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THE FUSULINID GENERA *POLYDIOXODINA* AND
SKINNERINA

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ABSTRACT

The fusulinids which have been assigned to the genera *Polydiexodina* DUNBAR & SKINNER and *Skinnerina* ROSS are discussed, and it is concluded that the Asiatic species assigned to *Polydiexodina* do not properly belong to that genus. They display certain differences with *Skinnerina* which make their assignment to that genus questionable, as well. Three species of *Skinnerina*, two of them new, are described from the Apache Mountains, Culberson County, Texas.

INTRODUCTION

The fusulinid genus *Polydiexodina* was first described by DUNBAR & SKINNER (1931), with *P. capitanensis* as the type-species. In the same paper a second species, *P. shumardi*, was also described. Since that time nineteen additional species and one variety have been assigned to that genus; one of the species was so assigned with question. Of this number, in addition to the two original species, only two others, *P. mexicana* DUNBAR and *P. oregonensis* BOSTWICK & NESTELL, now appear actually to belong to *Polydiexodina*; all four are known only from North America. Of the remaining 17 species and one variety, all but one species were described from various parts of Asia. The exception was found in west Texas.

Polydiexodina capitanensis, *P. shumardi*, and *P. mexicana* were obtained from beds of known late Guadalupian age; *P. oregonensis* was found in a cobble of light-colored, sandy limestone believed to have been derived from a Triassic conglomerate which crops out nearby. The evolutionary development of this last species is comparable to that of the first three, and it is believed to be essentially the same in age. No other fossils are associated in the cobble with *P. oregonensis*, nor has this limestone been found *in situ* in central Oregon.

KAHLER (1933) described the first of the Asiatic species to be assigned to *Polydiexodina*, *P. persica*, from Darreh-Duzden in Iran. It is elongate cylindrical in shape, with a length of about 24 mm, and has multiple tunnels. In KAHLER's illustrations, however, no well-defined median tunnel can be seen.

DUNBAR & SKINNER (1937) described an unusual fusulinid from the Apache Mountains, Culberson County, Texas, as *Polydiexodina? rotundata*. The material with which they were working consisted of a small chip of limestone which yielded only three specimens. Moreover, the exact locality and stratigraphic level from which it had been derived were uncertain. The piece of limestone had been collected, along with several others, by Mr. V. C. MALEY in the course of a traverse along the ridge of a north-south trending fault block at the northwest end of the Apache Mountains in southern Culberson County. The beds in this fault block, which is separated from the main part of the mountains by an alluvial valley, dip northwest, so the exposures along the ridge are progressively younger to the north. The southern part of the ridge is about 2.5 miles long, and it is cut by several cross faults near its northern end. To the north of this

is a gap in which there are several low, isolated hills, after which the ridge continues northward. At the extreme southern end the ridge is composed of late Leonardian Victorio Peak Limestone, whereas the extreme northern end is occupied by upper Guadalupian Capitan Limestone. The southern part of the ridge lies to the west of the old, now-abandoned, Jones Ranch house. MALEY, in the course of his traverse, had collected several small pieces of fossiliferous limestone of diverse lithology, and all had been placed in a single container labelled, "ridge west of Jones Ranch house, Apache Mountains." Since they had been collected over a distance of some two miles and from several stratigraphic levels, there was no way of determining the exact source of any particular piece. Nevertheless, DUNBAR & SKINNER considered the species to be so unusual as to warrant describing and naming it.

It most nearly resembles the genus *Polydiexodina* in that it possesses intensely fluted septa, well-developed cuniculi, and multiple tunnels. It differs from typical species of that genus, however, in that it has no well-defined median tunnel, its supplementary tunnels are sporadic in their development and occurrence, and its shape is thickly fusiform and short. Typical *Polydiexodina*, by contrast, has a well-defined central tunnel, its supplementary tunnels are regularly arranged and, once they appear,

continuous into the outer whorls, and its shape is elongate cylindrical. For these reasons they assigned their new species to *Polydiexodina* with question. From its evolutionary development they concluded that it was probably early Guadalupian in age.

During the next several years a number of unsuccessful efforts were made to find and collect more of this material, but it was not until 1946 that the zone was discovered near the north end of the southern portion of the ridge. This locality (Fig. 1) is approximately two miles north-northwest of the Jones Ranch house, at the point at which the ranch road makes its closest approach to the east foot of the ridge. At this place the gently sloping surface, in front of the escarpment and immediately west of the road, exposes the top of the Victorio Peak Limestone which here weathers light gray, nearly white, and is crowded with the shells of rather large species of *Parafusulina*. The latter, unfortunately, have been somewhat crushed and partially recrystallized, so their preservation is poor. A few feet above the Victorio Peak, near the base of the ridge, the zone of *Polydiexodina? rotundata* is exposed. It consists of several beds, one to two feet in thickness, of cherty, tan to light brown limestone. Overlying this zone is a covered interval, about 50 feet thick, which is capped by a massive, locally cliff-forming limestone. Two



FIG. 1. View westward toward *Skinnerina* locality, Apache Mountains. Collections T-410 and T-535 were made at point marked X.

collections, T-410 and T-535, were made from the zone at this locality, and the specimens illustrated in the present paper were obtained from these collections.

NEEDHAM (1937) described *Polydiexodina guadalupensis* from the Guadalupe Mountains in west Texas, but his species is synonymous with *P. shumardi* DUNBAR & SKINNER.

DUTKEVICH (in LICHAREW, 1939) described *Polydiexodina darwasica* from the Darwas series of Darwas in Asia. Like *P. persica*, and unlike the Texas species, it has no persistent median tunnel.

ERK (1942) described *Polydiexodina bithynica* and *P. diskayaensis* from the Bursa region in northwestern Turkey. Both species, like *P. capitansensis* and *P. shumardi*, are large and elongate cylindrical in shape and possess multiple tunnels. Unlike the west Texas species, however, no definite median tunnel is apparent. ERK illustrated several microspheric specimens in which the tunnels are retained. By contrast, in microspheric specimens of *P. capitansensis* and *P. shumardi* no tunnels are present outside the juvenarium. These Turkish species are associated with the genera *Sumatrana*, *Reichelina*, and *Codonofusiella* and with a species which ERK described as *Paraschwagerina sera*. This last form is probably congeneric with *Rugoschwagerina yabei* (VON STAFF) which occurs in Sicily with *Schwagerina*, *Yangchienia*, *Verbeekina*, *Neoschwagerina*, *Sumatrana*, and *Kahlerina*, accompanied by a lower Guadalupian ammonoid fauna. The Turkish forms are underlain by beds containing *Yangchienia*, *Neoschwagerina*, and *Cancellina*.

