard et al. 1993a), *Sengoerina* Altiner 1999, *Crescentia* Ciarapica, Cirilli, Martini and Zaninetti 1986, *Baisalina* Reitlinger 1965, *Dagmarita* Reitlinger 1965, *Eomarginulinella* Sosnina 1967 and *Partisania* Sosnina 1978 are reported herein from the Capitanian of West Texas.

Representatives of the genus *Graecodiscus* are known from the lower Dzhulfian of Greece (Vachard et al. 1993a) and upper Changhsingian of the Northwestern Caucasus (Pronina-Nestell and Nestell 2001). The genus *Sengoerina* was established from a Midian olistolith in northwestern Anatolia, Turkey (Altiner 1999). The age range of that genus, according to that author, is limited to the Midian. Vachard (personal communication, 2005) stated that he has specimens of *Sengoerina* in the Murgabian (= Wordian) strata in the Hindu Kush Mountains of northern Afghanistan.

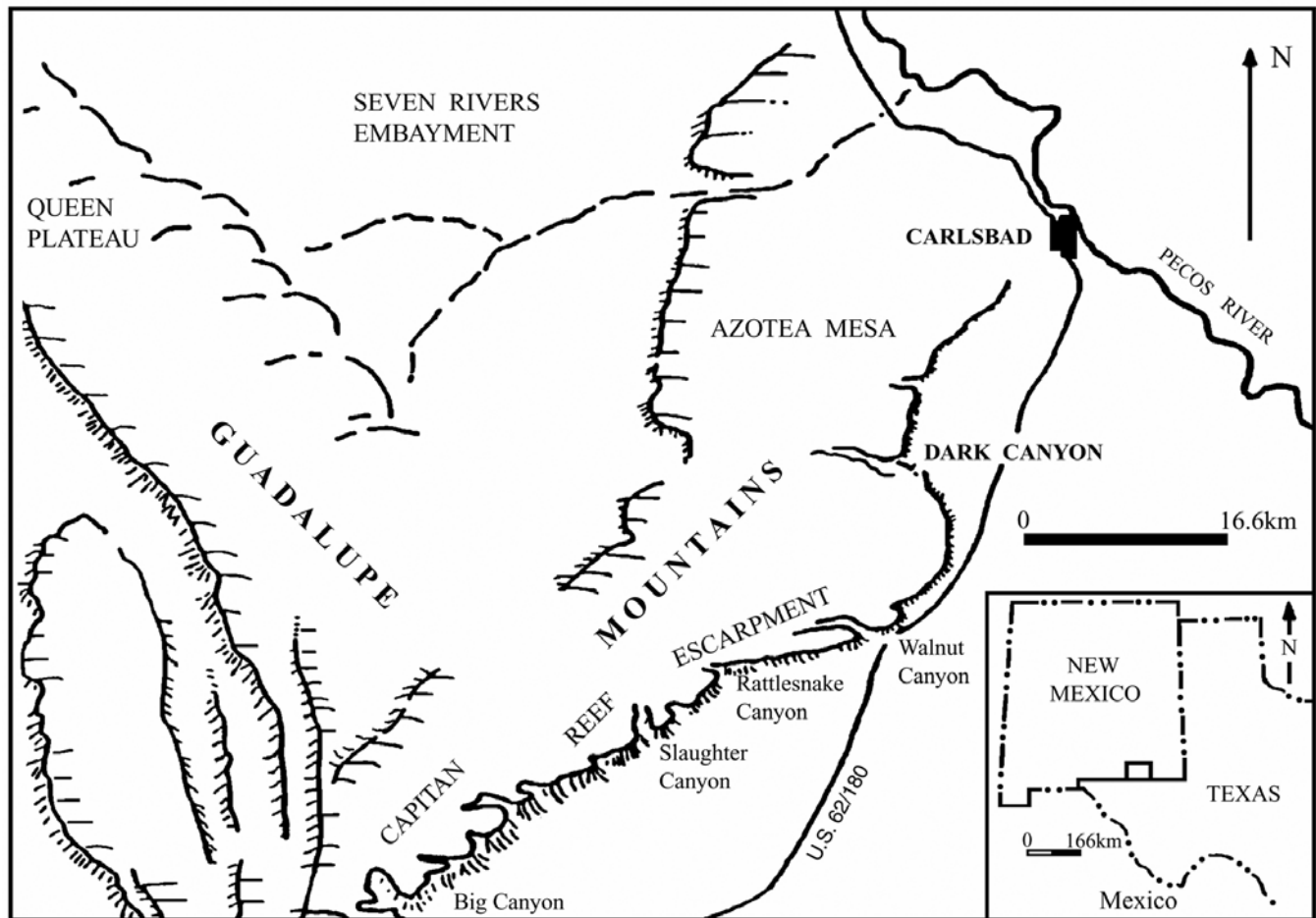
A representative of the genus *Crescentia* was described from a limestone lens of Permian age reworked into strata of the Triassic Monte Facito Formation in the western Lucania, Italy (Ciarapica et al. 1986). The age of this genus was established as Middle? and Late Permian by these authors.

The genus *Baisalina* is known from the late Midian to probably Dorashamian (= Changhsingian) in many regions of the Tethys. Nguyen Duc Tien (1986) on pl. 4, fig. 2 illustrated a specimen of a species identified as *Neoendothyra* cf. *N. bronnimanni* Bozorgnia from Sampou, Kampuchea. In our opinion, that form is a synonym of the new genus *Neoendothyranella* and species *Neoendothyranella wildei*, because it has plectogyroidal coiling of the first volutions, large size, and the initial part of the straight last chamber. In Kampuchea, this species occurs together with *Codonofusiella gubleri* Nguyen Duc Tien, *Pseudofusulina crassa* (Deprat), and *Lepidolina multiseptata multiseptata* (Deprat) indicating a late Midian (= Capitanian) age (Nguyen Duc Tien 1979). The distribution of the genus *Eomarginulinella* is limited to the late Midian (= Capitanian) (Sosnina 1967), and the range of the genus *Partisania* is from late Midian to Changhsingian. We have found one specimen of the genus *Dagmarita*, which extends its stratigraphic range from the uppermost part of the *Verbeekina grabau* Zone (corresponding to the *Neoschwagerina simplex* Zone) of the Chihshian (Zheng 1986) to within the Changhsingian. Therefore, based on the presence of species and genera of small foraminifers that are mostly confined to the late Midian (= Capitanian) in many regions, we conclude that the age of the Tansill Formation in the Guadalupe Mountains is late Capitanian and should not be considered as Lopingian (in part) as suggested by Wilde et al. (1999). Unfortunately, no conodonts have been found as yet in the Tansill Formation, but the range of *Paraboultonia* in conodont-bearing strata in the Apache Mountains is limited to the late Guadalupian (Lambert et al. 2002).

The fusulinacean assemblages present in the Amoco cores are dominated by endemic forms such as *Paraboultonia splendens* Skinner and Wilde, and *Codonofusiella* (*Lantschichites*) *altudaensis* Wilde and Rudine, *Yabeina texana* Skinner and Wilde, *Paradoxiella pratti* Skinner and Wilde, *Rauserella bengeensis* Wilde and Rudine, and *Reichelina lamarensis* Skinner and Wilde. A few species such as *Rauserella erratica* Dunbar, *Codonofusiella* cf. *C. paradoxa* Dunbar and Skinner, *Codonofusiella extensa* Skinner and Wilde, and rare specimens of *Parareichelina* sp. and *Reichelina* aff. *R. changhsingensis* Sheng and Chang are known from other regions. An analysis of the distribution and age of each species is given in the remarks section of their systematic description.

SYSTEMATIC DESCRIPTIONS

The authors use the system of higher protozoan taxa proposed by Cavalier-Smith (1998) and high foraminifer taxa (on the class and subclass level) proposed by V. Mikhalevich (1998,



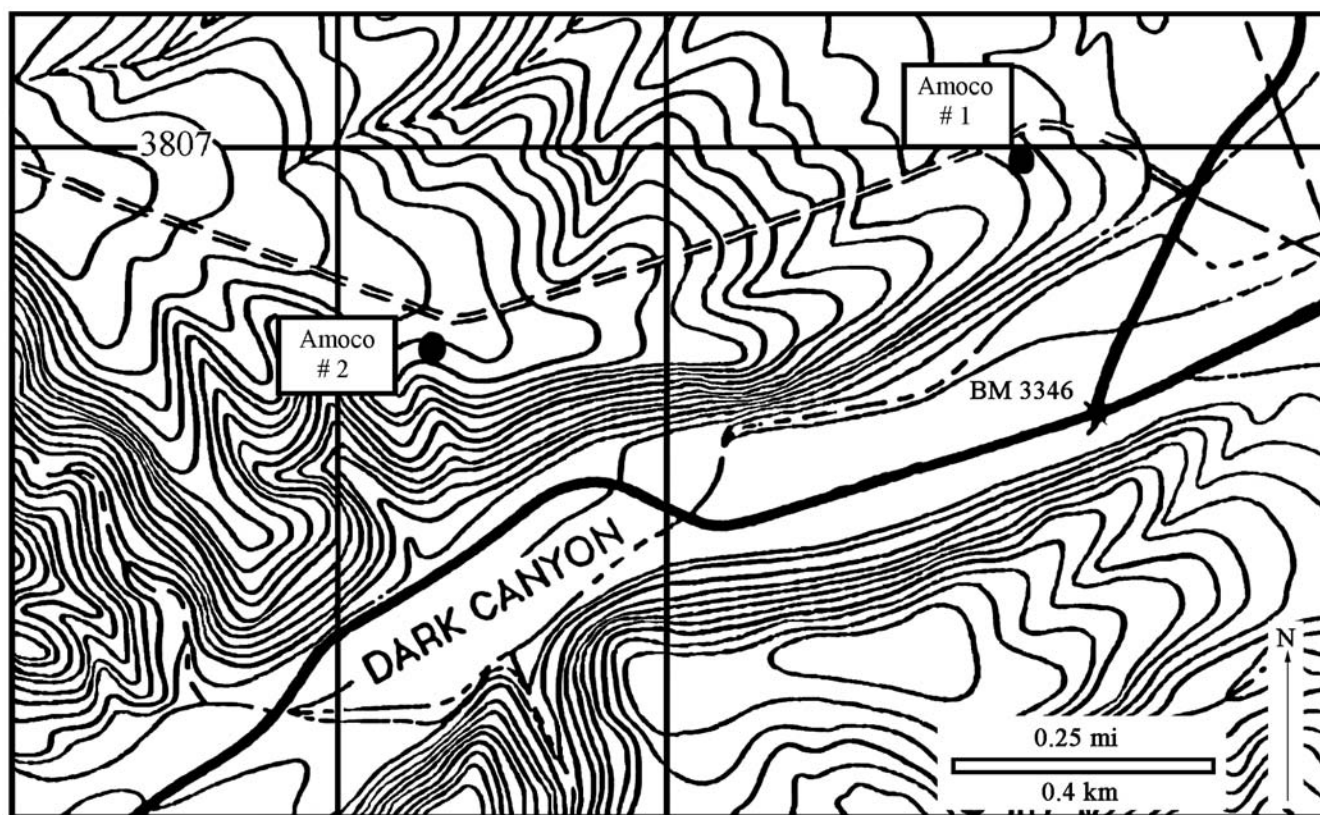
TEXT-FIGURE 2
Map of Guadalupe Mountains area (after Babcock 1977).

2000) for descriptions of new species. Within this framework, we have used several different workers' definitions for the scopes of the following orders: – Parathuramminida of Mikhalevich (1995), Tournayellida of Lipina and Reitlinger (1996), Hemigordiopsida of Pronina (1994) and partly (family Pseudolituotubidae) of Vdovenko et al. (1993), Biseriamminida, Endothyrida and superorder Fusulinoida of Rauser-Chernoussova et al. (1996) with some corrections of the present authors. Some data on classification of small foraminifers of Bozorgnia (1973), Loeblich and Tappan (1987), Mamet and Pinard (1992), and Vachard et al. (1994) were also taken into consideration. For descriptions of some new species we use the terminology: pseudocolonial test, pseudotubular chamber and pseudoinvolute test. Pseudocolonial tests are random aggregates of monothalamous (usually globular) tests that are not interconnected with apertures or openings (Rauser-Chernoussova and Fursenko 1959, p. 168). A pseudotubular chamber is a tube opened from the internal ventral side along the entire length of the test adjoined by the open part to the wall of the previous whorl (Rauser-Chernoussova and Fursenko 1959, p. 177). A pseudoinvolute test is a planispiral test in which secondary deposits fill not only the depressions between the whorls of the pseudotube, but also the umbonal depression, and by merging with the walls of the test, camouflage the evolute coiling of the whorls (Malakhova 1965, p. 159). Open nomenclature is used for a number of forms because properly oriented sections were

not available. The holotypes and paratypes have been deposited in the Division of Invertebrate Paleontology of the Natural History Museum and Biodiversity Research Center of the University of Kansas (KUMIP) as specimens 2,506,729–2,506,999. The distribution of small foraminiferal species in the Amoco #1 and #2 cores are listed in the Appendix 1 according to depth. Measurements of all fusulinacean specimens are given in text-figure 8.

Kingdom PROTOZOA Goldfuss 1817; emend. Owen 1858
Subkingdom NEOZOA Cavalier-Smith 1993; emend. Cavalier-Smith 1997
Phylum FORAMINIFERA (d'Orbigny 1826) Eichwald 1830 stat. nov. Margulis 1974
Class ASTORRHIZATA Saidova 1981; emend. Mikhalevich 1998
Order PARATHURAMMINIDA Mikhalevich 1980 [= Parathuramminida Sabirov 1987]
Family TUBERITINIDAE A. Miklukho-Maklay 1958
Subfamily TUBERITININAE A. Miklukho-Maklay 1958 [nom. transl. Loeblich and Tappan 1961 ex Tuberitinidae A. Miklukho-Maklay 1958]
Genus *Tuberitina* Galloway and Harlton 1928

Tuberitina variabilis Nestell and Nestell, n. sp.
Plate 1, figures 1–10



TEXT-FIGURE 3

Topographic map of east entrance of Dark Canyon and location of Amoco #1 and Amoco #2 cores (modified from USGS Kitchen Cove Quadrangle; scale 1:24,000; contour interval 20ft; after Parsley 1988).

Description: Test is pseudocolonial, attached, composed of one chamber or forms an accumulation of two-six chambers with flattened base. Test attaches to substratum by basal disk. Chambers are of semielliptical to ellipsoidal shape and increase very rapidly in height. Height of chamber in unilocular tests is 0.12-0.21mm; in bichambered tests, the height of the first chamber is 0.06-0.14mm, the second is 0.18-0.22mm. Width of chamber in unilocular tests is 0.17-0.22mm; in bichambered tests, the width of the first chamber is 0.1-0.2mm, the second is 0.18-0.21mm. Wall is calcareous, single layered, microgranular, from homogenous to slightly perforate. Thickness of wall in unilocular tests is 0.005-0.01mm; in bichambered tests, the wall thickness of the first chamber is 0.02mm, the second is 0.02-0.03mm. The shape of the chambers, and thickness and structure of the wall changes depending on the position of the section with respect to the center of the test. Triangular hickenings of the wall occur at the base of the test. An aperture is absent. Dimensions: total length of pseudocolony 0.72mm; diameter of base of chambers in a unilocular test 0.17-0.29mm; in bichambered, the first chamber is 0.13-0.22mm, second is 0.21-0.29mm.

Designation of types: The specimen illustrated on Plate 1, figure 1 is designated as the holotype (KUMIP 2,506,729). It is from the Dark Canyon Amoco #1 core, depth 80ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *variabilis* - variable.

Material: One hundred specimens of unilocular, bichambered and pseudocolonial tests.

Discussion: Based on the nature of the growth of the chambers, *Tuberitina variabilis* n. sp. is similar to *T. collosa* (Reitlinger 1950, p. 89, pl. 19, fig. 7-9) from the Middle Carboniferous (= Early and Middle Pennsylvanian) of the Russian Platform, but differs by its pseudocolonial character, semielliptical to ellipsoidal chamber shape, thinner wall, homogenous to slightly perforate wall structure (in *T. collosa* wall structure is coarse perforate), and smaller size.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon; Amoco #1 core, upper part of the Capitan and Tansill formations, and the Amoco #2 core, upper part of the Yates and lower and middle part of the Tansill formations; Middle Permian (Capitanian).

Class SPIRILLINATA Maslakova 1990; emend. Mikhalevich 1998

Subclass AMMODISCANA Mikhalevich 1980

Order TOURNAYELLIDA Hohenegger and Piller 1975

Family CHERNYSHINELLIDAE Reitlinger 1958; emend.

Lipina 1965 [nom. transl. Lipina and Reitlinger 1996 ex Chernyshinellinae Reitlinger 1958]

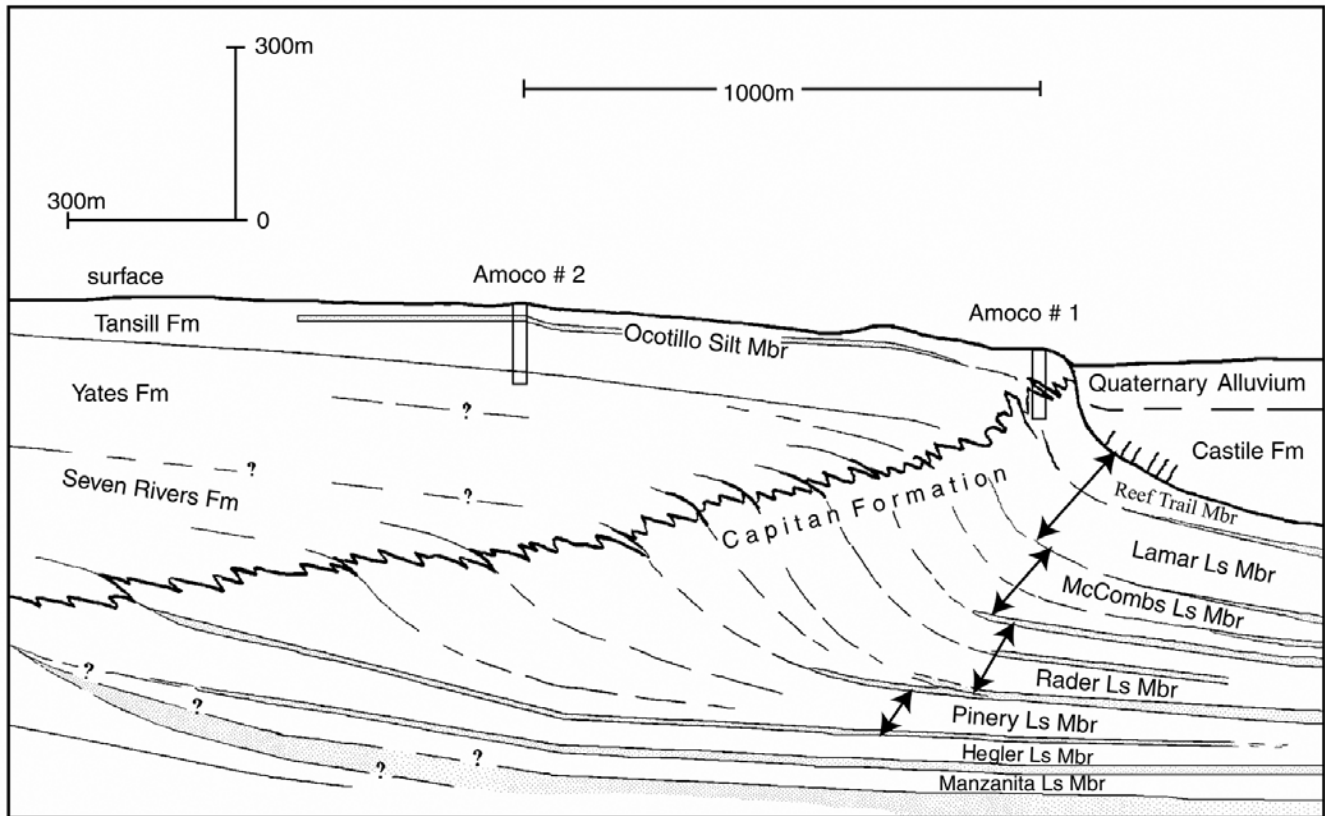
Subfamily MSTINIINAE Lipina 1989

Genus *Haplophragmina* Reitlinger 1950

Haplophragmina? infrequens Nestell and Nestell, n. sp.

Plate 1, figures 11-13

Description: Test is free, large, elongate, appears to consist of two parts. Initial part is spiral?, later becomes straight, round in



TEXT-FIGURE 4

East - west profile of Guadalupian strata at the mouth of Dark Canyon showing approximate location of the two Amoco cores (modified after Tyrrell 2002).

equatorial section. In straight part there are four crescentiform chambers that gradually increase in height and width. Height of the first chamber is 0.08mm, last is 0.14-0.16mm, width of the first chamber is 0.15-0.18mm, last is 0.25-0.36mm. Wall is calcareous, single layered, dark, thick, coarsely granular. Wall thickness is 0.05-0.08mm. Septa in the straight part of test are of arcuate shape with thickness and structure analogous to the wall. A cribrate aperture occurs only in the last two chambers. Dimensions: length (L) of test 1.14-1.21mm, width (W) 0.45-0.54mm, thickness 0.46mm, ratio L/W 2.1-2.7.

Designation of types: The specimen illustrated on Pl. 1, fig. 11 is designated as the holotype (KUMIP 2,506,739). It is from the Dark Canyon Amoco #2 core, depth 324.55-324.7ft, lower part of the Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *infrequens* – rare occurrence.

Material: 12 sections of different orientation.

Discussion: Based on the presence of a cribrate aperture in the last two chambers, *Haplophragmina? infrequens* n. sp. is similar to *H. potensa* Reitlinger (Reitlinger 1950, p. 29, pl. 4, fig. 9-10) from the Middle Carboniferous (= Early and Middle Pennsylvanian) of the Russian Platform, but differs by smaller test size, number of chambers in the straight part, crescentiform chambers, and much younger stratigraphical interval. This new species is assigned conditionally to the genus *Haplophragmina* because the known stratigraphical range of this genus is limited to Lower (= Mississippian) and Middle Carboniferous (= Early

and Middle Pennsylvanian) (Loeblich and Tappan 1987; Lipina and Reitlinger 1996).

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, upper part of the Yates and lower part of the Tansill formations; Middle Permian (Capitanian).

Order HEMIGORDIOPSIDA Mikhalevich 1987 [nom. transl.

G. Pronina 1990 ex Hemigordiopsina Mikhalevich 1987]

Suborder PSEUDOAMMODISCINA G. Pronina 1990

Family ORTHOVERTELLIDAE Mikhalevich 1988

Subfamily CALCIVERTELLINAE Loeblich and Tappan 1964

Genus *Tansillites* Nestell and Nestell, n. gen.

Calcitornella? (part.). – PANZANELLI-FRATONI et al. 1987, pl. 10, fig. 2.

Palaeonubecularia? (part). – CIARAPICA et al. 1986, pl. 3, fig. 5, 6.

Type species: *Tansillites anfractuosus* n. sp., USA, New Mexico, Guadalupe Mountains, Dark Canyon, Tansill Formation; Middle Permian (Capitanian).

Description: Test is probably attached, small, bichambered, evolute, with pseudotubular second chamber. Coiling is in two planes; initially the second chamber forms two volutions with a slight displacement relative to each other around the proloculus, and then changes the plane of coiling and spirals randomly. Wall is calcareous, single layered, microgranular, and very thin.

Etymology: After the Tansill Formation from which the genus is described.

Composition of the genus: Monotypic.

Discussion: Based on the type of coiling of the second chamber in the later stages, the genus *Tansillites* n. g. is similar to the genus *Baryshnikovia* Reitlinger from the Lower Carboniferous? (= Mississippian) and Lower Permian (= Cisuralian), Artinskian (in Vdovenko et al. 1993, p. 60, pl. 11, fig. 5-6), but differs from it by the type of coiling of its initial part and its thin microgranular wall.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Tansill Formation; Middle Permian (Capitanian); Italy, southern Apennines, limestone conglomerate of Permian age in the Triassic Monte Facito Formation.

Range: Middle Permian (Capitanian).

Tansillites anfractuosus Nestell and Nestell, **n. sp.**
Plate 1, figures 26-29; plate 2, figures 1-5

Description: Test is probably attached, small, bichambered, with a pseudotubular second chamber and shows two stages of growth. Initially the second chamber forms two displaced volutions around the proloculus, and then changes the plane of coiling and spirals randomly. Total number of volutions of the test is 4-6. Proloculus is spherical, with diameter 0.026-0.04mm. The first two volutions are low, with height 0.01mm. Successive volutions quickly increase in height from 0.03mm in third volution to 0.06mm in last one. Wall is calcareous, single layered, microgranular, thin, thickness 0.01mm. Dimensions: test height 0.24-0.28mm, test diameter 0.18-0.28mm, thickness 0.09mm.

Designation of types: The specimen illustrated on plate 2, figure 5 is designated as the holotype (KUMIP 2,506,762). It is from the Dark Canyon Amoco #1 core, depth 106ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *anfractuosus* - winding.

Material: 73 sections of different orientation.

Discussion: The type species is the only known representative of this genus.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, middle part of the Tansill Formation; Middle Permian (Capitanian).

Family PSEUDOLITUOTUBIDAE Conil and Longerstaey in
Conil et al. 1980; emend. Reitlinger in Vdovenko et al. 1993
Genus *Palaeonubecularia* Reitlinger 1950

Palaeonubecularia marginata Nestell and Nestell, **n. sp.**
Plate 2, figures 6-8

Description: Test is attached, large, irregular shape, consists of an accumulation of oriented chambers glomerately coiled around an elongate support. Proloculus not seen. Number of volutions is up to 19. Height of volutions is 0.052-0.1mm. Wall is calcareous, single layered, microgranular, thick, thickness up to 0.05mm. Dimensions: test diameter 0.73-4.21mm, width 0.57-1.19mm.

