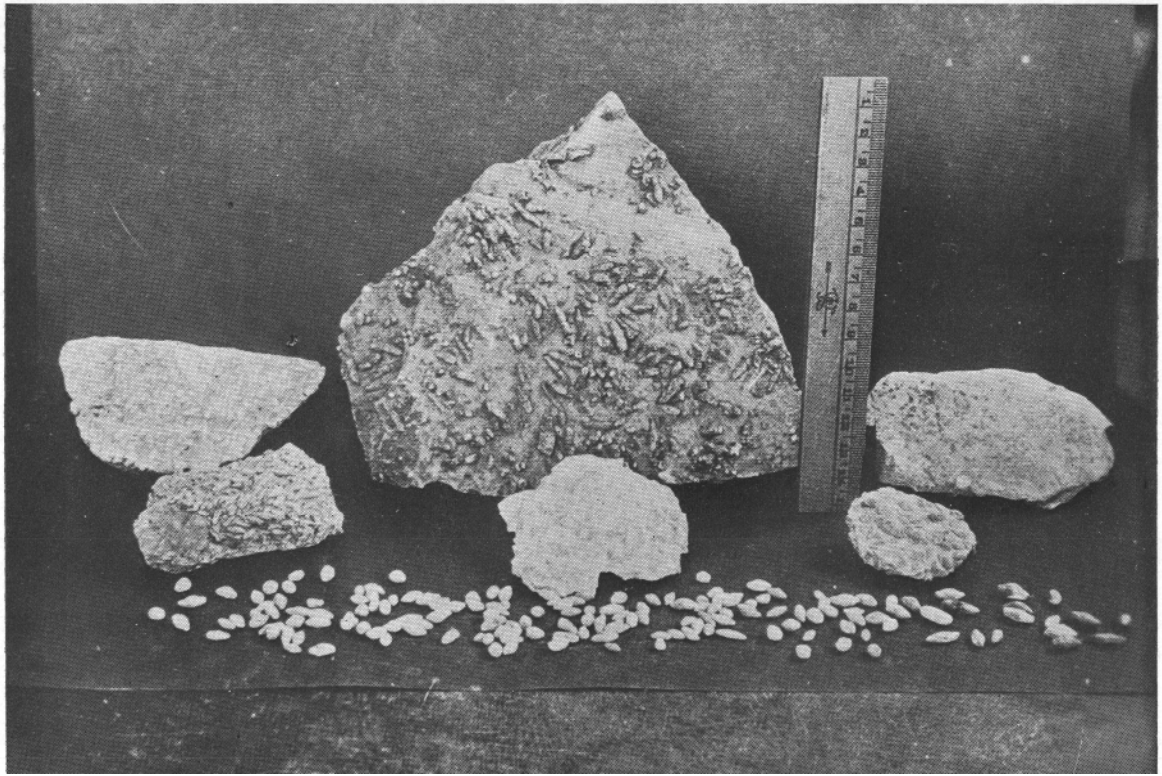


SOME TYPICAL FUSULINID SPECIMENS
(Scale in centimeters)

NEW MEXICO SCHOOL OF MINES

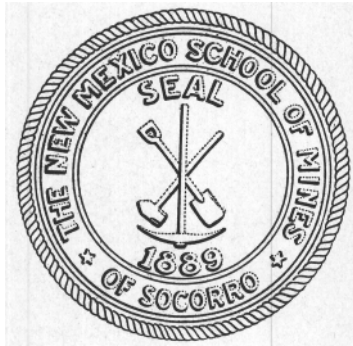
STATE BUREAU OF MINES AND
MINERAL RESOURCES

E. H. WELLS
President and Director

BULLETIN NO 14

Some New Mexico Fusulinidae

By
C. E. NEEDHAM



SOCORRO, N. M.
1937

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ILLUSTRATIONS

THE STATE BUREAU OF MINES AND MINERAL RESOURCES

The State Bureau of Mines and Mineral Resources of New Mexico was established by the New Mexico Legislature of 1927. It was made a department of the New Mexico School of Mines, and its activities are directed by the board of regents of the school. Its chief object is to assist and encourage the development of the mineral resources of the State.

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PUBLICATIONS

Bulletin No. 1. The Mineral Resources of New Mexico—Fayette A. Jones, 1915. (Out of print.)

Bulletin No. 2. Manganese in New Mexico—E. H. Wells, 1918. (Out of print.)

Bulletin No. 3. Oil and Gas Possibilities of the Puertecito District, Socorro and Valencia Counties, New Mexico—E. H. Wells, 1919. (Out of print.)

Bulletin No. 4. Fluorspar in New Mexico—W. D. Johnston, Jr., 1928. (Price 60 cents.)

Bulletin No. 5. Geologic Literature of New Mexico—T. P. Wootton, 1930. (Price 25 cents.)

Bulletin No. 6. Mining and Mineral Laws of New Mexico—C. H. Fowler, 1930. (Out of print.)

Bulletin No. 7. The Metal Resources of New Mexico and their Economic Features—S. G. Lasky and T. P. Wootton, 1933. (Price 50 cents.)

Bulletin No. 8. The Ore Deposits of Socorro County, New Mexico—S. G. Lasky, 1932. (Price 60 cents.)

Bulletin No. 9. The Oil and Gas Resources of New Mexico—Dean E. Winchester, 1933. (Price $1.50.)

Bulletin No. 10. The Geology and Ore Deposits of Sierra County, New Mexico—G. T. Harley, 1934. (Price 60 cents.)

Bulletin No. 11. The Geology of the Organ Mountains, with an Account of the Geology and Mineral Resources of Dona Ana County, New Mexico—Kingsley C. Dunham, 1935. (Price $1.00.)

Bulletin No. 12. The Non-Metallic Mineral Resources of New Mexico and their Economic Features (Exclusive of Fuels)—S. B. Talmage and T. P. Wootton, 1937. (Price 50 cents.) Bulletin

No. 13. Geology and Economic Features of the Pegmatites of Taos and Rio Arriba Counties, New Mexico—Evan Just (in preparation).

Bulletin No. 14. Some New Mexico Fusulinidae—C. E. Needham, 1937. (Price 50 cents.)

Note—Bulletins 1, 2, and 3 were issued by the Mineral Resources Survey of the New Mexico School of Mines.

Some New Mexico Fusulinidae

By C. E. NEEDHAM

INTRODUCTION

PURPOSE AND SCOPE OF INVESTIGATION

The Pennsylvanian and Permian formations of New Mexico contain an abundant fusulinid fauna. Fusulinids include the largest and most complex Paleozoic foraminifera. Because of their wide distribution, occurrence in vast numbers throughout great thicknesses of strata, and high specialization, they become valuable index fossils. The species and even the genera of this family have short stratigraphic ranges as compared with most of the common Pennsylvanian and Permian invertebrates. Therefore, they are probably the most reliable of any group for late Paleozoic correlation. Moreover, they are small enough to be recovered from well cuttings; hence they have particular significance in subsurface correlation. Their importance in this respect is only beginning to be realized.

Rocks of Pennsylvanian and Permian age in the State yield mineral wealth mainly in the form of ores, potash, and petroleum. It is hoped that this report may be of assistance in solving problems of a geologic nature that have particular bearing on the mineral resources of the State. The petroleum industry in particular will be able to utilize the information incorporated because of the close relationship of petroleum geology to paleontology and stratigraphy.

In order to be of maximum service, a report dealing with the fusulinids of New Mexico should point out the relationship of the New Mexico forms with those in other areas. Accordingly an attempt has been made to correlate our Pennsylvanian and Permian formations with those of other states on the basis of the fusulinids.

Two months were spent in the field by the writer during the summer of 1933 and two weeks in the summer of 1934. During this time a total of 58 collections were made from the general localities listed on the accompanying State map. No claim is made that these collections represent every species of fusulinid. New Mexico is one of the larger states, and the outcrops of Pennsylvanian and Permian rocks cover thousands of square miles. Moreover, the outcrops generally are found in rugged mountain ranges, many parts of which are accessible only on horseback. To visit all these outcrops in a few months would be an impossible

task. Unquestionably, new species of fusulinids remain to be discovered within the State, so the present report is largely a report of progress, which, it is hoped, is broad enough in its scope to afford a basis for a practical use of these fossils without being the last word on the subject.

From the 58 collections more than 200 thin sections were made for microscopic study. This phase of the work was pursued throughout the school year of 1933-34, for two months during the summer of 1934, and to some extent during the school years of 1934-35 and 1935-36.

ACKNOWLEDGMENTS

Whatever merit this report may have is due in no small measure to the kindly help of numerous people. Mr. Edgar Kraus of the Atlantic Oil Refining Co., Carlsbad, N. Mex., guided the writer to an important fusulinid locality in the Guadalupe Mountains and at the same time pointed out and discussed some of the perplexing problems of Permian stratigraphy. Mr. Ralph Koenig of the Texas Co., Carlsbad, N. Mex., loaned important notes and maps from the files of his company. Both Mr. Kraus and Mr. Koenig permitted the writer to examine well logs and cuttings on file in their offices. Mr. Milward Miller of the Humble Oil and Refining Co., Roswell, N. Mex., furnished a map of the Guadalupe Mountains region, which was used extensively in field work. Prof. G. T. Harley, of the New Mexico School of Mines, guided the writer to a very important Pennsylvanian section in the Cuchillo Mountains and assisted in securing a large collection of fusulinids. Mr. S. G. Lasky of the United States Geological Survey contributed collections from Pennsylvanian beds near Santa Rita and Hachita, and reported a newly-found exposure of Pennsylvanian rocks in the Pyramid Mountains near Lordsburg, from which a small collection was obtained by the writer. The photographic work was done entirely by Dr. M. L. Thompson of the University of Iowa. Mr. Lloyd Henbest of the United States Geological Survey edited the manuscript and offered many suggestions for its improvement. Mr. Charles Ryniker of the Gypsy Oil Company read a part of the manuscript and made a number of comments bearing on the stratigraphic interpretation. The thin sections for microscopic study were prepared largely by Messrs. Robert Augenthaler, Earl Herkenhoff, and Glen Brown, students in the New Mexico School of Mines.

METHODS OF INVESTIGATION

Of the twelve or fourteen characters commonly used in the identification of fusulinids, only three or four can be determined externally; the others are to be found in internal features. Complete identification, therefore, requires the study of oriented thin

sections or polished sections. Two sections are usually made, one axial and the other equatorial, both passing through the proloculum. A tangential section, parallel to the axis and cutting the penultimate whorl, is almost necessary in generic determination in many specimens, as it shows better than centered sections the true nature of the septal fluting.

In order that the characters and structure of the test may be better understood by the reader, figures showing the details of axial and equatorial sections are given on page 10, also a glossary of terms on page 11. The structure of the spiral wall is especially fundamental. The structure of the wall in *Fusulina* and *Wedekindellina,* genera that characterize the lower portion of the Magdalena formation, is shown in Fig. C, page 10. The structure of the wall in *Triticites* (Middle and Upper Magdalena) , *Schwagerina* and *Pseudoschwagerina* (Lower Permian) , *Parafusulina* (Middle Permian) , and *Polydiexodina* (Upper Permian) is shown in Fig. D, page 10.

The preparation of thin sections of fusulinids follows closely the usual procedure for making thin sections of rocks, except that grinding to a rather definite thickness is not necessary. Some advantage is gained if the specimens are free, but in many cases the only available specimens are imbedded in massive limestones. These usually show in relief on weathered surfaces and yield very good thin sections if chipped carefully from the rock before grinding.

No elaborate equipment is necessary for the preparation of thin sections. All the grinding can be done on a glass plate with two grades of grinding powder, although a power wheel speeds the work materially, especially if the specimens are imbedded in rock. For specimens in rock chips the method used was to grind the chips on the glass plate until the proloculum was reached, cement the polished side to a slide with Canada balsam, grind away the other side as much as convenient, then finish with fine powder on the glass plate.

Inasmuch as the proloculum is usually small and easily passed in the grinding, it is necessary to watch the specimen carefully to ascertain the progress. For this purpose a hand lens with good magnification is very useful. Examination of the wet polished surface in strong light will generally reveal even the smallest proloculum when it is reached.

For careful measurement of the internal characters a good microscope with micrometer eyepiece is essential. The use of the condensing lens usually makes the outlines of the proloculum and walls clearer and more distinct.

For heating the Canada balsam, a small electric hot plate proved very satisfactory. If this is not available, good results may be had from an alcohol lamp or tallow candle.