DUNBAR (1944) described *Polydiexodina mexicana* from high in the Guadalupian sequence at Las Delicias, Coahuila, Mexico. Both *P. capitansensis* and *P. shumardi* occur lower in the same section. It is a typical representative of the genus, with a well-defined median tunnel and with multiple tunnels which, once they appear, continue into the later whorls.

THOMPSON (1946), working with material collected by the late Dr. H. G. SCHENCK from the Bamian Limestone just west of Shibar Pass in Afghanistan, described *Polydiexodina afghanensis*. Although it has multiple tunnels, it resembles *P. persica* and *P. darwasica* in having no definite median tunnel. THOMPSON illustrated one tan-

gential section of a microspheric specimen which appears to have a number of narrow supplementary tunnels. I have some of this same material, a gift from Dr. SCHENCK, and my thin sections show the normal shape of this species to be elongate fusiform rather than subcylindrical. The supplementary tunnels are sporadic in their occurrence, rarely continuing for more than two successive whorls. THOMPSON referred the form which HAYDEN (1909) had assigned to *Fusulina elongata* SHUMARD to this species with question. While it seems probable that HAYDEN's material included specimens of *P. afghanensis*, the ones which he illustrated are markedly more slender and elongate, although they are certainly congeneric with THOMPSON's species. *P. afghanensis* occurs in the same piece of rock with the genera *Yangchienia*, *Schwagerina*, *Parafusulina*, *Neoschwagerina*, and *Afghanella*. Another collection from the Shibar Pass area contains a more slender, elongate species which closely resembles the one illustrated by HAYDEN. It is associated with the genera *Yangchienia*, *Schwagerina*, *Parafusulina*, *Chusenella*, *Misellina*, *Cancellina*, and *Neoschwagerina*.

DOUGLAS (1950) described a fusulinid fauna from Iranian Baluchistan, including a species which he identified as *Polydiexodina persica* KAHLER. Unfortunately, it was not associated with other fusulinids and its stratigraphic position, because of faulting, was uncertain. It, too, lacks a median tunnel.

TUMANSKAYA (1952) described three species from the Crimea as *Polydiexodina polae*, *P. crimea*, and *P. vediensis*. These are all elongate forms and none has a definite median tunnel. All have supplementary tunnels.

SHENG (1962) described *Polydiexodina tungluensis*, *P. chekiangensis*, and *P. chekiangensis* var. *lengwuensis*¹ from the uppermost part of the Tingchiashan Formation in a quarry at the village of Lengwu in Tunglu County, western Chekiang Province, China. *P. tungluensis* is elongate, slender fusiform in shape, has a rather wide median tunnel, and appears to lack supplementary tunnels. Its general appearance is that of an elongate species of *Chusenella*. *P. chekiangensis* and its variety *lengwuensis*, by contrast, have no median tunnel but do have sporadic supplementary tunnels. All three occur together and

¹ Names proposed after 1960 for a "variety" are not available under Art. 15 of the International Code of Zoological Nomenclature.

are associated with *Reichelina? changanchiaoensis* SHENG & WANG, *Codonofusiella schubertelloides* SHENG, *Codonofusiella* sp., *Minojapanella minuta* SHENG, and *Kahlerina sinensis* SHENG. Presence of *Codonofusiella* would seem to suggest a late Guadalupian age, but DOUGLASS (1970) has shown that in the Salt Range of West Pakistan this genus appears in the Lower Productus Limestone of Leonardian age. Thus, it may be expected in older beds in Asia than in North America. This conforms with the presence of *Codonofusiella* in association with the Turkish species described by ERK as noted above.

LLOYD (1963), described two species, *Polydiexodina praecursor* and *P. douglasi*. The first came from the Zinnar Formation of northern Iraq, and the second from Galleh Shu, Iran. The latter is based on the specimens assigned by DOUGLAS (1950) to *P. persica* KAHLER. Associated with *P. praecursor*, which LLOYD considered to be Lower Permian, are two species which he assigned to *Pseudoschwagerina*. The first, which he named *Pseudoschwagerina contorta* LLOYD, is represented by three imperfectly oriented sections, none of which cuts the proloculus. The second, which LLOYD called *Pseudoschwagerina* cf. *P. fusiformis* (KROTOW), is illustrated by ten randomly oriented sections. Again, none of these intersects the proloculus, but several cut the juvenarium deeply enough to indicate that the initial chamber is very small. According to LLOYD, M. L. THOMPSON (personal communication) expressed the opinion that this species should be assigned to *Rugoschwagerina*, a genus which is associated in Sicily with a lower Guadalupian ammonoid fauna. *Polydiexodina praecursor* has an elongate subcylindrical shape, as does *P. douglasi*. Both have sporadic supplementary tunnels but no median tunnel.

BOSTWICK & NESTELL (1965) described *Polydiexodina oregonensis* from the Suplee area in east-central Oregon. Their specimens came from a boulder of sandy limestone thought to have been derived from a Triassic conglomerate which crops out nearby. *P. oregonensis* is a typical member of the genus, having an elongate cylindrical shape, a well-defined median tunnel, and persistent supplementary tunnels. No other fusulinids are present in the rock which so far has not been found *in situ*.

LEVEN (1967) described three species from the

Pamir section which he assigned to *Polydiexodina*. Two of them, *P. zulumartensis* and *P. megasphaerica*, were new; the third he identified with THOMPSON's *P. afghanensis*. *P. zulumartensis* is subcylindrical in shape, whereas the other two are elongate fusiform. All three lack a median tunnel, but have sporadic supplementary tunnels. In addition, LEVEN referred to *Polydiexodina pamirica*, *P. shabalkini*, and *P. panfilovae*, but I have not seen a description or photographs of these species so I am unable to comment on their affinities.

Meanwhile, ROSS (1964) erected the new genus *Skinnerina*, with *S. typicalis* ROSS as the type-species. It is rather thickly fusiform in shape, has no persistent median tunnel, and has sporadic, discontinuous supplementary tunnels. His material came from the Road Canyon Formation (Word limestone one of earlier reports) at a locality northwest of Dugout Mountain in the Glass Mountains, Brewster County, Texas, and from a slightly higher zone in the basal Word Formation (restricted) in Gilliland Canyon, also in the Glass Mountains. I have found similar specimens at about the same level as his second locality on the southeast flank of Sullivan Peak, about midway between his two localities. At the localities in Gilliland Canyon and on Sullivan Peak rare specimens of *Rauserella* are present; numerous specimens of *Parafusulina* are associated with *Skinnerina* at all three places.