Designation of types: The specimen illustrated on plate 2, figure 6 is designated as the holotype (KUMIP 2,506,763). It is from

the Dark Canyon Amoco #1 core, depth 10ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *marginatus* - bordered.

Material: 27 sections of different orientation.

Discussion: Based on the height of the volutions, *P. marginata* n. sp. is similar to *Palaeonubecularia dublicata* (Wang) (described as *Tolypammina dublicata* in Wang 1986, p. 135, pl. 1, fig. 22), but differs from the latter by larger test size and number of volutions, random coiling around a long support, and thicker wall.

Remarks: According to Loeblich and Tappan (1987), the genus *Palaeonubecularia* is probably algal, but it is classified as a foraminifer by Reitlinger (in Vdovenko et al. 1993). Although the systematic position of the genus is controversial, we follow Reitlinger and refer this new species to the family Pseudolituotubidae.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle parts of the Tansill formations; Middle Permian (Capitanian).

Suborder HEMIGORDIOPSINA Mikhalevich 1987
Family HEMIGORDIOPSIDAE A. Nikitina 1969; emend.
Brönnimann, Whittaker and Zaninetti 1978
Subfamily HEMIGORDIINAE Reitlinger in Vdovenko et al.
1993 [nom. transl. G. Pronina 1994 ex Hemigordiidae
Reitlinger in Vdovenko et al. 1993]

Genus ***Pseudohemigordius*** Nestell and Nestell, **n. gen.**
Glomospira sp. – JURKIEWICZ 1966, pl. 1, fig. 9.

Type species: *Pseudohemigordius incredibilis* n. sp., USA, New Mexico, Guadalupe Mountains, Dark Canyon, Tansill Formation; Middle Permian (Capitanian).

Description: Test is free, bichambered, with pseudotubular second chamber, from lens-shaped to low conical, initial part is pseudoinvolute, one-two last volutions are evolute. Initially the second chamber forms one-two planispiral volutions, with subsequent volutions displaced relative to first volutions at small angle, and then the coiling becomes low trochospiral. Wall is calcareous, single layered, microgranular.

Etymology: On similarity with the genus *Hemigordius*.

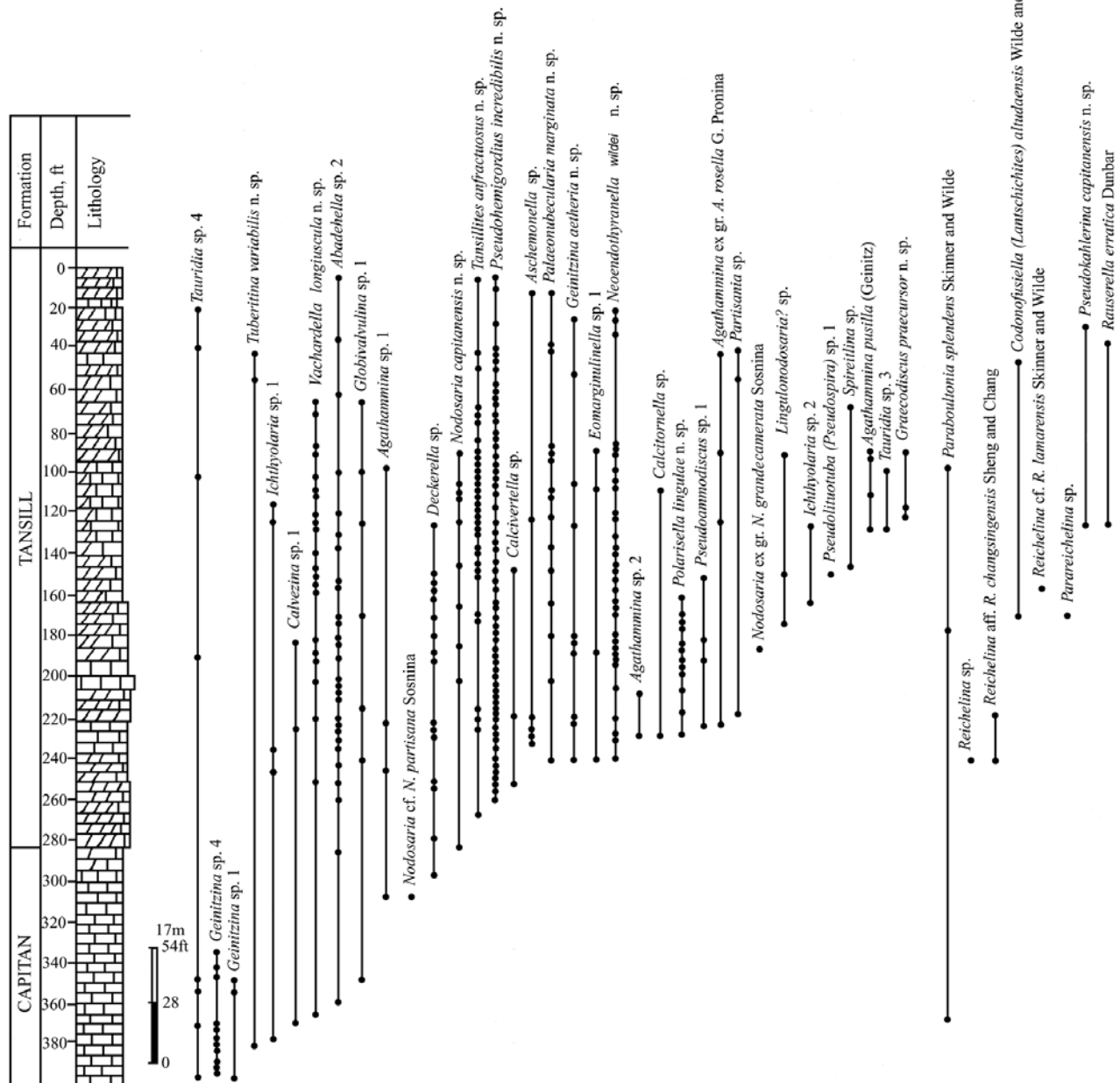
Composition of the genus: Monotypic.

Discussion: The new genus *Pseudohemigordius* differs from the genus *Hemigordius* Schubert 1908 by the low trochospiral coiling of the test.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle part of the Tansill formations; Middle Permian (Capitanian); Poland, Galenzice, Core Holes no. 2 and 6; lower Zechstein, the *Ammodiscus* Zone.

Range: Middle Permian (Capitanian).

Pseudohemigordius incredibilis Nestell and Nestell, **n. sp.**
Plate 2, figures 10-27



TEXT-FIGURE 5
Distribution of foraminifers in the Amoco #1 core (Section modified from Parsley 1988).

Description: Test is free, bichambered, with pseudotubular second chamber, from lens-shaped to low conical, initial part is pseudoinvolute, one-two last volutions are evolute. Proloculus is spherical, diameter 0.03-0.05mm. Number of volutions is 4-6. Initially the second chamber forms one-two planispiral volutions, with subsequent volutions displaced relative to first volutions at a small angle (pl. 2, fig. 12), then the coiling becomes low trochospiral. Height of volutions gradually increases from 0.01mm in first volution to 0.04mm in last one. Wall is calcareous, microgranular, thickness 0.01-0.02mm. Dimensions: test diameter 0.22-0.43mm, height 0.18-0.25mm, and thickness 0.1-0.19mm.

Variability: Size of tests is greatly variable, and the nature of the coiling varies from low (pl. 2, fig. 19, 20, 21) to relatively high trochospiral (pl. 2, fig. 17, 22, 23).

Designation of types: The specimen illustrated on plate 2, figure 18 is designated as the holotype (KUMIP 2,506,775), and the specimen on plate 2, figure 23 as the paratype (KUMIP 2,506,780). They are from the Dark Canyon Amoco #1 core, depth 42ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *incredibilis* - incredible.

Material: 170 sections of various orientations.

Discussion: Given in the description of the genus.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle parts of the Tansill formations; Middle Permian (Capitanian).

Family BAISALINIDAE Loeblich and Tappan 1986

Subfamily BAISALININAE Loeblich and Tappan 1986 [nom. transl. G. Pronina 1994 ex Baisalinidae Loeblich and Tappan 1986]

Genus *Baisalina* Reitlinger 1965

Baisalina americana Nestell and Nestell, n. sp.

Plate 2, figures 28-36

Description: Test is free, bichambered, involute, of oval-shape, compressed on both sides, with a rounded periphery, and with a pseudotubular second chamber subdivided into pseudo-chambers by rare septa. Number of volutions is 5-7. The proloculus is spherical, diameter 0.06-0.08mm. First two-four volutions are streptospirally coiled, last two volutions are planispiral. First volutions are low with height of 0.01-0.02mm, last 2-3 volutions sharply increase in height (from 0.04 to 0.07mm in last). Wall is calcareous, single layered, microgranular, thickness 0.03-0.04mm. Septa are rare, short, and triangular in shape. Aperture is at base of apertural face, slit or oval shaped? Dimensions: greatest test diameter 0.52-0.71mm, width 0.37-0.49mm.

Designation of types: The specimen illustrated on Pl. 2, fig. 31 is designated as the holotype (KUMIP 2,506,788). It is from the Dark Canyon Amoco #2 core, depth 177.1-177.25ft, middle part of the Tansill Formation, Middle Permian (Capitanian).

Etymology: It is the first species of the genus *Baisalina* found in America.

Material: 80 sections of different orientation.

Discussion: *B. americana* n. sp. is similar to *Baisalina globosa* (Wang 1982, p. 15, pl. 3, fig. 15) based on the planispiral coiling of the two last volutions but differs by the 2.5 times smaller test size, and rare location of septa.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, middle part of the Tansill Formation, Middle Permian (Capitanian).

Family AGATHAMMINIDAE Ciarapica, Cirilli and Zaninetti 1987 [nom. transl. G. Pronina 1994 ex Agathamminidae Ciarapica, Cirilli and Zaninetti 1987]

Subfamily AGATHAMMININAE Ciarapica, Cirilli and Zaninetti 1987

Genus *Agathammina* Neumayr 1887; emend. Wolanska 1959

Agathammina pusilla (Geinitz 1848)

Plate 3, figures 1-5

Serpula pusilla GEINITZ 1848, pl. 3, fig. 3-6; 1861, p. 39, pl. 10, fig. 15-21.

Trochammina pusilla JONES, PARKER and KIRKBY 1869, p. 390, pl. 13, fig. 2-6, 15.

Glomospira pusilla PAALZOW 1935, p. 30, pl. 3, fig. 8.

Agathammina pusilla WOLANSKA 1959, p. 47, pl. 1, fig. 1-3; pl. 2, fig. 1-55. – SCHERP 1962, p. 304, pl. 5, fig. 1-10. – JURKIEWICZ 1966, pl. 2, fig. 9-13. – MIKLUKHO-MAKLAY and UKHARSKAYA 1975, p. 50, pl. 6, fig. 11-13; pl. 14, fig. 9-11. – PRONINA 1988a, pl. 3, fig. 5, 6. – PRONINA 1988b, pl. 1, fig. 25-26. – PALMIERI 1994, p. 31-32, pl. 29, fig. 12-13. – LEVEN and OKAY 1996, pl. 8, fig. 11.

Discussion: Our specimens are very similar to *A. pusilla* (Geinitz) described by Miklukho-Maklay (Miklukho-Maklay and Ukharskaya 1975, p. 50, pl. 6, fig. 11-13, pl. 14, fig. 9-11) from the Naujoji Akmene Formation of the Zechstein in the Baltic Area, but differs by smaller test size.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, lower and middle parts of the Tansill Formation; Middle Permian (Capitanian); the lower and middle Zechstein of Germany; the *Agathammina pusilla* Zone of the lower Zechstein in Poland; the Naujoji Akmene Formation of the Zechstein in the Baltic area; the Khachik Formation of the upper Midian in Transcaucasia; the Mantuan Productus Bed of the Peawaddy Formation of the Bowen Basin in Australia; the Karakaya Complex (Hodul Unit) in northwestern Turkey.

Genus *Graecodiscus* Vachard in Vachard et al. 1993a

Graecodiscus praecursor Nestell and Nestell, n. sp.

Plate 4, figures 1-2

Description: Test is free, large, globular in center and discoidal on periphery, bichambered. The pseudotubular second chamber forms two stages of growth. Proloculus is spherical, its diameter 0.06mm. Total number of volutions is 6-8.5. Initial part of test is coiled as in *Quinqueloculina* and resembles an equatorial section of *Agathammina*, consists of four - six volutions. Last stage is planispiral with 2-2.5 volutions. The height of volutions gradually increases from 0.05mm in first volution to 0.14mm in last. Wall is calcareous, single layered, microgranular. Thickness of the wall is 0.03mm in the first volution and 0.07mm in the last one. Dimensions: test length (L) 1.29-1.79mm, length of initial part 0.75mm, cross diameter of initial part 0.78mm, width (W) of planispiral part 0.58mm; ratio L/cross diameter 1.7-2.3.

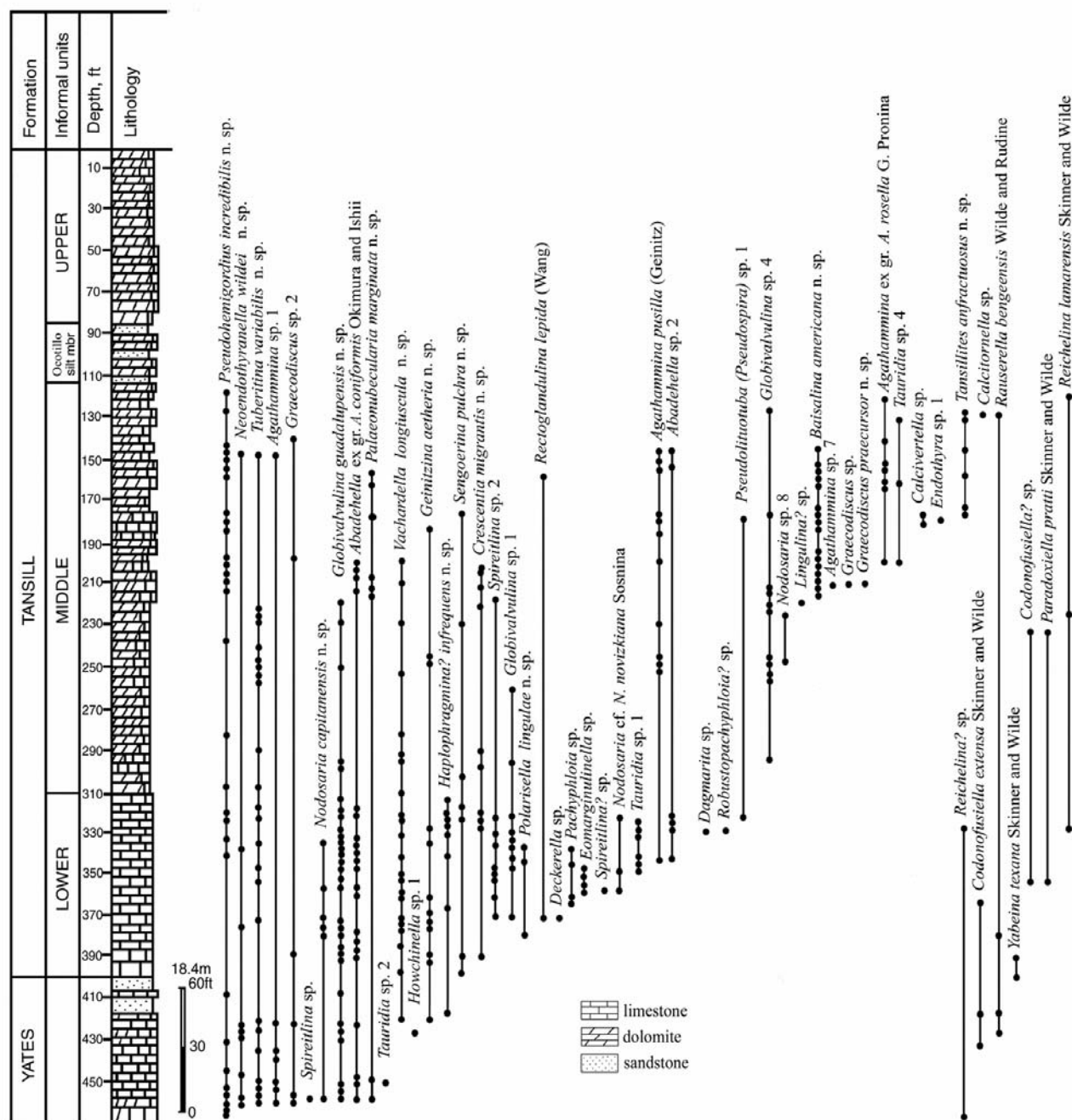
Designation of types: The specimen illustrated on plate 4, figure 1 is designated as the holotype (KUMIP 2,506,808); the specimen on plate 4, figure 2 is designated as the paratype (KUMIP 2,506,809). They are from the Dark Canyon Amoco #1 core: the holotype - depth 120ft, paratype - depth 90ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *praecursor* - predecessor.

Material: 2 axial and 2 oblique sections.

Discussion: Based on the two stages of growth, *G. praecursor* n. sp. is similar to *G. teresae* Vachard (in Vachard et al. 1993a, p. 227, pl. 6, fig. 2) but differs by having fewer volutions in the initial part, by quinqueloculine - like coiling that is not streptospiral in the initial part, and by having a smaller test size.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, middle part of the Tansill Formation; Middle Permian (Capitanian).



TEXT-FIGURE 6

Distribution of foraminifers in the Amoco #2 core (Section modified from Parsley 1988). Informal units after Tyrrell et al. 1978.

Class NODOSARIATA Mikhalevich 1992
 Subclass NODOSARIANA Mikhalevich 1992
 Order NODOSARIIDA Calkins 1926 [= Lagenida Fursenko 1958, Nodosariida Güvenc 1967]
 Family NODOSARIIDAE Ehrenberg 1838 [= Protonodosariidae Mamet and Pinard 1992]
 Subfamily NODOSARIINAE Ehrenberg 1838
 Genus *Nodosaria* Lamarck 1812

Nodosaria capitanensis Nestell and Nestell, n. sp.
 Plate 4, figures 4-6

Description: Test is small, from tongue-shaped to rectangular-oval in shape, from weakly to moderate elongate, rounded in transverse section. Number of chambers is 3-5. Proloculus is oval, weakly projected, with maximum diameter 0.045mm and minimum diameter 0.02-0.06mm. Successive chambers are rectangular, of moderate height, very slowly increasing in height and of almost constant width. Height of the second chamber 0.015-0.03mm, last is 0.015-0.04mm, width of second chamber 0.05mm, last is 0.05-0.07mm. Wall is calcareous, monolamellar, radial, and thin, its thickness 0.007-0.015mm. Attachment of chambers is simple. Sutures are simple, straight, not excavated. Septa are straight, of similar structure as the

wall, thinner than the wall, and with very well developed thickenings near the apertural border of septa, their height is 0.02mm. Dimensions: test length (L) 0.13-0.17mm, width (W) 0.06-0.075mm, ratio of L/W 1.7-2.7.

Designation of types: The specimen illustrated on Pl. 4, fig. 4 is designated as the holotype (KUMIP 2,506,811). It is from the Dark Canyon Amoco #2 core, depth 358.1-358.25ft, lower part of the Tansill Formation, Middle Permian (Capitanian).

Etymology: From the El Capitan Peak in the Guadalupe Mountains National Park, West Texas, USA.

Material: 17 axial sections.

Discussion: Based on the test shape and oval shape of proloculus, *Nodosaria capitanensis* n. sp. is similar to *N. dora-schamensis* (Pronina 1989, p. 32, pl. 1, fig. 27-31) but differs by larger test size, weakly projected proloculus and simple attachment of chambers.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle parts of the Tansill formations; Middle Permian (Capitanian).

Genus *Polarisella* Mamet and Pinard 1992

Polarisella lingulae Nestell and Nestell, n. sp.
Plate 4, figure 13

Description: Test is small, tongue-shaped, moderate to very elongate, with a rounded peripheral end, and is rounded in transverse section. Number of chambers is 5-9. Proloculus not seen, but is probably projected. Successive chambers are of trapeziform shape, low, last chamber is crescentiform in shape. Chambers gradually increase in height (from 0.02mm in the second chamber to 0.04mm in the last one), sharply increase in width in the first four chambers (from 0.06mm in the second to 0.13mm in the sixth chamber), and remain constant (0.13mm) in the last two chambers. Chambers overlap one another insignificantly in the first four chambers and weakly in the last chambers. Sutures are excavated in the last two chambers. Wall is calcareous, monolamellar, radial, with thickness 0.015-0.045mm. Aperture is terminal, central, and appears rounded. Attachment of chambers is simple. Septa are box-shaped in early chambers and thinner than wall, successive septa arcuate and with the same thickness as the wall. Dimensions: test length (L) 0.32-0.42mm, width (W) 0.10-0.12mm, ratio of L/W 3.0-3.5.

Designation of types: The specimen illustrated on Pl. 4, fig. 13 is designated as the holotype (KUMIP 2,506,818). It is from the Dark Canyon Amoco #1 core, depth 198ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *lingula* – small tongue.

Material: 10 axial and 11 oblique sections.

Discussion: Based on the size of the test, *P. lingulae* n. sp. is similar to *P. angjieshanensis* (Wang) (Wang 1986, p. 136, pl. 2, fig. 4) but differs from the latter by its rounded periphery, crescentiform shape of the last chamber, and deepened sutures in the last two chambers.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, lower part of the Tansill Formation; Middle Permian (Capitanian).

Family GEINITZINIDAE Bozorgnia 1973

Genus *Geinitzina* Spandel 1901; emend. Sellier de Civrieux and Dessauvage 1965 [= *Geinitzella* Spandel 1898]

Geinitzina aetheria Nestell and Nestell, n. sp.

Plate 4, figures 26-31

Description: Test is small, of triangular shape, weakly elongate, flattened, and oval in transverse section. Initial end is mucronate, terminal end is widely rounded with a depression in the middle. Number of chambers is 5-10. Proloculus is small, spherical, with diameter 0.02mm. Following chambers are very low, sinus-shaped, very slowly increasing in height and very rapidly in width. Height of the second chamber is 0.01-0.02mm, width 0.03mm; height of the last chamber 0.023-0.03mm, width is 0.15mm. Wall is calcareous, monolamellar, radial, thin, with a thickness of 0.01mm. Aperture is terminal, oval in shape. Overlapping of chambers is significant. Septa are sinus-shaped, with the same thickness and structure as the wall, and without thickenings near the apertural border of septa. Dimensions: test length (L) 0.17-0.25mm, width (W) 0.11-0.16mm, thickness 0.06-0.08mm, ratio of L/W 1.5-1.6.

Designation of types: The specimen illustrated on Pl. 4, fig. 27 is designated as the holotype (KUMIP 2,506,836). It is from the Dark Canyon Amoco #1 core, depth 172ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *aetherius* - ethereal.

Material: 33 sections of different orientation.

Discussion: *Geinitzina aetheria* n. sp. is similar to *G. araxensis* (Pronina 1989, p. 34, pl. 2, fig. 1-2) based on the low chambers, but differs by triangular shape of the test and absence of thickenings near the apertural border of the septa.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle parts of the Tansill formations; Middle Permian (Capitanian).

Class ROTALIATA Mikhalevich 1980

Subclass TEXTULARIANA Mikhalevich 1980

Order BISERIAMMINIDA Mikhalevich 1981

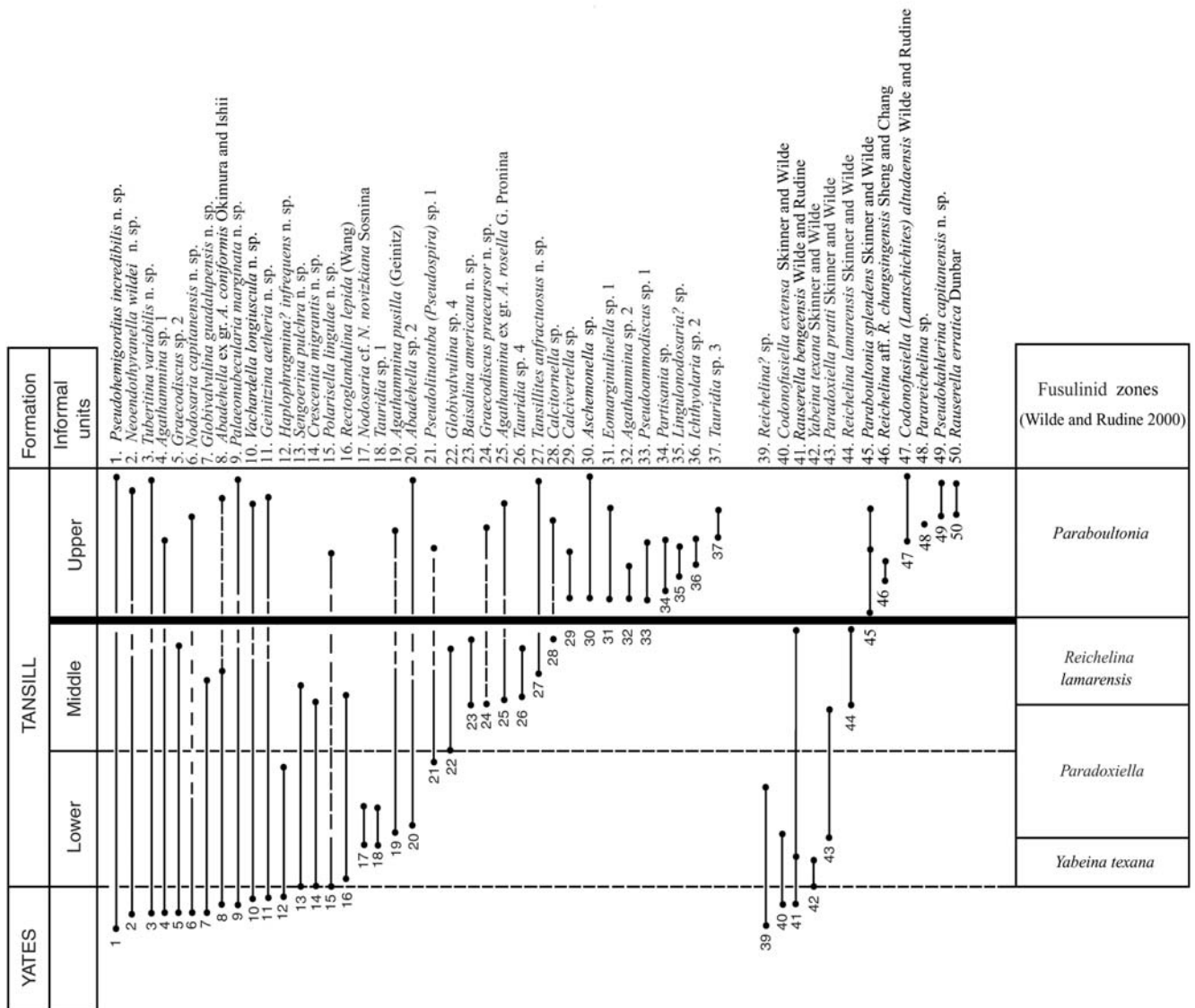
Family GLOBIVALVULINIDAE Reitlinger 1950

Genus *Globivalvulina* Schubert 1921

Globivalvulina guadalupensis Nestell and Nestell, n. sp.