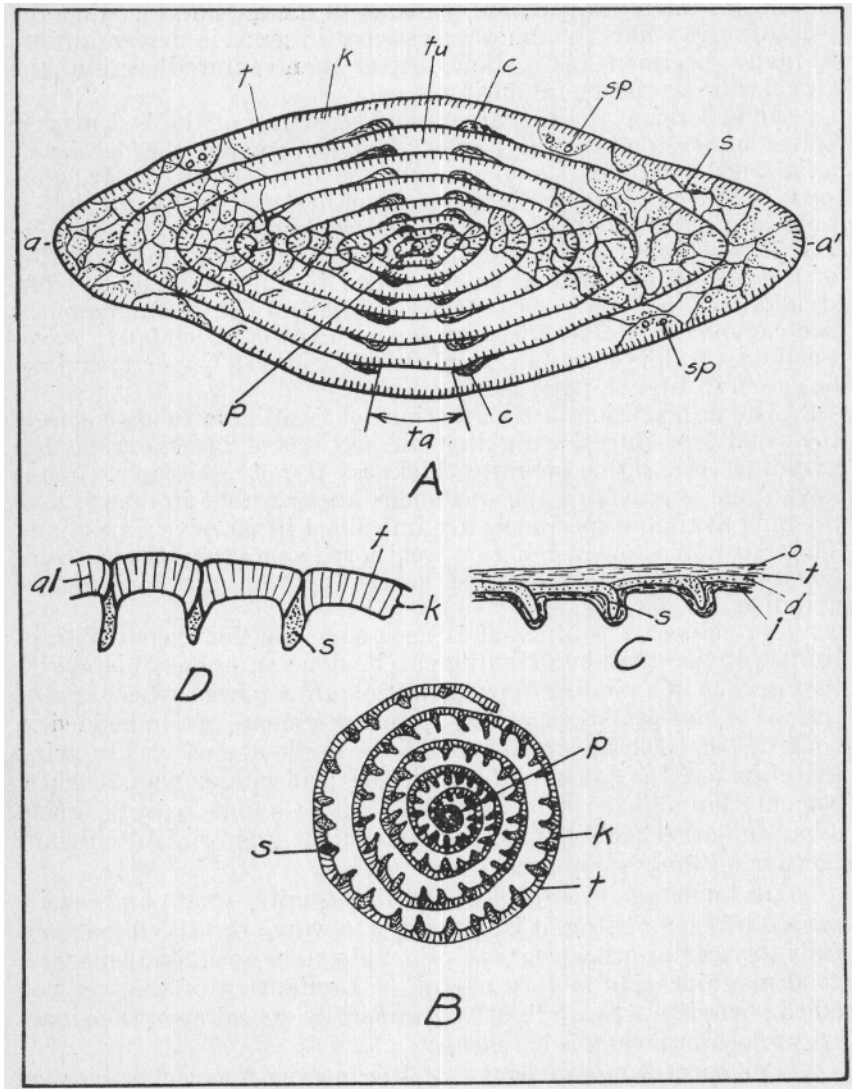


FIGURE 1—Diagram of Fusulinid characters
(See opposite page)

EXPLANATION OF FIGURES

A and B Axial and equatorial sections, showing certain fusulinid characters.

C. Part of equatorial section, showing structure of walls and septa of *Fusulina* and *Wedekindellina.*

D. Part of equatorial section, showing structure of walls and septa of *Triticites, Schwagerina, Pseudoschwagerina, Parafusulina,* and *Polydiexodina.*

o, outer tectorium ; t, tectum ; d, diaphanotheca ; i, inner tectorium ; s, septum ; c, chomata ; tu, tunnel ; ta, tunnel angle ; sp. septal pore ; k, keriotheca ; al, alveoli ; p, proloculum ; a—a', axis.

GLOSSARY OF TERMS

Alveoli. Small columnar structures characteristic of the keriotheca.

Antetheca. The last septal face.

Axis. An imaginary line about which the test is coiled.

Chomata. A pair of ridges laid down along each side of the tunnel.

Diaphanotheca. The inner layer of the wall in *Staffella, Fusulina,* and *Wedekindellina.*

External furrows. Axial grooves that mark the exterior of the test.

Form ratio. The ratio of length of test to diameter.

Juvenarium. The proloculum and the first chambers.

Keriotheca. The inner layer of the wall in *Triticites, Schwagerina, Pseudoschwagerina, Parafusulina,* and *Polydiexodina.*

Parachomata. Spiral ridges that replace the original chomata in certain forms having multiple tunnels.

Proloculum. The first chamber.

Septa. Axial partitions between chambers.

Septal pores. Minute perforations over the antetheca and septa.

Septal fluting. Corrugations of the septa.

Tectorium. The outer and the inner layer of the wall in *Staffella, Fusulina,* and *Wedekindellina.*

Tectum. The thin rind-like outer layer in the wall of *Triticites, Schwagerina, Pseudoschwagerina, Parafusulina,* and *Polydiexodina.*

Test. The shell of the fusulinid.

Tunnel. A spiral opening extending from the proloculum through the later septa, generally lying in the equatorial plane.

Tunnel angle. The angle subtended by the walls of the tunnel as measured in axial sections.

Whorl. A single complete turn or volution.

DESCRIPTION OF LOCALITIES

No. 1. Along U. S. Highway No. 64, between Taos and the crest of the Sangre de Cristo Mountains, Taos County. Two collections were made, the first about 8 miles east, the second about 13 miles east of Taos. The first contains *Fusulina taosensis* Needham, n. sp.; the second, *Fusulina euryteines* Thompson.

No. 2. At the northern outskirts of Jemez Springs, Sandoval County. The upper part of the Magdalena formation is exposed here and carries an abundance of *Triticites jemezensis* Needham, n. sp., and *T. kellyensis* Needham, n. sp.

No. 3. North of U. S. Highway No. 66, near Canyoncito, Santa Fe County. *Triticites rhodesi* Needham, n. sp. is found near the fault contact of the Magdalena formation with the pre-Cambrian complex.

No. 4. In an old quarry north of U. S. Highway No. 66, near Doretta, San Miguel County. *Fusulina euryteines* Thompson occurs here.

No. 5. Along a secondary road leading from Las Vegas to San Geronimo, San Miguel Co., about 7 miles east of San Geronimo. A small dome exposes granite overlain by the Magdalena formation. *Fusulina euryteines* Thompson is found a short distance above the granite, also *F. socorroensis* Needham, n. sp.

No. 6. Two collections were obtained near Montezuma Hot Springs, northwest of Las Vegas, San Miguel Co., one near the old power plant at the springs, the other about 4 miles northwest of the springs. At the first locality *Wedekindellina euthysepta* (Henbest) is found, at the second, *Fusulina euryteines* Thompson.

No. 7. Along Tijeras and Cedro Canyons, 13 to 16 miles east of Albuquerque, Bernalillo Co. A short distance above the pre-Cambrian complex in Tijeras Canyon are found *Wedekindellina euthysepta* (Henbest), *W. excentrica* (Roth and Skinner), *Fusulina euryteines* Thompson, and *F. socorroensis* Needham n. sp. In Cedro Canyon a short distance south of the Ranger station are found *Triticites ventricosus* (Meek), and . *fresnalensis* Needham, n. sp.

No. 8. Along U. S. Highway No. 366, about a mile east of Barton, near the west edge of the Estancia Valley, Santa Fe Co. *Triticites wellsi* Needham n. sp. occurs here.

No. 9. Along U. S. Highway No. 60, about 20 miles east of Bernardo, where the highway passes through the north end of the Los Pinos Mountains, Socorro Co. The Pennsylvanian rocks are faulted down against pre-Cambrian schists, and the zones of *Fusulina* and *Wedekindellina* are faulted out. T. *nebraskensis* Thompson occurs lowest in the section and is succeeded by more robust species of *Triticites.*

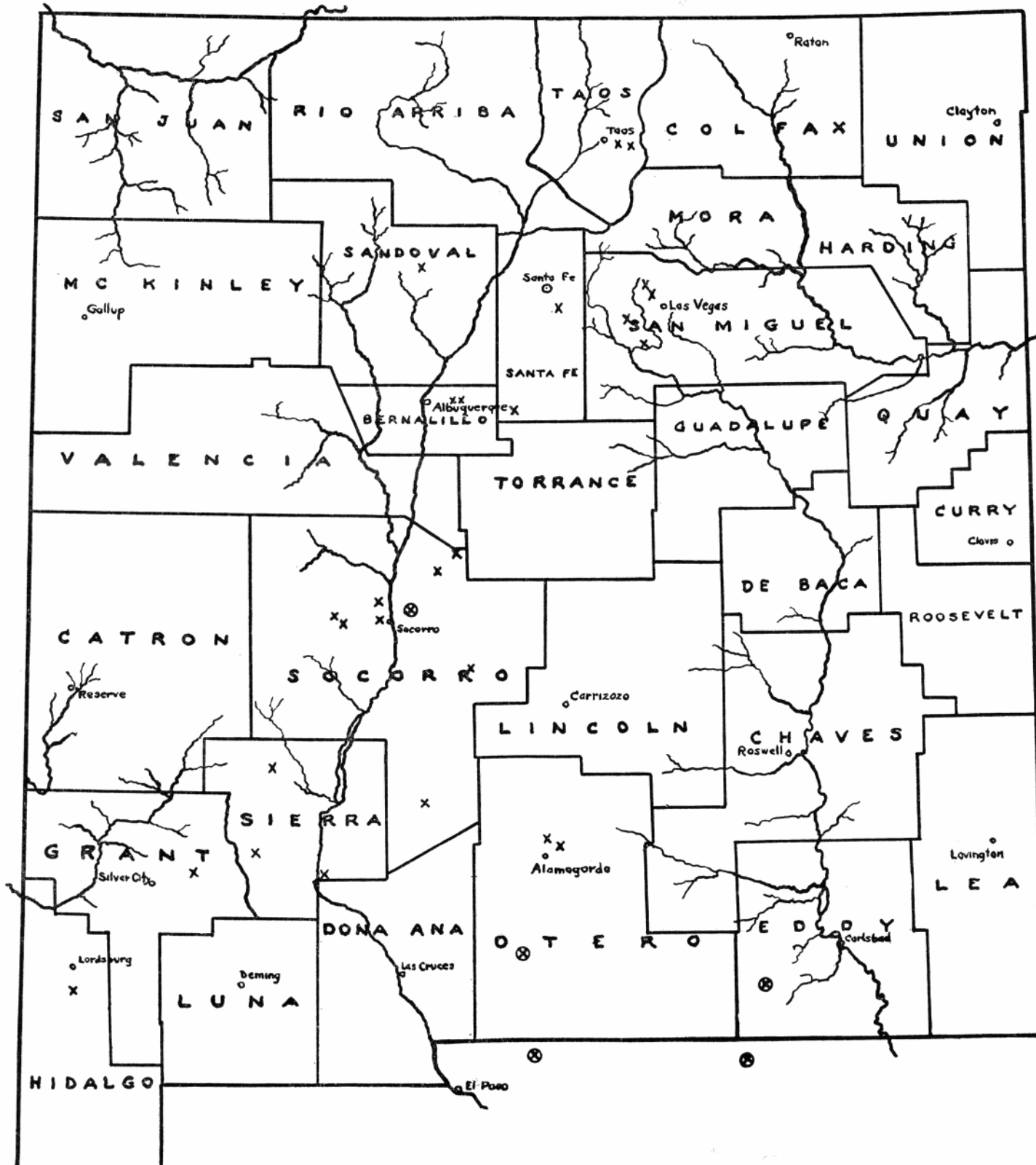
No. 10. Along a ranch road leading east from La Joya into the south end of the Sierra Los Pinos, Socorro Co. This is the zone of *Fusulina.* The specimens are too poor for specific determination.

No. 11. In Corkscrew Canyon at the south end of the Lemitar Mountains about 4 miles west of Lemitar, Socorro Co. Two collections were obtained, one from each side of the pre-Cambrian uplift. Both collections contained the same forms, *Wedekindellina euthysepta* (Henbest), *Fusulina euryteines* Thompson, and *F. socorroensis* Needham, n. sp.

No. 12. At Socorro Mt., about three miles west of Socorro, Socorro county. *Fusulina euryteines* Thompson, *F. socorroensis* Needham, n. sp., and *F. novamexicana* Needham, n. sp. are abundant. *Wedekindellina euthysepta* (Henbest) also occurs here. The zone of *Triticites* is not exposed below the Tertiary rhyolites.