A comparison of all these species indicates that they can be divided into three major groups:

- 1) True *Polydiexodina*, represented by *P. capitanensis*, *P. shumardi*, *P. mexicana*, and *P. oregonensis*, which are large and elongate subcylindrical in shape. It possesses a well-defined median tunnel and persistent, more or less regularly arranged supplementary tunnels. Septal folds are narrow and septal loops, as seen in axial sections, are rounded across the tops and are commonly only about one-half as high as the chambers. Secondary deposits are largely confined to a zone along the axis of coiling. Microspheric specimens are giants and have no tunnels outside the juvenarium, in these respects resembling similar microspheric individuals of *Parafusulina* (*Parafusulina*), the immediate ancestor of *Polydiexodina*.
- 2) *Skinnerina*, represented by three west Texas

species, two of which are described here for the first time, which are moderate in size and subcylindrical to fusiform in shape. It has no well-defined median tunnel, and the supplementary tunnels are sporadic and discontinuous. Septal loops, as seen in axial sections, are high and commonly squared off across the tops rather than being rounded. This is particularly true in the middle portion of the shell. Secondary deposits are widely distributed throughout the shell and commonly cause the tops of septal loops to appear greatly thickened. Microspheric specimens tend to be more slender in proportions and somewhat longer than their megalospheric counterparts, and the tunnels are retained. In the septal characters, distribution of secondary deposits, relatively small microspheric specimens, and retention of tunnels in the microspheric form *Skinnerina* resembles *Parafusulina* (*Skinnerella*), its probable immediate ancestor.

- 3) The third group is represented by the Asiatic species which have been assigned to *Polydiexodina*. These species are large and vary from elongate fusiform to elongate subcylindrical in shape, approaching *Polydiexodina* in these respects. Like *Skinnerina*, they have no well-defined median tunnel and their supplementary tunnels are sporadic and discontinuous. The nature of their

septal loops and the distribution of secondary deposits are the same as in *Skinnerina*. The microspheric specimens, like those of *Skinnerina*, are somewhat larger than their megalospheric counterparts, but not greatly so, and the tunnels are retained. The principal differences from *Skinnerina* are in size and shape. Whether or not these differences are sufficient to warrant placing them in a separate genus, or subgenus, is open to question. They are probably slightly younger than the west Texas species of *Skinnerina* since associated fusulinid genera are found in Sicily with an ammonoid fauna very similar to that of the middle and upper parts of the Word Formation of the Glass Mountains. It is not believed that this group is ancestral to true *Polydiexodina*, but that it represents the end point of a separate evolutionary branch which began in late Wolfcampian or early Leonardian time with species of *Schwagerina* such as *S. crassitectoria* and *S. guembeli*. This line developed progressively through *Parafusulina* (*Skinnerella*) and *Skinnerina* to the large Asiatic species.

I wish to thank the Humble Oil & Refining Company for permission to publish this paper.

All figured specimens are deposited in the collections of the Kansas University Museum of Invertebrate Paleontology, Lawrence, Kansas.

SYSTEMATIC PALEONTOLOGY

Family FUSULINIDAE von Möller, 1878

Subfamily SCHWAGERININAE Dunbar & Henbest, 1930

Genus SKINNERINA Ross, 1964, emend.
Skinner

ORIGINAL DIAGNOSIS.—“Tests are thickly fusiform with multiple tunnels and with thick secondary deposits coating the septal folds. Two well developed tunnels are most common in the outer two or three volutions of these tests. However, tunnels may be lacking or irregularly displayed in the early volutions and one to four irregular tunnels may appear sporadically throughout the test. Cuniculi are high and well developed where

opposing folds of adjacent septa have been resorbed at their junctions. The septal folds are commonly low and have straight sides and flattened or rounded crests. Thick secondary deposits coat the septa but are thin or lacking on the floor of the chambers.

“The spiral wall is composed of a tectum and a keriotheca and is thin in early volutions. It increases in thickness in the outer two or three volutions as a result of thickening of the keriotheca, which becomes coarsely alveolar.

“Type-species.—*Skinnerina typicalis* Ross, n. sp.”

DISCUSSION.—At first glance, *Skinnerina typicalis* Ross appears to be quite distinct from the

axial section figured as the holotype of *Polydiexodina? rotundata* DUNBAR & SKINNER. But, as those authors mentioned, their holotype specimen had suffered an accident which broke off both ends of the shell after the formation of the sixth volution. Thereafter, the individual continued to live and added three more whorls which, while growing normally in diameter, grew very little in the axial direction. The result was an abnormally short specimen of stubby proportions. A comparison of the uninjured volutions

with the corresponding whorls of the holotype of *S. typicalis* Ross shows a close agreement between the two specimens. Furthermore, a large number of specimens from the type locality of *P. rotundata* are unquestionably conspecific with the holotype of *S. typicalis*. Under the circumstances, there seems to be little doubt that *Skinnerina typicalis* Ross is a synonym of *Polydiexodina? rotundata* DUNBAR & SKINNER, and the type-species of *Skinnerina* is *Polydiexodina? rotundata* DUNBAR & SKINNER (= *Skinnerina typicalis* Ross).

EXPLANATION OF PLATES

All figures are unretouched photographs. Specimen catalogue numbers are assigned in KUMIP (Kansas University Museum of Invertebrate Paleontology).

FIGURE

PLATE 1

- 1-8. *Skinnerina rotundata* (DUNBAR & SKINNER). —1-4. Axial sections of topotypes, $\times 10$. —5-8. Sagittal sections of topotypes, $\times 10$. 1, 2, 5-8 from collection T-410; 3, 4 from collection T-535. (Fig. 1-8, KUMIP 2,503,401-8.)

FIGURE

PLATE 2

- 1-5. *Skinnerina rotundata* (DUNBAR & SKINNER). —1-3. Axial sections of microspheric topotypes, $\times 10$. —4-5. Sagittal sections of microspheric topotypes, $\times 10$. 1-3 from collection T-410; 4, 5 from collection T-535. (Fig. 1-5, KUMIP 2,503,409-13.)

FIGURE

PLATE 3

- 1-2. *Skinnerina rotundata* (DUNBAR & SKINNER). —1. Part of the specimen shown in Pl. 2, fig. 1, $\times 40$. Three tunnels are visible in the right half of the outermost whorl at the bottom of the figure. —2. Part of the specimen shown in Pl. 2, fig. 2, $\times 40$. Both from collection T-410. (Fig. 1-2, KUMIP 2,503,409-10.)