Plate 5, figures 14-25

Description: Test is free, large, of oval shape, involute, biserial, with planispiral coiling. Number of volutions is two; number of chambers in two volutions is 8-10. Proloculus is large, spherical, diameter 0.06mm. Following chambers are of subglobular shape, gradually increasing in height (from 0.05mm in the second chamber to 0.1-0.12mm in the sixth chamber). The last chamber very rapidly increases in height and width, and in lateral sections is mushroom-shaped (pl. 5, fig. 14, 18). Height of the last chamber is 0.3-0.35mm, width is 0.42-0.67mm. Wall is calcareous, microgranular, and thick, thickness in the last



TEXT-FIGURE 7

Range chart of foraminiferal species in Amoco cores. Black horizontal line denotes Ocotillo Silt Member. Missing number 38 signifies space between small foraminifers and fusulinaceans.

volution is 0.03-0.04mm. Septa are curved, thick, with three layers in the initial chambers: external and internal layer of microgranular structure, intermediate layer of coarse-radial structure, and in the last volutions with one layer of microgranular structure. Thickness of the microgranular layer in the initial chambers is 0.02mm, coarse-radial layer is 0.02-0.03mm. Dimensions: larger test diameter 0.54-0.92mm, smaller 0.38-0.60mm.

Designation of types: The specimen illustrated on Pl. 5, fig. 18 is designated as the holotype (KUMIP 2,506,868); the specimens illustrated on Pl. 5, fig. 14 (KUMIP 2,506,864), Pl. 5, fig. 20 (KUMIP 2,506,870), Pl. 5, fig. 25 (KUMIP 2,506,875) are designated as the paratypes. They are from the Dark Canyon Amoco #2 core, the holotype: depth 324.2-324.35ft, paratypes: fig. 14 - depth 326.45-326.6ft, fig. 20 - depth 343.9-344.05ft,

fig. 25 - depth 326.75-326.9ft, lower Tansill Formation; Middle Permian (Capitanian).

Etymology: From Guadalupe Peak, Guadalupe Mountains National Park, West Texas, USA.

Material: 101 sections of different orientation.

Discussion: Based on the large size of the test, *G. guadalupensis* n. sp. is similar to *G. vonderschmitti* (Reichel 1946, p. 556, fig. 37a-e), but differs by the last chamber rapidly increasing in height, and the absence of a radial layer of the wall in the last chamber.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, upper part of the Yates, lower and middle Tansill formations; Middle Permian (Capitanian).

Species	Reg. No.	Figure	Length	Width	F. R.	Di. Prol.	Radius vector						
							1	2	3	4	5	6	7
<i>Codonofusiella</i> cf. <i>C. paradoxa</i>	2,506,925	Pl. 8, fig. 1	1.268	0.812		0.054	0.09	0.164	0.253	0.497			
<i>C. (Lantschichites) altudaensis</i>	2,506,926	Pl. 8, fig. 2		0.818		0.049	0.066	0.125	0.209	0.574			
<i>Paraboultonia splendens</i>	2,506,928	Pl. 8, fig. 3	1.695	0.398		0.046	0.094	0.142	0.238				
<i>Pseudokahlerina capitaneensis</i>	2,506,921	Pl. 7, fig. 24	0.463	0.976		0.093	0.149	0.232	0.467	0.584			
<i>Pseudokahlerina capitaneensis</i>	2,506,920	Pl. 7, fig. 23	0.492	0.788		0.082	0.127	0.193	0.284	0.421			
<i>Pseudokahlerina capitaneensis</i>	2,506,923	Pl. 7, fig. 26		0.891		0.074	0.114	0.138	0.211	0.341			
<i>Pseudokahlerina capitaneensis</i>	2,506,922	Pl. 7, fig. 25	0.414	0.998		0.073	0.133	0.251	0.489				
<i>Paraboultonia splendens</i>	2,506,929	Pl. 8, fig. 5		0.629		0.058	0.093	0.125	0.203				
<i>Rauserella erratica</i>	2,506,938	Pl. 8, fig. 4		0.872		0.041	0.078	0.171	0.298				
<i>Pseudokahlerina capitaneensis</i>	2,506,924	Pl. 7, fig. 27	0.453	0.563		0.087	0.128	0.206	0.341				
<i>Paraboultonia splendens</i>	2,506,930	Pl. 8, fig. 6	3.171	0.663		0.054	0.082	0.118	0.162	0.0232	0.0365		
<i>C. (Lantschichites) altudaensis</i>	2,506,927	Pl. 8, fig. 7	2.295	0.708		0.061	0.073	0.124	0.221	0.447			
<i>Parareichelina</i> sp.	2,506,939	Pl. 8, fig. 8	0.074	0.873	12.9								
<i>Paraboultonia splendens</i>	2,506,931	Pl. 8, fig. 9	2.743	0.628		0.077	0.094	0.142	0.223	0.344			
<i>Paraboultonia splendens</i>	2,506,932	Pl. 8, fig. 10	3.242	0.728		0.078	0.083	0.126	0.177	0.251	0.426		
<i>Paraboultonia splendens</i>	2,506,933	Pl. 8, fig. 11	3.041	0.751		0.076	0.098	0.134	0.192	0.289	0.434		
<i>Paraboultonia splendens</i>	2,506,934	Pl. 8, fig. 12	2.553	0.583		0.054	0.093	0.148	0.194	0.316			
<i>Paraboultonia splendens</i>	2,506,937	Pl. 8, fig. 15		0.841		0.052	0.096	0.144	0.219	0.318	0.446		
<i>Paraboultonia splendens</i>	2,506,935	Pl. 8, fig. 13	2.388	0.496		0.446	0.057	0.096	0.164	0.294			
<i>Reichelina</i> aff. <i>R. changsingensis</i>	2,506,940	Pl. 8, fig. 16	0.119	0.936	24								
<i>Paraboultonia splendens</i>	2,506,936	Pl. 8, fig. 14	2.351	0.579		0.062	0.066	0.127	0.196	0.321			
<i>Paraboultonia splendens</i>	2,506,941	Pl. 9, fig. 1	bkn	0.597		0.048	0.088	0.112	0.207	0.341			
<i>Paraboultonia splendens</i>	2,506,942	Pl. 9, fig. 2		0.682		0.063	0.088	0.116	0.168	0.295			
<i>Paraboultonia splendens</i>	2,506,943	Pl. 9, fig. 3	1.692	0.363		0.047	0.092	0.123	0.192				
<i>Paraboultonia splendens</i>	2,506,944	Pl. 9, fig. 4	1.934	0.473		0.042	0.088	0.172	0.274				
<i>Reichelina</i> aff. <i>R. changsingensis</i>	2,506,948	Pl. 9, fig. 6		0.421		0.035							
<i>Paraboultonia splendens</i>	2,506,945	Pl. 9, fig. 5	1.408	0.482		0.048	0.069	0.098	0.164	0.268			
<i>Paraboultonia splendens</i>	2,506,946	Pl. 9, fig. 7		1.133		0.044	0.067	0.097	0.172	0.271	0.477		
<i>Paraboultonia splendens</i>	2,506,947	Pl. 9, fig. 8		0.668		0.061	0.084	0.118	0.192	0.338			
<i>Reichelina lamarensis</i>	2,506,949	Pl. 9, fig. 9		1.141		0.027		0.044	0.091	0.152	0.227	0.761	
<i>Rauserella bengeensis</i>	2,506,959	Pl. 9, fig. 10	0.591	0.328		0.036	0.036	0.046	0.097	0.187			
<i>Rauserella bengeensis</i>	2,506,960	Pl. 9, fig. 11	0.618	0.351		0.038		0.042	0.116	0.196			
<i>Rauserella bengeensis</i>	2,506,961	Pl. 9, fig. 12		0.397		0.032	0.047	0.086	0.132	0.233			
<i>Rauserella bengeensis</i>	2,506,962	Pl. 9, fig. 13		0.453		0.051	0.054	0.097	0.144	0.297			
<i>Rauserella bengeensis</i>	2,506,963	Pl. 9, fig. 14	0.622	0.341		0.036	0.03	0.035	0.107	0.295			
<i>Rauserella bengeensis</i>	2,506,964	Pl. 9, fig. 15	0.538	0.318		0.037	0.041	0.062	0.097	0.157			
<i>Reichelina lamarensis</i>	2,506,950	Pl. 9, fig. 16	0.429	0.654		0.039	0.039	0.072	0.126	0.297	0.393		
<i>Reichelina lamarensis</i>	2,506,951	Pl. 9, fig. 17		0.619			0.037	0.038	0.088	0.188	0.343		
<i>Reichelina lamarensis</i>	2,506,952	Pl. 9, fig. 18	0.349	0.612		0.041	0.053	0.104	0.162	0.293			
<i>Reichelina lamarensis</i>	2,506,953	Pl. 9, fig. 19	0.398	1.313		0.037	0.046	0.069	0.112	0.153	0.296	0.853	
<i>Reichelina lamarensis</i>	2,506,954	Pl. 9, fig. 20		0.583		0.04	0.041	0.064	0.111	0.178	0.349		
<i>Reichelina lamarensis</i>	2,506,955	Pl. 9, fig. 21	0.348	0.672		0.042	0.039	0.076	0.126	0.214	0.371		
<i>Reichelina lamarensis</i>	2,506,956	Pl. 9, fig. 22	0.379	1.324									
<i>Reichelina lamarensis</i>	2,506,957	Pl. 9, fig. 23	0.319	1.122		0.038	0.046	0.083	0.142	0.243	0.769		
<i>Reichelina lamarensis</i>	2,506,958	Pl. 9, fig. 24	0.422	1.018		0.033	0.052	0.084	0.156	0.284	0.641		
<i>Reichelina lamarensis</i>	2,506,965	Pl. 10, fig. 1	0.388	0.837		0.036	0.036	0.061	0.108	0.197	0.543		
<i>Reichelina lamarensis</i>	2,506,966	Pl. 10, fig. 2	0.481	0.821		0.037	0.047	0.087	0.137	0.236	0.511		
<i>Reichelina lamarensis</i>	2,506,967	Pl. 10, fig. 3	0.398	1.029		0.033	0.026	0.074	0.219	0.653			
<i>Reichelina lamarensis</i>	2,506,968	Pl. 10, fig. 4	0.388	0.687		0.028	0.044	0.117	0.191	0.456			
<i>Reichelina lamarensis</i>	2,506,969	Pl. 10, fig. 5	0.437	0.964									
<i>Reichelina lamarensis</i>	2,506,970	Pl. 10, fig. 6		0.847									
<i>Reichelina</i> sp.	2,506,971	Pl. 10, fig. 7		0.767									
<i>Paradoxiella pratti</i>	2,506,972	Pl. 10, fig. 8		1.768									
<i>Paradoxiella pratti</i>	2,506,973	Pl. 10, fig. 9		1.449		0.087	0.074	0.133	0.249	0.567			
<i>Codonofusiella extensa</i>	2,506,974	Pl. 10, fig. 10	2.992	0.742		0.052							
<i>Rauserella bengeensis</i>	2,506,977	Pl. 10, fig. 11		0.496		0.034							
<i>Codonofusiella extensa</i>	2,506,975	Pl. 10, fig. 12	1.507	0.538		0.076	0.064	0.111	0.193	0.309			
<i>Yabeina texana</i>	2,506,979	Pl. 10, fig. 13	1.782	1.238		0.098	0.093	0.144	0.219	0.296	0.386	0.594	0.642
<i>Yabeina texana</i>	2,506,980	Pl. 10, fig. 14		1.083		0.073	0.049	0.102	0.164	0.234	0.324	0.424	0.548
<i>Yabeina texana</i>	2,506,981	Pl. 10, fig. 15		1.533									
<i>Codonofusiella extensa</i>	2,506,976	Pl. 10, fig. 16	2.838	0.694		0.058	0.069	0.098	0.143	0.218	0.374		
<i>Rauserella bengeensis</i>	2,506,978	Pl. 10, fig. 17		0.567	0.737	0.079							
<i>Codonofusiella extensa</i>	2,506,982	Pl. 11, fig. 1	2.134	1.309		0.068	0.064	0.113	0.181	0.278	0.557		
<i>Rauserella bengeensis</i>	2,506,997	Pl. 11, fig. 2	0.352	0.472		0.081	0.083	0.152	0.237				
<i>Codonofusiella extensa</i>	2,506,983	Pl. 11, fig. 3	3.146	0.771		0.076	0.059	0.103	0.179	0.277	0.432		
<i>Codonofusiella extensa</i>	2,506,984	Pl. 11, fig. 4		1.593		0.068	0.059	0.106	0.167	0.271	0.417		
<i>Rauserella erratica</i>	2,506,999	Pl. 11, fig. 6	1.969	0.652									
<i>Codonofusiella extensa</i>	2,506,985	Pl. 11, fig. 5		1.282		0.068	0.059	0.088	0.152	0.251	0.403		
<i>Rauserella bengeensis</i>	2,506,998	Pl. 11, fig. 7	0.326	0.223		0.089	0.082	0.139	0.218				
<i>Codonofusiella extensa</i>	2,506,986	Pl. 11, fig. 8	2.688	1.294		0.056	0.044	0.074	0.106	0.171	0.248	0.938	
<i>Codonofusiella extensa</i>	2,506,987	Pl. 11, fig. 9	2.124	0.616		0.053	0.088	0.128	0.226	0.353			
<i>Codonofusiella extensa</i>	2,506,988	Pl. 11, fig. 10		2.159		0.063	0.084	0.169	0.252	0.339			
<i>Codonofusiella extensa</i>	2,650,989	Pl. 11, fig. 11	2.653	0.652		0.072	0.041	0.062	0.118	0.216	0.379		
<i>Codonofusiella extensa</i>	2,506,990	Pl. 11, fig. 12	1.849	0.635		0.059	0.046	0.077	0.134	0.211	0.352		
<i>Codonofusiella extensa</i>	2,506,991	Pl. 11, fig. 13		1.571		0.062	0.054	0.082	0.119	0.296	0.348		
<i>Codonofusiella extensa</i>	2,506,992	Pl. 11, fig. 14		0.569		0.073	0.059	0.072	0.114	0.195	0.321		
<i>Codonofusiella extensa</i>	2,506,993	Pl. 11, fig. 15	3.132	0.688		0.042	0.029	0.054	0.094	0.141	0.233	0.377	
<i>Codonofusiella extensa</i>	2,506,994	Pl. 11, fig. 16		1.695			0.038	0.081	0.177	0.333			
<i>Codonofusiella extensa</i>	2,506,995	Pl. 11, fig. 17		1.842		0.053	0.047	0.092	0.193	0.325			
<i>Codonofusiella extensa</i>	2,506,996	Pl. 11, fig. 18		1.993		0.064							

TEXT-FIGURE 8

Measurements of the fusulinacean specimens in the Amoco cores. All measurements in mm, F. R. denotes form ratio, Di. Prol. - diameter of proloculus.

Wall thickness							Half length							Septal count						
1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
0.014	0.016	0.021	0.028	0.029			0.066	0.148	0.343	0.689										
0.011	0.014	0.018	0.023	0.026			0.073	0.122	0.273	0.711	1.569									
0.009	0.012	0.017	0.022				0.064	0.121	0.357	0.698										
0.009	0.011	0.019	0.028	0.032			0.056	0.091	0.171	0.228	0.232									
0.009	0.012	0.024	0.016	0.023			0.054	0.062	0.103	0.193	0.246									
0.009	0.011	0.012	0.016	0.014										4	5					
0.008	0.016	0.021	0.032				0.049	0.078	0.104	0.266										
0.009	0.011	0.014	0.016																	
0.008	0.011	0.014	0.016																	
0.009	0.013	0.024	0.026				0.048	0.074	0.134	0.168						7	8			
0.008	0.009	0.012	0.014	0.016	0.022		0.059	0.092	0.239	0.479	1.042	1.676								
0.008	0.009	0.012	0.014	0.016	0.021		0.056	0.114	0.298	0.678	1.327									
0.008	0.009	0.012	0.015	0.021			0.096	0.254	0.496	1.091	1.512									
0.009	0.011	0.012	0.013	0.016	0.021		0.068	0.068	0.187	0.444	1.342	1.688								
0.009	0.011	0.011	0.012	0.014	0.021		0.058	0.086	0.292	0.585	1.373	1.732								
0.009	0.009	0.011	0.013	0.016			0.074	0.141	0.368	1.032	1.276									
0.009	0.009	0.01	0.012	0.015	0.016									14	17	22	27	40		
0.008	0.009	0.01	0.011	0.013	0.016		0.042	0.071	0.188	0.676	1.224									
0.008	0.011	0.012	0.013	0.014			0.056	0.074	0.196	0.706	1.191									
0.008	0.011	0.012	0.014	0.018			0.064	0.086	0.248	0.679	0.906									
0.007	0.008	0.009	0.012	0.015										6	15	18	25			
0.007	0.008	0.009	0.011				0.057	0.203	0.663	0.932										
0.008	0.009	0.011	0.014				0.087	0.196	0.577	1.168										
0.006	0.008	0.011	0.013	0.016			0.041	0.074	0.148	0.338	0.749									
0.007	0.01	0.011	0.013	0.015	0.018									5	12	18	23	33		
0.008	0.008	0.01	0.014	0.017										4	15	21	31			
	0.014	0.018	0.021	0.025	0.032			9	13	18	26									
0.007	0.009	0.011	0.015				0.049	0.087	0.137	0.293										
	0.009	0.012	0.014					0.041	0.122	0.286										
0.007	0.008	0.011	0.012											4	6	8				
0.007	0.008	0.009	0.014											5	7					
0.008	0.008	0.01	0.015				0.041	0.079	0.131	0.248										
0.007	0.008	0.011	0.016				0.041	0.077	0.133	0.286										
0.009	0.012	0.014	0.018	0.022			0.022	0.042	0.076	0.143	0.223									
	0.013	0.014	0.015	0.017										12	17	20				
0.009	0.013	0.016	0.019				0.041	0.061	0.092	0.146										
0.007	0.008	0.009	0.012	0.012	0.017		0.022	0.028	0.066	0.097	0.139	0.181								
0.007	0.009	0.012	0.015	0.017										8	12	15	20			
0.008	0.01	0.011	0.014	0.018			0.025	0.041	0.082	0.132	0.176									
0.008	0.009	0.012	0.014	0.017			0.028	0.043	0.082	0.121	0.153									
0.007	0.009	0.012	0.015	0.018			0.031	0.048	0.079	0.118	0.183									
0.008	0.009	0.012	0.016	0.019			0.031	0.041	0.066	0.123	0.198									
0.009	0.011	0.015	0.017	0.019			0.035	0.057	0.088	0.154	0.241									
0.011	0.013	0.016	0.017																	
0.008	0.011	0.014	0.0116				0.048	0.071	0.124	0.286										
0.007	0.008	0.012	0.021						16	25										
0.009	0.012	0.014	0.016				0.071	0.163	0.338	0.748										
0.011	0.013	0.016	0.016	0.015	0.016	0.21	0.098	0.144	0.217	0.336	0.468	0.622	0.823	9	11	14	17	22	29	
0.009	0.01	0.012	0.014	0.016	0.018	0.022														
0.009	0.01	0.013	0.014	0.016			0.067	0.104	0.196	0.368	1.477									
0.008	0.009	0.013	0.015	0.016			0.079	0.157	0.326	0.582	1.156									
0.007	0.009	0.012					0.072	0.084	0.191											
0.009	0.01	0.012	0.014	0.016			0.086	0.169	0.328	0.556	1.562									
0.009	0.01	0.013	0.015	0.016												10	18	27		
0.009	0.01	0.011	0.012																	
0.006	0.008	0.01	0.013	0.014			0.047	0.068	0.098					7	15	22	28			
0.007	0.008	0.009	0.01	0.012	0.015	0.019	0.036	0.074	0.122	0.274	0.471	1.376								
0.008	0.01	0.012	0.015				0.049	0.148	0.362	1.456										
0.007	0.008	0.01	0.01											7	15	21				
0.007	0.008	0.01	0.012	0.016	0.019		0.054	0.097	0.166	0.386	1.262									
0.006	0.008	0.011	0.014	0.016	0.022		0.048	0.079	0.151	0.334	0.881									
0.007	0.008	0.01	0.012	0.016	0.019											12	15	23		
0.007	0.008	0.01	0.015	0.018			0.066	0.097	0.182	0.389	0.773									
0.007	0.008	0.009	0.012	0.014	0.016		0.051	0.092	0.154	0.242	0.479	1.534								
0.009	0.011	0.014	0.016																	
0.008	0.011	0.013	0.018																	

TEXT-FIGURE 8

Continued.

Genus *Sengoerina* Altiner 1999

Sengoerina pulchra Nestell and Nestell, **n. sp.**
Plate 6, figures 3-6

Description: Test is large, elongate, biserial, with a planispiral initial part and short uncoiled last part. Initial part consists of one volution with six rounded chambers. Proloculus is spherical, with a diameter of 0.04-0.06mm. Successive chambers rapidly increase in height and width. Height of the second chamber is 0.04mm, third is 0.10mm, fourth is 0.14mm, fifth is 0.18mm, width of the third chamber is 0.15mm, fourth is 0.17mm, fifth is 0.28mm. Short uncoiled part consists of two rounded chambers in each row gradually increasing in height and width. Height of the first chamber is 0.16-0.18mm, width is 0.22mm, the height of the second chamber is 0.20-0.25mm, width is 0.40mm. Wall is calcareous, single layered, microgranular, with a thickness of 0.03mm. Septa are curved, with the same structure as the wall, and thinner than the wall. Thickness of the septa is 0.015mm. Septa have an extra small plate (oral projection) that appears in the last chamber and covers the aperture. Precise shape of the aperture is unknown. Dimensions: test height 0.65-0.80mm, diameter 0.39-0.57mm, and thickness 0.43mm.

Designation of types: The specimen illustrated on plate 6, figure 5 is designated as the holotype (KUMIP 2,506,880), the specimen on Pl. 6, fig. 3 as the paratype (KUMIP 2,506,878). They are from the Dark Canyon Amoco #2 core, the holotype: depth 391.55-391.7ft, paratype: - depth 178.3-178.45ft; the holotype – lower and paratype – middle part of the Tansill Formation; Middle Permian (Capitanian).

Etymology: From the Latin *pulcher* - beautiful.

Material: 6 sections of different orientation.

Discussion: *Sengoerina pulchra* n. sp. differs from *S. argandi* (Altiner 1999, p. 215, pl. 1, fig. 1-10) by larger size of the test, rounded chambers, and single layered wall without a radial layer on the septa.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, lower and middle part of the Tansill Formation, Middle Permian (Capitanian).

Family DAGMARITIDAE Bozorgnia 1973
Genus *Crescentia* Ciarapica, Cirilli, Martini and Zaninetti 1986

Crescentia migrantis Nestell and Nestell, **n. sp.**
Plate 6, figures 7-12

Description: Test is free, large, biserial, with a planispiral initial part and short uncoiled last part, and with spinose outgrowths in place of the attachment of the chambers. The initial part forms one volution with 4-6 chambers in it. Proloculus is large, spherical, with diameter 0.06-0.08mm. Successive chambers gradually increase in height from 0.05mm to 0.11mm. Uncoiled part consists of 1-3 chambers of crescentiform shape in each row, gradually increasing in height and very slowly in width. Height of the first chamber is 0.14-0.16mm, width is 0.14-0.19mm, height of the last chamber 0.16mm, width is 0.20mm. Wall is calcareous, single layered, microgranular, with a thickness of 0.05mm. Septa are curved, three layered, with intermediate radial layer (thickness 0.015mm) and microgranular external layer (thickness 0.020mm) and a thin internal layer. Septa have an extra plate in the last chamber that covers the aperture. Di-

mensions: test height 0.58-1.03mm, diameter of spiral part 0.51-0.56mm, and test width 0.5-0.56mm.

Designation of types: The specimen illustrated on Pl. 6, fig. 11 is designated as the holotype (KUMIP 2,506,886), the specimen on Pl. 6, fig. 8 as the paratype (KUMIP 2,506,883). They are from the Dark Canyon Amoco #2 core, the holotype: depth 199.85-200.0ft, paratype - depth 213.7-213.85ft, middle Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *migrans* - emigrant.

Material: 21 sections of different orientation.

Discussion: From the only representative of the genus *Crescentia*, *C. vertebralis* Ciarapica, Cirilli, Martini and Zaninetti (Ciarapica et al. 1986, p. 208, pl. 1, fig. 1, 2), *Crescentia migrantis* n. sp. differs by larger size of the test, slightly longer uncoiled part, and thicker intermediate radial layer on the septa.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, lower and middle part of the Tansill Formation, Middle Permian (Capitanian).

Order ENDOTHYRIDA Fursenko 1958
Family ENDOTEBIDAE Vachard, Martini, Rettori and Zaninetti 1994

Genus *Vachardella* Nestell and Nestell, **n. gen.**
Type species: *Vachardella longiuscula* n. sp., USA, New Mexico, Guadalupe Mountains, Dark Canyon, the lower parts of the Tansill Formation; Middle Permian (Capitanian).