No. 13. In the Coyote Hills about 13 miles northeast of Socorro, Socorro county. In the Yeso formation (Permian) a few specimens of *Triticites*

NEW MEXICO


SCALE OF MILES
0 10 20 30 40 50
Localities from which collections were made
X Pennsylvanian
⊗ Permian
SAN JUAN
RIO ARRIBA
TAOS
COLFAX
UNION
MORA
HARDING
SANDOVAL
MC KINLEY
SANTA FE
SAN MIGUEL
VALENCIA
BERNALILLO
GUADALUPE
QUAY
TORRANCE
CURRY
DE BACA
ROOSEVELT
CATRON
SOCORRO
LINCOLN
CHAVES
SIERRA
GRANT
DONA ANA
OTERO
EDDY
LEA
LUNA
HIDALGO
Raton
Clayton
Taos
Santa Fe
Las Vegas
Albuquerque
Gallup
Clovis
Socorro
Reserve
Carrizozo
Roswell
Silver City
Alamogordo
Lovington
Carlsbad
Las Cruces
Deming
Lordsburg
El Paso

were found. Specific identification was not possible. A short distance to the north in Valle del Ojo de la Parida were found large blocks of Pennsylvanian limestone in valley fill believed to be late Pliocene or Pleistocene in age. In these blocks *Fusulina euryteines* Thompson was found in abundance. Also one specimen of the genus *Ozawainella* was found.

No. 14. In the Magdalena Mountains, Socorro County. Collections were made at Kelly, carrying *Fusulina euryteines* Thompson and *Wedekindellina euthysepta* (Henbest) from the lower part of the Magdalena formation and *Triticites kellyensis* Needham, n. sp. from the extreme upper part. In Water Canyon, on the east side of the range, a collection yielded *Wedekindellina euthysepta* (Henbest) and *Fusulina socorroensis* Needham, n. sp.

No. 15. At the Hansonburg lead mine in the westward facing escarpment of the Oscura Mountains, Socorro County. The collection yielded *Fusulina euryteines* Thompson.

No. 16. In the Cuchillo Mountains northwest of Hot Springs and a short distance east of Fairview, Sierra County. *Fusulina euryteines* Thompson and *Wedekindellina euthysepta* (Henbest) occur in the lower parts of the exposures above and below the monzonite sill. *Triticites cuchil-loensis* Needham, n. sp. occurs through the middle part of the exposures.

No. 17. At and near Kingston, Sierra Co. The lower part of the Magdalena formation is exposed, and the beds are repeated two or three times by north-south faults. These beds carry *Fusulina euryteines* Thompson and *Staff ella atokensis* Thompson.

No. 18. Toward the south end of the Caballos Mountains on the east side of the Rio Grande near Arrey, Sierra Co. Just above the valley floor, *Fusulina euryteines* Thompson is found in Magdalena limestones.

No. 19. About a mile northeast of Santa Rita, Grant Co. *Fusulina euryteines* Thompson occurs in chert in the Magdalena formation. This collection was made by Mr. S. G. Lasky.

No. 20. About 8 or 9 miles south of Lordsburg and about 2 miles east of the Lordsburg-Animas highway, in the Pyramid Mountains, Hidalgo Co. A small outcrop of the Magdalena formation, discovered by S. G. Lasky, yielded a few specimens of the genus. *Triticites.* Specific determination could not be made.

No. 21. For several miles up La Luz and Fresnal Canyons, between La Luz and Cloudcroft, Otero Co. All the collections came from Pennsylvanian beds. *Triticites ventricosus* (Meek), *T. ventricosus* var. *sacramentoensis* Needham, n. var., and *T. gallowayi* Needham, n. sp. occur through a considerable thickness of the exposures. At the top, near High Rolls, *T. fresnalensis* Needham, n. sp. is found.

No. 22. Along Rhodes Canyon, leading through the San Andres Mountains, Socorro Co., 40 to 45 miles west of Tularosa. *Triticites ventricosus* (Meek) and *T. rhodesi* Needham, n. sp. were found here.

No. 23. The eastern foothills of the Jarilla Mountains, 3 to 4 miles north of Oro Grande, Otero Co. Permian limestones are exposed here and yield *Pseudoschwagerina morsei* Needham, n. sp., *Schwagerina emaciata* (Beede) and *S. emaciata* var. *jarillaensis* Needham, n. var.

No. 24. About 2 miles northeast of Hueco Tanks, El Paso County, Texas, and again about 8 miles west of Hueco Tanks. Hueco limestones of lower Permian age in these exposures carry *Pseudoschwagerina fusulinoides* (Schellwien), *P. uddeni* (Beede and Kniker), *Schwagerina huecoensis* (Dunbar and Skinner), and *S. thompsoni* Needham, n. sp.

No. 25. Last Chance Canyon in the Guadalupe Mountains, a short distance east of Sitting Bull Falls, near the east line of sec. 35, T. 23 S., R. 22 E., Eddy County, New Mexico. *Parafusulina dunbari* Needham, n. sp. is found in abundance here in the Dog Canyon limestone.

No. 26. Guadalupe Point, Culberson County, Texas. Dark limestones at the top of the Delaware Mountain formation and white limestone at the base of the Capitan formation yield an abundance of *Polydiexodina guadalupensis* Needham, n. sp. Some 600 to 800 feet below the base of the Capitan limestone *Parafusulina dunbari* Needham, n. sp. is found very abundantly in the Delaware Mountain formation.

STRATIGRAPHIC SIGNIFICANCE

An attempt has been made in the accompanying charts to show the stratigraphic range of the various species described in the report. It will be noted that nine genera have been recognized in the State, and, with the possible exception of the genera *Ozawainella* and *Staff ella,* that each is sufficiently limited in its range to permit the recognition of five major faunal zones in descending order, as follows:

Permian
- Zone of *Polydiexodina*
- Zone of *Parafusulina*
- Zone of *Schwagerina* and of *Pseudoschwagerina,* also possibly the upper part of the *Triticites* zone in central New Mexico

Pennsylvanian
- Zone of *Triticites*
- Zone of *Fusulina* and of *Wedekindellina;* also carries *Staffella* and *Ozawainella*

The Pennsylvanian rocks of New Mexico are known as the Magdalena formation. In the ridges near the Rio Grande the Magdalena has been divided into the Sandia formation below and the Madera formation above. However, the plane of division between the two is so inconstant and the lithologic character of the Pennsylvanian rocks varies to such an extent from place to place that divisions corresponding with the Sandia and Madera formations cannot be recognized in many parts of the State.

The zone of *Fusulina* and *W Wedekindellina* apparently does not extend to the base of the formation. Its first appearance above the base is variable, as is to be expected because of the variation in the deposition of sediments upon the unconformity developed in pre-Pennsylvanian time. Near Taos, elastic sediments several hundred to 1,000 feet thick lie below this zone. In the foothills west of Las Vegas it has been found very close to pre-Cambrian granite, especially in a small dome about 7 miles east of San Geronimo. This dome was probably an island in the Magdalena sea. In the Sandia Mountains east of Albuquerque this zone makes its appearance 200 to 250 feet above the base; in the Socorro Mountains, 500 to 600 feet, in the Oscura Mountains at least 300 feet, at Santa Rita approximately 110 feet, in Water Canyon in the Magdalena Mountains about 400 feet, and in the ridges a few miles east of Socorro, the first known occurrence of *Fusulina* is about 700 feet above the base of the Magdalena formation.

The thickness of this zone is not the same everywhere, depending again on the rate of sedimentation during Pennsylvanian time. Its maximum development is near Taos, where it appears to be well over 1,000 feet thick. In the central part of the State, where the Magdalena formation is most typically developed, it ranges from 300 to 400 feet in thickness.

The zone of *Fusulina* and *Wedekindellina* in New Mexico carries *Fusulina euryteines* Thompson, *F. socorroensis* Needham, n. sp., *F. novamexicana* Needham, n. sp. *F. taosensis* Needham, n. sp., *Wedekindellina euthysepta* (Henbest) , and *W. excentrica* Roth and Skinner. *Fusulina euryteines* characterizes a widespread zone in shales of Cherokee age in Missouri, in the Millsap division of the Strawn group in north-central Texas, and in the Haymond formation in the Marathon Basin of west Texas. Closely related species are found in the Hermosa and McCoy formations of Colorado.

Wedekindellina euthysepta characterizes a zone in the base of the Carbondale formation in Illinois, in the Millsap formation of north-central Texas, in the Atoka shale of Oklahoma, and in the McCoy formation of Colorado. *W. excentrica* is also found in the McCoy formation and in the Hermosa formation.

Thus, the lower one-half to two-thirds of the Magdalena formation is to be correlated with parts of the Strawn and Des Moines series of the mid-Continent region, the McCoy and Hermosa formations of Colorado, parts of the Pottsville and Carbondale formations of Illinois, and the Haymond of west Texas.

The zone of *Triticites* appears a short distance above the zone of *Fusulina* and *Wedekindellina,* and, so far as known, does not contain any other fusulinid genera. This zone contains *Triticites ventricosus* (Meek) with one variety, *T. nebraskensis* Thompson, *T. wellsi* Needham, n. sp., *T. gallowayi* Needham, n. sp., *T. fresnalensis* Needham, n. sp., *T. cuchilloensis* Needham, n. sp., *T. jemezensis* Needham, n. sp., *T. rhodesi* Needham, n. sp., and *T. kellyensis* Needham, n. sp.

Probably the oldest representative of this zone is *Triticites nebraskensis,* which is found toward the north end of the Sierra Los Pinos. *T. ventricosus* and its varieties appear in the upper part of the formation and extend to the base of the Permian, or possibly a short distance into the Permian. *T. fresnalensis* is found only a short distance below the Permian, as are *T. kellyensis* and *T. jemezensis. T. gallowayi* and *T. wellsi* occur slightly below these, and *T cuchilloensis* is found somewhat below the middle of the *Triticites* zone. *T. rhodesi* is found below *T. ventricosus.*

The contact of the top of the Magdalena formation with the overlying Permian red beds (Abo sandstone) is also irregular, and the zone of *Triticites* accordingly varies in thickness from place to place. Near Taos, *Triticites* was not found, although the

zone may be merely unfossiliferous. Elsewhere, it has been found in the following mountains : Jemez, Sangre de Cristo (near Santa Fe) , Sandia, Manzano, Los Pinos, Magdalena, Cuchillo, San Andres, Sacramento, Big hatchet, and Pyramid. In the central part of the state the thickness of the zone is 300 to 500 feet.

Triticites nebraskensis characterizes a zone in the Missouri series of Nebraska and Iowa. Closely related forms are the long-ranging group of *T. irregularis,* which characterizes the Missouri series and the Canyon series of Texas. On this basis, the lower part of the zone of *Triticites* in New Mexico is correlated with the above named divisions in Iowa, Missouri, Kansas, Nebraska, and Texas.

Triticites ventricosus and its varieties characterize the Wabaunsee formation in the upper part of the Virgil series of Kansas and Nebraska, and the upper part of the Cisco series of north-central Texas. Thus, the upper portion of the Magdalena formation in some parts of New Mexico is upper Cisco and upper Virgil in age.

However, *T. ventricosus* has not been found everywhere in the upper Magdalena beds. The forms developed in these beds, particularly in the Jemez, Magdalena, and southern Sangre de Cristo Mountains, and in the Coyote Hills near Socorro, are much advanced over *T. nebraskensis* and *T. irregularis* but are not as advanced as *T. ventricosus.* Therefore, these beds are older than the Wabaunsee formation of Nebraska and probably correlate with the Shawnee formation of that region.

North of the Texas-New Mexico state line the Permian succession consists of the Abo formation below and the Chupadera formation above. The Chupadera formation is further divided into two members : lower, the Yeso ; and upper, the San Andres. West of Carlsbad the San Andres formation is overlain by the Dog Canyon limestone.

Along the Texas-New Mexico state line the Permian sequence comprises the Hueco limestone at the base, which is overlain farther east by the Bone Springs limestone, the Delaware Mountain formation, and the Capitan limestone, in ascending order.

As is described elsewhere in this report, a small collection from the Yeso formation northeast of Socorro contained species of fusulinids, which may be *Triticites ventricosus,* or some of its varieties. In Nebraska and Kansas this group ranges as high as the Chase formation of Permian age. Therefore, it appears probable that the Yeso of New Mexico has its correlatives somewhere within the Big Blue group of Nebraska and Kansas.

The lower part of the Permian in New Mexico is not characterized, however, by *Triticites* but by *Schwagerina* and *Pseudoschwagerina.* In the Jarilla Mountains, Otero County, *Pseudoschwagerina morsei* Needham, n. sp., is abundant, *Schwagerina emaciata* (Beede) is plentiful, and *S. emaciata* var. *jarillaensis*

Needham, n. var., is abundant in the Hueco limestone. In the Hueco Mountains, *Pseudoschwagerina fusulinoides* (Schellwien) , *P. uddeni* (Beede and Kniker) , *Schwagerina huecoensis* (Dunbar and Skinner) , and *S. thompsoni* Needham, n. sp., are found in the lower part of the Hueco limestone (restricted) . None of these species has been found in the Permian beds north of the Jarilla Mountains.