FIGURE

PLATE 4

- 1-3. *Skinnerina rotundata* (DUNBAR & SKINNER). —1. Part of the specimen shown in Pl. 2, fig. 3, $\times 40$. —2. Part of the specimen shown in Pl. 2, fig. 4, $\times 40$. —3. Part of the specimen shown in Pl. 2, fig. 5, $\times 40$.

- 1 from collection T-410; 2, 3 from collection T-535. (Fig. 1-3, KUMIP 2,503,411-13.)

FIGURE

PLATE 5

- 1-7. *Skinnerina fusiformis* SKINNER, n. sp. —1. Axial section of the holotype, $\times 10$. —2-5. Axial sections of paratypes, $\times 10$. —6-7. Sagittal sections of paratypes, $\times 10$. 1-6 from collection T-410; 7 from collection T-535. (Fig. 1-7, KUMIP 2,503,414-20.)

FIGURE

PLATE 6

- 1-7. *Skinnerina mildredae* SKINNER, n. sp. —1. Axial section of the holotype, $\times 10$. —2-3. Axial sections of paratypes, $\times 10$. —4-5. Sagittal sections of paratypes, $\times 10$. —6-7. Axial sections of microspheric paratypes, $\times 10$. 1, 2, 5, 6 from collection T-535; 3, 4, 7 from collection T-410. Fig. 1-7, KUMIP 2,503,421-27.)

FIGURE

PLATE 7

- 1-2. *Skinnerina mildredae* SKINNER, n. sp. —1. Part of the specimen shown in Pl. 6, fig. 6, $\times 40$. —2. Part of the specimen shown in Pl. 6, fig. 7, $\times 40$. 1 from collection T-535; 2 from collection T-410. (Fig. 1-2, KUMIP 2,503,426-27.)

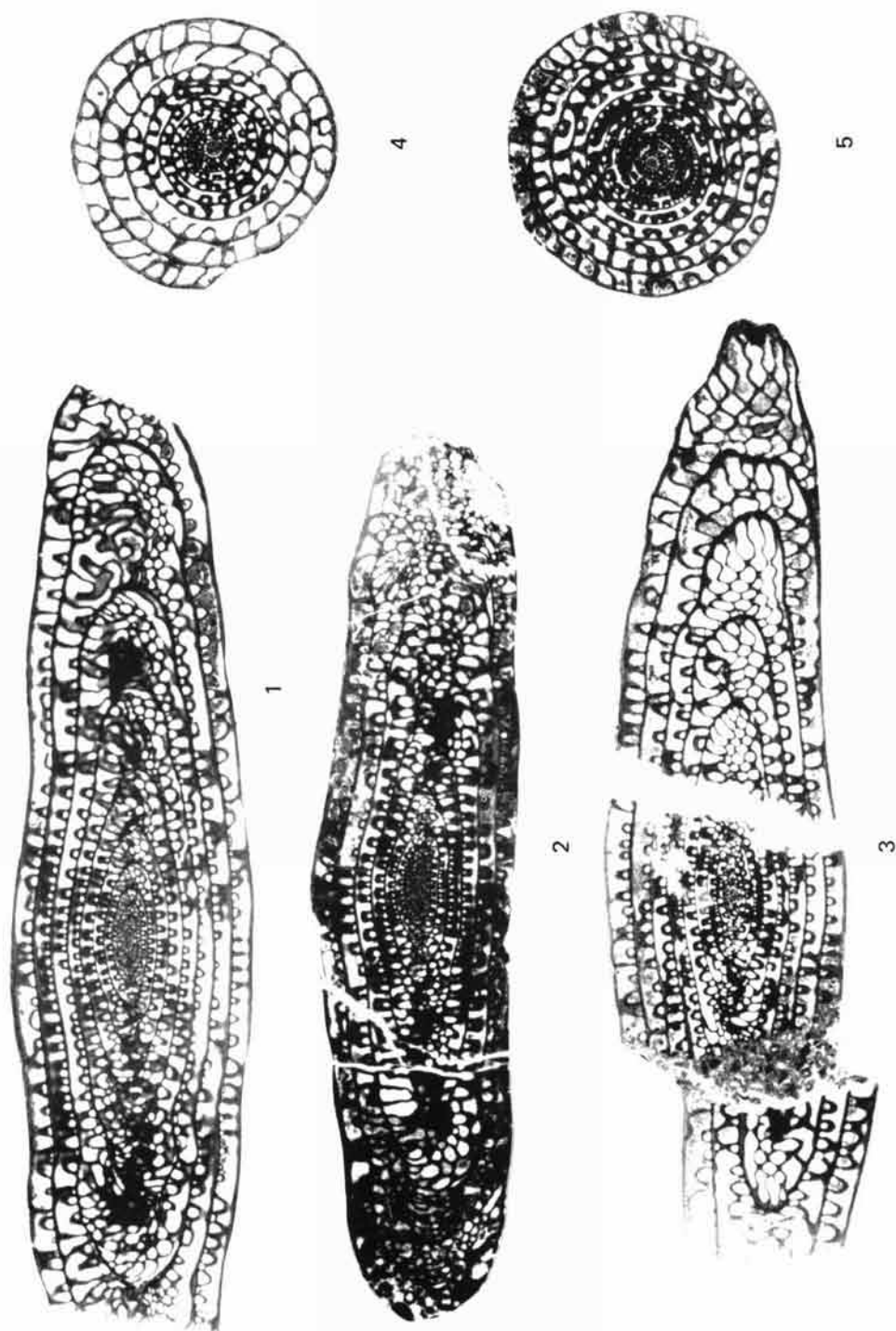
FIGURE

PLATE 8

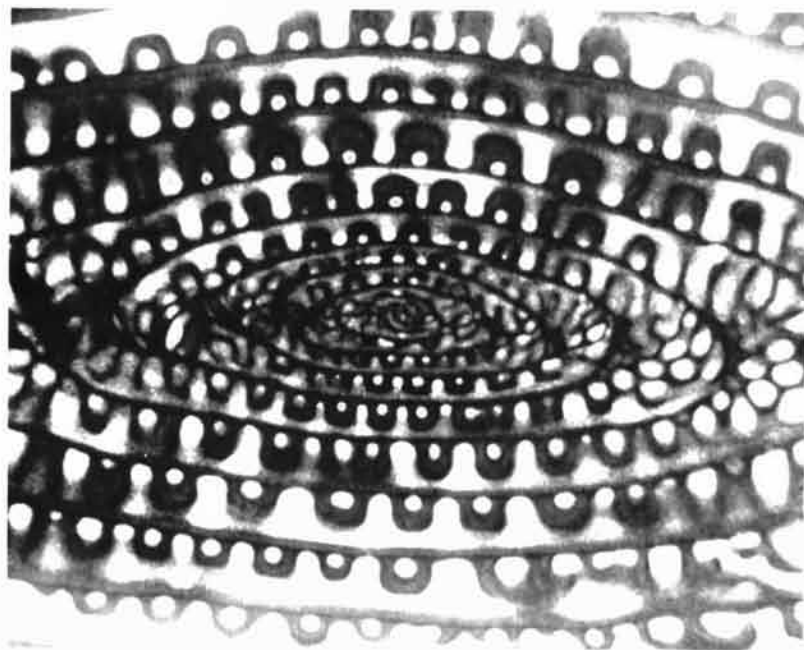
- 1-2. *Skinnerina mildredae* SKINNER, n. sp. —1. Part of the specimen shown in Pl. 6, fig. 6, $\times 100$. —2. Part of the specimen shown in Pl. 6, fig. 7, $\times 100$. 1 from collection T-535; 2 from collection T-410. (Fig. 1-2, KUMIP 2,503,426-27.)