Description: Test is large, elongate, with two stages of growth: initial planispiral part and rectilinear later part. Planispiral part has one to one and a half volutions. Septa are straight and short in this part. Straight part contains 2-8 chambers. Septa of this part are almost horizontal or with a slight inclination to the axis, and are thick; they are similar to the wall in structure. Wall is calcareous, single layered, coarsely granular, and thick. The wall consists of large grains of calcite that create the impression of an agglutinated wall. The calcareous composition of these grains was confirmed by examining the wall structure with polarized light. Aperture is terminal and simple.

Etymology: Named after Dr. D. Vachard for his contributions to the study of the Paleozoic foraminifers.

Discussion: The new genus *Vachardella* is similar to the genus *Granuliferelloides* McKay and Green 1963 from the lowermost Carboniferous (Tournaisian) of Canada (McKay and Green 1963) on the basis of two stages of growth, but differs from it by the planispiral volution in the coiled part, crescentiform shape of the chambers in the straight part, and much younger stratigraphic interval. From the Triassic genus *Endotebanella* Vachard, Martini, Rettori and Zaninetti (Vachard et al. 1994), the new genus differs by the larger size of the test, different type of coiling in the initial spiral part of the test and its very smaller development, longer straight part and more coarsely granular structure of the wall.

Remarks: The wall of our new genus is calcareous, single layered, coarsely granular, and thick. It consists of large grains of calcite that create the impression of an agglutinated wall and resembles the morphology of the genus *Ammobaculites* Cushman 1910. According to Bender (1995), *Ammobaculites* has an ag-

glutinated wall with an inner and outer organic layer. Our new genus, known only in thin section, appears to have neither an inner nor outer organic layer, and the wall consists of calcitic grains floating in calcareous cement.

Our new genus could have the same controversial status as the genus *Miliammina* (Cretaceous - Holocene) by having the morphological features of two foraminiferal groups, the miliolids and textulariids. Based on test morphology, *Miliammina* has been assigned to the Miliolida (Haynes 1981). Based on its agglutinated wall, it has been assigned to the Textulariida (Loeblich and Tappan 1987). In a recent paper on actin phylogeny of foraminifers, Flakowski et al. (2005) concluded that genus *Miliammina* belongs to the Miliolida and not to the Textulariida.

Occurrence: USA, New Mexico, Gaudalupe Mountains, Dark Canyon; the upper part of the Yates and Tansill formations.

Range: Middle Permian (Capitanian).

Vachardella longiuscula Nestell and Nestell, **n. sp.**
Plate 1, figures 14-19

Description: Test is large, elongate, with two stages of growth: initial planispiral part and straight later part. Proloculus is spherical, with a diameter of 0.04mm. Planispiral part has one volution with 5 chambers in it. Septa are straight and short in this part. Straight part contains 2-8 chambers of crescentiform shape gradually increasing in height and very slowly in width: height of the first chamber is 0.04-0.05mm, width is 0.04-0.09mm, last one is 0.078-0.104mm and 0.15mm. Septa of this part are almost horizontal or with a slight inclination to the axis, and thick; they are analogous to the wall in structure. Wall is calcareous, single layered, coarsely granular, and thick, with a thickness of 0.026-0.052mm. The wall consists of large grains of calcite that creates the impression of an agglutinated wall. The calcareous composition of these grains was confirmed by examining the wall structure with polarized light. Aperture is terminal and simple. Dimensions: test height 0.49-1.258mm, width 0.18-0.44mm, and diameter of the spiral part 0.16-0.31mm.

Designation of types: The specimen illustrated on Pl. 1, fig. 15 is designated as the holotype (KUMIP 2,506,743). It is from the Dark Canyon Amoco #2 core, depth 389.35-389.5ft, lower part of the Tansill Formation, Middle Permian (Capitanian).

Etymology: From the Latin *longiusculus* - long.

Material: 56 sections (37 axial longitudinal and 24 oblique).

Discussion: Given in the description of the genus.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Capitan and Tansill formations, and the Amoco #2 core, upper part of the Yates and lower and middle Tansill formations; Middle Permian (Capitanian).

Family ENDOTHYRANOPSIDAE Reitlinger 1958; emend. Reitlinger 1981
Subfamily NEOENDOTHYRINAE Reitlinger in Rauser-Chernoussova et al. 1996

Genus ***Neoendothyranella*** Nestell and Nestell, **n. gen.**
Neoendothyra (part.). – NGUYEN DUC TIEN 1986, pl. 4, fig. 2.

Type species: *Neoendothyranella wildei* n. sp., USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Tansill Formation; Middle Permian (Capitanian).

Description: Test is free, large, elongate, consists of two parts: initial part as in the genus *Neoendothyra*; last part is straight and uniserial. Coiling is plectogyroidal in the initial 2-2.5 volutions. Strong secondary deposits cover the base of each volution and fill up the lateral sides. Uniserial part is cylindrical with 4-6 chambers. Aperture is terminal and central in uniserial part. In the initial part, septa are oblique, thin, with small bulges at ends. Septa are thick in the straight part, with mace-shape thickenings near apertural border of septa.

Etymology: Name by similarity with the genus *Neoendothyra*.

Discussion: Based on the type of test structure, *Neoendothyranella* n. gen. is similar to *Endothyranella* Galloway and Harlton 1930 (in Galloway and Ryniker 1930), but differs by its carinate periphery, plectogyroidal coiling, and the presence of secondary deposits in the initial part of the test.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon; Kampuchea at the locality Sampou.

Range: Middle Permian (Capitanian).

Neoendothyranella wildei Nestell and Nestell, **n. sp.**
Plate 6, figures 14-22

Neoendothyra cf. *N. bronnimanni* NGUYEN DUC TIEN 1986, pl. 4, fig. 2.

Description: Test is large, elongate, composed of two parts: the initial part as in the genus *Neoendothyra*; last part is straight and uniserial. Coiling of the initial part is plectogyroidal with 2-2.5 volutions. Volutions rapidly increase in height. Height of the first volution is 0.19-0.25mm, second is 0.51-0.65mm. Number of chambers in all volutions is 17. Septa are oblique in the initial part of the test, with small bulges at the ends. Secondary deposits are developed at the base of the volutions. Straight part is cylindrical, consists of 4-5 rounded-rectangular chambers, slowly increasing in height and width. Height of the first chamber 0.09-0.11mm, width is 0.14-0.35mm; height of fourth chamber is 0.15-0.21mm, width is 0.33-0.42mm. Septa are straight, with mace-shape thickenings at apertural border of septa. Height of thickenings is 0.05-0.06mm. Wall is calcareous, single layered, microgranular, thickness in the initial part and in the uniserial part is 0.02-0.035mm. Dimensions: test height 1.62-1.97mm, great diameter of initial part 0.74-0.87mm, small diameter of initial part 0.27-0.33mm, height of uniserial part 0.85-1.21mm, and width 0.39-0.46mm.

Designation of types: The specimen illustrated on plate 6, figure 22 is designated as the holotype (KUMIP 2,506,897), the specimen on Pl. 6, fig. 21 as the paratype (KUMIP 2,506,896). They are from the Dark Canyon Amoco #1 core, the holotype: depth 220ft, paratype: - depth 231.5ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: After the late Dr. Garner Wilde who has contributed very much information about fusulinacean distribution and taxonomy, especially in the Permian rocks of West Texas.

Material: 51 sections of different orientation.

Discussion: Only type species is known.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, Tansill Formation, and the Amoco #2 core, upper part of the Yates and lower and middle parts of the Tansill formations; Middle Permian (Capitanian); Kumpuchea, locality Sampou; Middle Permian.

Superorder FUSULINOIDA Fursenko 1958 [nom. transl. Rauser-Chernousova and Solovieva in Rauser-Chernousova et al. 1996 ex Fusulinida Fursenko 1958]

Order OZAWAINELLIDA Solovieva 1980 [nom. transl. Solovieva and Reitlinger in Rauser-Chernousova et al. 1996 ex Ozawainellinae Thompson and Foster 1937]

Family OZAWAINELLIDAE Thompson and Foster 1937 [nom. transl. A. Miklukho-Maklay, Rauser-Chernousova and

PLATE 1

1-10 – *Tuberitina variabilis* Nestell and Nestell, n. sp.

- 1 KUMIP 2,506,729, holotype, pseudocolony of tuberitinas, ×90, Amoco #1 core, depth: 80ft;
- 2 KUMIP 2,506,730; pseudocolony of tuberitinas, ×90, Amoco #2 core, depth: 257.95-258.1ft;
- 3 KUMIP 2,506,731, axial section of three chambered specimen, ×90, Amoco #1 core, depth: 194ft;
- 4 KUMIP 2,506,732, axial section of bichambered specimen, ×90, Amoco #1 core, depth: 80ft;
- 5 KUMIP 2,506,733, axial section of unilocular specimen, ×90, Amoco #1 core, depth: 286ft;
- 6 KUMIP 2,506,734, axial section of bichambered specimen, ×90, Amoco #2 core, depth: 464.55-464.7ft;
- 7 KUMIP 2,506,735, tangential section, ×90, Amoco #1 core, depth: 252ft;
- 8 KUMIP 2,506,736, axial section of bichambered specimen, ×90, Amoco #1 core, depth: 172ft;
- 9 KUMIP 2,506,737, axial section of unilocular specimen, ×90, Amoco #1 core, depth: 270ft;
- 10 KUMIP 2,506,738, axial section of unilocular specimen, ×90, Amoco #1 core, depth: 226ft.

11-13. *Haplophragmina? infrequens* Nestell and Nestell, n. sp.

- 11 KUMIP 2,506,739, holotype, close to axial section, ×64, Amoco #2 core, depth: 324.55-324.7ft;
- 12 KUMIP 2,506,740, transverse section, ×64, Amoco #2 core, depth: 327.3-327.45ft;
- 13 KUMIP 2,506,741, close to axial section, ×64, Amoco #2 core, depth: 329.05-329.2ft

14-19 – *Vachardella longiuscula* Nestell and Nestell, n. gen., n. sp.

- 14 KUMIP 2,506,742, axial section, ×64, Amoco #2 core, depth: 347.65-347.8ft;

- 15 KUMIP 2,506,743, holotype, axial section, ×64, Amoco #2 core, depth: 389.35-389.5ft;

- 16 KUMIP 2,506,744, close to axial section, ×64, Amoco #1 core, depth: 204ft;

- 17 KUMIP 2,506,745, axial section, ×64, Amoco #1 core, depth: 122ft;

- 18 KUMIP 2,506,748, equatorial section of the initial part, ×64, Amoco #2 core, depth: 213.05-213.2ft;

- 19 KUMIP 2,506,747, equatorial section of the initial part, ×90, Amoco #2 core, depth: 285.2-285.35ft.

20 – *Vachardella* sp. 1, KUMIP 2,506,746, axial section, ×64, Amoco #2 core, depth 298.0-298.15ft.

21-22 – *Pseudoammodiscus* sp. 1.

- 21 KUMIP 2,506,749, axial section, ×90, Amoco #1 core, depth: 192ft;

- 22 KUMIP 2,506,750, equatorial section, ×90, Amoco #1 core, depth: 226ft.

23 – *Calcitornella* sp., KUMIP 2,506,751, axial section, ×90, Amoco #1 core, depth 230ft.

24-25 – *Calcivertella* sp..

- 24 KUMIP 2,506,752, close to axial section, ×90, Amoco #2 core, depth 178.3-178.45ft;

- 25 KUMIP 2,506,753, equatorial section, ×90, Amoco #1 core, depth 146ft.

26-29 – *Tansillites anfractusus* Nestell and Nestell, n. gen., n. sp.

- 26 KUMIP 2,506,754, equatorial section, ×90, Amoco #2 core, depth: 129.95-130.1ft;

- 27 KUMIP 2,506,755, equatorial section, ×90, Amoco #1 core, depth: 90ft;

- 28 KUMIP 2,506,756, lateral section, ×90, Amoco #1 core, depth: 72ft;

- 29 KUMIP 2,506,757, close to axial section, ×90, Amoco #2 core, depth: 145.1-145.25ft.

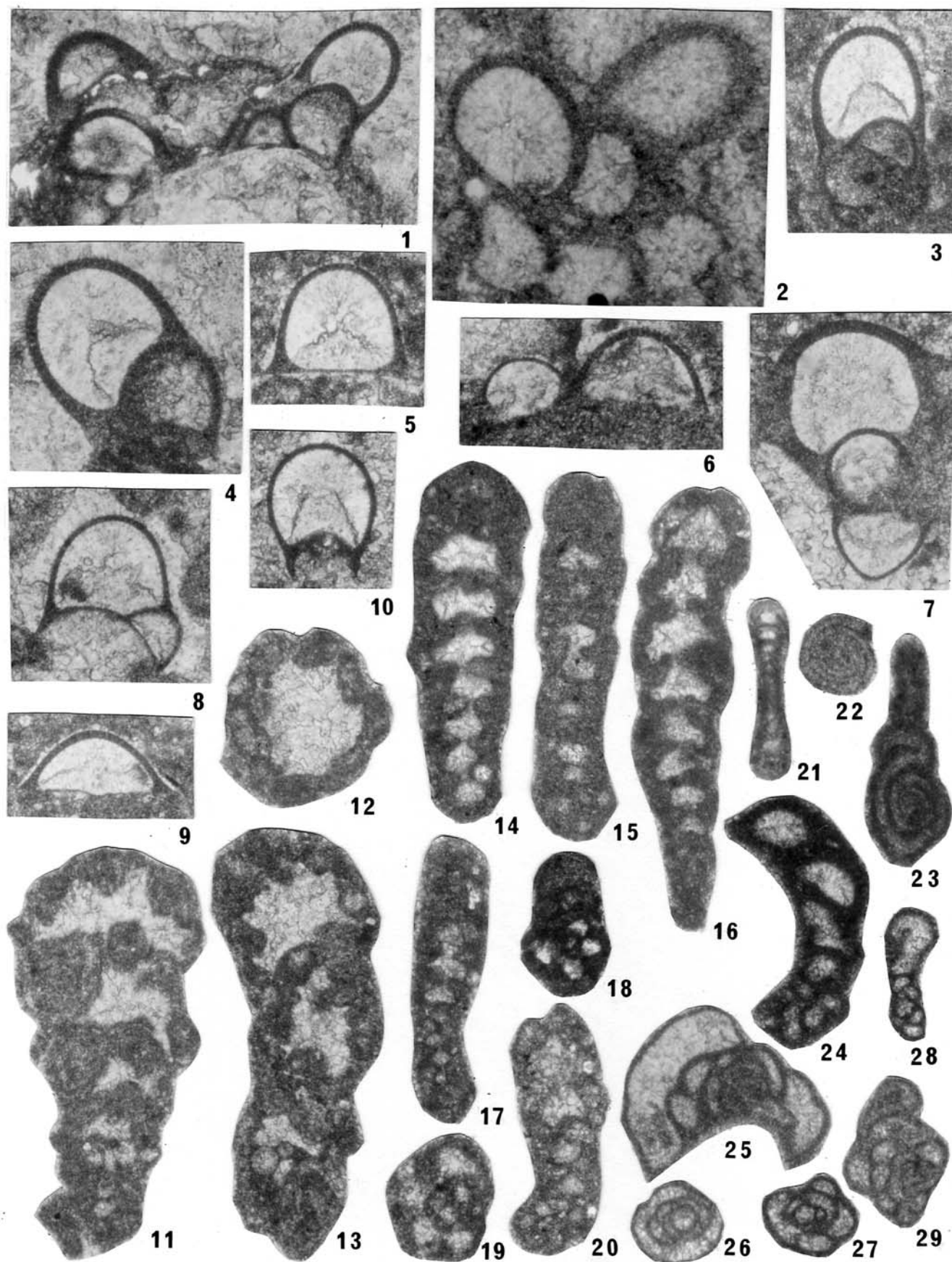


PLATE 2

1-5 – *Tansillites anfractusus* Nestell and Nestell, n. gen., n. sp.

- 1 KUMIP 2,506,758, axial section, ×90, Amoco #1 core, depth: 76ft;
- 2 KUMIP 2,506,759, axial section, ×90, Amoco #1 core, depth: 72ft;
- 3 KUMIP 2,506,760, equatorial section, ×90, Amoco #1 core, depth: 90ft;
- 4 KUMIP 2,506,761, axial section, ×90, Amoco #2 core, depth: 177.3-177.45ft;
- 5 KUMIP 2,506,762, holotype, axial section, ×90, Amoco #1 core, depth: 106ft.

6-8 – *Palaeonubecularia marginata* Nestell and Nestell, n. sp.

- 6 KUMIP 2,506,763, holotype, axial section, ×32, Amoco #2 core, depth: 177.85-178.0ft;
- 7 KUMIP 2,506,764, axial section, ×32, Amoco #1 core, depth: 148ft;
- 8 KUMIP 2,506,765, axial section, ×32, Amoco #1 core, depth: 10ft.

9 – *Pseudolituotuba (Pseudospira)* sp. 1, KUMIP 2,506,766, close to axial section, ×56, Amoco #1 core, depth 154ft.

10-27 – *Pseudohemigordius incredibilis* Nestell and Nestell, n. gen., n. sp.

- 10 KUMIP 2,506,767, juvenile specimen, axial section, ×90, Amoco #1 core, depth: 108ft;
- 11 KUMIP 2,506,768; juvenile specimen, equatorial section, ×90, Amoco #1 core, depth: 108ft;
- 12 KUMIP 2,506,769, axial section, ×90, Amoco #1 core, depth: 88ft;
- 13 KUMIP 2,506,770, equatorial section, ×90, Amoco #2 core, depth: 298.0-298.15ft;
- 14 KUMIP 2,506,771, axial section, ×90, Amoco #1 core, depth: 262ft;
- 15 KUMIP 2,506,772, axial section, ×90, Amoco #1 core, depth: 262ft;
- 16 KUMIP 2,506,773, equatorial section, ×90, Amoco #1 core, depth: 90ft;
- 17 KUMIP 2,506,774, lateral section, ×90, Amoco #1 core, depth: 220ft;
- 18 KUMIP 2,506,775, holotype, lateral section, ×90, Amoco #1 core, depth: 42ft;

- 19 KUMIP 2,506,776, lateral section, ×90, Amoco #1 core, depth: 42ft;

- 20 KUMIP 2,506,777, lateral section, ×90, Amoco #2 core, depth: 155.5-155.65ft;

- 21 KUMIP 2,506,778, axial section, ×90, Amoco #1 core, depth: 42ft;

- 22 KUMIP 2,506,779, lateral section, ×90, Amoco #2 core, depth: 342.45-342.6ft;

- 23 KUMIP 2,506,780, paratype, lateral section, ×90, Amoco #1 core, depth: 42ft;

- 24 KUMIP 2,506,781, tangential section, ×90, Amoco #1 core, depth: 106ft;

- 25 KUMIP 2,506,782, tangential section, ×90, Amoco #1 core, depth: 106ft;

- 26 KUMIP 2,506,783, lateral section, ×90, Amoco #2 core, depth: 216.3-216.45ft;

- 27 KUMIP 2,506,784, lateral section, ×90, Amoco #2 core, depth: 285.2-285.35ft.

28-36. *Baisalina americana* Nestell and Nestell, n. sp.

- 28 KUMIP 2,506,785, lateral section, ×64, Amoco #2 core, depth: 150.8-150.95ft;

- 29 KUMIP 2,506,786, equatorial section, ×64, Amoco #2 core, depth: 177.3-177.45ft;

- 30 KUMIP 2,506,787, lateral section, ×64, Amoco #2 core, depth: 150.8-150.95ft;

- 31 KUMIP 2,506,788, holotype, axial section, ×64, Amoco #2 core, depth: 177.1-177.25ft;

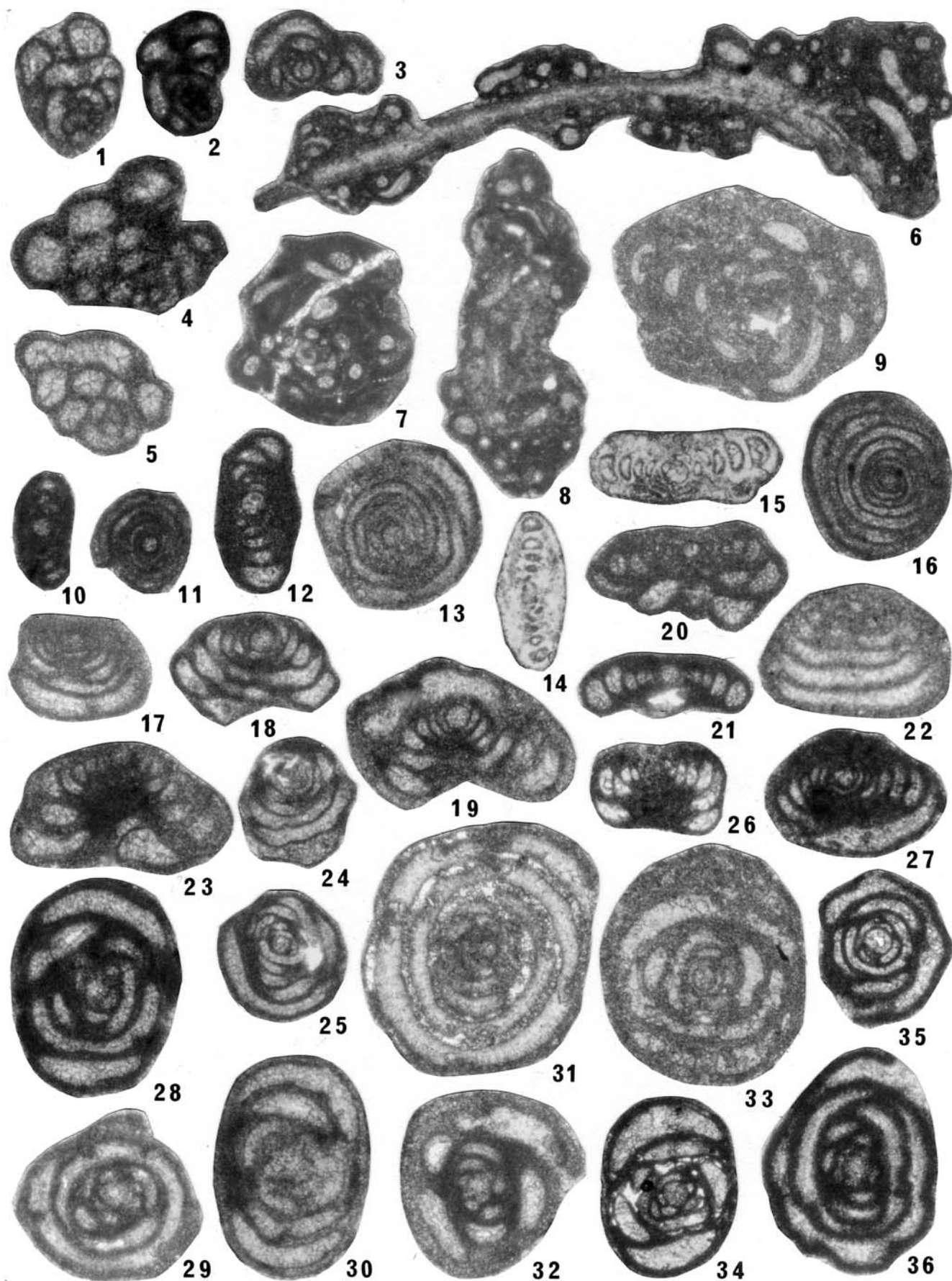
- 32 KUMIP 2,506,789, equatorial section, ×64, Amoco #2 core, depth: 150.8-150.95ft;

- 33 KUMIP 2,506,790, close to axial section, ×64, Amoco #2 core, depth: 148.65-148.8ft;

- 34 KUMIP 2,506,791, lateral section, ×64, Amoco #2 core, depth: 213.05-213.2ft;

- 35 KUMIP 2,506,792, equatorial section, ×64, Amoco #2 core, depth: 177.3-177.45ft ;

- 36 KUMIP 2,506,793, equatorial section, ×64, Amoco #2 core, depth: 177.45-177.6ft.



Rozovskaya 1958 ex *Ozawainellinae* Thompson and Foster 1937]

Subfamily REICHELININAE A. Miklukho-Maklay 1959

Genus *Reichelina* Erk 1942; emend. K. Miklukho-Maklay 1954

Reichelina lamarensis Skinner and Wilde 1955

Plate 9, figures 16-24; Plate 10, figures 1-6

Reichelina lamarensis SKINNER and WILDE 1955, p. 927-940, pl. 89, figs. 1-9. – YANG and YANCEY 2000, pl. 9-2, figs. 1-16. – WILDE and RUDINE 2000, p. 347-348, pl. 15-2, figs. 1-5, pl. 15-3, figs. 1-11, pl. 5-4, figs. 1-9, pl. 15-5, figs. 1-3.

Reichelina bengensis YANG and YANCEY 2000, p. 198-199, pl. 9-2, figs. 17-20.

Reichelina birdensis YANG and YANCEY 2000, p. 198-199, pl. 9-2, figs. 21-27.

Description: Test is minute, inner volutions coiled discoidally; much of the last or outer volution uncoiled from the inner coils in an axial section, with up to 7 septal divisions in the uncoiled part of an axially oriented specimen. Mature specimens generally have about 5 volutions, although a few specimens reach 7 volutions. Diameter (D) and length (L) reach 1.32mm and 0.42mm in mature specimens, respectively ($L/D = 3.14$). Spirotheca is very thin, ranges from 0.007mm in the first volution to about 0.017mm in the last volutions, and consists of a tectum and possibly recrystallized diaphanotheca. Septa are strongly convex and unfluted, septal pores are common. Proloculus varies from very tiny in probable microspheric specimens and averages about 0.4mm in megalospheric specimens. Tunnel is low, narrow, and indistinct in some specimens. Chomata low and broad, and extend laterally to the polar region and join across the tunnel floor.

Material: 17 oriented specimens.