Pseudoschwagerina fusulinoides and *P. uddeni* characterize the middle of the Wolfcamp formation in the Glass Mountains of West Texas, but they have not been reported in Kansas or Nebraska.

Schwagerina emaciata is characteristic of the Cottonwood limestone of the Big Blue group in Nebraska, and the Florence shale of Kansas. On this basis, the limestones in the Jarilla Mountains near Oro Grande are considered to be of Lower Permian age and are a northern extension of the Hueco limestone (restricted) of the Hueco Mountains.

Above the zone of *Schwagerina* and *Psuedoschwagerina* is the zone of *Parafusulina.* In the Guadalupe Mountains of New Mexico and Texas this zone is represented by the one species, *P. dunbari* Needham, n. sp. This species is very abundant in the upper part of the Delaware Mountain sandstone at Guadalupe Point, Texas, and in cherty limestones in Last Chance Canyon, New Mexico. These cherty limestones are considered to be the Dog Canyon limestone.

Parafusulina dunbari is closely related to *P. wordensis* Dunbar and Skinner, which characterizes the upper part of the Word formation of the Glass Mountains, west Texas. It is probable, therefore, that the limestones in Last Chance Canyon and the middle part of the Delaware Mountain sandstone correlate with some part of the Word formation of the Glass Mountains.

The highest of the Permian fusulinid zones in this part of the United States is the zone of *Polydiexodina.* At Guadalupe Point, Tex., *Polydiexodina guadalupensis* Needham, n. sp. is abundant in the dark limestone at the top of the Delaware Mountain formation and in the base of the white Capitan limestone. A closely related form, *P. shumardi* Dunbar and Skinner, occurs about 2,000 feet above the base of the Delaware Mountain formation in the Delaware Mountains.

In the higher parts of the Capitan limestone *Polydiexodina capitanensis* is reported. The writer did not collect from beds this high. No species of *Polydiexodina* have been described from New Mexico, although they probably occur in some part of the Guadalupe Mountains. Crandall [1] reports large fusulinids from the thin-bedded Carlsbad limestones in sec. 28, T. 26 S., R. 21 E., New Mexico. The stratigraphic position of these beds makes it

[1] Crandall, K. H., personal communication, 1934.

appear likely that the fusulinids in them are some species of *Polydiexodina.*

Inasmuch as *Polydiexodina* occupies a higher zone than *Parafusulina* and characterizes the Capitan limestone, and inasmuch as the Dog Canyon limestone, overlying the San Andres limestone, is characterized by *Parafusulina,* it follows that the San Andres limestone can hardly be thought to grade laterally into the Capitan limestone, as numerous geologists suppose. It is believed that the San Andres is the equivalent of the Bone Springs and the Leonard formations, and the Dog Canyon the equivalent of the Word formation and the middle part of the Delaware Mountain formation.

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DESCRIPTIONS OF SPECIES

Genus STAFFELLA Ozawa, 1925

STAFFELLA ATOKENSIS (?) Thompson

Plate II, figs. 1, 2

Description.—Three specimens of this genus were found in thin sections of a rather hard limestone from one locality. Because of the scarcity of specimens and the lack of proper orientation, the exact determination of this species is slightly in doubt.

The tests are small, with axial diameter the shorter. The axial diameters of the three specimens are respectively : 0.29 mm., 0.31 mm., 0.37 mm. ; corresponding measurements for the equatorial diameters are : 0.43 mm., 0.45 mm., 0.55 mm. ; form ratios, in the same order : 0.667 :1; 0.688 :1; 0.673 :1. The tests are nautiloid, and the peripheral margin is round. Our sections show three or four whorls. Chomata are prominent in all whorls. The tunnel is narrow, having an angle of 21° to 23°. The walls are thin, measuring 0.015 mm. to 0.02 mm. in the third and fourth whorls. The proloculum has an outside diameter of 0.06 mm. to 0.07 mm.

Discussion.— Of the species of this genus described from America, our specimens most resemble *Staff ella atokensis* Thompson in size and form ratio. *S. keytei* Roth and Skinner has a form ratio of about 0.86:1 and a slightly narrower tunnel than our species.

Occurrence.—Found in limestones in the lower half of the Magdalena formation in the eastern foothills of the Black Range, near Kingston, Sierra Co. The genus *Fusulina* occurs very abundantly in the same beds.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; figured specimens are Nos. P 38.2 and P 39.2 from near Kingston.

Genus OZAWAINELLA Thompson, 1935

OZAWAINELLA sp.

Plate II, *fig.* 3

Description.—The only good specimen of this genus in our collections was found in a thin section of limestone. Specific determination has not been attempted from the one specimen.

The test is lenticular, planispiral, nearly bilaterally symmetrical, periphery angled. The equatorial diameter is 0.58 mm., the axial diameter, 0.135 mm. The chomata have very slight development. The tunnel is narrow, but well defined, and has an angular width of about 10°. The walls are very thin, scarcely

exceeding 0.01 mm. in the later whorls. Our specimen shows six whorls.

Occurrence.—In limestones from the lower half of the Magdalena formation in Valle del Ojo de la Parida, about ten miles northeast of Socorro. In the same rocks are found abundant *Fusulina* and *Wedekindellina.* The blocks of limestone yielding these forms are not in place, inasmuch as this little valley is filled with debris from the adjacent hills, and numerous large blocks of pre-Cambrian crystalline rocks, as well as blocks of limestone, are found resting along the valley walls. The stratigraphy of the locality is further complicated by extensive faulting, but the position of the limestone blocks in the stratigraphic column is definite because of the association with *Fusulina* and *Wedekindellina.*

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimen is No. P 48.2, from Valle de Ojo de la Parida, Socorro County.

Genus FUSULINA Fisher, 1837

FUSULINA EURYTEINES Thompson

Plate II, figs. 4, 5

Fusulinella meeki Dunbar and Condra, Nebr. Geol. Survey Bull. 2, ser. 2, p. 78, p1. 2, figs. 12-14; pl. 15, figs. 4-6, 1927

Fusulina meeki M. P. White, Univ. Texas Bull. 3211, p. 27, pl. 1, figs. 7-12, 1932

Fusulina euryteines Thompson, Univ. Iowa Studies, vol. 16, p. 310, pl. 22, figs. 4, 13, 14, 18, 1934

Exterior.—The test is medium in size. Adults have a length of 4.0 mm. to 6.0 mm. and a diameter of 1.6 mm. to 2.5 mm. The form ratio ranges from 2.1:1 to 2.77:1 and averages 2.45:1 for eighteen specimens measured from five different localities.

The shape of the test is fusiform with straight axis and sharply rounded to somewhat bluntly pointed ends. The lateral slopes are gently convex to more or less concave.

Equatorial section.—Adults have six to seven and one-half whorls. The heights of the whorls are 0.04 mm. to 0.07 mm. in the first whorl, 0.06 mm. to 0.08 mm. in the second, 0.09 mm. to 0.13 mm. in the third, 0.12 mm. to 0.15 mm. in the fourth, 0.16 mm. to 0.19 mm. in the fifth, 0.17 mm. to 0.22 mm. in the sixth, and 0.18 mm. to 0.24 mm. in the seventh, as measured near the end of each whorl.

The septal count is 10 to 13 in the first whorl, 16 to 22 in the second, 18 to 26 in the third, 20 to 28 in the fourth, 24 to 33 in the fifth, and 26 to 36 in the sixth. The proloculum has an outside diameter of 0.12 mm. to 0.20 mm.

The thicknesses of the spiral wall are 0.01 mm. to 0.02 mm. in the first whorl, 0.02 mm. to 0.03 mm. in the second, 0.022 mm. to 0.035 mm. in the third, 0.03 mm. to 0.037 mm. in the fourth, 0.032 mm. to 0.045 mm. in the fifth, and 0.035 mm. to 0.045 mm. in the sixth, as measured near the end of each whorl. The wall is composed of outer and inner tectoria, tectum, and diaphanotheca.

Axial section.—The fluting is strong throughout, although slightly more in the ends than in the mid-zone. Chomata are developed in all the whorls. The tunnel angle has a width of 12° to 14° in the first whorl, 13° to 16° in the second, 14° to 19° in the third, 15° to 20° in the fourth, 17° to 21° in the fifth, 18° to 22° in the sixth, and 21° to 25° in the seventh. Septal pores are usually lacking, but rarely a few small pores are found in the outer whorls of some specimens.

Discussion.—This species very closely resembles *F. rockymontana* Roth and Skinner. However, it has a slightly narrower tunnel, fewer and finer septal pores, and fewer septa.

It is distinguished from *F. haworthi* in having somewhat more pointed ends, more septa on the average, slightly higher volutions, and a narrower tunnel.

Occurrence.—This species is very abundant in a zone in the lower half of the Magdalena formation in the Caballos Mountains, near Arrey, Sierra Co. ; near Santa Rita, Grant Co. ; in the Sangre de Cristo Mountains ; in the Cuchillo Mountains, Sierra Co. ; in the Magdalena and Socorro Mountains, Socorro Co., and in the Sandia Mountains east of Albuquerque. Commonly associated with it is *Wedekindellina euthysepta* (Henbest).

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos. P 37.1 and P 37.2 from the Sangre de Cristo Mountains, 15 to 20 miles east of Taos.

FUSULINA SOCORROENSIS Needham, n. sp.

Plate II, figs. 6-10

Exterior.—The test is of medium size. Adult specimens have a length ranging from 4.2 mm. to 6.5 mm. and a diameter of 1.6 mm. to 2.5 mm. The form ratio varies from 2.3:1 to 2.9:1 and averages 2.66 :1. The shape of the test is fusiform with straight axis and sharply rounded to somewhat bluntly pointed ends. The lateral slopes are gently convex to somewhat concave.

Equatorial section.—Adults show from five and one-half to seven and one-half whorls. The heights of the whorls are 0.04 mm. to 0.06 mm. in the first whorl, 0.05 mm. to 0.09 mm. in the second, 0.08 mm. to 0.12 mm. in the third, 0.12 mm. to 0.18 mm. in the fourth, 0.15 mm. to 0.22 mm. in the fifth, 0.18 mm. to 0.25 mm. in the sixth, and 0.21 mm. to 0.26 mm. in the seventh, as

measured near the end of each whorl. The septa number 9 to 14 in the first whorl, 11 to 18 in the second, 15 to 22 in the third, 17 to 26 in the fourth, 19 to 27 in the fifth, 22 to 30 in the sixth, and 26 to 32 in the seventh. The proloculum has an outside diameter of 0.09 mm. to 0.18 mm. The thicknesses of the wall are 0.01 mm. to 0.02 mm. in the first whorl, 0.015 mm. to 0.025 mm. in the second, 0.02 mm. to 0.03 mm. in the third, 0.022 mm. to 0.04 mm. in the fourth, 0.03 mm. to 0.04 mm. in the fifth and sixth, as measured near the end of each whorl. The wall is composed of outer and inner tectoria, tectum and diaphanotheca.

Axial section.—The fluting is moderate to strong across the mid-zone and strong toward the ends of all specimens. The chomata are prominent in all whorls. The tunnel is moderately wide, having values of 20° to 25° in the first whorl, 18° to 20° in the second, 21° to 30° in the third, 24° to 31° in the fourth, 28° to 40° in the fifth, and 33° to 50° in the sixth. A few septal pores are seen in occasional specimens, but for the most part they are lacking.

Discussion.—This species is distinguished from *F. euryteines* mainly by its much wider tunnel, its slightly greater length, and its greater form ratio. These features and its scarcity of septal pores separate it from *F. rockymontana* Roth and Skinner.

Occurrence.—Commonly associated with *F. euryteines* and *Wedekindellina euthysepta* in the lower half of the Magdalena formation in the Socorro Mountains, Lemitar Mountains, Sangre de Cristo Mountains east of San Geronimo and also northwest of Montezuma Hot Springs, Magdalena Mountains near Kelly, and the north end of the Oscura Mountains on the Bursum Ranch.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 16.1, P 16.3, P 18.1, P 18.2, P 18.3, P 18.4 (cotypes) ; the figured specimens are Nos. P 16.1, P 16.3, P 18.1, and P 18.2 from the Socorro Mountains west and northwest of Socorro.

FUSULINA NOVAMEXICANA Needham, n. sp.