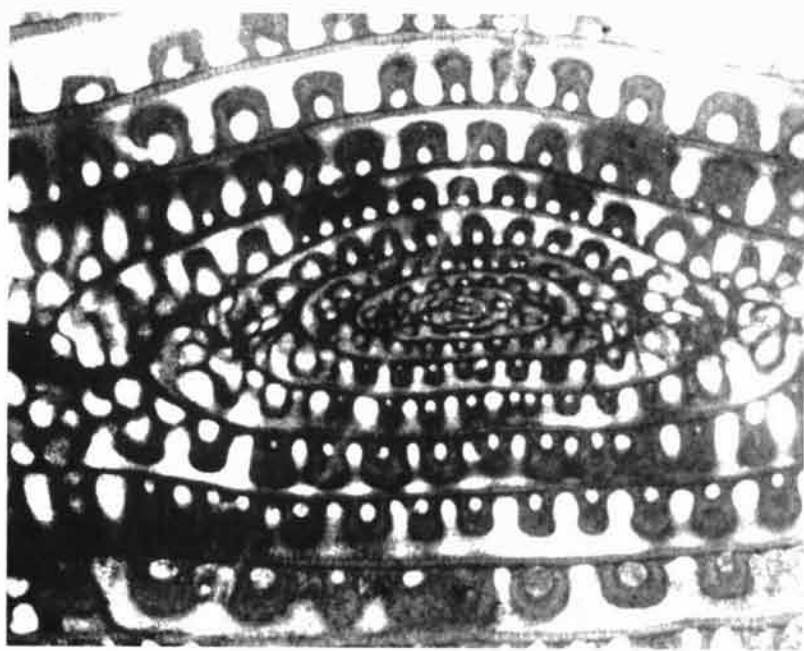
Skinnerina rotundata



Skinnerina rotundata



1

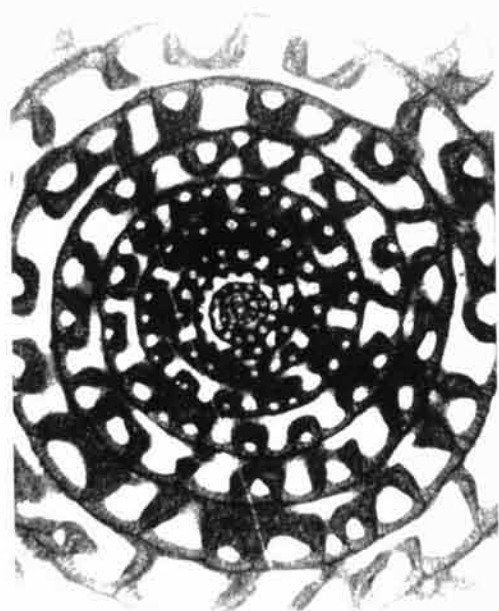


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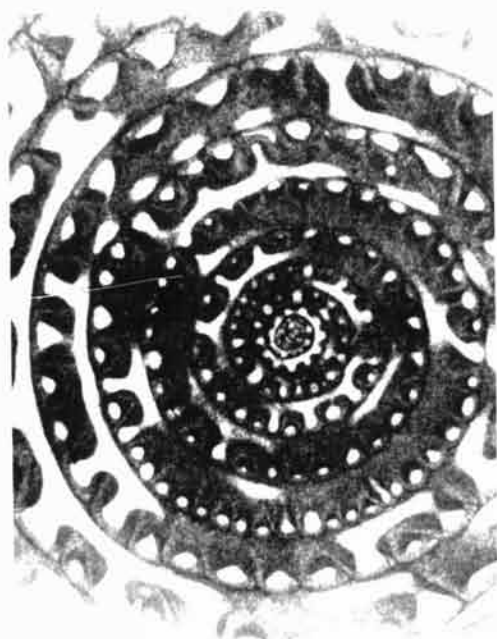
Skinnerina rotundata



1



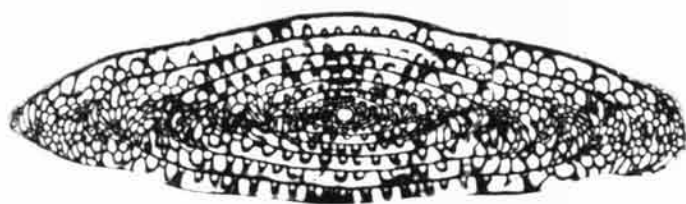
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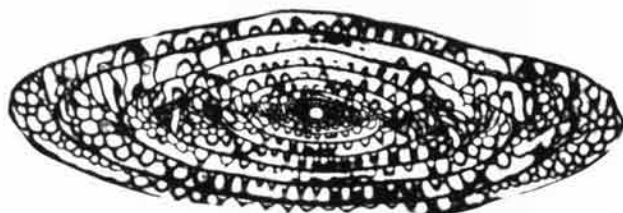
3