Discussion: The genus *Reichelina* was first described by Erk (1942) from late Middle Permian strata near Bursa, Turkey. Skinner and Wilde (1955) described *Reichelina lamarensis*, the first species of this genus to be found in North America. It was originally found in the Lamar Limestone Member of the Bell Canyon Formation from a locality known as Buck Hill (located on private property) on the south side of the road into McKittrick Canyon in Guadalupe Mountains National Park. Skinner and Wilde (1955) noted that sporadic specimens occur throughout the Lamar. This species has been recently described from similar age strata in the northern part of the Del Norte Mountains and western part of the Glass Mountains in West Texas (Wilde and Rudine 2000). Yang and Yancey (2000) also noted this same species and described three new species, *R. bengensis*, *R. birdensis*, and *R. haneefi* from the same area. They also referred *Ozawainella delawarensis* Dunbar and Skinner 1937 to the genus *Reichelina*. Skinner and Wilde (1955) had previously suggested the latter referral with question. The present authors take a conservative approach to the speciation of American forms of this genus and consider that the species *R. bengensis* and *R. birdensis* are population variants of *R. lamarensis*. This conclusion is based on numerous oriented sections of *R. lamarensis* made from strata at the south side of the mouth of Dark Canyon in which a great variation of morphology can be seen in a single sample. We consider that *R. haneefi* possibly constitutes a different species from *R. lamarensis*.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core. *Reichelina lamarensis* occurs in the Dark Canyon Amoco #2 core at various levels ranging from 110.85ft to a depth of 216.45ft. The species is common to abun-

PLATE 3

1-5 – *Agathammina pusilla* (Geinitz).

- 1 KUMIP 2,506,794, equatorial section, $\times 40$, Amoco #1 core, depth: 116ft;
- 2 KUMIP 2,506,795, axial lateral section, $\times 40$, Amoco #1 core, depth: 116ft;
- 3 KUMIP 2,506,796, axial section, $\times 64$, Amoco #2 core, depth: 231.75-231.9ft;
- 4 KUMIP 2,506,797, equatorial section, $\times 64$, Amoco #2 core, depth: 183.9-184.05ft;
- 5 KUMIP 2,506,798, tangential lateral section, $\times 64$, Amoco #1 core, depth: 128ft.

6-7 – *Agathammina* sp. 7

- 6 KUMIP 2,506,799, equatorial section, $\times 64$, Amoco #2 core, depth: 216.3-216.45ft;
- 7 KUMIP 2,506,800, axial section, $\times 64$, Amoco #2 core, depth: 216.3-216.45ft.

8-11 – *Agathammina* ex gr. *A. rosella* G. Pronina

- 8 KUMIP 2,506,801, equatorial? section, $\times 40$, Amoco #2 core, depth: 153.6-153.75ft;
- 9 KUMIP 2,506,802, axial? section, $\times 64$, Amoco #2 core, depth: 202.25-202.4ft;
- 10 KUMIP 2,506,803, equatorial? section, $\times 64$, Amoco #1 core, depth: 126ft;
- 11 KUMIP 2,506,804, axial? section, $\times 64$, Amoco #1 core, depth: 120ft.

12 – *Agathammina* sp. 1, KUMIP 2,506,805, axial lateral section, $\times 90$, Amoco #2 core, depth 465.0-465.15ft.

13 – *Graecodiscus* sp., KUMIP 2,506,806, close to axial section, $\times 55$, Amoco #1 core, depth 154ft.

14 – *Agathammina* sp. 2, KUMIP 2,506,807, close to axial section, $\times 55$, Amoco #1 core, depth 208ft.



PLATE 4

1-2 – *Graecodiscus praecursor* Nestell and Nestell, n. sp.

1 KUMIP 2,506,808, holotype, close to axial section, ×40, Amoco #1 core, depth: 120ft

2 KUMIP 2,506,809, paratype; close to axial section, ×40, Amoco #1 core, depth: 90ft.

3 – *Graecodiscus* sp. 2, KUMIP 2,506,810, close to axial section, ×64, Amoco #2 core, depth 465.0-465.15ft.

4-6 – *Nodosaria capitaneensis* Nestell and Nestell, n. sp.

4 KUMIP 2,506,811, holotype, axial section, ×90, Amoco #2 core, depth: 358.1-358.25ft;

5 KUMIP 2,506,812, axial section, ×90, Amoco #1 core, depth: 186ft;

6 KUMIP 2,506,813, axial section, ×90, Amoco #2 core, depth: 463.65-463.8ft.

7 – *Nodosaria* cf. *N. novizkiana* Sosnina, KUMIP 2,506,814, close to axial section, ×90, Amoco #2 core, depth 329.75-329.9ft.

8 – *Nodosaria* sp. 8, KUMIP 2,506,815, axial section, ×90, Amoco #2 core, depth 231.75-231.9ft.

9 – *Nodosaria* ex gr. *N. grandecamerata* Sosnina, KUMIP 2,506,816, tangential section, ×64, Amoco #1 core, depth 190.5ft.

10 – *Nodosaria* cf. *N. partisana* Sosnina, KUMIP 2,506,817, close to axial section, ×90, Amoco #1 core, depth 310.1ft.

11 – *Robustopachyphloia*? sp., KUMIP 2,506,849, axial section, ×90, Amoco #2 core, depth 332.25-332.4ft.

12 – *Lingulina*? sp., KUMIP 2,506,819, tangential axial section, ×90, Amoco #2 core, depth 221.7-221.85ft.

13 – *Polarisella lingulae* Nestell and Nestell, n. sp., KUMIP 2,506,818, holotype, close to axial section, ×90, Amoco #1 core, depth 198ft.

14 – *Rectoglandulina lepida* (Wang), KUMIP 2,506,820, close to axial section, ×90, Amoco #2 core, depth 155.0-155.15ft.

15, 18 – *Eomarginulinella*? sp.

15 KUMIP 2,506,823, lateral section, ×90, Amoco #2 core, depth: 360.85-361.0ft;

18 KUMIP 2,506,824, lateral section, ×90, Amoco #2 core, depth: 358.95-359.1ft.

16-17 – *Eomarginulinella* sp. 1

16 KUMIP 2,506,821, close to axial section, ×64, Amoco #1 core, depth: 88ft;

17 KUMIP 2,506,822, close to axial section, ×64, Amoco #1 core, depth: 110ft.

19-20 – *Calvezina* sp. 1.

19 KUMIP 2,506,825, transverse section, ×90, Amoco #1 core, depth 372ft;

20 KUMIP 2,506,826, close to axial section, ×90, Amoco #1 core, depth 372ft.

21-22 – *Lingulonodosaria*? sp.

21 KUMIP 2,506,828, axial lateral section, ×90, Amoco #1 core, depth: 174ft.

22 KUMIP 2,506,827, axial section, ×90, Amoco #1 core, depth: 88ft.

23-25 – *Geinitzina* sp. 1.

23 KUMIP 2,506,847, transverse section, ×90, Amoco #1 core, depth: 356ft;

24 KUMIP 2,506,848, tangential axial section, ×90, Amoco #1 core, depth: 350ft;

25 KUMIP 2,506,844, lateral section, ×90, Amoco #1 core, depth: 374ft.

Fig. 26-31 – *Geinitzina aetheria* Nestell and Nestell, n. sp., x 90.

26 KUMIP 2,506,835, transverse section, ×90, Amoco #1 core, depth: 176ft;

27 KUMIP 2,506,836, holotype, axial section, ×90, Amoco #1 core, depth: 172ft;

28 KUMIP 2,506,837, lateral section, ×90, Amoco #1 core, depth: 226ft;

29 KUMIP 2,506,839, lateral section, ×90, Amoco #1 core, depth: 102ft;

30 KUMIP 2,506,838, lateral section, ×90, Amoco #1 core, depth: 172ft;

31 KUMIP 2,506,840, close to axial section, ×90, Amoco #1 core, depth: 186ft.

32-34 – *Geinitzina* sp. 4

32 KUMIP 2,506,841, tangential transverse section, ×90, Amoco #1 core, depth: 336.5ft;

33 KUMIP 2,506,842, close to axial section, ×90, Amoco #1 core, depth: 378ft;

34 KUMIP 2,506,843, lateral section, ×90, Amoco #1 core, depth: 396ft.

35-37 – *Tauridia* sp. 1

35 KUMIP 2,506,831, axial section, ×90, Amoco #2 core, depth: 344.05-344.2ft;

36 KUMIP 2,506,830, axial lateral section, ×90, Amoco #2 core, depth: 343.5-343.65ft;

37 KUMIP 2,506,829, axial section, ×90, Amoco #2 core, depth: 324.2-324.35ft.

38-41 – *Pachyphloia* sp.

38 KUMIP 2,506,852, transverse section, ×90, Amoco #2 core, depth: 343.5-343.65ft;

39 KUMIP 2,506,851, tangential lateral section, ×90, Amoco #2 core, depth: 365.5-365.65ft;

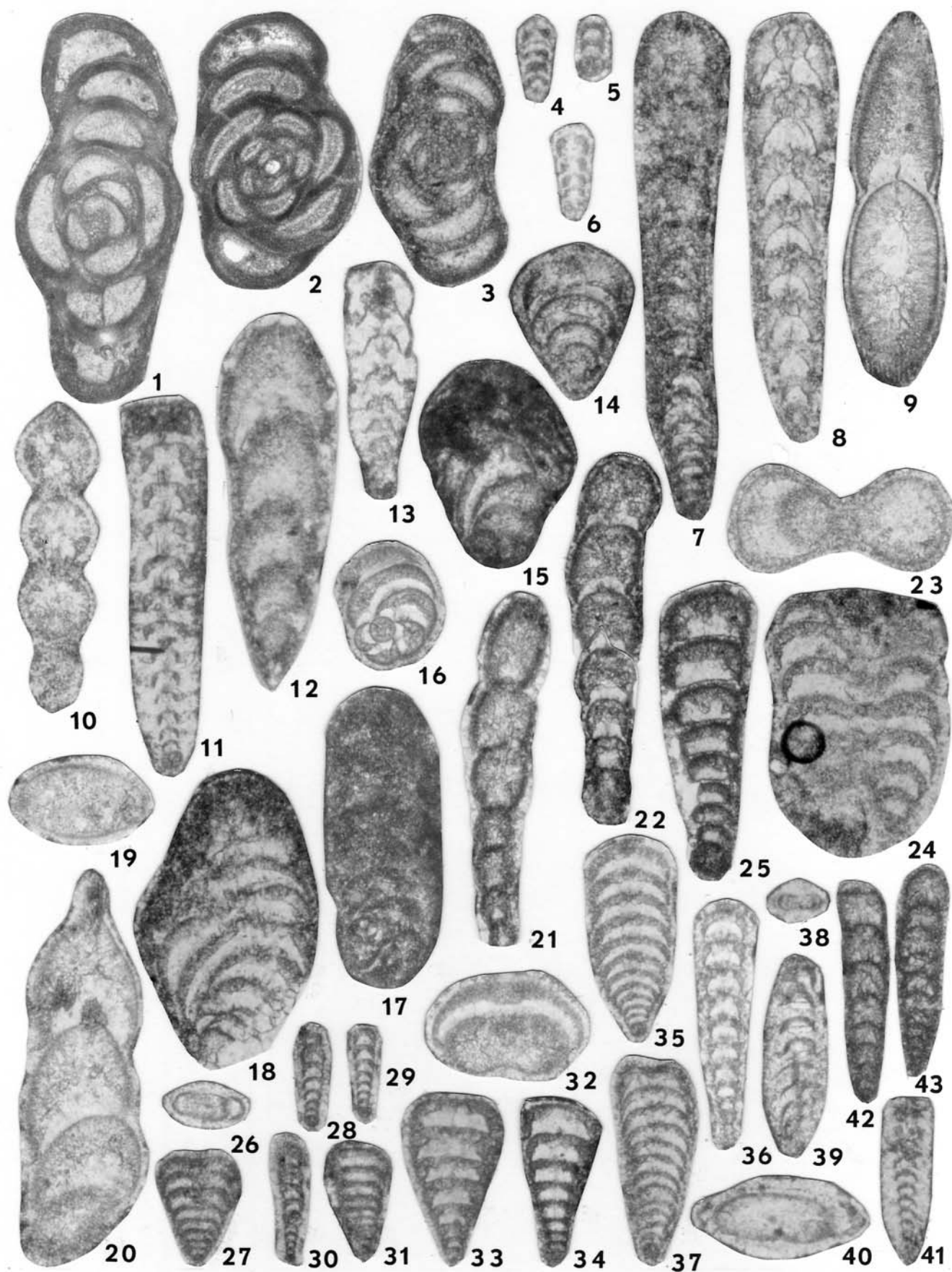
40 KUMIP 2,506,850, transverse section, ×90, Amoco #2 core, depth: 365.5-365.65ft;

41 KUMIP 2,506,853, lateral axial section, ×90, Amoco #2 core, depth: 366.5-366.65ft.

42-43 – *Ichthyolaria* sp. 1

42 KUMIP 2,506,855, lateral section, ×90, Amoco #1 core, depth: 238ft;

43 KUMIP 2,506,854, lateral section, ×90, Amoco #1 core, depth: 378ft.



dant in the depth interval from 199.65 to 211.05ft. One specimen from a depth of 322.75ft is questionably referred to *Reichelina lamarensis*.

Reichelina* aff. *R. changhsingensis Sheng and Chang 1958
Plate 8, figure 16; plate 9, figure 6

Description: Test is minute, inner volutions discoidal, outer volution significantly uncoiled on one side of the inner coils in an axial section, with 24 septal divisions in the uncoiled part of axially oriented specimen. Diameter (D) and length (L) are 0.936mm and 0.119mm, respectively ($L/D = 0.127$). The equatorial specimen has a diameter of 0.421mm, proloculus diameter of 0.035mm and 10 septal divisions in the uncoiled part.

Discussion: Only one poorly oriented axial specimen of this variant of *Reichelina* that exhibits a significant uncoiling of the last chamber was seen in the collection. It is questionably referred to *R. changhsingensis*. One other equatorial specimen is

also referred to this species with question. The species *R. changhsingensis* is well known from many localities in late Middle and Upper Permian strata in the Tethys.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, depth 222ft (axial specimen) and 244ft (equatorial specimen), Tansill Formation, Middle Permian (Capitanian).

Genus *Parareichelina* Miklukho-Maklay in Rauser-Chernousova and Fursenko 1959

***Parareichelina* sp.**
Plate 8, figure 8

Description: Test is minute, inner volutions coiled, slightly inflated discoid, outer volution uncoiled in a flare that can be seen on opposite sides of the inner coils in an axial or oriented equa-

PLATE 5

1-2 – *Tauridia* sp. 3

- 1 KUMIP 2,506,833, axial section, $\times 90$, Amoco #1 core, depth: 98ft;
- 2 KUMIP 2,506,832, transverse section, $\times 90$, Amoco #1 core, depth: 126ft.

3 – *Tauridia* sp. 2, KUMIP 2,506,834, lateral section, $\times 90$, Amoco #2 core, depth 453.1-453.25ft.

4-5 – *Tauridia* sp. 4

- 4 KUMIP 2,506,846, close to axial section, $\times 90$, Amoco #1 core, depth: 108ft;
- 5 KUMIP 2,506,845, lateral section, $\times 90$, Amoco #1 core, depth: 192ft.

6 – *Howchinella* sp. 1, KUMIP 2,506,856, close to axial section, $\times 90$, Amoco #2 core, depth 429.15-429.3ft.

7-8 – *Ichthyolaria* sp. 2

- 7 KUMIP 2,506,857, transverse section, $\times 90$, Amoco #1 core, depth: 166ft;
- 8 KUMIP 2,506,858, tangential axial section, $\times 90$, Amoco #1 core, depth: 128ft.

9 – *Partisania* sp., KUMIP 2,506,859, tangential section, $\times 64$, Amoco #1 core, depth 42ft.

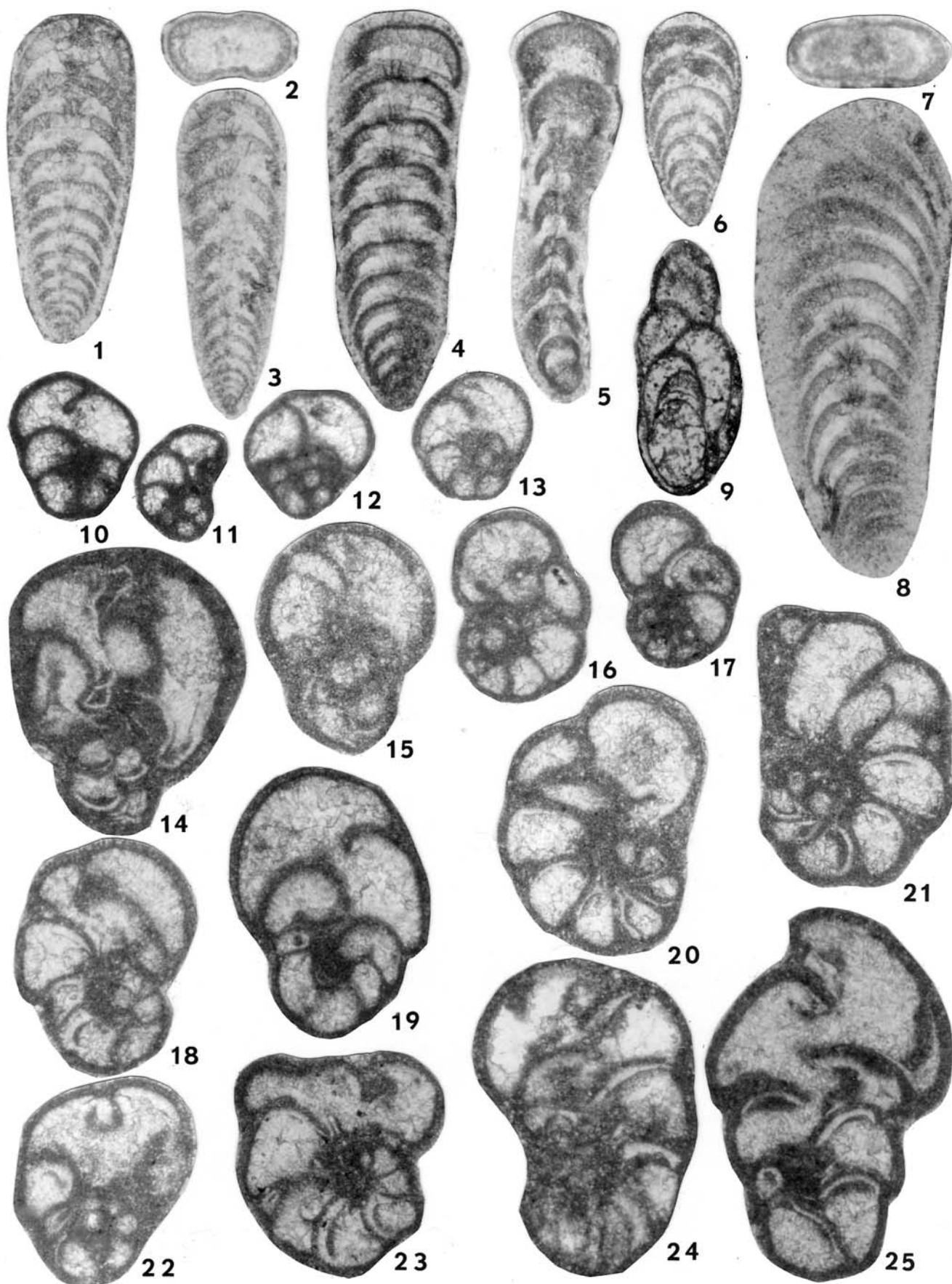
10-13 – *Globivalvulina* sp. 4

- 10 KUMIP 2,506,861, tangential section, $\times 64$, Amoco #2 core, depth: 213.05-213.2ft;
- 11 KUMIP 2,506,860, axial section, $\times 64$, Amoco #2 core, depth: 213.05-213.2ft;
- 12 KUMIP 2,506,862, lateral section, $\times 64$, Amoco #2 core, depth: 375.0-375.15ft;

- 13 KUMIP 2,506,863, close to axial section, $\times 64$, Amoco #2 core, depth: 230.0-230.15ft.

14-25 – *Globivalvulina guadalupensis* Nestell and Nestell, n. sp.

- 14 KUMIP 2,506,864, paratype, lateral section, $\times 64$, Amoco #2 core, depth: 326.45-326.6ft;
- 15 KUMIP 2,506,866, tangential lateral section, $\times 64$, Amoco #2 core, depth: 318.0-318.15ft;
- 16 KUMIP 2,506,865, axial section, $\times 64$, Amoco #2 core, depth: 452.1-452.25ft;
- 17 KUMIP 2,506,867, axial section, $\times 64$, Amoco #2 core, depth: 375.95-376.1ft;
- 18 KUMIP 2,506,868, holotype, axial section, $\times 64$, Amoco #2 core, depth: 324.2-324.35ft;
- 19 KUMIP 2,506,869, tangential section, $\times 64$, Amoco #2 core, depth: 382.8-382.95ft;
- 20 KUMIP 2,506,870, paratype, axial section, $\times 64$, Amoco #2 core, depth: 343.9-344.05ft;
- 21 KUMIP 2,506,871, axial section, $\times 64$, Amoco #2 core, depth: 342.45-342.6ft;
- 22 KUMIP 2,506,872, tangential lateral section, $\times 64$, Amoco #2 core, depth: 344.05-344.2ft;
- 23 KUMIP 2,506,873, axial section, $\times 64$, Amoco #2 core, depth: 430.8-430.95ft;
- 24 KUMIP 2,506,874, tangential lateral section, $\times 64$, Amoco #2 core, depth: 346.85-347.0ft;
- 25 KUMIP 2,506,875, paratype, tangential section, $\times 64$, Amoco #2 core, depth: 326.75-326.9ft.



torial section, with 9 and 12 septal divisions, respectively. Diameter (D) and length (L) are 0.873mm and 0.074mm, respectively $L/D = 0.085$.

Discussion: Only one tangential section of this form was seen in the collection. As the specimen clearly exhibits a flare in two opposite directions in an axial section, it is referred to *Para-reichelina*. This fusulinacean genus is known from several localities in the Tethys including the Northwestern Caucasus (K. Miklukho-Maklay 1954, Pronina-Nestell and Nestell 2001), Sikhote-Alin (Sosnina 1968) and the Koryak (Davydov et al. 1996) area of eastern Siberia, Himalayas (Ladakh) (Lys et al. 1980), China (Sheng 1963), and Northern California (Stevens et al. 1991).

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, depth 174ft, Tansill Formation, Middle Permian (Capitanian).

Genus *Rauserella* Dunbar 1944

Rauserella erratica Dunbar 1944

Plate 8, figure 4, plate 11, figure 6

Rauserella erratica DUNBAR 1944, p. 37-38, pl. 9, figs. 1-8; ROSS 1964, p. 315, pl. 50, figs. 1, 2. – TELLEZ-GIRON and NESTELL 1983, pl. 10, fig. 3; VACHARD et al. 1993b, pl. 6, fig. 12, pl. 8, figs. 15, 16. – YANG and YANCEY 2000, p. 197, pl. 9-1, figs. 1-7.

Description: Test is highly irregularly fusiform, consisting of 4-7 volutions, of which the inner ones are very tightly coiled planispirally, generally highly skew to the axis of coiling of the last several volutions. The direction of axis of coiling shifts during growth so the tests are very irregular in appearance. Test length is generally less than 1.5mm and width less than 0.5mm. Spirotheca thin, ranging from about 0.007mm in the inner volutions to about 0.017mm in the last volution, consisting of a tectum and diaphanotheca. Proloculus is spherical, minute, 0.041mm in the specimen illustrated on Pl. 8, fig. 4. Tunnel is narrow and not well developed. Septa are generally planar to slightly fluted in the outer volutions.

Discussion: *Rauserella erratica* is a robust species of the genus that exhibits a few skewed coils in the inner volutions followed by somewhat regular elongate fusiform coiling. This genus and species were first described from Middle Permian strata at Las

PLATE 6

1-2 – *Globivalvulina* sp. 1

- 1 KUMIP 2,506,876, tangential axial section, $\times 64$, Amoco #1 core, depth: 128ft;
- 2 KUMIP 2,506,877, tangential lateral section, $\times 64$, Amoco #2 core, depth: 342.9-343.05ft.

3-6 – *Sengoerina pulchra* Nestell and Nestell, n. sp.

- 3 KUMIP 2,506,878, paratype, axial section, $\times 64$, Amoco #2 core, depth: 178.3-178.45ft;
- 4 KUMIP 2,506,879, tangential section, $\times 64$, Amoco #2 core, depth: 407.35-407.5ft;
- 5 KUMIP 2,506,880, holotype, lateral section, $\times 64$, Amoco #2 core, depth: 391.55-391.7ft;
- 6 KUMIP 2,506,881, axial section, $\times 64$, Amoco #2 core, depth: 344.05-344.2ft.

7-12 – *Crescentia migrantis* Nestell and Nestell, n. sp.

- 7 KUMIP 2,506,882, close to axial section, $\times 64$, Amoco #2 core, depth: 324.4-324.55ft;
- 8 KUMIP 2,506,883, paratype, lateral section, $\times 64$, Amoco #2 core, depth: 213.7-213.85ft;
- 9 KUMIP 2,506,884, tangential lateral section, $\times 64$, Amoco #2 core, depth: 303.5-303.65ft;
- 10 KUMIP 2,506,885, tangential lateral section, $\times 64$, Amoco #2 core, depth: 323.9-324.05ft;
- 11 KUMIP 2,506,886, holotype, axial section, $\times 64$, Amoco #2 core, depth: 199.85-200.0ft;

- 12 KUMIP 2,506,887, equatorial section of the initial part, $\times 64$, Amoco #2 core, depth: 324.55-324.7ft.

13 – *Endothyra* sp., KUMIP 2,506,888, equatorial section, $\times 64$, Amoco #2 core, depth 178.3-178.45ft.

14-22 – *Neoendothyranella wildei* Nestell and Nestell, n. gen., n. sp.