Plate II, figs. 11-15

Exterior.—The test is medium large for the genus. Adults are 4.5 mm. to 5.4 mm. in length and 2.2 mm. to 2.7 mm. in diameter. The form ratio varies from 1.9:1 to 2.15:1 and averages slightly more than 2.0:1.

The shape of the test is ventricose to fusiform with straight axis and concave lateral slopes. The ends are rather blunt. Septal furrows are moderate in depth.

Equatorial section.—Adults have nine to nine and one-half whorls. The heights of the whorls are 0.06 mm. to 0.075 mm. in the first, 0.07 mm. to 0.10 mm. in the second, 0.10 mm. to 0.15 mm.

in the third, 0.11 mm. to 0.17 mm. in the fourth, 0.14 mm. to 0.21 mm. in the fifth, 0.18 mm. to 0.25 mm. in the sixth, 0.21 mm. to 0.27 mm. in the seventh, 0.22 mm. to 0.30 mm. in the eighth, and 0.23 mm. to 0.31 mm. in the ninth, as measured near the end of each whorl.

There are 12 to 14 septa in the first whorl, 19 to 21 in the second, 22 to 26 in the third, 28 to 32 in the fourth, 32 to 34 in the fifth, 36 to 42 in the sixth, 40 to 44 in the seventh, and 42 to 45 in the eighth. The proloculum has an outside diameter of 0.16 mm. to 0.20 mm.

The thickness of the spiral wall is 0.028 mm. to 0.03 mm. in the first and second whorls, 0.03 mm. to 0.04 mm. in the third, 0.035 mm. to 0.045 mm. in the fourth, 0.04 mm. to 0.05 mm. in the fifth, 0.05 mm. to 0.06 mm. in the sixth and seventh, and 0.05 mm. to 0.065 mm. in the eighth and ninth, as measured near the end of each whorl.

The wall is composed of outer and inner tectoria, tectum, and diaphanotheca.

Axial section.-Septal fluting is pronounced throughout, although somewhat more intense in the ends than across the mid-zone. Chomata are well developed in all whorls.

The tunnel is narrow, subtending angles of 12° to 14° in the first six whorls, then gradually increasing to as much as 20° in the eighth and ninth whorls.

Septal pores have not been observed.

The form ratio increases gradually with growth of the organism. A typical specimen of nine whorls shows the following development : form ratio, first whorl, 1.25 :1; second, 1.4 :1; third, 1.42 :1; fourth, 1.44 :1; fifth, 1.45 :1; sixth, 1.54 :1; seventh, 1.56 :1; eighth, 1.82 :1; ninth, 2.0 :1.

Discussion.-This species is readily distinguished from most members of this genus found in the Rocky Mountain region. It is larger than *Fusulina pattoni,* n. sp. and *F. taosensis,* n. sp., and its whorls are more numerous. It has more whorls and a lower form ratio than *F. euryteines* Thompson, *F. rockymontana* Roth and Skinner, and *F. socorroensis,* n. sp.

This form is probably closely related to *F. distenta* Roth and Skinner, which it resembles in a great many respects. It is slightly larger than that species and has a somewhat higher form ratio.

Occurrence.-The stratigraphic position of this species cannot be stated definitely, inasmuch as it has been found only in a faulted block of Magdalena limestone on the east face of Socorro Peak. Associated with it is *Wedekindellina.*

Repository.-New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 18.7, P 18.8, P 18.9, P 18.10, P 18.11 (cotypes) ; figured specimens are Nos. P 18.7, P 18.8,

P 18.9, P 18.10, and P 18.11 from Socorro Peak, three miles west of Socorro.

FUSULINA TAOSENSIS Needham, n. sp.

Plate II, *fig.* 16; Plate III, figs. 1, 2

Exterior.—The test is small. Adults have an average length of about 2.8 mm. and an average diameter of about 1.25 mm., although large specimens attain a length of 4.0 mm. and a diameter of 1.6 mm. The form ratio varies from 1.8:1 to 2.8:1 and averages near 2.3:1.

The shape of the test is fusiform to ventricose with straight axis and gentle convex slopes on typical specimens. The ends are blunt. Septal furrows are distinct.

Equatorial section.—Adults have from five and one-half to six and one-half volutions. The heights of the volutions are 0.04 mm. to 0.045 mm. in the first volution, 0.05 mm. to 0.075 mm. in the second, 0.085 mm. to 0.10 mm. in the third, 0.12 mm. to 0.15 mm. in the fourth, 0.16 mm. to 0.18 mm. in the fifth, and 0.18 mm. to 0.20 mm. in the sixth, as measured near the end of each whorl.

The septal count is 10 to 12 in the first volution, 14 to 16 in the second, 15 to 17 in the third, 17 to 18 in the fourth, 17 to 20 in the fifth, and 21 to 24 in the sixth. The proloculum has an outside diameter of 0.12 mm. to 0.20 mm.

The spiral wall has a thickness of 0.010 mm. to 0.015 mm. in the first volution, 0.015 mm. to 0.02 mm. in the second, 0.018 mm. to 0.026 mm. in the third, 0.022 mm. to 0.03 mm. in the fourth, 0.03 mm. to 0.04 mm. in the fifth, and 0.032 mm. to 0.045 mm. in the sixth, as measured near the end of each whorl.

The wall is composed of outer and inner tectoria, tectum, and diaphanotheca.

Axial section.—The septa are fluted throughout, although somewhat more so in the ends than across the mid-zone. The chomata are thick and heavy in all volutions. The tunnel angle is about 16° in the first volution, 17° to 22° in the second, 20° to 23° in the third, 21° to 25° in the fourth, 22° to 26° in the fifth, and 25° to 27° in the sixth. Septal pores have not been observed.

In its development, a typical specimen has a form ratio of about 1.7:1 in the second whorl, 2.0 :1 in the fourth, and 2.25:1 in the fifth.

Discussion.—This species is considerably smaller than *Fusulina euryteines* Thompson, *F. socorroensis* n. sp., and *F. novamexicana* n. sp. *F. haworthi* (Beede) is larger, has a smaller proloculum and a wider tunnel. *F. girtyi* (Dunbar and Condra) is somewhat larger, has more volutions, and a much lower form ratio. *F. pumila* Thompson has more volutions, a lower form ratio, and more septa. *F. lucasensis* Thompson has more volu-

tions, more septa, and a smaller proloculum. *F. kayi* Thompson is slightly larger, has a higher form ratio and a smaller proloculum. *F. pattoni,* n. sp. has a slightly thinner wall, a wider tunnel, and its septa are less fluted.

Occurrence.—This species is found along U. S. Highway 64, eight or nine miles east of Taos, in the Sangre de Cristo Mountains The Pennsylvanian section is very thick near Taos and is probably cut by a fault just east of the village. It is likely that this species occurs at least a thousand feet above the base of the Pennsylvanian. It underlies the zone of *F. euryteines.*

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P. 50.1, P 50.2, P 50.3, P 50.5 (cotypes) ; the figured specimens are Nos. P 50.2, P 50.3 and P 50.5.

FUSULINA PATTONI Needham, n. sp.

Plate III, *figs.* 3-5

Exterior.—The test is small. Adults have a length of 2.0 mm. to 3.0 mm., a diameter of 1.0 mm. to 1.3 mm., and a form ratio of 2.0:1 to 2.45:1. The shape of the test is fusiform with straight axis, ends broadly to somewhat acutely rounded, and gentle convex lateral slopes. The ends of some specimens are slightly twisted. The antetheca is high and prominent and increases slightly in height from the middle toward the ends. Septal furrows are deep.

Equatorial section.—Adults have five to five and one-half whorls, or rarely six. The heights of the whorls are 0.03 mm. to 0.038 mm. in the first whorl, 0.045 mm. to 0.06 mm. in the second, 0.08 mm. to 0.11 mm. in the third, 0.11 mm. to 0.135 mm. in the fourth, 0.145 mm. to 0.17 mm. in the fifth, and 0.18 mm. to 0.19 mm. in the sixth, as measured near the end of each whorl.

There are 8 to 9 septa in the first whorl, 11 to 12 in the second, 12 to 16 in the third, 15 to 19 in the fourth, and 20 to 23 in the fifth. The proloculum has an outside diameter of 0.09 mm. to 0.12 mm.

The wall is about 0.01 mm. thick in the first whorl, 0.015 mm. to 0.017 mm. in the second, 0.02 mm. to 0.028 mm. in the third, 0.022 mm. to 0.03 mm. in the fourth, and 0.025 mm. to 0.035 mm. in the fifth and sixth, as measured near the end of each whorl. The wall is composed of an outer and an inner tectorium, a very thin tectum, and a rather thick diaphanotheca.

Axial section.—The septal fluting is slight to moderate across the mid-zone but considerably stronger in the ends. Chomata are prominent in all whorls, although in some specimens they are rather faint in the final half-whorl.

The tunnel angles are 17° to 20° in the first whorl, 19° to 22° in the second, 22° to 30° in the third, 26° to 34° in the fourth, and 30° to 40° in the fifth and sixth.

The form ratio increases with growth of the organism, being near 1.2:1 for the first whorl and gradually increasing to 1.9:1 or 2.0:1 in the fourth whorl.

Discussion.—The study of this new species has been possible through the courtesy and permission of Dr. Leroy T. Patton of the Texas Technological College, to whom grateful acknowledgment is made. The collection is a part of that made by Dr. Patton, who conducted a field party into southwestern Colorado during the summer of 1932. The presence of Pennsylvanian sediments in this particular area was first recognized by Dr. Patton. The fusulinids in question were kindly furnished by Mr. R. K. Valentine, a member of Dr. Patton's party at that time.

This species bears considerable resemblance to *Fusulina taosensis,* n. sp., with which it is compared under the description of that species. Compared with *F. haworthi* (Beede) , *F. pattoni* is somewhat smaller and has fewer volutions. *F. hartvillensis* Roth and Skinner has a much higher form ratio. *F. minutissima* Roth and Skinner is a smaller form and has a slightly higher form ratio. *F. meeki tregoensis* Roth and Skinner has a lower form ratio and a greater number of volutions.

Occurrence.—Abundant in the Hermosa formation of Pennsylvian age in the thin-bedded limestones along the east bluff of the Rio Piedra at its junction with Sheep Creek, T. 35 N., R. 4 W., Archuleta County, Colorado.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 15.1, P 15.3, P 15.4, P 15.5, P 15.6, P 15.7 (cotypes) ; the figured specimens are Nos. P 15.4 and P 15.7.

Genus WEDEKINDELLINA Dunbar and Henbest, 1933

WEDEKINDELLINA EUTHYSEPTA (Henbest)

Plate III, figs. 6-8

Fusulinella euthusepta Henbest, Jour. Paleo., vol. 2, p. 80, p1. 8, figs. 6-8; pl. 9, figs. 1, 2, 5, 1928.

Fusulinella euthusepta Galloway and Ryniker, Okla. Geol. Survey Circular 21, p. 25, pl. 5, figs. 6-11, 1930.

Fusulina euthusepta M. P. White, Univ. Texas Bull. 3211, p. 24, pl. 1, figs. 1-3, 1932.

Wedekindellina euthysepta Thompson, Univ. Iowa Studies, N. S. 284, Vol. 16, No. 4, p. 282, pl. 20, figs. 1, 2, 7, 9, 12, 13, 17, 22, 24-27 , 1934.

Exterior.—The test is small. Adult specimens have a length of 2.7 mm. to 3.65 mm., with an average of 3.2 mm. ; a diameter of 0.75 mm. to 1.1 mm., with an average of 0.93 mm. ; and a form ratio of 3.2:1 to 3.8:1, with an average of 3.5:1.

The shape of the test is elongate-fusiform with the axis straight, or nearly straight, ends sharply rounded to pointed, and lateral slopes gentle. The ends show slight twisting in some specimens. The antetheca is of uniform height from the middle to the ends of the test. Septal furrows are marked by a thin line.

Equatorial section.—Adult individuals have from seven to nine and one-half whorls. The heights of the whorls are 0.02 mm. to 0.022 mm. in the first whorl, 0.022 mm. to 0.037 mm. in the second, 0.03 mm. to 0.045 mm. in the third, 0.037 mm. to 0.05 mm. in the fourth, 0.045 mm. to 0.07 mm. in the fifth, 0.075 mm. to 0.10 mm. in the sixth, and 0.077 mm. to 0.12 mm. in the seventh, as measured near the end of each whorl. The septa number 8 to 10 in the first whorl, 11 to 13 in the second, 14 to 16 in the third, 16 to 18 in the fourth, 18 to 20 in the fifth, 21 to 23 in the sixth, and 25 to 26 in the seventh. The proloculum is small, having an outside diameter ranging from 0.045 mm. to 0.07 mm. The thicknesses of the spiral wall are 0.005 mm. to 0.008 mm. in the first whorl, 0.007 mm. to 0.01 mm. in the second, 0.009 mm. to 0.015 mm. in the third, 0.01 mm. to 0.017 mm. in the fourth, 0.015 mm. to 0.02 mm. in the fifth, 0.017 mm. to 0.022 mm. in the sixth, and 0.02 mm. to 0.022 mm. in the seventh, as measured near the end of each whorl. The height of the chamber cavity is from four to five times the thickness of the wall in the last whorls. The wall is composed of a thin outer and a moderately thick inner tectorium, a very thin tectum, and a rather thick diaphanotheca.