Skinnerina fusiformis



1



2



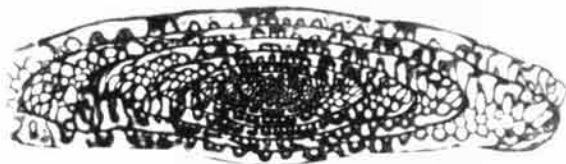
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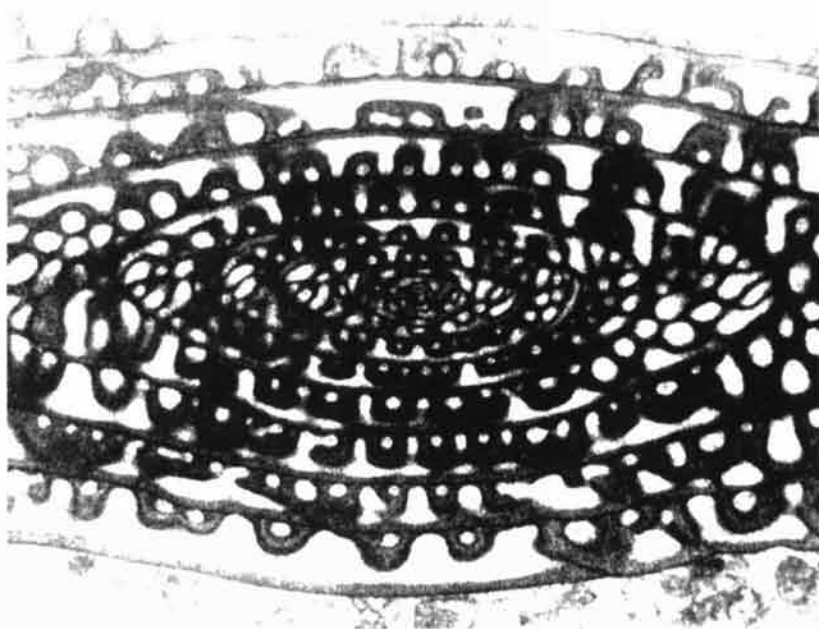
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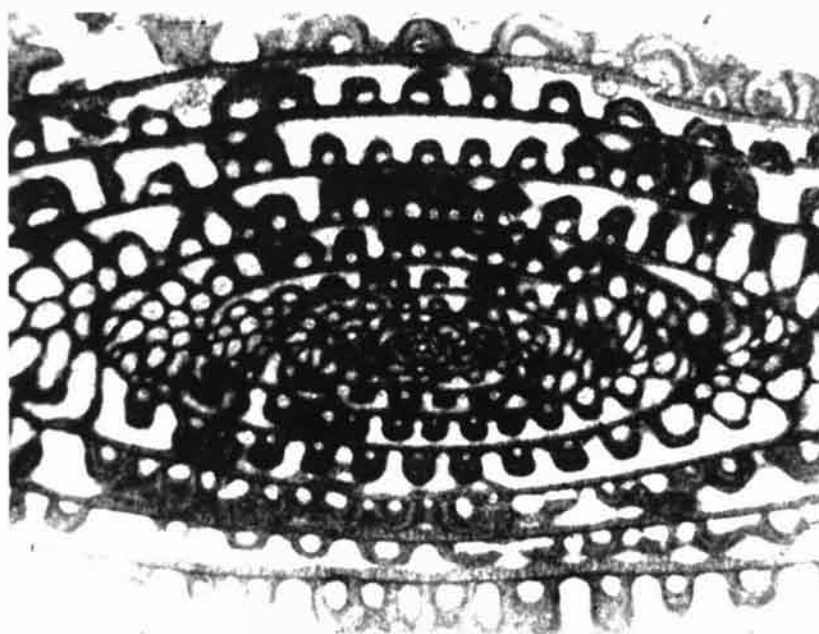
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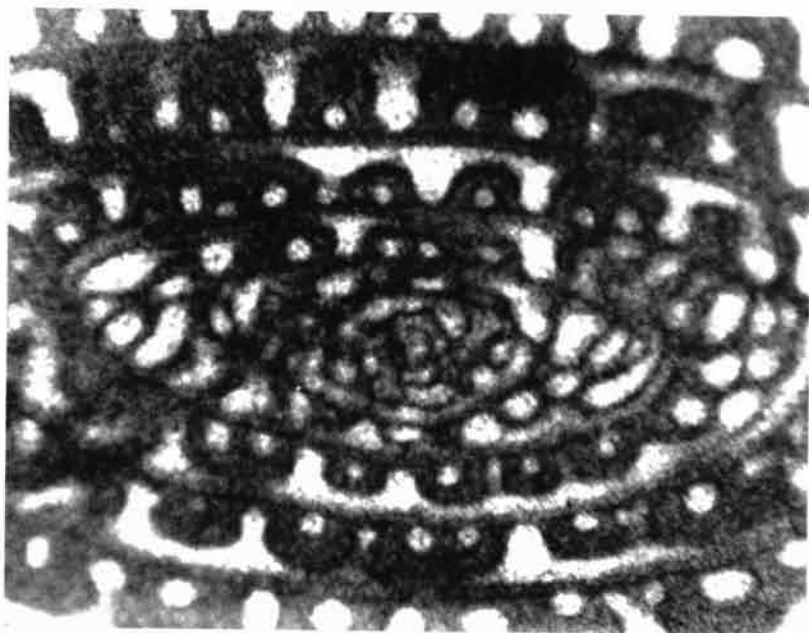


1

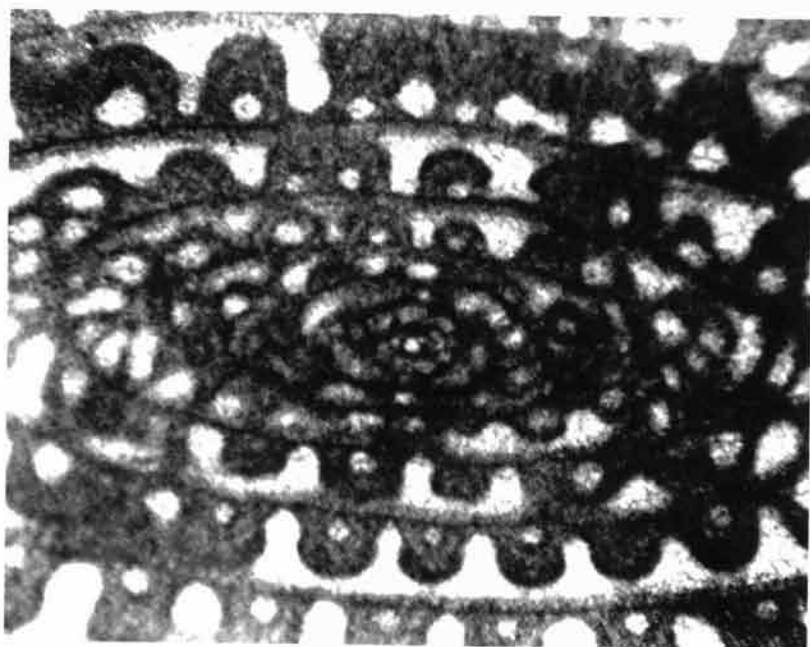


2

Skinnerina mildredae



1



2

Skinnerina mildredae

EMENDED DIAGNOSIS.—Shells of moderate size, fusiform to subcylindrical in shape; spirotheca, consisting of tectum and keriotheca, rather thin; septa intensely and regularly folded in such manner that septal loops, as seen in axial sections, are commonly squared off across the tops and are often wider at the tops than at the bases, especially in the middle part of the shell; secondary deposits on the septa well developed and widely distributed throughout the shell; such deposits commonly cause septal loops to appear markedly thickened across the tops where plane of section crosses them obliquely; cuniculi well developed throughout shell; proloculus small to large in size; no well-defined median tunnel present, but supplementary tunnels sporadically and discontinuously developed. Microspheric specimens commonly more slender and somewhat longer than their megalospheric counterparts, with minute proloculus and discoidal juvenarium consisting of one or two whorls coiled askew to outer volutions; tunnels developed as in megalospheric individuals.