- 14 KUMIP 2,506,889, tangential lateral section of the initial part, $\times 64$, Amoco #2 core, depth: 427.4-427.55ft;
- 15 KUMIP 2,506,890, tangential lateral section of the initial part, $\times 64$, Amoco #1 core, depth: 170ft;
- 16 KUMIP 2,506,891, tangential axial section of the initial part, $\times 64$, Amoco #1 core, depth: 22ft;
- 17 KUMIP 2,506,892, tangential lateral section of the initial part, $\times 64$, Amoco #1 core, depth: 108ft;
- 18 KUMIP 2,506,893, tangential lateral section of the initial part, $\times 64$, Amoco #1 core, depth: 152ft;
- 19 KUMIP 2,506,894, close to axial section of the initial part, $\times 64$, Amoco #1 core, depth: 172ft;
- 20 KUMIP 2,506,895, close to axial section of the initial part, $\times 64$, Amoco #1 core, depth: 90ft;
- 21 KUMIP 2,506,896, paratype, lateral section, $\times 64$, Amoco #1 core, depth: 231.5ft;
- 22 KUMIP 2,506,897, holotype, lateral section, $\times 64$, Amoco #1 core, depth: 220ft.



Delicias, Coahuila, Mexico (Dunbar 1944, Tellez-Giron and Nestell 1983). It is also common in coeval strata in the Glass, Del Norte (Yang and Yancey 2000), and Guadalupe Mountains of West Texas, and near Olinalá in the Mexican State of Guerrero (Vachard et al. 1993b). It is also known in the eastern Tethys in China in the Maokou Formation in Guizhou Province (Yang 1985), the Qixia Formation in Jiangsu Province (Zhang et al. 1988), the Permian of the Nanhua Range in northeastern China (Han 1985) and possibly at other localities. Sosnina (1968) also described a new subspecies, *R. erratica ussuriensis*, from the Southern Primorye area that we consider to probably be conspecific with *R. erratica*.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, the depth 128ft (pl. 8, fig. 4),

Tansill Formation, and the Amoco #2 core, the depth 425.2-426ft, upper part of the Yates Formation; Middle Permian (Capitanian). Only two specimens referred to this species are illustrated although other poorly oriented specimens were seen in both cores that could possibly be referred to this species.

Rauserella bengeensis Wilde and Rudine 2000
Plate 9, figures 10-15, Plate 10, figures 11, 17, Plate 11, figures 2, 7

Rauserella bengeensis WILDE and RUDINE 2000, p. 348, pl. 15-1, figs. 1-9, pl. 15-2, figs. 6-10.

Discussion: *Rauserella bengeensis* is a very tiny member of the genus *Rauserella* and was first described from Middle Permian strata exposed in the Glass and Del Norte mountains of West

PLATE 7

1 – *Dagmarita* sp., KUMIP 2,506,898, lateral section, ×90, Amoco #2 core, depth 331.9-332.05ft.

2-7 – *Abadehella* ex gr. *A. coniformis* Okimura and Ishii

2 KUMIP 2,506,899, axial section, ×64, Amoco #2 core, depth: 202.1-202.25ft;

3 KUMIP 2,506,900, lateral section, ×64, Amoco #2 core, depth: 197.95-198.1ft;

4 KUMIP 2,506,901, axial section, ×64, Amoco #2 core, depth: 380.85-381.0ft;

5 KUMIP 2,506,902, transverse section, ×64, Amoco #2 core, depth: 378.4-378.55ft;

6 KUMIP 2,506,903, axial section, ×64, Amoco #2 core, depth: 215.95-216.1ft;

7 KUMIP 2,506,904, axial section, ×64, Amoco #1 core, depth: 38ft.

8-11 – *Abadehella* sp. 2

8 KUMIP 2,506,905, close to axial section, ×64, Amoco #2 core, depth: 330.5-330.65ft;

9 KUMIP 2,506,906, close to axial section, ×64, Amoco #2 core, depth: 346.85-347.0ft;

10 KUMIP 2,506,907, close to axial section, ×64, Amoco #1 core, depth: 180ft;

11 KUMIP 2,506,908, close to axial section, ×64, Amoco #1 core, depth: 138ft.

12 – *Spireitlina* sp. 2, KUMIP 2,506,909, close to axial section, ×90, Amoco #2 core, depth 324.55-324.7ft.

13 – *Spireitlina* sp., KUMIP 2,506,910, close to axial section, ×64, Amoco #2 core, depth 465.0-465.15ft.

14 – *Spireitlina*? sp., KUMIP 2,506,911, axial section, ×90, Amoco #2 core, depth 358.1-358.25ft.

15-16 – *Deckerella* sp.

15 KUMIP 2,506,912, close to axial section of young specimen, ×32, Amoco #1 core, depth: 255.5ft

16 KUMIP 2,506,913, tangential axial section of adult specimen, ×32, Amoco #1 core, depth: 282ft.

17-22 – *Aschemonella* sp.

17 KUMIP 2,506,914, axial section, ×64, Amoco #1 core, depth: 228ft;

18 KUMIP 2,506,915, tangential section, ×64, Amoco #1 core, depth: 238ft;

19 KUMIP 2,506,916, close to axial section, ×64, Amoco #1 core, depth: 230ft;

20 KUMIP 2,506,917, tangential section, ×64, Amoco #1 core, depth: 231.5ft;

21 KUMIP 2,506,918; close to axial section, ×64, Amoco #1 core, depth: 224ft;

22 KUMIP 2,506,919, axial? section of the apertural end, ×64, Amoco #1 core, depth: 126ft.

23-27 – *Pseudokahlerina capitanensis* Nestell and Nestell, n. sp.

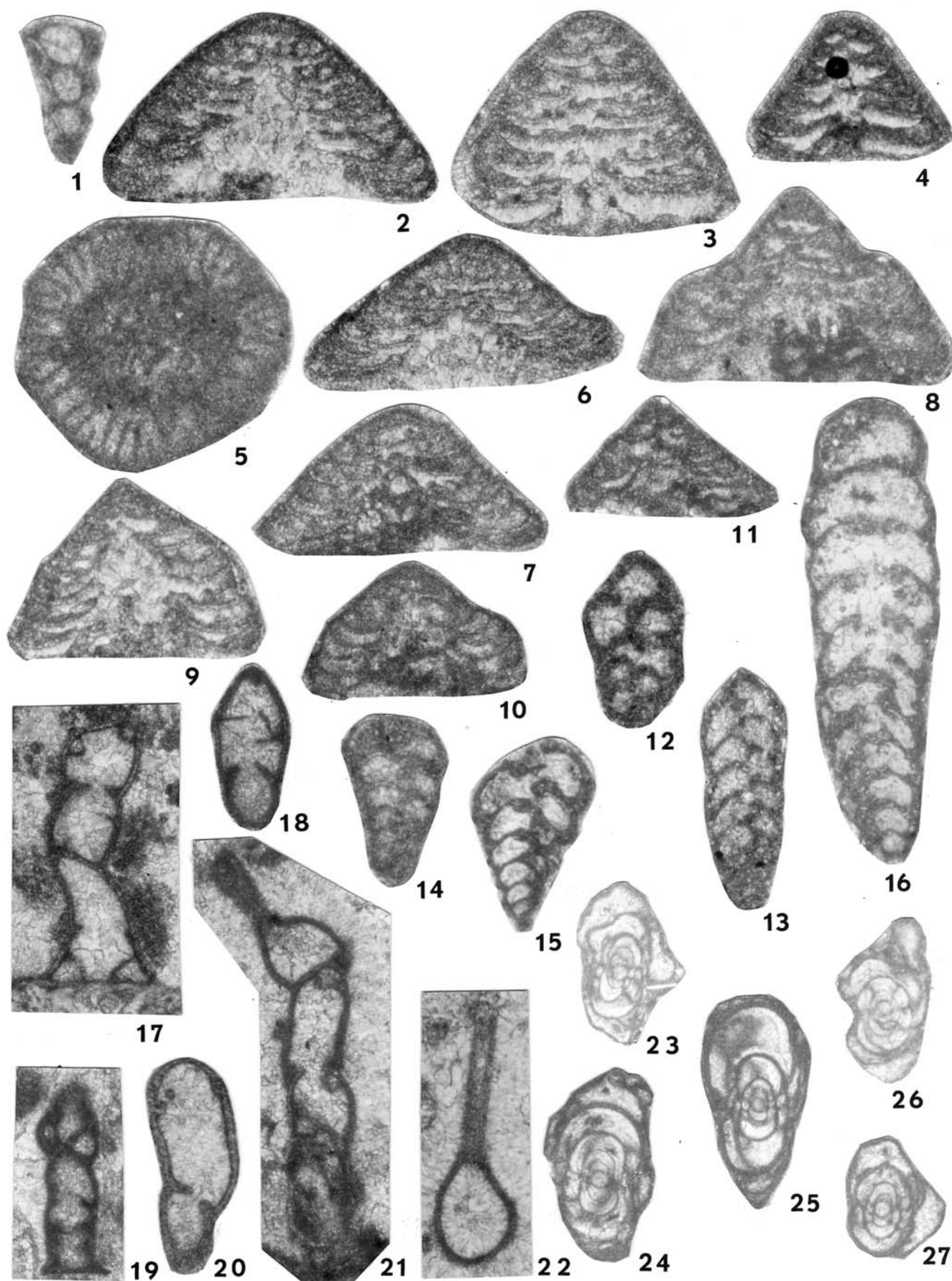
23 KUMIP 2,506,920, axial section, ×40, Amoco #1 core, depth: 116ft;

24 KUMIP 2,506,921, holotype, axial section, ×40, Amoco #1 core, depth: 110ft;

25 KUMIP 2,506,922, axial section, ×40, Amoco #1 core, depth: 120ft;

26 KUMIP 2,506,923, axial section, ×40, Amoco #1 core, depth: 120ft;

27 KUMIP 2,506,924, axial section, ×40, Amoco #1 core, depth: 128-128.15ft.



Texas (Wilde and Rudine 2000). We have a number of very small specimens that resemble this species at several levels in both cores. Some are not well oriented. As many of our specimens seem to closely agree with the type material, we refer these forms to the *R. bengeensis*.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, the depth 128ft (pl. 8, fig. 4), Tansill Formation, and the Amoco #2 core, depth 372.95-373.1ft, 423.8-423.95ft, Yates Formation, and depth 142.2-144.35ft, 145.85-146.0ft, 424.35-424.5ft, 425.85-426.0ft, Tansill Formation; Middle Permian (Capitanian).

Order SCHUBERTELLIDA Skinner 1931 [nom. transl. Chediya in Rauser-Chernoussova et al. 1996 ex Schubertellidae A. Miklukho-Maklay, Rauser-Chernoussova and Rozovskaya 1958]

Family BOULTONIIDAE Skinner and Wilde 1954

Genus *Paraboultonia* Skinner and Wilde 1954

Paraboultonia splendens Skinner and Wilde 1954

Plate 8, figures 3, 5, 6, 9-15; Plate 9, figures 1-5, 7, 8

Lantschichites splendens (Skinner and Wilde) in SHENG 1963, pl.12, figs. 16-22. – YANG and YANCEY 2000, p. 202-203, pl. 9-3, figs. 1-6, 11. – WILDE and RUDINE 2000, p. 348-349, pl. 15-8, figs. 1-11, pl. 15-9, figs. 1-7.

Discussion: A number of well-oriented specimens of this species are present in the two cores. It is unnecessary to give a detailed description as this species was recently thoroughly

discussed by Wilde and Rudine (2000). The taxonomic position of *Paraboultonia splendens* Skinner and Wilde in the fusulinacean world has been the subject of some disagreement for a number of years. Tumanskaya (1953) described the subgenus *Lantschichites* of the genus *Codonofusiella* with type species *C. (L.) maslennikovi*, a form that is very similar to the genus *Paraboultonia* with type species *P. splendens* erected by Skinner and Wilde (1954). This genus was also considered as a synonym of *Lantschichites* by Miklukho-Maklay et al. with no comment (in Rauser-Chernoussova and Fursenko 1959). Later, Sheng (1963) elevated *Lantschichites* to generic status and since that time, most fusulinacean workers have suppressed *Paraboultonia* in favor of *Lantschichites*. The basic difference between the two genera is in the uncoiled last volution. The last whorl expands in *Paraboultonia*, but the septa continue to touch the floor of the previous whorl, whereas the last whorl is significantly uncoiled in *Lantschichites*, and the septa in the uncoiled part are attached to the previous septal face, as in the genus *Codonofusiella*. Whether or not this difference is of generic character is a matter of opinion and disagreement continues. Both points of view are discussed in two recent papers in the same symposium volume (Yang and Yancey 2000, Wilde and Rudine 2000), where species of both genera are described from the Glass and Del Norte Mountains in West Texas. We tend to agree with Wilde and Rudine (2000) and consider *Paraboultonia* to be a separate genus based on sections made of topotype material recently collected in the Apache Mountains. In samples collected in Seven Heart Gap (Skinner and Wilde 1954) from the “six inch limestone bed about 40ft below the top of the Bell Canyon Formation near the east end of the Apache

PLATE 8

1 – *Codonofusiella* cf. *C. paradoxa* Dunbar and Skinner, KUMIP 2,506,925, axial section, ×40, Amoco #1 core, depth 44ft.

2, 7 – *Codonofusiella* (*Lantschichites*) *altudaensis* Wilde and Rudine

2 KUMIP 2,506,926, oblique section, ×32, Amoco #1 core, depth: 44-45ft;

7 KUMIP 2,506,927, axial section, ×32, Amoco #1 core, depth: 172ft.

3, 5, 6, 9-15 – *Paraboultonia splendens* Skinner and Wilde

3 KUMIP 2,506,928, axial section, ×40, Amoco #1 core, depth: 98ft;

5 KUMIP 2,506,929, equatorial section, ×40, Amoco #1 core, depth: 128ft;

6 KUMIP 2,506,930, axial section, ×40, Amoco #1 core, depth: 156ft;

9 KUMIP 2,506,931, axial section, ×32, Amoco #1 core, depth: 178ft;

10 KUMIP 2,506,932, axial section, ×32, Amoco #1 core, depth: 196-197ft;

11 KUMIP 2,506,933, axial section, ×32, Amoco #1 core, depth: 196-197ft;

12 KUMIP 2,506,934, axial section, ×40, Amoco #1 core, depth: 202ft;

13 KUMIP 2,506,935, equatorial section, ×40, Amoco #1 core, depth: 208-209ft;

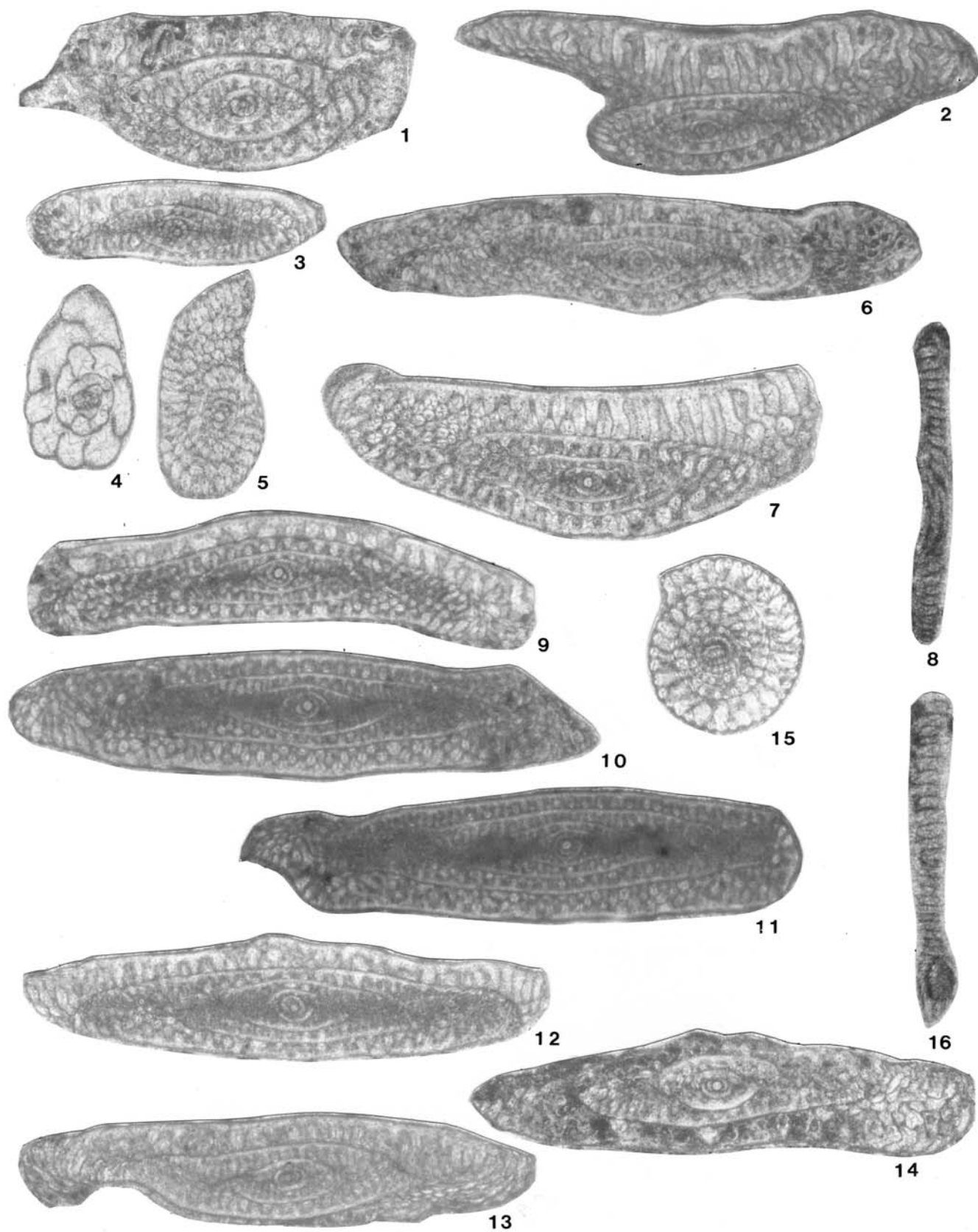
14 KUMIP 2,506,936, ×40, Amoco #1 core, depth: 228ft;

15 KUMIP 2,506,937, axial section, ×40, Amoco #1 core, depth: 202ft.

4 – *Rauserella erratica* Dunbar, KUMIP 2,506,938, equatorial section, ×40, Amoco #1 core, depth 128ft.

8 – *Parareichelina* sp., KUMIP 2,506,939, axial section, ×64, Amoco #1 core, depth 174ft.

16 – *Reichelina* aff. *R. changhsingensis* Sheng and Chang, KUMIP 2,506,940, parallel axial section, ×64, Amoco #1 core, depth 222ft.



Mountains, southern Culberson County, Texas”, there are no specimens that show a significant uncoiled portion of the test. For that reason, the generic identity of *Paraboultonia* is considered valid and is used in this paper. Only two of the forms illustrated from the Amoco cores appear to have a significant uncoiled portion and they are referred below to *C. (L.) altudaensis* Wilde and Rudine. *Paraboultonia splendens* also occurs in the Guadalupe Mountains in the upper part of the Lamar Limestone and Reef Trail Member of the Bell Canyon Formation in the McKittrick Canyon area (Wilde et al. 1999). It is also common in surface collections made by the authors in the transitional Capitan to Tansill limestone at the mouth of Dark Canyon where the Amoco #1 core was taken.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, illustrated specimens in the interval from the depth 98-228ft, Tansill Formation; Middle Permian (Capitanian). Specimens possibly referable to *P. splendens* were seen in the Amoco #1 core from the depth 10-366ft, but

some poorly oriented specimens seen in the upper part of the core show uncoiling typical of *C. (L.) altudaensis*.

Family PALAEOFUSULINIDAE A. Miklukho-Maklay 1963; emend. Leven 1987 [nom. transl. Chediya in Rauser-Chernousova et al. 1996 ex Palaeofusulininae A. Miklukho-Maklay 1963]

Genus *Codonofusiella* Dunbar and Skinner 1937

Subgenus *Lantschichites* Tumanskaya 1953

Codonofusiella (Lantschichites) altudaensis Wilde and Rudine 2000

Plate 8, figures 2, 7

Description: Two specimens, only one of which is well oriented, appear to slightly uncoil and are referred to this species. Test is minute, polar regions are blunt and cylindrical. Diameter (D) 0.708mm, length (L) 2.296mm, L/D = 3.2. There are five volutions, the last volution is slightly uncoiled, septa are intensely fluted from pole to pole, high septal folds are squared

PLATE 9

1-5, 7, 8 – *Paraboultonia splendens* Skinner and Wilde

1 KUMIP 2,506,941, axial section, ×40, Amoco #1 core, depth: 230ft;

2 KUMIP 2,506,942, equatorial section, ×40, Amoco #1 core, depth: 230ft;

3 *KUMIP 2,506,943, axial section, ×40, Amoco #1 core, depth: 231.5ft;

4 KUMIP 2,506,944, axial section, ×40, Amoco #1 core, depth: 242ft;

5 KUMIP 2,506,945, axial section, ×40, Amoco #1 core, depth: 246ft;

7 KUMIP 2,506,946, equatorial section, ×40, Amoco #1 core, depth: 297-298ft;

8 KUMIP 2,506,947, equatorial section, ×40, Amoco #1 core, depth: 362ft.

6 – *Reichelina* aff. *R. changhsingensis* Sheng and Chang, KUMIP 2,506,948, equatorial section, ×64, Amoco #1 core, depth 244ft.

9, 16-24 – *Reichelina lamarensis* Skinner and Wilde

9 KUMIP 2,506,949, equatorial section, ×64, Amoco #2 core, depth: 110.85-111.0ft;

16 KUMIP 2,506,950, axial section, ×64, Amoco #2 core, depth: 177.3-177.45ft;

17 KUMIP 2,506,951, equatorial section, ×64, Amoco #2 core, depth: 178.5-178.65ft;

18 KUMIP 2,506,952, axial section, ×64, Amoco #2 core, depth: 199.65-199.8ft;

19 KUMIP 2,506,953, axial section, ×64, Amoco #2 core, depth: 202.1-202.25ft;

20 KUMIP 2,506,954, equatorial section, ×64, Amoco #2 core, depth: 202.25-202.4ft;

21 KUMIP 2,506,955, axial section, ×64, Amoco #2 core, depth: 202.25-202.4ft;

22 KUMIP 2,506,956, axial section, ×64, Amoco #2 core, depth: 207.15-207.3ft;

23 KUMIP 2,506,957, axial section, ×64, Amoco #2 core, depth: 209.3-209.45ft;

24 KUMIP 2,506,958, axial section, ×64, Amoco #2 core, depth: 210.9-211.05ft.

10-15 – *Rauserella bengeensis* Wilde and Rudine

10 KUMIP 2,506,959, axial section, ×90, Amoco #2 core, depth: 144.2-144.35ft;

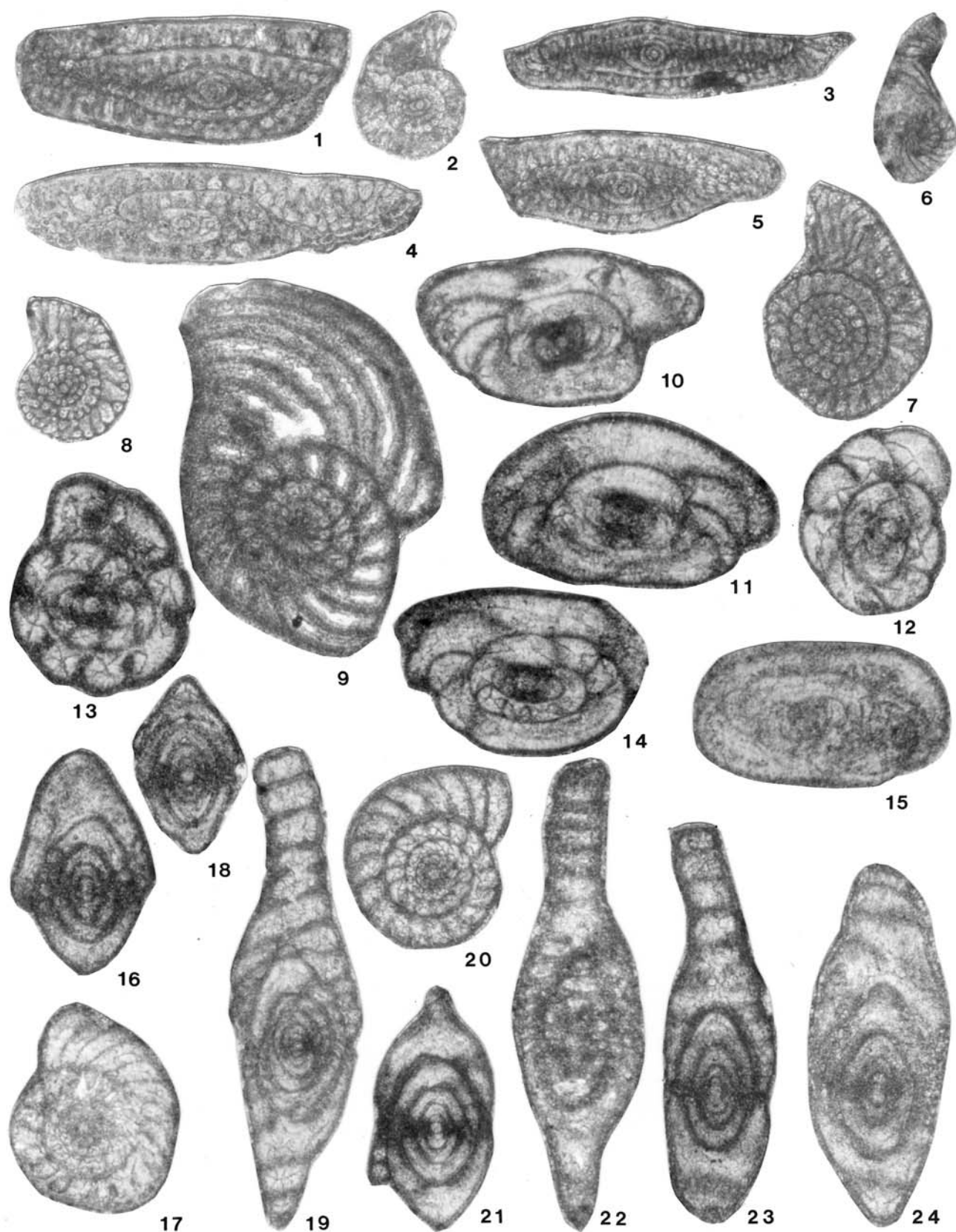
11 KUMIP 2,506,960, axial section, ×90, Amoco #2 core, depth: 144.2-144.35ft;

12 KUMIP 2,506,961, equatorial section, ×90, Amoco #2 core, depth: 145.85-146.0ft;

13 KUMIP 2,506,962, equatorial section, ×90, Amoco #2 core, depth: 145.85-146.0ft;

14 KUMIP 2,506,963, axial section, ×90, Amoco #2 core, depth: 145.85-146.0ft;

15 KUMIP 2,506,964, axial section, ×90, Amoco #2 core, depth: 145.85-146.0ft.



off at the top in the last volution. Spirotheca is very thin (from 0.008mm in the first volution to 0.021mm in the 6th), consists of tectum and diaphanotheca. Proloculus is minute, outside diameter is 0.061mm.