Axial section.—The fluting is absent in the middle of the chambers and slight in the ends. Chomata are moderately strong to strong in all but the final whorl, or half-whorl. The axial filling is pronounced, extending the full length of the test and filling the equatorial zone to the fourth or fifth whorl. The tunnel is narrow, having a value of 18° to 20° in the early whorls and gradually increasing to 25° or 30° in the final whorls, although in the last half-whorl of some individuals the tunnel widens greatly and subtends an angle as great as 50°. In the first two or three whorls the form ratio is less than 2.0:1; after that, it increases to near 3.0:1 and shows very little change with further growth of the organism.

Discussion.—There are only a few species with which *Wedekindellina euthysepta* (Henbest) might be confused. In many respects it is similar to *Wedekindellina henbesti* (Skinner) but is shorter, has a lower form ratio, and a much smaller proloculum. It is larger than *Wedekindellina minuta* (Henbest) and has three or four more whorls on the average. It is more slender, therefore has a much higher form ratio than *Wedekindellina excentrica* (Roth and Skinner) and *W. coloradoensis* (Roth and Skin-

ner), or varieties of these species, and the spiral of the tunnel is more nearly plane.

Occurence.—This species marks a prominent zone in the lower part of the Magdalena formation in the Lemitar Mountains, Magdalena Mountains at Kelly and in Water Canyon, Tij eras Canyon east of Albuquerque, Socorro Mountains, Sangre de Cristo Mountains immediately west of Las Vegas, and the Cuchillo Mountains. In the Sandia Mountains it is associated with *Wedekindellina excentrica* (Roth and Skinner) .

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos. P 43.1, P 43.2 from Montezuma Hot Springs in San Miguel County, and No. P 22.1 from Tijeras Canyon east of Albuquerque.

WEDEKINDELLINA EXCENTRICA (Roth and Skinner)

Plate III, figs. 9-11; Plate IV, fig. 1

Wedekindella excentrica Roth and Skinner, Jour. Paleo., vol. 4, p. 340, pl. 30, figs. 1-3, 1930

Exterior.—The test is small. Full grown specimens have a length of 2.6 mm. to 4.0 mm. and a diameter of 0.9 mm. to 1.3 mm. The form ratio varies from 2.8:1 to 3.2:1 and averages 3.1 :1. The shape of the test is elongate-fusiform, with the axis straight, or nearly straight, ends finely rounded, and lateral slopes gentle. The antetheca is of uniform height from the middle of the test to the ends. Septal furrows are flush, or nearly so.

Equatorial section.—Adult specimens have eight to ten volutions. The heights of the volutions are 0.016 mm. to 0.022 mm. in the first volution, 0.02 mm. to 0.025 mm. in the second, 0.028 mm. to 0.03 mm. in the third, 0.032 mm. to 0.04 mm. in the fourth, 0.045 mm. to 0.058 mm. in the fifth, 0.055 mm. to 0.067 mm. in the sixth, 0.067 mm. to 0.075 mm. in the seventh, 0.075 mm. to 0.10 mm. in the eighth, 0.105 mm. to 0.12 mm. in the ninth, and 0.12 mm. to 0.14 mm. in the tenth, as measured near the end of each whorl. The septa number 9 to 11 in the first whorl, 11 to 13 in the second, 14 to 16 in the third, 17 to 19 in the fourth, 20 to 23 in the fifth, 23 to 25 in the sixth, and 24 to 26 in the seventh. The proloculum is small, having an outside diameter of 0.06 mm. to 0.077 mm. The thicknesses of the wall are 0.006 mm. to 0.007 mm. in the first whorl, 0.007 mm. to 0.009 mm. in the second, 0.01 mm. to 0.012 mm. in the third, 0.01 mm. to 0.014 mm. in the fourth, 0.015 mm. to 0.017 mm. in the fifth, 0.022 mm. to 0.028 mm. in the sixth, 0.028 mm. to 0.03 mm. in the seventh, eighth, ninth, and tenth, as measured near the end of each whorl. The wall is composed of a thin outer and a moderately thick inner tectorium, a very thin tectum, and a rather thick diaphanotheca.

Axial section.—The septa are plane across the equatorial zone and weakly fluted toward the poles. Chomata are pronounced in all whorls. The axial filling is pronounced. The tunnel is narrow, having a value of about 15° in the early whorls and gradually increasing to 25° or 27° in the outer whorls. The course of the tunnel is very erratic, showing in axial sections abrupt offsets from one whorl to the next. The form ratio attains a value of near 3.0:1 after the first two or three whorls and does not show further change with growth of the organism.

Discussion.—This species is compared with *Wedekindellina euthysepta* (Henbest) under the description of that species. This species has a higher form ratio and a more crooked tunnel than *Wedekindellina coloradoensis* (Roth and Skinner) .

Occurrence.—Rather abundant in the lower part of the Magdalena formation along Tij eras Canyon in the Sandia Mountains east of Albuquerque. Associated with it are occasional specimens of *W. euthysepta* (Henbest) .

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources; Nos. P 22.3, P 22.4, P 22.6, and P 22.7. The figured specimens are from Tijeras Canyon in the Sandia Mountains.

Genus TRITICITES Girty, 1904

TRITICITES NEBRASKENSIS Thompson

Plate IV, figs. 2, 3

Triticites exigua Schellwien and Staff, Paleontographica, vol. 59, p, 179, text *fig.* 10, pl. 15, fig. 4 *(non F. vulgaris exigua* Schellwien), 1912

Triticites exiguus Dunbar and Condra, Nebr. Geol. Survey Bull. 2, ser. 2, p. 111, pl. 8, figs. 1-5, 1927

Triticites nebraskensis Thompson, Univ. Iowa studies, N. S. 284, vol. 16, No. 4, footnote p. 281, 1934.

Exterior.—Tests are very small, attaining a length of 2.3 mm. to 4.5 mm. and a diameter of 0.7 mm. to 1.3 mm. The form ratio varies from 3.0:1 to 4.2:1 and averages 3.25:1 for twenty specimens measured.

The shape of the test is subcylindrical to elongate-fusiform with broadly rounded to acutely rounded ends. The axis is straight to slightly curved. The lateral slopes are very gentle. Preservation of the material has made it impossible to determine the nature of the furrows and the antetheca.

Equatorial section.—Adult specimens have five to five and one-half whorls. The heights of the whorls are 0.028 mm. to 0.037 mm. in the first whorl, 0.04 mm. to 0.06 mm. in the second, 0.08 mm. to 0.11 mm. in the third, 0.11 mm. to 0.15 mm. in the fourth, and 0.15 mm. to 0.18 mm. in the fifth, as measured near the end of each whorl.

The septal count is 9 to 10 in the first whorl, 12 to 15 in the second, 14 to 18 in the third, 19 to 20 in the fourth, and 21 to 25 in the fifth. The proloculum has an outside diameter of 0.09 mm. to 0.12 mm.

The thicknesses of the wall are 0.01 mm. to 0.015 mm. in the first whorl, 0.02 mm. to 0.022 mm. in the second, 0.025 mm. to 0.03 mm. in the third, 0.035 mm. to 0.045 mm. in the fourth, and 0.04 mm. to 0.045 mm. in the fifth, as measured near the end of each whorl.

The wall is composed of a thin tectum, and, for the genus, a rather faintly alveolar keriotheca, which has 10 alveoli in 0.125 mm. to 0.135 mm.

Axial section.—The septa are nearly plane across the middle of the chambers and only moderately fluted toward the ends, so that in axial section the fluting is confined to a narrow axial zone. Chomata are moderately strong in all whorls except the final whorl, where they are absent in most specimens.

The tunnel is wide, having a value of 22° to 30° in the first whorl, 30° to 45° in the second, 40° to 65° in the third, and 45° to 88° in the fourth.

Septal pores are few and small, and, when present, are near the ends in the outer whorl.

The form ratio increases gradually with growth, being from 1.3:1 to 1.5:1 in the first whorl, reaching a value of 2.0:1 near the second whorl, and increasing to near 3.0 :1 in the third or fourth whorl.

Discussion.—This species has many of the characteristics of *T. irregularis,* but in general it is considerably smaller and not so slender.

From *T. cullomensis* var. *pygmaeus* Dunbar and Condra it is distinguished by its much higher form ratio.

From. *T. jemezensis,* n. sp., it is distinguished by having about one less whorl on the average, lower volutions after the first volution, much wider tunnel, and thinner walls in the later whorls.

Occurrence.—In the Magdalena limestones near the north end of the Los Pinos Mountains along the Bernardo-Mountainair highway. At this point the Pennsylvanian rocks are faulted down against pre-Cambrian schists and lie in an overturned syncline against the fault. Our collection comes from near the base of the exposed section. It is not possible to determine how much of the normal sequence is faulted out, but it appears likely that some 400 feet to 500 feet is missing, inasmuch as the zone of *Wedekindellina* and *Fusulina,* lying below the zone of *Triticites,* is not present.

Repository.-New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are No. 33.3 from the north end of the Sierra Los Pinos, Socorro County, about six miles southeast of Scholle.

TRITICITES VENTRICOSUS (Meek)

Plate IV, figs. 4; 7-9

Fusulina cylindrica var. *ventricosa* Meek, Proc. Acad. Nat. Sci. Philadelphia, vol. 10, p. 261, 1858.

Fusulina cylindrica Meek and Hayden (part), Paleo. Upper Missouri, Smithsonian Contrib. to Knowledge, vol. 14, p. 14, 1865.

Triticites ventricosus Dunbar and Condra, Nebr. Geol. Sur. Bull. 2, ser. 2, p. 84, pl. 3, figs. 1-6; pl. 4, *figs.* 1-3; 1927.

Triticites ventricosus M. P. White, Univ. of Texas Bull. 3211, p. 70, pl. 7, figs. 1-9, 1932.

Exterior.-This species displays a considerable degree of variation in external proportions. The test is medium to large in size. Adult specimens attain a length of 6.0 mm. to 8.0 mm. and a diameter of 2.4 mm. to 4.0 mm. The form ratio varies from 2.0:1 to 2.4:1 and averages 2.2:1.

The shape of the test is fusiform to ventricose with blunt to sharply rounded ends, straight axis, and gentle slopes. The antetheca is of uniform height, or nearly so, throughout its length. The septal furrows are moderately deep.

Equatorial section.-Adult specimens have seven to nine volutions. The heights of the volutions are 0.04 mm. to 0.06 mm. in the first volution, 0.07 mm. to 0.10 mm. in the second, 0.12 mm. to 0.16 mm. in the third, 0.17 mm. to 0.22 mm. in the fourth, 0.23 mm. to 0.32 mm. in the fifth, 0.28 mm. to 0.38 mm. in the sixth, 0.33 mm. to 0.43 mm. in the seventh, and 0.35 mm. to 0.45 mm. in the eighth, as measured near the end of each whorl.

The septa number 11 to 13 in the first whorl, 16 to 24 in the second, 19 to 26 in the third, 20 to 27 in the fourth, 22 to 28 in the fifth, 25 to 30 in the sixth, and 26 to 33 in the seventh.

The proloculum has an outside diameter of 0.10 mm. to 0.185 mm.

The thicknesses of the wall are 0.02 mm. to 0.03 mm. in the first whorl, 0.027 mm. to 0.045 mm. in the second, 0.03 mm. to 0.055 mm. in the third, 0.055 mm. to 0.08 mm. in the fourth, 0.065 mm. to 0.09 mm. in the fifth, 0.075 mm. to 0.11 mm. in the sixth, 0.085 mm. to 0.12 mm. in the seventh, and 0.115 mm. to 0.125 mm. in the eighth, measured near the end of each whorl. The height of the chamber cavity in the last whorls is three to three and one-half times the thickness of the wall.

The wall is composed of a thin tectum and a thick keriotheca which has 10 alveoli in 0.175 mm. to 0.22 mm.