AGE.—Specimens from the Glass Mountains occur in Road Canyon Formation and in basal Word Formation; those from the Apache Mountains were found in an unnamed limestone supposedly of about the same age and possibly equivalent to the Cutoff Member of the Bone Spring Formation.

SKINNERINA ROTUNDATA (Dunbar & Skinner)

Plate 1, figures 1-8; Plate 2, figures 1-5;

Plate 3, figures 1, 2; Plate 4, figures 1-3

Polydiexodina? rotundata DUNBAR & SKINNER, 1937, Texas Univ., Bull. 3701, p. 697-699, pl. 81, fig. 1,2.

Skinnerina typicalis Ross, 1964 (*partim*), Jour. Paleontology, v. 38, p. 314, 315, pl. 50, fig. 3, 5-13 (*not* pl. 50, fig. 4).

Shell moderate in size, fusiform, with slightly convex to slightly concave lateral slopes and bluntly pointed poles. Mature individuals have 8 to 9.5 volutions, and measure 10.0 to 11.3 mm in length and 3.6 to 4.8 mm in diameter. Form ratio varies from 2.77 to 2.97, averaging about 2.88.

Spirotheca, composed of tectum and keriotheca, rather thin, measuring 43 to 56 microns in thickness in sixth whorl, 50 to 56 microns in seventh, and 59 to 73 microns in eighth. Septa intensely and regularly fluted from pole to pole; septal loops, as seen in axial sections, one-half to three-

fourths as high as chambers, commonly squared off across tops, particularly in central part of shell; many septal loops wider at tops than at bases, producing mushroom-shaped outline. Secondary deposits, coating both anterior and posterior faces of septa, widely distributed throughout shell, causing many septal loops to appear markedly thickened across tops where section cuts them obliquely. Cuniculi high and well developed. Phrenothecae not observed. Septa number 11 in first whorl, 16 to 24 in second, 21 to 25 in third, 23 to 25 in fourth, 23 to 25 in fifth, 23 to 28 in sixth, 29 to 32 in seventh, 29 to 36 in eighth, and 36 to 38 in ninth.

Proloculus moderate in size, its outside diameter varying from 237 to 301 microns and averaging about 265 microns. No well-defined median tunnel present; supplementary tunnels sporadically and discontinuously developed, often continuing for less than one volution and rarely extending for more than two volutions; such tunnels may vary in number from zero to as many as 4 or 5 in a whorl, and there is no definite pattern of distribution; in width they may vary from that of a single septal fold to the width of 5 or 6 such folds. Weak chomata present only on the proloculus.

Microspheric individuals occur in a numerical ratio of about 1 to 30 megalospheric specimens; they are more slender in proportions than their megalospheric counterparts and are up to 50 percent longer. Most such specimens are incomplete, having had one or both ends broken off prior to lithification. Five of the best microspheric individuals available to me are figured in Plates 2, 3, and 4. The specimen shown in Plate 2, figure 1, is incomplete, but a close approximation of its length may be obtained by doubling its half length. Such procedure gives an estimated length of 16.0 mm and a diameter of 3.5 mm, with an estimated form ratio of 4.57. This individual has 12.5 whorls, the first 1.5 of which are discoidal and coiled askew to the later ones. The outside diameter of the proloculus is 30 microns. The second specimen (Pl. 2, fig. 2) has 11 volutions and measures 12.5 mm in length and 2.9 mm in diameter, with a form ratio of 4.31; outside diameter of proloculus is 29 microns, and the first 1.5 volutions are discoidal and coiled askew to the later ones. The third specimen (Pl. 2, fig. 3) has 12 whorls, an estimated length of 15.2 mm,

a diameter of 3.4 mm, and an estimated form ratio of 4.47. The outside diameter of the proloculus is 35 microns, and the first 2 whorls are discoidal and coiled askew to the later ones. All three have sporadic, discontinuous supplementary tunnels, in this respect differing from the microspheric specimens of *Parafusulina* (*Parafusulina*) and *Polydiexodina* which have no tunnels outside the juvenarium and which, in addition, are several times the size of their megalospheric counterparts. The two sagittal sections (Pl. 2, fig. 4,5) have 12.5 and 13.5 whorls and diameters of 3.75 and 4.0 mm, respectively. In the first of these, septal count from the first through the twelfth whorl is 6-10-13-15-19-26-28-24-28-27-28-29; in the second, from the second through the thirteenth whorl, it is 8-11-12-18-24-28-42-31-32-32-37-50.

DISCUSSION.—The above description is based entirely on specimens from the Apache Mountains. Allowing for differences in proloculus size, a comparison of their early whorls with the first five undamaged volutions of the holotype of *Polydiexodina? rotundata* DUNBAR & SKINNER shows such a close agreement that there can be little doubt that they are conspecific with the latter. A similar comparison with the holotype of *Skinnerina typicalis* Ross also shows agreement well within the limits of specific variation. Finally, a comparison of the early whorls of the holotype of *Polydiexodina? rotundata* with the corresponding volutions of the holotype of *Skinnerina typicalis* makes the conclusion that only a single species is represented almost inescapable. Since the specific name *rotundata* has a priority of 27 years, the name *typicalis* is suppressed as a synonym.

Skinnerina rotundata occurs in the Apache Mountains with *S. fusiformis* SKINNER, n. sp., and with *S. mildredae* SKINNER, n. sp. It differs from the former in having a smaller proloculus, more numerous whorls, and larger size. It differs from the latter in having a larger proloculus, more numerous whorls, larger size, and a smaller form ratio.