Discussion: As noted above in the discussion of *Paraboultonia*, Wilde and Rudine (2000) present a through discussion of the controversial status of the genus *Codonofusiella* with subgenus *Lantschichites*. We basically agree with their conclusions regarding the status of this form and do not feel that this paper is the proper place to discuss this problem further. Both of the specimens illustrated here appear to begin to uncoil in the last volution.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, illustrated specimens (pl. 8, fig. 2) from a depth of 44-45ft, and (pl. 8, fig. 7) from a depth of 172ft, Tansill Formation, Middle Permian (Capitanian).

Codonofusiella* cf. *C. paradoxica Dunbar and Skinner 1937
Plate 8, figure 1

Codonofusiella paradoxica DUNBAR and SKINNER 1937, p. 607-609, pl. 45, figs. 1-9. – SHENG 1963, p.47, pl. 6, figs. 21-24. – YANG and YANCEY 2000, p. 202, pl. 9-3, figs. 7-9.

Description: Only one specimen of this species with five volutions was noted in the cores. Length (L) 1.268mm, diameter (D) 0.812mm, L/D = 1.56. Wall thickness is from 0.004mm in the first volution to 0.021mm in the fifth volution, with tec-

tum and diaphanotheca. Septa are intensely fluted with high and narrow septal folds. Proloculus is tiny, 0.054mm. Tunnel is poorly developed in the first two normally coiled volutions.

Discussion: *Codonofusiella paradoxica* Dunbar and Skinner is a small form of this genus with a reduced flare. It is known from the Glass and Del Norte Mountains (Yang and Yancey 2000), and in the Chinati Mountains (Skinner 1940) to the south of the Guadalupe Mountains in West Texas. It has also been reported from the eastern Tethys in the Wujiaping Limestone, Guizhou Province, in China (Sheng 1963).

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, depth 44ft, Tansill Formation, Middle Permian (Capitanian).

Codonofusiella extensa Skinner and Wilde 1955
Plate 10, figures 10, 12, 16; Plate 11, figures 1, 3-5, 8-18

Codonofusiella extensa SKINNER and WILDE 1955, p. 930-934, pl. 89, fig. 10, pl. 90, figs. 1-5, pl. 91, figs. 1-6. – VACHARD et al. 1993b, pl. 6, figs. 18-21, pl. 7, figs. 1-9. – YANG and YANCEY 2000, p. 202, pl. 9-3, figs. 10.

Description: Test is small, with coiled inner part of four to five fusiform volutions and an uncoiled thin flare that expands laterally in a slightly concave manner along the entire test. The septa of the flare increase in length and do not reach back to the main part of the test in the later part of the flare. The coiling of the innermost volutions is often skewed to the later ones. Half width

PLATE 10

1-6 – *Reichelina lamarensis* Skinner and Wilde

- 1 KUMIP 2,506,965, axial section, ×64, Amoco #2 core, depth: 213.05-213.2ft;
- 2 KUMIP 2,506,966, axial section, ×64, Amoco #2 core, depth: 213.05-213.2ft;
- 3 KUMIP 2,506,967, axial section, ×64, Amoco #2 core, depth: 215.55-215.7ft;
- 4 KUMIP 2,506,968, axial section, ×64, Amoco #2 core, depth: 215.95-216.1ft;
- 5 KUMIP 2,506,969, axial section, ×64, Amoco #2 core, depth: 216.3-216.45ft;
- 6 KUMIP 2,506,970, equatorial section, ×64, Amoco #2 core, depth: 216.3-216.45ft.

7 – *Reichelina* sp., KUMIP 2,506,971, equatorial section, ×64, Amoco #2 core, depth: 322.75-322.9ft.

8-9 – *Paradoxiella pratti* Skinner and Wilde

- 8 KUMIP 2,506,972, oblique section, ×40, Amoco #2 core, depth: 330.1-330.25ft;
- 9 KUMIP 2,506,973, equatorial section, ×40, Amoco #2 core, depth: 330.5-330.65ft.

10, 12, 16 – *Codonofusiella extensa* Skinner and Wilde

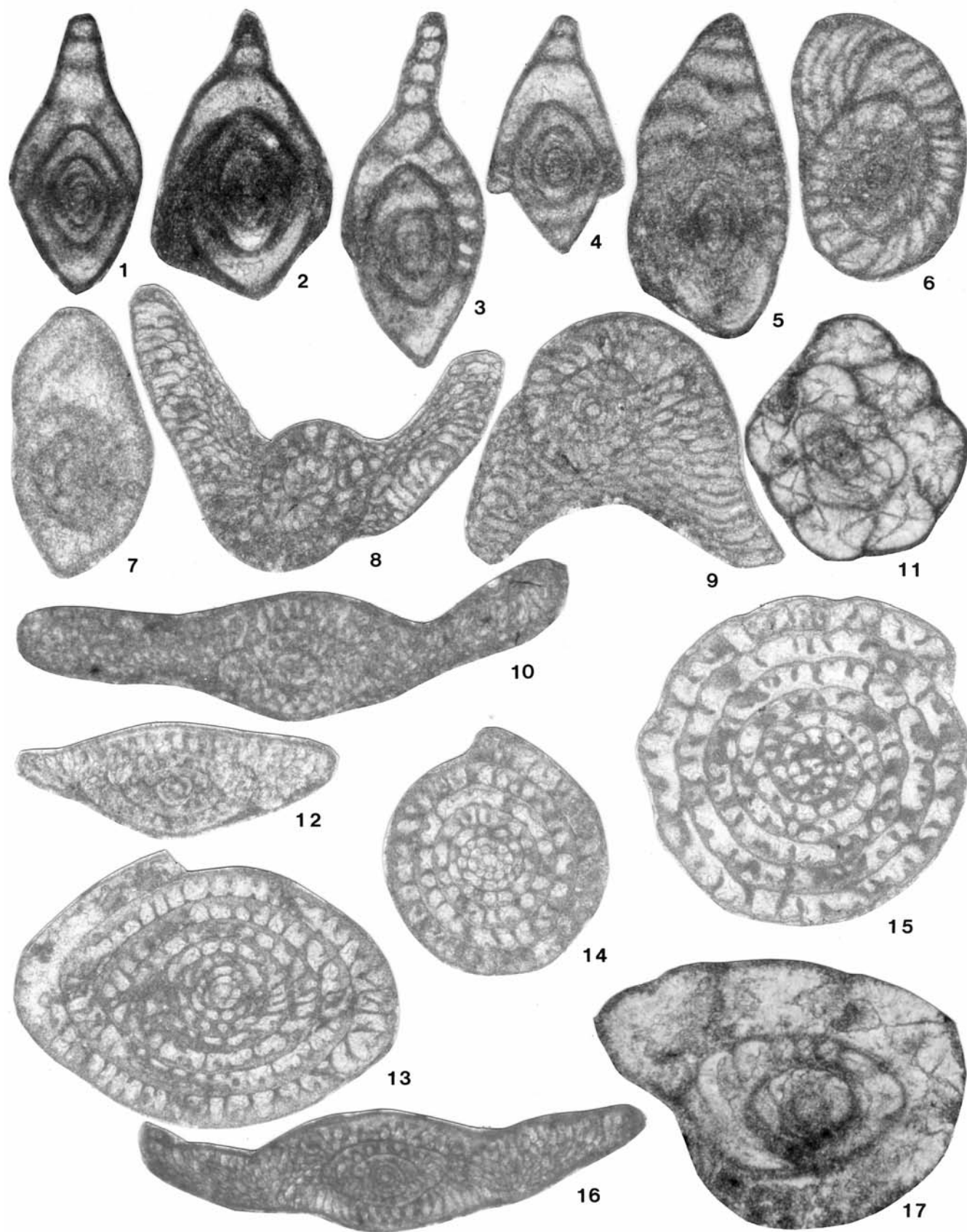
- 10 KUMIP 2,506,974, axial section, ×32, Amoco #2 core, depth: 333.0-333.15ft;
- 12 KUMIP 2,506,975, axial section, ×40, Amoco #2 core, depth: 390.05-390.2ft;
- 16 KUMIP 2,506,976, axial section, ×32, Amoco #2 core, depth: 423.5-423.9ft.

11, 17 – *Rauserella bengeensis* Wilde and Rudine

- 11 KUMIP 2,506,977, axial section, ×90, Amoco #2 core, depth: 372.95-373.1ft;
- 17 KUMIP 2,506,978, oblique equatorial section, ×90, Amoco #2 core, depth: 423.8-423.95ft.

13-15 – *Yabeina texana* Skinner and Wilde

- 13 KUMIP 2,506,979, oblique section, ×40, Amoco #2 core, depth: 391.55-391.7ft;
- 14 KUMIP 2,506,980, equatorial section, ×40, Amoco #2 core, depth: 392.5-392.65ft;
- 15 KUMIP 2,506,981, equatorial section showing development of axial septulae, ×40, Amoco #2 core, depth: 392.5-392.65ft.



ranges from 0.041mm in the first volution to 0.379mm in the unflared portion of the fifth volution. Half width of flared test (pl. 11, fig. 8) is 0.938mm. Half-length ranges from 0.036mm in the first volution to 1.562mm in the fifth or sixth volution. Spirotheca is thin, ranging from 0.006mm in the first volution to 0.022mm in the seventh volution, with a tectum and diaphanotheca. Septa are intensely fluted with high and narrow septal folds. Proloculus tiny, diameter ranges from 0.042mm to 0.076mm. Tunnel is narrow, bordered by weak chomata in the inner volutions.

Discussion: This distinctive species is very abundant in a few-meter interval of calcite spar grainstone in the Amoco #2 core just preceding the appearance of *Yabeina texana*.

It is difficult to assign poorly oriented specimens to this genus unless the flare is shown. It was originally described from the McCombs Limestone Member of the Bell Canyon Formation in a small exposure of this limestone near the mouth of McKittrick Canyon, Guadalupe Mountains, West Texas. It is also present in the basal Lamar Limestone in Bear Canyon at the type locality of *Yabeina texana*, where it occurs with this genus. It has also been reported from the Glass and Del Norte Mountains (Yang and Yancey 2000) and from near Olinalá in the Mexican state of Guerrero (Vachard et al. 1993b).

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, depth 420.0-434.45ft, upper part of the Yates Formation. This species is abundant in grainstone several meters thick in this interval that is immediately below quartz sandstone at the top of the Yates Formation in the core. Specimens possibly referable to this species also occur in the core as deep as 466ft and in the intervals 410-407ft, 396-387.5ft, 360-361ft, and 333ft.

Genus *Paradoxiella* Skinner and Wilde 1955

Paradoxiella pratti Skinner and Wilde 1955

Plate 10, figures 8, 9

Paradoxiella pratti SKINNER and WILDE 1955, p. 934-937, pl. 91, fig. 7-9, pl. 92, fig. 1-10, pl. 93, fig. 1.

Description: Test is small, almost disk-shaped with inflated center portion. The coiled part of the test typically consists of three volutions, followed by an uncoiled flare of two volutions that expands rapidly so that the chambers of the flare are extended laterally with sharply recurved ends that terminate against the test. Spirotheca is thin, consisting of a tectum and diaphanotheca. Thin septa are intensely fluted. The spherical proloculus is minute, about 50 microns. Tunnel is low, narrow, and bordered by weakly developed chomata in the coiled part of the test. Only one equatorial section (pl. 10, fig. 9) of four volutions is well oriented, width 1.449mm, diameter of

PLATE 11

1, 3-5, 8-18 – *Codonofusiella extensa* Skinner and Wilde

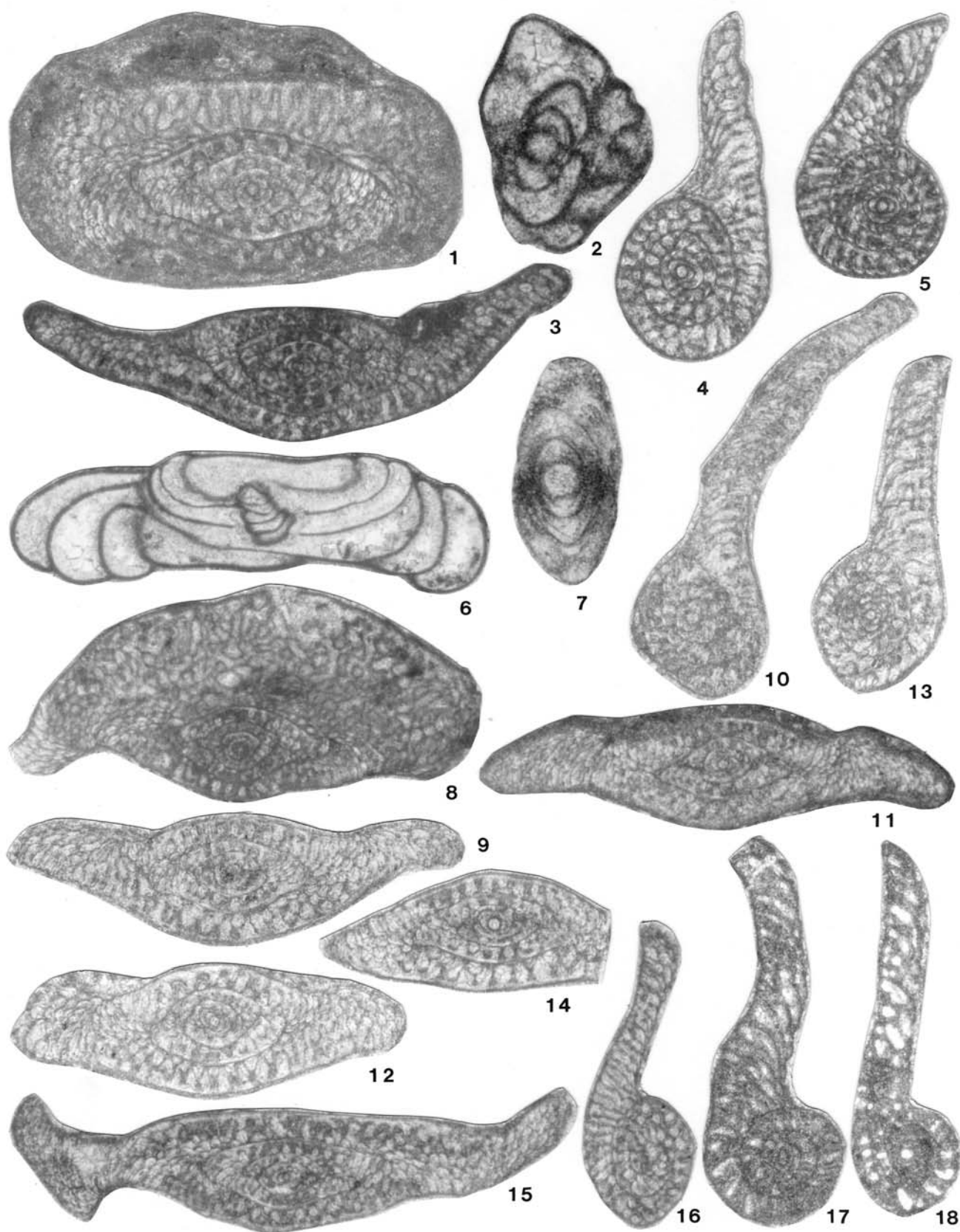
- 1 KUMIP 2,506,982, axial section, ×40, Amoco #2 core, depth: 423.9-424.6ft;
- 3 KUMIP 2,506,983, axial section, ×32, Amoco #2 core, depth: 424.8-425.2ft;
- 4 KUMIP 2,506,984, equatorial section, ×40, Amoco #2 core, depth: 424.8-425.2ft;
- 5 KUMIP 2,506,985, equatorial section, ×40, Amoco #2 core, depth: 425.2-426.0ft;
- 8 KUMIP 2,506,986, axial section, ×32, Amoco #2 core, depth: 426.7-428.0ft;
- 9 KUMIP 2,506,987, axial section, ×40, Amoco #2 core, depth: 427.4-427.55ft;
- 10 KUMIP 2,506,988, equatorial section, ×40, Amoco #2 core, depth: 427.4-427.55ft;
- 11 KUMIP 2,506,989, axial section, ×32, Amoco #2 core, depth: 428.4-428.55ft;
- 12 KUMIP 2,506,990, axial section, ×40, Amoco #2 core, depth: 428.4-428.55ft;

- 13 KUMIP 2,506,991, equatorial section, ×40, Amoco #2 core, depth: 428.75-428.9ft;
- 14 KUMIP 2,506,992, axial section, ×40, Amoco #2 core, depth: 431.05-431.2ft;
- 15 KUMIP 2,506,993, axial section, ×32, Amoco #2 core, depth: 431.05-431.2ft;
- 16 KUMIP 2,506,994, equatorial section, ×40, Amoco #2 core, depth: 431.05-431.2ft;
- 17 KUMIP 2,506,995, equatorial section, ×40, Amoco #2 core, depth: 434.3-434.45ft;
- 18 KUMIP 2,506,996, equatorial section, ×40, Amoco #2 core, depth: 434.3-434.45ft;

2, 7 – *Rauserella bengeensis* Wilde and Rudine

- 2 KUMIP 2,506,997, equatorial section, ×90, Amoco #2 core, depth: 424.35-424.5ft;
- 7 KUMIP 2,506,998, oblique section, ×90, Amoco #2 core, depth: 425.85-426.0ft.

6 – *Rauserella erratica* Dunbar, KUMIP 2,506,999, parallel axial section, ×32, Amoco #2 core, depth 425.2-426ft.



proloculus is 0.087mm, half widths are 0.074, 0.133, 0.249, and 0.567mm in the fourth volution, and wall thickness increases from 0.007mm in the first volution to 0.021mm in the fourth volution, septa 16 in the second volution to 25 in the third volution. The other section (pl. 10, fig. 8) is slightly oblique, of three volutions and with diameter 1.768mm.

Discussion: *Paradoxiella* was first described from a locality known as Buck Hill (located on private property), on the east side of the road into McKittrick Canyon in Guadalupe Mountains National Park. It is common in an interval from 15 to 30ft above the base of the Lamar Limestone Member of the Bell Canyon Formation. The genus *Paradoxiella* has also been reported in West Texas from the Glass Mountains and from "float" in the Apache Mountains (Wilde et al. 1999, p. 73, Wilde and Rudine 2000). It is also reported from the Tethys in the Akasaka Limestone (Sada and Skinner 1977), in reworked pebbles in the Kwanto Massif (Ishii and Takahashi 1960) in Japan, in the Akiyoshi Limestone Group, southwest Japan (Sakamoto et al. 2000), questionably (poorly oriented specimens) in an exotic block of Lamayuru, Himalayas (Ladakh) (Lys et al. 1980) and in Greece (Vachard et al. 1993c).

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, depth 258.55-248.5ft, middle Tansill Formation where it is common. Specimens referable to this genus are possibly present above and below this interval, but without seeing the distinctive recurved flare of the later volutions this species is difficult to differentiate from *Codonofusiella*.

Order STAFFELLIDA A. Miklukho-Maklay 1949 [nom. transl. Rauser-Chernousova in Rauser-Chernousova et al. 1996 ex Staffellinae A. Miklukho-Maklay 1949]

Family KAHLERINIDAE Leven 1963 [nom. transl. Rauser-Chernousova in Rauser-Chernousova et al. 1996 ex Kahlerininae Leven 1963]

Genus *Pseudokahlerina* Sosnina 1968

Pseudokahlerina capitanensis Nestell and Nestell, **n. sp.**
Plate 7, figures 23-27

Description: Test is disc-shaped, strongly compressed along the axis of coiling with straight or slightly compressed sides. Umbilical depressions are wide but not deep, periphery narrowly rounded. The ratio of length to width is 0.474 in the holotype. Initial chamber is small, spherical, its diameter 0.093mm. Spiral is narrow in the initial two volutions and rapidly increases in height in the following ones. Diameters of volutions (in mm): in the first 0.149, in the second 0.232, in the third 0.467 and the fourth 0.584. Wall in the initial volutions is thin and indistinct, 0.009mm in the first volution to 0.032mm in the 5th volution. Diaphanotheca porous and weakly developed. Septa are plane, thin in the initial volutions, straight and slightly curved, long, arcuate and curved, noticeably thickened at the ends. Chomata are indistinct.

Designation of types: The specimen illustrated on plate 7, figure 24 is designated as the holotype (KUMIP 2,506,921). It is from the Dark Canyon Amoco #1 core, depth 110ft, Tansill Formation, Middle Permian (Capitanian).

Etymology: From El Capitan Peak of the Guadalupe Mountains.

Material: Five axial sections.

Discussion: Specimens of the genus *Pseudokahlerina* are very similar to *Kahlerina* Kochansky-Devidé and Ramovs 1955 but are separated based on the external outline of the test, size, wall structure and weak development of chomata. *Kahlerina* has a small test with a thick wall of finely perforate structure and is compressed along the axis of coiling. However, *Pseudokahlerina* has a less massive test, strongly compressed along the axis of coiling, a thinner wall with less distinct perforate (porous) structure, a more rapidly untwisted spiral, and long arcuate and curved septa in the last volution.

Sosnina (1968) introduced the new genus *Pseudokahlerina* and described five new species from the late Midian (*Metadoliolina lepida* Zone) of the South Primorye. Chediya (in Kotlyar et al. 1989) described (based on one axial section) *Pseudokahlerina porrecta* from the Transcaucasia in the late Midian Khachik Horizon, the *Chusenella minuta* Zone, and Stevens et al. (1997) illustrated *Pseudokahlerina?* sp. as a tangential section. Our new species does not resemble these species and especially differs in the very irregular type of coiling in some specimens (juveniles) and the large proloculus.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #1 core, depth 128.15–110ft, Tansill Formation, Middle Permian (Capitanian).

Order NEOSCHWAGERININIDA Minato and Honjo 1966
Family NEOSCHWAGERINIDAE Dunbar and Condra 1927
[nom. transl. Dunbar in Cushman 1948 ex Neoschwagerininae Dunbar and Condra 1927]

Subfamily NEOSCHWAGERININAE Dunbar and Condra 1927

Genus *Yabeina* Deprat 1914

Yabeina texana Skinner and Wilde 1955
Plate 10, figures 13-15

Yabeina texana SKINNER and WILDE 1955, p. 937-940, pl. 93, fig. 2-4, pl. 94, fig. 1-4, pl. 95, fig. 1-4.

Description: Test is small, inflated, ellipsoidal, with 8-10 volutions in mature specimens, first two or three are sometimes skewed to the axis of coiling. Spirotheca is thin with tectum and finely alveolar keriotheca. Septa are irregularly spaced and generally curved. Parachomata are present throughout test, low and thick in inner whorls, and high and narrow in outer whorls. Pendent shaped primary transverse septula connect with the parachomata to form a box-like chamberlet with elliptical openings on the sides. One or two transverse secondary septula and up to four or five axial septula are present in mature tests. Proloculus is small and spherical. Three typical specimens of this genus are illustrated. Only one equatorial section (pl. 10, fig. 14) of seven volutions is well oriented, width 1.083mm, diameter of proloculus 0.073mm, half width of successive chambers 0.049, 0.102, 0.164, 0.234, 0.324, 0.424, and 0.548mm, wall thickness increases from 0.009mm in the first volution to 0.022mm in the seventh volution, septa increase from 8 in the first volution to 27 in the seventh volution. The slightly oblique axial section illustrated (pl. 10, fig. 13) of eight volutions has diameter of 1.238mm and length of 1.782mm, diameter of proloculus 0.098mm. The other equatorial specimen (pl. 10, fig. 15) of eight volutions has diameter of 1.533mm.

Discussion: *Yabeina texana* was originally described from Bear Canyon in what is now Guadalupe Mountains National Park, lo-

cated about 55 kilometers to the southwest of Dark Canyon. At the type locality it ranges through the basal 15ft of the Lamar Limestone Member of the Bell Canyon Formation. It has also been reported in the basal part of the Tansill Formation from the third spur northeast of McKittrick Canyon (Tyrrell 1962) and occurs in a surface outcrop in the base of the north wall of Dark Canyon at the base of the Tansill Formation about 1500 meters from the mouth of the canyon. The correlation of the basal Lamar Limestone Member in the forereef to the basal Tansill Formation in the backreef is based in part on the presence of this genus. We have also recently found this species in the Apache Mountains at Seven Heart Gap in the upper part of the Bell Canyon Formation in the top of a debris flow and about a meter below the stratum typicum of *Paraboultonia splendens*. Recently, a form identified as *Yabeina texana* was reported from the Akiyoshi Limestone Group in southwest Japan (Sakamoto et al. 2000), but in our opinion the forms illustrated in that paper as *Yabeina texana* and the conclusion of the authors that the fauna discussed is of Dzhulfian age are both questionable.