Axial section.—The septal fluting is slight in the middle of the chambers, becoming absent in the final whorls, but is pronounced in all chambers toward the ends. Chomata are moderately strong to strong in all whorls except the last, or last half-whorl.

The tunnel is narrow, having a value of 12° to 20° in the early whorls and gradually increasing to a value of 28° to 35° in final whorls.

Septal pores are abundant and large in most specimens after the fourth or fifth whorl.

The form ratio increases gradually with growth. In the first whorl it is 1.5 :1 to 1.7 :1; in the fourth and fifth whorls 1.65 :1 to 1.8 :1, from which it increases to 2.0 :1 or more at maturity.

Discussion.—Inasmuch as this species shows much variation both in its external and internal characters, it is a problem to decide which of these variable forms should be designated as varieties. However, differences among them are considered great enough to afford a basis for the recognition of one separate variety in New Mexico.

Occurrence.—This species is abundant through a zone in the upper part of the Magdalena formation in the Sacramento Mountains east of Alamogordo, in the north end of the Manzano Mountains east of Albuquerque, and in Rhodes Canyon in the San Andres Mountains, Socorro Co.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are No. P 9.3 from Cedro Canyon in the Manzano Mountains, Nos. P 2.0, P 2.1, P 2.4 from the Sacramento Mountains near Alamogordo.

TRITICITES VENTRICOSUS

var. SACRAMENTOENSIS Needham, n. var.

Plate IV, figs. 5, 6, 10, 11; Plate V, fig. 1

Exterior.—The test is large. Adult specimens are 7.0 mm. to 8.0 mm. in length and 3.6 mm. to 4.0 mm. in diameter, giving a form ratio varying from 1.97 :1 to 2.1:1 and averaging 2.0 :1.

The shape of the test is fusiform to ventricose, with straight axis, gentle convex lateral slopes and rather pointed to slightly rounded ends. The antetheca is of uniform height from the middle to the ends. Septal furrows are moderately deep.

Equatorial section.—Adult specimens have six to seven and one-half volutions. The heights of the successive whorls are 0.085 mm. to 0.092 mm. in the first whorl, 0.16 mm. to 0.185 mm. in the second, 0.22 mm. to 0.25 mm in the third, 0.32 mm. to 0.35 mm. in the fourth, and 0.36 mm. to 0.43 mm. in the fifth and sixth, as measured near the end of each whorl.

The septa number 10 to 12 in the first volution, 15 to 19 in the second, 19 to 25 in the third, 23 to 28 in the fourth, 24 to 26 in the fifth, and 26 to 29 in the sixth.

The proloculum has an outside diameter of 0.155 mm. to 0.185 mm.

The thickness of the wall, as measured near the end of each whorl, is 0.025 mm. to 0.03 mm. in the first whorl, 0.042 mm. to 0.045 mm. in the second, 0.075 mm. to 0.078 mm. in the third, 0.09 mm. to 0.105 mm. in the fourth, 0.092 mm. to 0.11 mm. in the fifth, and sixth, and 0.10 mm. to 0.11 mm. in the seventh. The height of the chamber cavity in the last whorls is approximately four times the thickness of the wall.

The wall is composed of a tectum and coarse keriotheca which has 10 alveoli in 0.17 mm. to 0.20 mm.

Axial section.—The fluting is slight in the equatorial regions and moderate toward the poles. Chomata are well developed in all whorls except the final, where they become weak or lacking.

The tunnel angle is of moderate width, having a value of 15° to 22° in the first whorl, 17° to 25° in the second, 18° to 28° in the third, 21° to 32° in the fourth, 30° to 35° in the fifth, and 31° to 37° in the sixth.

Septal pores have been observed in small numbers in the fifth and sixth whorls. They are rather small, measuring about 0.01 mm. in diameter.

The form ratio increases gradually with growth, being near 1.5 :1 for the first and second whorls, increasing to about 1.8 :1 or 1.9 :1 for the third and fourth, and near 2.0:1 for the later whorls.

Discussion.—This variety of the species differs from the typical species in its more gibbous form expressed by a slightly lower form ratio, fewer volutions, much higher volutions, and more rapid increase in wall thickness. In size and form ratio it is very similar to *Triticites ventricosus* var. *inflates* Galloway and Ryniker, but it has fewer and higher volutions and thicker walls in the middle volutions.

Occurrence.—This variety is abundant in the upper half of the Magdalena formation in the Sacramento Mountains immediately east of La Luz, Otero Co. It is associated with abundant typical *Triticites ventricosus* (Meek) but has been found to occur mainly in the lower part of the *Triticites ventricosus* zone.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources Nos. P 5.0, P 5.2, P 5.3 (cotypes) ; the figured specimens are Nos. P 5.0, P 5.2 and P 5.3 from near La Luz Siding, Otero County.

TRITICITES KELLYENSIS Needham, n. sp.

Plate V, *figs.* 2-5; 7

Exterior.—The test is medium to fairly large in size. Adults are 6.0 mm. to 8.0 mm. in length and 2.5 mm. to 2.9 mm. in diameter. The form ratio varies from 2.3:1 to 2.8:1 and averages 2.5:1 for ten specimens measured. The shape of the test is fusiform with blunt to rather pointed ends, straight axis, and convex to concave lateral slopes. The antetheca increases slightly in height toward the poles. Septal furrows are rather prominent.

Equatorial section.—This species has seven to eight whorls. The heights of the whorls are 0.03 mm. to 0.04 mm. in the first whorl, 0.04 mm. to 0.055 mm. in the second, 0.07 mm. to 0.10 mm. in the third, 0.12 m. to 0.15 mm. in the fourth, 0.20 mm. to 0.26 mm in the fifth, 0.22 mm. to 0.31 mm. in the sixth, 0.29 mm. to 0.35 mm. in the seventh, and 0.31 mm. to 0.38 mm. in the eighth, as measured near the end of each whorl.

The septal count is 9 to 12 in the first whorl, 12 to 19 in the second, 15 to 22 in the third, 17 to 24 in the fourth, 19 to 25 in the fifth, 22 to 27 in the sixth, 24 to 29 in the seventh, and 28 to 30 in the eighth. The proloculum has an outside diameter of 0.10 mm. to 0.16 mm.

The wall thickness is about 0.02 mm. in the first whorl, 0.025 mm. to 0.03 mm. in the second, 0.03 mm. to 0.035 mm. in the third, 0.035 mm. to 0.04 mm. in the fourth, 0.045 mm. to 0.055 mm. in the fifth, 0.06 mm. to 0.07 mm. in the sixth and seventh, and 0.07 mm. to 0.08 mm. in the eighth, as measured near the end of each whorl. The wall is composed of a tectum and keriotheca, which has 10 alveoli in 0.150 mm. to 0.185 mm., as measured in the later whorls.

Axial section.—The fluting is lacking across the mid-zone of the later whorls, moderate across the mid-zone of the earlier whorls, and intense in the ends of all whorls. The chomata are strong except in the last whorl, where they are weak or nearly absent.

The tunnel has a width of 16° to 20° in the first whorl, 17° to 25° in the second, 18° to 26° in the third, 20° to 28° in the 'fourth, 25° to 35° in the fifth, 30° to 40° in the sixth, and 32° to 42° in the seventh. A few septal pores are found in some specimens, but in most specimens they have not been observed.

Discussion.—Although this is a robust species, it has not attained the sturdiness of the *Triticites ventricosus* group, as is shown by its somewhat smaller size, thinner walls, and lower chambers. Instead, it appears to have reached about the stage of development of some of the forms that characterize the lower Virgil series of Nebraska and the upper Canyon series of Texas. This form is slightly larger than *T. cullomensis* Dunbar and Condra, usually has about one more whorl, and in the early whorls its chambers are lower, and in the later ones its wall is thinner.

From *T. secalicus* (Say) it is distinguished chiefly by its lower form ratio, different shape, narrower tunnel, and coarser texture of the keriotheca.

Compared with *T. acutus* Dunbar and Condra, it has a lower form ratio, a different shape, and the wall in the later whorls is thinner. It is a slightly larger form than *T. moorei* Dunbar and Condra, has about one more whorl, and its form ratio is lower.

Occurrence.—This species is found near the top of the Magdalena formation in the Magdalena Mountains near Kelly, and in the Jemez Mountains at Jemez Springs. The zone of *T. ven-tricosus* has not been found above it in these localities.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 21.1, P 21.2, P 21.3, P 21.4, (cotypes) ; the figured specimens are Nos. P 21.3 and P 21.4, from near Kelly in the Magdalena Mountains, and Nos. P 11.00 and P 11.8 from near Jemez Springs in the Jemez Mountains.

TRITICITES CUCHILLOENSIS Needham, n. sp.

Plate V, figs. 6; 840

Exterior.—The test is large. Adults attain a length of 9.2 mm. to 11.3 mm. and a diameter of 1.85 mm. to 2.1 mm. The form ratio varies from 4.5:1 to 5.8:1 and averages 5.2:1 for six specimens measured.

The shape of the test is elongate-elliptical to subcylindrical with straight axis and very gentle, convex slopes. The ends are blunt to somewhat pointed. Septal furrows are moderate in depth.

Equatorial section.—Mature specimens have seven and one-half to eight volutions. The heights of the volutions are 0.03 mm. to 0.037 mm. in the first, 0.037 mm. to 0.045 mm. in the second, 0.05 mm. to 0.062 mm. in the third, 0.062 mm. to 0.075 mm. in the fourth, 0.10 mm. to 0.12 mm. in the fifth, 0.155 mm. to 0.20 mm. in the sixth, 0.20 mm. to 0.26 mm. in the seventh, and 0.24 mm. to 0.29 mm. in the eighth, as measured near the end of each volution.

The septa number 12 to 13 in the first volution, 16 to 18 in the second, 18 to 20 in the third, 20 to 22 in the fourth, 24 to 26 in the fifth, 26 to 29 in the sixth, and 28 to 31 in the seventh. The proloculum is rather small, having an outside diameter of 0.08 mm. to 0.10 mm.

The thickness of the wall is about 0.015 mm. in the first volution, 0.015 mm. to 0.022 mm. in the second, 0.02 mm. to 0.025 mm. in the third, 0.02 mm. to 0.028 mm. in the fourth, 0.028 mm. to 0.03 mm. in the fifth, 0.03 mm. to 0.032 mm. in the sixth, 0.04 mm. to 0.045 mm. in the seventh, and 0.045 mm. to 0.055 mm. in the eighth, as measured near the end of each volution.

The wall is composed of tectum and keriotheca which has 10 alveoli in 0.135 mm. to 0.155 mm.

Axial section.—The fluting is moderate across the mid-zone of the inner whorls and pronounced in the ends of all whorls. Across the mid-zone of the outer whorls it becomes very slight or absent. Chomata are prominent in all whorls.

The tunnel is narrow in the early whorls and widens rapidly in the outer whorls, having angles of 17° to 19° in the first, second, and third whorls, 18° to 22° in the fourth, 21° to 31° in the fifth, 32° to 45° in the sixth, 42° to 48° in the seventh, and 43° to 52° in the eighth.

Septal pores are rather abundant toward the ends of the outer whorls.

The form ratio increases with growth of the organism. A rather typical specimen of eight whorls shows a ratio of about 1.4:1 for the first whorl, 1.8 :1 for the second, 2.3 :1 for the third, 2.85 :1 for the fourth, 3.1:1 for the fifth, 3.6:1 for the sixth, and 4.1:1. for the seventh.

Discussion.—The great length and high form ratio of this species make it readily distinguishable from nearly every species of the genus *Triticites.* From large specimens of *T. irregularis* it is separated by its stronger fluting, thinner walls, and more volutions. It differs from *T. secalicus* in having a much higher form ratio. In many respects it bears close resemblance to *T. ohioensis* Thompson, but it is longer and has a slightly higher form ratio, its later volutions are much lower, and its septa are somewhat more strongly fluted.

Compared with *T. osagensis* Newell this species has a lower form ratio, a narrower tunnel, and a much thinner wall after the fifth volution.

Occurence.—This form is rare near the middle of the Magdalena formation in the Cuchillo Mountains.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 26:1, P 26.2 (cotypes) ; the figured specimens are Nos. P 26.1 and P 26.2 from the Cuchillo Mountains, T. 11 S., R. 7 W., about six miles east of Chloride, Sierra County.

TRITICITES WELLSI Needham, n. sp.

Plate VI, figs. 1-3

Exterior.—The test is small to medium in size, attaining a length up to 6.0 mm. and a diameter of 1.5 mm. to 2.0 mm. The form ratio varies from 2.8:1 to 3.1:1 and averages 3.0:1 for eight typical specimens. The shape of the test is elongate to elliptical, with straight axis, bluntly rounded ends, and very gentle, convex slopes. Septal furrows are moderately deep.