OCCURRENCE.—In the Apache Mountains *Skinnerina rotundata* (DUNBAR & SKINNER) is abundant in a relatively thin zone immediately above the Victorio Peak Limestone in collections T-410 and T-535. This locality is about 2 miles north-northwest of the old Jones Ranch house, near the base of a north-south trending fault escarpment, at the point at which the ranch road most closely approaches the latter. In the Glass Mountains Ross has reported it from the Road Canyon Formation northwest

of Dugout Mountain, and from a slightly higher zone in Gilliland Canyon. It is also present at about the same stratigraphic level as the latter occurrence on the southeast slope of Sullivan Peak. It seems to be less common in the Glass Mountains than in the Apache Mountains. In both areas it is associated with *Parafusulina* and rare specimens of *Rausevella*.

SKINNERINA FUSIFORMIS Skinner, n. sp.

Plate 5, figures 1-7

Skinnerina typicalis Ross, 1964 (*partim*), Jour. Paleontology, v. 38, p. 314, 315, pl. 50, fig. 4 (*not* pl. 50, fig. 3, 5-13).

Shell moderate in size, fusiform, with slightly convex to slightly concave lateral slopes and bluntly pointed poles. Mature individuals have 7 to 8 whorls, and measure 7.8 to 10.2 mm in length and 3.1 to 4.1 mm in diameter. Form ratio varies from 2.51 to 2.94, averaging about 2.75.

Spirotheca, composed of tectum and keriotheca, rather thin, measuring 46 to 53 microns in thickness in the sixth volution and 49 to 62 microns in the seventh. Septa intensely and regularly fluted throughout shell; septal loops, as seen in axial sections, one-half to three-fourths as high as chambers and commonly squared off across tops, particularly near middle of shell; some septal loops wider at tops than at bases. Secondary deposits, coating both anterior and posterior surfaces of septa, widely distributed throughout shell causing many septal loops to appear thickened across tops. Septa number 12 in first volution, 15 to 22 in second, 19 to 24 in third, 22 to 28 in fourth, 22 to 33 in fifth, 29 to 40 in sixth, 33 to 37 in seventh, and about 41 in eighth. Cuniculi high and well developed. Phrenothecae absent.

Proloculus large and commonly irregular in shape; outside diameters of 4 spherical examples measure 386, 379, 351, and 454 microns, respectively; three irregularly shaped examples measure 350 by 450, 346 by 549, and 288 by 357 microns, respectively. No well-defined central tunnel present; supplementary tunnels sporadically and discontinuously developed, often extending for less than one whorl and seldom continuing for more than two successive volutions; some volutions may have no tunnels whereas others may possess as many as 3 or 4; in width they vary from that of a single septal fold to the width of several such folds. Weak chomata present only on proloculus.

DISCUSSION.—*Skinnerina fusiformis* SKINNER,

n. sp., differs from *S. rotundata* (DUNBAR & SKINNER), with which it occurs, in its smaller size, less numerous volutions, and larger proloculus. The specimen illustrated by Ross as his plate 50, figure 4, appears to be an immature example of this species.

OCCURRENCE.—This species is abundant in the Apache Mountains, Culberson County, Texas, in collections T-410 and T-535. It is associated with *Skinnerina rotundata* (DUNBAR & SKINNER), *S. mildredae* SKINNER, n. sp., *Parafusulina* (*Parafusulina*), and rare specimens of *Rausserella*.

SKINNERINA MILDREDAE Skinner, n. sp.

Plate 6, figures 1-7; Plate 7, figures 1, 2; Plate 8, figures 1, 2

Shell of moderate size, slender fusiform to sub-cylindrical with straight to slightly convex lateral slopes and bluntly pointed poles. Mature individuals have 7.5 to 8.5 volutions, and measure 7.3 to 9.1 mm in length and 2.1 to 3.1 mm in diameter. Form ratio varies from 2.88 to 3.48, averaging about 3.25.

Spirotheca, composed of tectum and keriotheca, measures 29 to 45 microns in thickness in sixth whorl, 37 to 53 microns in seventh, and 32 to 63 microns in eighth. Septa intensely and regularly fluted from pole to pole; septal loops, as seen in axial sections, one-half to three-fourths as high as chambers and commonly flattened across tops, particularly in middle part of shell. Secondary deposits, coating both anterior and posterior faces of septa, widely distributed throughout shell, but not so pronounced as in *Skinnerina rotundata* (DUNBAR & SKINNER) and in *S. fusiformis* SKINNER, n. sp. Such deposits commonly cause septal loops to appear thickened across tops. Septa number 12 to 15 in first whorl, 14 to 20 in second, 15 to 20 in third, 17 to 21 in fourth, 20 to 25 in fifth, 23 to 28 in sixth, 31 to 32 in seventh, and about 30 in eighth. Cuniculi high and well developed. Phrenothecae not observed.

Proloculus rather small, its outside diameter varying from 187 to 250 microns, averaging about

212 microns. No well-defined median tunnel present; supplementary tunnels discontinuous and erratically distributed, varying in number from none to 2 or 3 per whorl; such tunnels usually narrow, but occasionally width may be that of several septal folds. Weak chomata present only on proloculus.

Microspheric specimens are rather rare; two of the best available to me are figured on Plates 6, 7, and 8. The first of these (Pl. 6, fig. 6) has 10.5 whorls, and measures an estimated 8.1 mm in length and 2.1 mm in diameter, with an estimated form ratio of 3.86. Thickness of spirotheca measures 23 microns in sixth volution, 23 in seventh, and 33 in eighth. Outside diameter of proloculus is 45 microns, and first 1.5 whorls are thickly discoidal and coiled somewhat askew to later ones. Narrow supplementary tunnels irregularly distributed throughout shell. The second microspheric individual (Pl. 6, fig. 7) has 11 volutions, and measures an estimated 11.6 mm in length and 2.3 mm in diameter, with an estimated form ratio of 5.04. Thickness of spirotheca measures 26 microns in sixth whorl, 27 microns in seventh, and 36 microns in eighth. Outside diameter of proloculus is 33 microns, and first 1.5 volutions are discoidal and coiled askew to later ones. Narrow supplementary tunnels discontinuous and sporadic in distribution.

DISCUSSION.—*Skinnerina mildredae* SKINNER, n. sp., is the smallest and most slenderly proportioned member of the genus presently known. It differs from *S. rotundata* (DUNBAR & SKINNER) and from *S. fusiformis* SKINNER, n. sp., in its smaller size, smaller proloculus, larger form ratio, and less pronounced development of secondary deposits. Its microspheric form differs from that of *S. rotundata* in smaller size for a given number of volutions. This species is named for my wife, MILDRED SKINNER.

OCCURRENCE.—*Skinnerina mildredae* is abundant in collections T-410 and T-535 from the Apache Mountains, Culberson County, Texas. It has not been found in the Glass Mountains.

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