Occurrence: USA, New Mexico, Guadalupe Mountains, Dark Canyon, the Amoco #2 core, depth 387.5-396.5ft, basal part of Tansill Formation, and top of the Yates Formation at 399ft. This species is common to abundant in the noted interval and also in a similar interval in the base of the Tansill Formation in basal part of the outcrop in the north wall of Dark Canyon just to the south of the corehole.

CONCLUSIONS

Four new genera (*Tansillites*, *Pseudohemigordius*, *Vachardella*, and *Neoendothyranella*) and sixteen new species of foraminifers are described from late Guadalupian strata in the two Amoco cores in Dark Canyon. The small foraminifers present in the cores are diverse, but are represented mostly by what appear to be endemic forms with only a few species known from the Tethyan realm (e.g., South China, Transcaucasia, South Primorye, and Cambodia), and the Zechstein of Poland and the Baltic area, and Australia. Many of the fusulinacean species are also endemic with a few species known in the Tethyan realm, but most of them are known in North America in autochthonous late Guadalupian age rocks only in West Texas and Mexico. A few genera such as *Reichelina*, *Codonofusiella*, and *Yabeina* are also known from allochthonous rocks of the same age in accreted terranes of the Pacific Northwest.

None of the small foraminifers and fusulinaceans studied in the two Dark Canyon cores indicates to us a post-Guadalupian age for these strata and we do not agree with Wilde's suggestion that the *Paraboultonia* Zone is possibly Lopingian in age (Wilde et al. 1999, fig. 3). Lambert et al. (2002) recently established that the uppermost Guadalupian strata in the nearby Apache Mountains contain the conodont *Clarkina postbitteri hongshuiensis* where the last occurrence of the fusulinacean species *Paraboultonia splendens* is approximately 2m below the last occurrence of that conodont. Thus, within the current status of the placement of the uppermost Guadalupian boundary, the foraminifers in the Dark Canyon cores would be late middle Permian.

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and fusulinacean zonation of the Guadalupian of West Texas. Daniel Vachard (University of Lille), Greg Wahlman (BP America), Calvin Stevens (San Jose State University) and Michael Kaminski (University College London) made useful suggestions to improve the manuscript. We also thank Willis Tyrrell for his information on the occurrences of *Yabeina* in the Guadalupe Mountains Permian sections. Bruce Wardlaw aided in the construction of the Permian correlation chart.

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APPENDIX 1

A LIST OF THE DISTRIBUTION OF THE SMALL FORAMINIFERS IN AMOCO CORES

Tuberitina variabilis Nestell and Nestell, n. sp.: Amoco #1 core, depth: 46, 58, 64, 66, 68, 70, 72, 74, 76, 78, 80, 88, 92, 93.6, 98, 108, 110, 112, 166, 168, 170, 172, 174, 176, 178, 180, 184, 186, 188, 190.5, 194, 196, 198, 200, 202, 204, 208, 220, 222, 224, 226, 228, 230, 231.5, 235, 240, 242, 244, 246, 248, 250, 252, 254, 255.5, 260, 268, 270, 286, 344, 344.9, 348, 350, 354, 364, 366, 380, 386ft; Amoco #2 core, depth: 148.85-149.0, 216.3-216.45, 227.75-229.9, 228.5-228.65, 230.0-230.15, 230.85-231.0, 243.0-243.15, 243.85-244.0, 248.5-248.65, 249.85-250.0, 250.3-250.45, 251.2-251.35, 255.35-255.5, 256.05-256.21, 257.0-257.15, 257.95-258.1, 258.55-258.7, 293.6-293.75, 309.9-310.05, 318.35-318.5, 322.0-322.15, 337.4-337.5, 349.65-349.8, 354.7-354.85, 355.95-356.1, 375.0-375.15, 424.35-424.5, 425.25-425.4, 425.85-426.0, 427.1-427.25, 440.8-440.95, 453.25-453.4, 459.65-459.8, 462.55-462.7, 463.05-463.2, 463.65-463.8ft.

Haplophragmina? infrequens Nestell and Nestell, n. sp.: Amoco #2 core, depth: 314.05-314.2, 323.9-324.05, 324.55-324.7, 326.45-326.6, 327.3-327.45, 327.95-328.1, 329.05-329.2, 330.5-330.65, 331.9-332.05, 374.3-374.45, 423.8-423.95ft.

Pseudoammodiscus sp. 1: Amoco #1 core, depth: 154, 182, 192, 226ft.

Calcitornella sp.: Amoco #1 core, depth: 114, 230ft; Amoco #2 core, depth 124.95-125.1ft.

Calcivertella sp.: Amoco #1 core, depth: 146, 220, 254ft; Amoco #2 core, depth: 177.85-178.0, 178.3-178.45ft.

Tansillites anfractusus Nestell and Nestell, n. gen., n. sp.: Amoco #1 core, depth: 4, 46, 52, 68, 72, 76, 82, 88, 90, 92, 93.6, 98, 100, 102, 104, 106, 108, 112, 116, 118, 120, 122, 124, 126, 128, 130, 138, 140, 146, 148, 150, 174, 176, 218, 222, 226, 270ft; Amoco #2 core, depth: 129.0-129.15, 129.95-130.1, 145.1-145.25, 156.5-156.65, 177.3-177.45ft.

Palaeonubecularia marginata Nestell and Nestell, n. sp.: Amoco #1 core, depth: 10, 42, 44, 88, 90, 104, 108, 110, 112, 122, 138, 148, 166, 180, 184, 202, 244ft; Amoco #2 core, depth: 152.0-152.15, 154.25-154.4, 177.85-178.0, 210.0-210.15, 211.75-211.9, 213.05-213.2, 216.3-216.45, 464.05-464.2ft.

Pseudolituotuba (Pseudospira) sp. 1: Amoco #1 core, depth 154ft; Amoco #2 core, depth: 178.05-178.2, 178.3-178.45, 210.0-210.15, 326.45-326.6, 326.75-326.9ft.

Pseudohemigordius incredibilis Nestell and Nestell, n. gen., n. sp.: Amoco #1 core, depth: 4, 10, 32, 42, 44, 70, 72, 76, 78, 90, 92, 93.6, 98, 102, 104, 106, 108, 110, 112, 114, 118, 120, 122, 126, 138, 140, 146, 148, 152, 154, 156, 158, 160, 162, 166, 170, 172, 174, 176, 178, 180, 184, 186, 188, 190.5, 194, 196, 198, 200, 202, 204, 206, 208, 218, 220, 226, 228, 230, 231.5, 235, 240, 242, 244, 246, 248, 252, 255.5, 262ft; Amoco #2 core, depth: 119.55-119.7, 129.0-129.15, 129.45-129.6, 145.1-145.25, 145.85-146.0, 148.85-149.0, 150.8-150.95, 151.7-151.85, 153.6-153.75, 154.0-154.15, 155.5-155.65, 156.5-156.65, 156.95-157.1, 160.05-160.2, 177.1-177.25, 177.3-177.45, 177.45-177.6, 178.3-178.45, 182.8-182.95, 198.2-198.35, 199.65-199.8, 199.85-200.0, 200.65-200.8, 202.1-202.25, 202.25-202.4, 202.7-202.85, 203.0-203.15, 206.0-206.15, 208.25-208.4, 209.15-209.3, 209.3-209.45, 215.55-215.7, 216.3-216.45, 216.85-217.0, 240.4-240.55, 285.2-285.35, 309.9-310.05, 322.75-322.9, 323.5-323.65, 323.9-324.05, 324.2-324.35, 324.55-324.7, 325.95-326.1, 326.3-326.45, 326.45-326.6, 326.75-326.9, 327.95-328.1, 329.05-329.2, 329.75-329.9, 330.7-330.8, 331.9-332.05, 335.65-335.8, 342.45-342.6, 342.9-343.05, 351.85-352.0, 353.6-353.75, 354.7-354.85, 360.85-361.0, 362.0-362.15, 365.5-365.65, 370.95-371.1, 372.95-373.1, 373.6-373.75, 373.95-374.1, 374.3-374.45, 375.0-375.15, 375.8-375.95, 377.65-377.8, 378.0-378.15, 378.4-378.55, 378.7-378.85, 379.0-379.15, 390.05-390.2, 396.0-396.15, 409.2-409.35, 434.3-434.45, 447.4-447.55, 449.3-449.45, 453.25-453.4, 454.2-454.35, 463.65-463.8, 464.05-464.2, 468.5-468.65ft.

Baisalina americana Nestell and Nestell, n. sp.: Amoco #2 core, depth: 144.2-144.35, 148.65-148.8, 148.85-149.0, 149.25-149.4, 149.65-149.8, 150.8-150.95, 151.1-151.25, 151.7-151.85, 152.0-152.15, 152.75-152.9, 153.6-153.75, 154.0-154.15, 154.25-154.4, 155.5-155.65, 155.9-156.05, 156.15-165.3, 156.5-156.65, 156.95-157.1, 157.4-157.55, 160.05-160.2, 160.5-160.65, 163.9-164.05, 164.75-164.9, 165.25-165.4, 166.55-166.7, 174.0-174.15, 177.1-177.25, 177.3-177.45, 177.45-177.6, 177.6-177.75, 177.85-178.0, 178.05-178.2, 178.3-178.45, 178.5-178.65, 182.05-182.2, 183.35-183.5, 183.9-184.05, 196.25-196.4, 197.95-198.1, 198.2-198.35, 198.9-199.05, 199.65-199.8, 199.85-200.0, 200.65-200.8, 201.1-201.25, 201.5-201.65, 202.1-202.25, 202.25-202.4, 202.7-202.85, 203.0-203.15, 206.0-206.15, 208.25-208.4, 209.15-209.3, 209.3-209.45, 210.0-210.15, 210.9-211.05, 211.75-211.9, 212.85-213.0, 213.05-213.2, 213.7-213.85, 214.15-214.3, 214.65-214.8, 215.55-215.7, 215.95-216.1, 216.3-216.45ft.

Agathammina pusilla (Geinitz): Amoco #1 core, depth: 90, 92, 116, 128ft; Amoco #2 core, depth: 144.2-144.35, 149.25-149.4, 152.0-152.15, 177.6-177.75, 178.02-178.2, 183.9-184.05, 199.85-200.0, 231.75-231.9, 249.85-250.0, 250.3-250.45, 348.85-349.0ft.

Agathammina sp. 7: Amoco #2 core, depth 216.3-216.45ft.

Agathammina ex gr. *A. rosella* G. Pronina: Amoco #1 core, depth: 46, 88, 126, 230ft; Amoco #2 core, depth: 119.55-119.7, 139.8-139.95, 152.0-152.15, 153.6-153.75, 159.8-159.95, 160.35-160.5, 202.25-202.4ft.

Agathammina sp. 1: Amoco #1 core, depth: 98, 222, 246, 310.1ft; Amoco #2 core, depth: 145.1-145.25, 427.1-427.25, 440.8-440.95, 443.9-444.05, 453.1-453.25, 465.0-465.15ft.

Agathammina sp. 2: Amoco #1 core, depth: 208, 231.5ft.

Graecodiscus sp.: Amoco #1 core, depth: 154ft; Amoco #2 core, depth 215.95-216.1ft.

Graecodiscus praecursor Nestell and Nestell, n. sp.: Amoco #1 core, depth: 90, 120, 126ft; Amoco #2 core, depth 210.0-210.15ft.

Graecodiscus sp. 2: Amoco #2 core, depth: 144.2-144.35, 199.85-200.0, 394.85-395.0, 426.7-426.85, 427.1-427.25, 428.4-428.55, 428.75-428.9, 450.15-450.3, 462.55-462.7, 463.65-463.8, 465.0-465.15ft.

Nodosaria capitaneensis Nestell and Nestell, n. sp.: Amoco #1 core, depth: 90, 106, 112, 116, 126, 146, 166, 186, 204, 286ft; Amoco #2 core, depth: 338.4-338.5, 358.1-358.25, 373.95-374.1, 378.0-378.15, 381.0-381.15, 463.65-463.8ft.

Nodosaria cf. *N. novizkiana* Sosnina: Amoco #1 core, depth 341.9ft; Amoco #2 core, depth: 329.75-329.9, 354.7-354.85ft.

Nodosaria sp. 8: Amoco #2 core, depth: 231.75-231.9, 252.0-252.15ft.

Nodosaria ex gr. *N. grandecamerata* Sosnina: Amoco #1 core, depth 190.5ft.

Nodosaria cf. *N. partisana* Sosnina: Amoco #1 core, depth 310.1ft.

Polarisella lingulae Nestell and Nestell, n. sp.: Amoco #1 core, depth: 160, 172, 176, 178, 184, 186, 188, 192, 196, 208, 220, 228ft; Amoco #2 core, depth: 333.85-334.0, 347.65-347.8, 379.0-379.15ft.

Lingulina? sp.: Amoco #2 core, depth 221.7-221.85ft.

Rectoglandulina lepida (Wang): Amoco #2 core, depth: 155.0-155.15, 375.95-376.1ft.

Eomarginulinella sp. 1: Amoco #1 core, depth: 88, 110, 190.5, 242ft.

Eomarginulinella? sp.: Amoco #2 core, depth: 354.7-354.85, 358.95-359.1, 360.85-361.0, 363.75-363.9ft.

Calvezina sp. 1: Amoco #1 core, depth: 184, 226, 372ft.

Lingulonodosaria? sp.: Amoco #1 core, depth: 88, 150, 174ft.

Tauridia sp. 1: Amoco #2 core, depth: 324.2-324.35, 324.55-324.7, 332.75-332.9, 333.35-333.5, 343.5-343.65, 344.05-344.2, 347.65-347.8, 354.7-354.85ft.

Geinitzina aetheria Nestell and Nestell, n. sp.: Amoco #1 core, depth: 32, 50, 90, 102, 104, 128, 144, 166, 170, 172, 176, 180, 184, 186, 188, 190.5, 222, 226, 242ft; Amoco #2 core, depth: 178.3-178.45, 248.5-248.65, 249.85-250.0, 251.2-251.35, 334.35-334.5, 338.4-338.55, 365.5-365.65, 366.5-366.65, 373.6-373.75, 374.3-374.45, 375.95-376.1, 378.0-378.15, 392.5-392.65, 425.25-425.4ft.

Geinitzina sp. 4: Amoco #1 core, depth: 336.5, 344.9, 348, 372, 374, 378, 380, 382, 386, 394, 396ft.

Geinitzina sp. 1: Amoco #1 core, depth: 350, 356, 398ft.

Pachyphloia sp.: Amoco #2 core, depth: 343.5-343.65, 365.5-365.65, 366.5-366.65ft.

Robustopachyphloia? sp.: Amoco #2 core, depth 332.25-332.4ft.

Howchinella sp. 1: Amoco #2 core, depth 429.15-429.3ft.

Ichthyolaria sp. 1: Amoco #1 core, depth: 114, 128, 238, 255.5, 378ft.

Ichthyolaria sp. 2: Amoco #1 core, depth: 128, 166ft.

Tauridia sp. 3: Amoco #1 core, depth: 98, 126ft.

Tauridia sp. 2: Amoco #2 core, depth 453.1-453.25ft.

Tauridia sp. 4: Amoco #1 core, depth: 20, 46, 108, 192, 356, 398ft; Amoco #2 core, depth: 129.0-129.15, 160.5-160.65, 208.25-208.4ft.

Partisania sp.: Amoco #1 core, depth: 42, 54, 220ft.

Globivalvulina sp. 4: Amoco #2 core, depth: 124.95-125.1, 178.5-178.65, 213.05-213.2, 215.55-215.7, 222.85-223.0, 230.0-230.15, 233.85-234.0, 249.85-250.0, 250.3-250.45, 255.35-255.5, 257.0-257.15, 297.35-297.5ft.

Globivalvulina guadalupensis Nestell and Nestell, n. sp.: Amoco #2 core, depth: 224.8-224.95, 232.2-232.35, 251.2-251.35, 297.35-297.5, 298.0-298.15, 318.0-318.15, 324.7-324.85, 325.95-326.1, 330.5-330.65, 332.75-332.9, 333.0-333.15, 333.35-333.5, 333.85-334.0, 334.35-334.5, 335.65-335.8, 336.05-336.2, 336.35-336.5, 337.4-337.5, 340.2-340.3, 340.35-340.5, 340.5-340.65, 341.0-341.15, 342.45-342.6, 342.9-343.05, 343.5-343.65, 343.9-344.05, 344.05-344.2, 346.0-346.15, 346.85-347.0, 347.65-347.81, 348.65-348.8, 349.65-349.8, 350.85-351.0, 352.5-352.65, 352.8-352.95, 353.6-353.75, 354.7-354.85, 358.1-358.25, 358.95-359.1,

359.15-359.3, 360.85-361.0, 362.0-362.15, 375.0-375.15, 375.8-375.95, 375.95-376.1, 378.7-378.85, 382.8-382.95, 389.65-389.8, 390.95-391.1, 391.4-391.55, 391.55-391.7, 394.4-394.55, 394.85-395.0, 409.2-409.35, 426.7-426.85, 428.75-428.9, 429.15-429.3, 429.35-429.5, 430.05-430.2, 431.05-431.2, 431.5-431.65, 452.1-452.25, 455.1-455.25, 459.4-459.55, 461.7-461.85, 463.05-463.2ft.

Globivalvulina sp. 1: Amoco #1 core, depth: 66, 100, 128, 172, 218, 242, 350ft; Amoco #2 core, depth: 258.55-258.7, 297.6-297.75, 324.4-324.55, 329.75-329.9, 330.1-330.25, 330.7-330.8, 331.9-332.05, 336.05-336.2, 338.4-338.55, 342.9-343.05, 343.5-343.65, 348.85-349.0, 373.6-373.75ft.

Sengoerina pulchra Nestell and Nestell, n. sp.: Amoco #2 core, depth: 178.3-178.45, 232.2-232.35, 302.0-302.15, 318.0-318.15, 324.4-324.55, 344.05-344.2, 391.55-391.7, 407.35-407.5ft.

Dagmarita sp.: Amoco #2 core, depth 331.9-332.05ft.

Crescentia migrantis Nestell and Nestell, n. sp.: Amoco #2 core, depth: 199.85-200.0, 202.25-202.4, 213.7-213.85, 221.7-221.85, 293.6-293.75, 303.5-303.65, 322.75-322.9, 323.5-323.65, 323.9-324.05, 324.4-324.55, 324.55-324.7, 326.3-326.45, 326.45-326.6, 327.3-327.45, 392.5-392.65ft.

Endothyra sp.: Amoco #2 core, depth 178.3-178.45ft.

Vachardella longiuscula Nestell and Nestell, n. gen., n. sp.: Amoco #1 core, depth: 66, 72, 88, 92, 104, 110, 112, 122, 126, 128, 140, 146, 148, 154, 158, 184, 190.5, 192, 204, 220, 254, 366ft; Amoco #2 core, depth: 197.95-198.1, 198.2-198.35, 199.85-200.0, 213.05-213.2, 213.4-213.55, 232.2-232.35, 257.95-258.1, 285.2-285.35, 297.35-297.5, 298.0-298.15, 312.75-312.9, 323.5-323.65, 323.9-324.05, 324.2-324.35, 324.4-324.55, 324.55-324.7, 326.3-326.45, 326.45-326.6, 332.25-332.4, 332.75-332.9, 347.65-347.8, 352.0-352.15, 354.7-354.85, 363.9-364.05, 365.5-365.65, 373.95-374.1, 375.0-375.15, 375.95-376.1, 377.65-377.8, 379.0-379.15, 389.35-389.5, 389.65-389.8, 407.35-407.5, 423.8-423.95ft.

Vachardella sp. 1: Amoco #2 core, depth 298.0-298.15ft.

Neoendothyranella wildei Nestell and Nestell, n. gen., n. sp.: Amoco #1 core, depth: 22, 26, 36, 88, 90, 92, 98, 104, 108, 124, 126, 134, 138, 140, 144, 146, 148, 152, 158, 162, 166, 168, 170, 172, 180, 184, 188, 192, 196, 198, 208, 220, 222, 230, 231.5, 240ft; Amoco #2 core, depth: 148.85-149.0, 317.75-317.9, 342.45-342.6, 349.65-349.8, 377.65-377.8, 425.85-426.0, 427.1-427.25, 427.4-427.55, 427.8-427.95, 429.15-429.3, 430.05-430.2, 449.15-449.3, 462.55-462.7, 463.05-463.2ft.

Abadehella ex gr. *A. coniformis* Okimura and Ishii: Amoco #1 core, depth 38ft; Amoco #2 core, depth: 197.95-198.1, 198.2-198.35, 199.85-200.0, 201.1-201.25, 202.1-202.25, 202.25-202.4, 202.7-202.85, 208.25-208.4, 215.95-216.1, 322.0-322.15, 322.75-322.9, 323.5-323.65, 323.9-324.05, 327.95-328.1, 329.75-329.9, 338.4-338.55, 340.5-340.65, 341.0-341.15, 347.65-347.8, 348.65-348.8, 348.85-349.0, 350.85-351.0, 360.85-361.0, 362.9-363.05, 363.9-364.05, 365.5-365.65, 366.5-366.65, 370.95-371.1, 371.85-372.0, 372.95-373.1, 373.6-373.75, 374.3-374.45, 375.0-375.15, 375.95-376.1, 377.65-377.8, 378.0-378.15, 378.4-378.55, 378.7-378.85, 379.0-379.15, 380.4-380.55, 380.55-380.7, 380.85-381.0, 381.55-381.7, 384.95-385.1, 388.0-388.15, 391.4-391.55, 392.5-392.65, 394.4-394.55, 394.85-395.0, 427.1-427.25, 427.8-427.95, 453.25-453.4, 459.4-459.55ft.

Abadehella sp. 2: Amoco #1 core, depth: 4, 38, 100, 122, 132, 138, 156, 158, 170, 174, 180, 182, 190.5, 202, 204, 206, 208, 220, 222, 224, 231.5, 235, 242, 252, 260, 286, 360ft; Amoco #2 core, depth: 144.2-144.35, 325.95-326.1, 326.75-326.9, 330.5-330.65, 344.05-344.2, 346.85-347.0ft.

Spireitlina sp.: Amoco #1 core, depth: 66, 148ft; Amoco #2 core, depth 465.0-465.15ft.

Spireitlina sp. 2: Amoco #2 core, depth: 216.85-217.0, 324.55-324.7, 333.35-333.5, 336.05-336.2, 351.85-352.0, 352.5-352.65, 354.7-354.85, 363.75-363.9, 373.6-373.75ft.

Spireitlina? sp.: Amoco #2 core, depth 358.1-358.25ft.

Deckerella sp.: Amoco #1 core, depth: 126, 152, 156, 158, 160, 172, 180, 188, 192, 222, 228, 230, 254, 255.5, 282, 298ft; Amoco #2 core, depth 374.3-374.45ft.

Aschemonella sp.: Amoco #1 core, depth: 10, 126, 224, 228, 230, 231.5, 238ft.

APPENDIX 2

A LIST OF DESCRIBED TAXA

Tuberitina variabilis Nestell and Nestell, n. sp.
Plate 1, figs. 1-10

Haplophragmina? infrequens Nestell and Nestell, n. sp.
Plate 1, figs. 11-13

Tansillites Nestell and Nestell, n. gen.

Tansillites anfractuosus Nestell and Nestell, n. sp.
Plate 1, figs. 26-29; Plate 2, figs. 1-5

Palaeonubecularia marginata Nestell and Nestell, n. sp.
Plate 2, figs. 6-8

Pseudohemigordius Nestell and Nestell, n. gen.

Pseudohemigordius incredibilis Nestell and Nestell, n. sp.
Plate 2, figs. 12-27

Baisalina americana Nestell and Nestell, n. sp.
Plate 2, figs. 28-36

Agathammina pusilla (Geinitz 1848)
Plate 3, figs. 1-5

Graecodiscus praecursor Nestell and Nestell, n. sp.
Plate 4, figs. 1-2

Nodosaria capitanensis Nestell and Nestell, n. sp.
Plate 4, figs. 4-6

Polarisella lingulae Nestell and Nestell, n. sp.
Plate 4, fig. 13

Geinitzina aetheria Nestell and Nestell, n. sp.
Plate 4, figs. 26-31

Globivalvulina guadalupensis Nestell and Nestell, n. sp.
Plate 5, figs. 14-25

Sengoerina pulchra Nestell and Nestell, n. sp.
Plate 6, figs. 3-6

Crescentia migrantis Nestell and Nestell, n. sp.
Plate 6, figs. 7-12

Vachardella Nestell and Nestell, n. gen.

Vachardella longiuscula Nestell and Nestell, n. sp.
Plate 1, figs. 14-19

Neoendothyranella Nestell and Nestell, n. gen.

Neoendothyranella wildei Nestell and Nestell, n. sp.
Plate 6, figs. 14-22

Reichelina lamarensis Skinner and Wilde 1955
Plate 9, figs. 16-24; Plate 10, figs. 1-6

R. aff. R. changhsingensis Sheng and Chang 1958
Plate 8, fig. 16, Plate 9, fig. 6

Parareichelina sp.
Plate 8, fig. 8

Rauserella erratica Dunbar 1944
Plate 8, fig. 4, Plate 11, fig. 6

Rauserella bengeensis Wilde and Rudine 2000
Plate 9, figs. 10-15; Plate 10, figs. 11, 17; Plate 11, figs. 2, 7

Paraboultonia splendens Skinner and Wilde 1955
Plate 8, figs. 3, 5, 6, 9-15; Plate 9, figs. 1-5, 7, 8

Codonofusiella (Lantschichites) altudaensis Wilde and Rudine 2000
Plate 8, figs. 2, 7

C. cf. C. paradoxica Dunbar and Skinner 1937
Plate 8, fig. 1

C. extensa Skinner and Wilde 1955
Plate 10, figs. 10, 12, 16; Plate 11, figs. 1, 3-5, 8-18

Paradoxiella pratti Skinner and Wilde 1955
Plate 10, figs. 8, 9

Pseudokahlerina capitanensis Nestell and Nestell, n. sp.
Plate 7, figs. 23-27

Yabeina texana Skinner and Wilde 1955
Plate 10, figs. 13-15