Equatorial section.—Adults have six to six and one-half whorls. The heights of the whorls are 0.03 mm. to 0.035 mm. in the first whorl, 0.045 mm. to 0.065 mm. in the second, 0.07 mm. to 0.11 mm. in the third, 0.12 mm. to 0.165 mm. in the fourth, 0.20 mm. to 0.29 mm. in the fifth, and 0.24 mm. to 0.30 mm. in the sixth, as measured near the end of each whorl.

The septal count is 10 to 12 in the first whorl, 11 to 13 in the second, 16 to 18 in the third, 17 to 20 in the fourth, and 18 to 21 in the fifth. The proloculum has an outside diameter of 0.09 mm. to 0.12 mm.

The thickness of the wall is 0.014 mm. to 0.016 mm. in the first whorl, 0.02 mm. to 0.022 mm. in the second, 0.028 mm. to 0.032 mm. in the third, 0.03 mm. to 0.037 mm. in the fourth, and 0.045 mm. to 0.052 mm. in the fifth and sixth, as measured near the end of each whorl. The wall is composed of a tectum and a coarse keriotheca, which has 10 alveoli in 0.16 mm. to 0.20 mm.

Axial section.—Septal plications are absent across the middle zone and moderately strong toward the ends of the test. Chomata are prominent to the final whorl, where they become weak or absent.

The tunnel is rather wide, having a value of 16° to 21° in the first whorl, 21° to 27° in the second, 25° to 30° in the third, 33° to 43° in the fourth, 40° to 58° in the fifth, and 5.0° to 55° in the sixth.

The form ratio increases with the growth of the organism. A typical specimen of six whorls shows development as follows : form ratio, first whorl, 1.25 :1; second, 1.68 :1; third, 2.0 :1; fourth 2.47 :1; fifth, 2.95 :1; the individual, 3.1:1.

Discussion.—The thin walls of this species serve to distinguish it from many other species of the genus *Triticites.* In this respect, however, it closely resembles *T. irregularis* and its varieties, to which it is probably related, but from which it is separated chiefly by its lower form ratio. This species is named for President E. H. Wells.

Occurrence.—The stratigraphic position of this species is uncertain because of the isolation of the outcrops in which it occurs. However, it is probably well above the middle of the Magdalena formation, but in the lower part of the zone of *Triticites.*

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 23.1, P 23.2, P 23.3, and P 23.4 (cotypes) ; the figured specimens are Nos. P 23.1, P 23.3, and P 23.4 from limestones along the highway about one and one-half miles east of Barton, southwest corner of Santa Fe County.

TRITICITES GALLOWAYI Needham, n. sp.

Plate VI, figs. 4-7

Exterior.-The test is small to medium in size, adults having a length of 4.3 mm. to 6.3 mm. and a diameter of 1.75 mm. to 2.5 mm. The form ratio varies from 2.2:1 to 2.5:1 and averages 2.36 :1 for seven typical specimens measured.

The shape of the test is elliptical to fusiform with broadly rounded to somewhat finely rounded ends and straight axis. The antetheca is of nearly uniform height throughout its length, except near the ends of the test, where it increases slightly. The septal furrows are shallow.

Equatorial section.-Adult individuals have five to six and one-half whorls. The heights of the whorls are 0.052 mm. to 0.07 mm. in the first, 0.08 mm. to 0.12 mm. in the second, 0.15 mm. to 0.20 mm. in the third, 0.22 mm. to 0.29 mm. in the fourth, 0.28 mm. to 0.34 mm. in the fifth, and 0.31 mm. to 0.35 mm. in the sixth, as measured near the end of each whorl.

The septa are few and increase but slightly after the third whorl, numbering 7 to 9 in the first whorl, 12 to 13 in the second, 13 to 15 in the third, 14 to 17 in the fourth, 15 to 17 in the fifth, and 17 to 20 in the sixth. The proloculum has an outside diameter of 0.125 mm. to 0.17 mm.

The thickness of the wall is 0.015 mm. to 0.022 mm. in the first whorl, 0.022 mm. to 0.03 mm. in the second, 0.035 mm. to 0.05 mm. in the third, 0.06 mm. to 0.085 mm. in the fourth, 0.075 mm. to 0.10 mm. in the fifth, and 0.08 mm. to 0.11 mm. in the sixth, as measured near the end of each whorl.

The wall is composed of a thin tectum and thick keriotheca which has 10 alveoli in 0.16 mm. to 0.18 mm.

Axial section.-The fluting is very slight in the middle of the chambers and is only moderate toward the ends of the test. Furthermore, it is confined to a rather narrow axial zone. Chomata are somewhat weak but are present in all whorls except the last, or last half-whorl.

The tunnel is rather wide, having a value of 23° to 26° in the the first whorl, 26° to 33° in the second, 31° to 42° in the third, 37° to 52° in the fourth, and 50° to 62° in the fifth. Septal pores are very few or lacking.

The form ratio increased with growth. The development of two typical specimens is shown respectively as follows : first whorl, ratio, 1.1:1, 1.16.1; second, 1.75 :1, 1.6 :1; third, 1.8 :1, 1.95 :1; fourth, 2.3 :1, 2.0 :1; fifth, 2.37 :1, 2.4 :1.

Discussion.-This species has unusually high volutions and thick walls in the outer whorls for a form so small and with so few volutions. It is also characterized by its few septa.

In some respects it resembles *T. cullomensis* Dunbar and Condra and *T. moorei* Dunbar and Condra. From the former it is

distinguished by its lower form ratio, higher volutions, and fewer septa. It also has one-half to one less whorl on the average. From the latter it differs in its lower form ratio, higher volutions, thicker walls, and wider tunnel.

From *T. jemezensis,* n. sp., it is distinguished by its greater size, lower form ratio, thicker walls, wider tunnel, fewer septa, and higher volutions.

This species is named for Dr. J. J. Galloway.

Occurrence.—Characterizes a zone in limestones of Magdalena age 150 to 200 feet below the red Abo formation along La Luz Canyon in the Sacramento Mountains.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 8.1, P 8.2, P 8.3, P 8.4 (cotypes) ; the figured specimens are Nos. P. 8.1, P 8.2, P 8.3, P 8.4 from La Luz Canyon about two miles east of La Luz, Otero County.

TRITICITES JEMEZENSIS Needham, n. sp. Plate VI, figs. 8-11

Exterior.—The test is small. Adult specimens are 3.2 mm. to 4.9 mm. in length and 1.2 mm. to 1.9 mm. in diameter. The form ratio varies from 2.25:1 to 2.95:1 and averages 2.6 :1.

The shape of the test is fusiform with straight axis and finely rounded to pointed ends. In some individuals the extended portion of the volution at the ends tends to round up to meet the antetheca, giving the ends a slightly twisted appearance. The lateral slopes are gently convex. The antetheca is high and prominent for such a small species and is of uniform height except at the polar extremities, where it increases slightly. The septal furrows are prominent for a small form.

Equatorial section.—Adult specimens have six to six and one-half volutions. The heights of the whorls are 0.035 mm. to 0.038 mm. in the first, 0.06 mm. to 0.07 mm. in the second, 0.10 mm. to 0.12 mm. in the third, 0.18 mm. to 0.20 mm. in the fourth, 0.20 mm. to 0.275 mm. in the fifth, and 0.275 mm. to 0.30 mm. in the sixth, as measured near the end of each whorl.

The septal count is 10 to 11 in the first whorl, 13 to 15 in the second, 15 to 19 in the third, 17 to 19 in the fourth, 21 to 22 in the fifth, and 22 to 23 in the sixth.

The proloculum has an outside diameter of 0.077 mm. to 0.108 mm. and an average of 0.09 mm. for six specimens measured.

The thickness of the wall is 0.009 mm. to 0.01 mm. in the first whorl, 0.012 mm. to 0.015 mm. in the second, 0.023 mm. to 0.025 mm. in the third, 0.04 mm. to 0.05 mm. in the fourth, 0.06 mm. to 0.062 mm. in the fifth, and 0.062 mm. to 0.07 mm. in the sixth, as measured near the end of each whorl. The height of the last chamber is approximately three times the thickness of the wall.

The wall is composed of tectum and keriotheca which has 10 alveoli in 0.155 mm. to 0.170 mm.

Axial section.—The fluting is slight in the middle of the chambers, becoming absent in the final whorl, but is pronounced in all chambers toward the ends. Chomata are present, but not strong, in all whorls except the last, or last half-whorl.

The tunnel is moderate in width, having a value of 12° to 24° in the first 18° to 25° in the second, 22° to 30° in the third, 28° to 38° in the fourth, 35° to 55° in the fifth. The 55° value is larger than is typical for this species.

Septal pores have not been observed. If present they are probably very small and few.

The form ratio increases gradually with growth of the organism. The development of a rather typical individual of six and one-half whorls is as follows : form ratio, first whorl, 1.2 :1; second, 1.5 :1; third, 1.75 :1; fourth, 1.8 :1; fifth, 1.85 :1; sixth, 2.1 :1 ; for the individual, 2.35:1.

Discussion.—This small species might be confused with a number of other small species from different parts of the country. Its twisted ends make it bear resemblance to *Triticites moorei* Dunbar and Condra. It differs from this species, however, in its less twisted ends, less pronounced elevation of the keriotheca near the poles, smaller proloculum, smaller size, lower form ratio, more volutions, greater increase in the number of septa after the third volution, fewer septal pores, and thinner walls in the early whorls.

It is distinguished from *Triticites acutus* Dunbar and Condra in being smaller in size, more inflated, in having a lower form ratio, fewer septa, smaller proloculum, fewer septal pores, thinner walls, slighter septal fluting, and a slightly wider tunnel.

It differs from *Triticites nebraskensis* Thompson in being broader, having a lower form ratio, deeper septal furrows, coarser alveoli, and a narrower tunnel.

It is smaller than *Schwagerina emaciata* (Beede) , has a lower form ratio, less fluting in the equatorial zone, fewer septa, a smaller proloculum, thinner walls in the early whorls, and stronger chomata.

Compared with *Triticites cullomensis* var. *pygmaeus* Dunbar and Condra, it is slightly larger, has more septa on the average, and shows more intense fluting toward the poles.

From *Triticites irregularis* (Schellwien and Staff) it differs in its fewer septa, narrower tunnel, thinner walls in the early whorls, and higher whorls after the first or second whorl. It is also shorter and thicker, thus giving it a lower form ratio.

Occurrence.—This species is abundant in the thin limestones in the extreme upper part of the Magdalena formation at Jemez

Springs. The zone appears to be rather narrow and is found approximately 150 feet below the basal Permian red beds.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 11.0, P 11.2, and P 11.4 (cotypes) ; figured specimens are Nos. P 11.0, P 11.2, and P 11.4, from Jemez Springs, Sandoval County.

TRITICITES FRESNALENSIS Needham, n. sp.

Plate VI, figs. 12-17

Exterior.—The test is of medium size. Adult forms are 4.0 mm. to 6.6 mm. in length and 1.3 mm. to 2.1 mm. in diameter. The form ratio varies from 3.1:1 to 4.3:1 and averages 3.6:1 for twenty-four specimens.

The shape of the test is elongate fusiform with gentle convex slopes and rounded to somewhat pointed ends. The axis is straight or slightly curved. Septal furrows are moderately deep. The antetheca increases slightly from the middle to the ends of the chambers.

Equatorial section.—Adult individuals have five to seven volutions. The heights of the volutions, as measured near the end of each volution, are 0.04 mm. to 0.06 mm. in the first volution, 0.05 mm. to 0.08 mm. in the second, 0.08 mm. to 0.11 mm. in the third, 0.13 mm. to 0.17 mm. in the fourth, 0.17 mm. to 0.185 mm. in the fifth and 0.18 mm. to 0.23 mm. in the sixth. The septa number 10 to 12 in the first whorl, 13 to 17 in the second, 18 to 20 in the third, 19 to 22 in the fourth, and 19 to 23 in the fifth. The proloculum varies from 0.09 mm. to 0.15 mm. in outside diameter. The thickness of the wall is 0.010 mm. to 0.015 mm. in the first whorl, 0.015 mm. to 0.02 mm. in the second, 0.022 mm. to 0.03 mm. in the third, 0.03 mm. to 0.044 mm. in the fourth, and 0.04 mm. to 0.055 mm. in the fifth and sixth.

The height of the chamber cavity in the last whorl is approximately three and one-half times the thickness of the wall.

The wall is composed of thin tectum and keriotheca, the alveoli of which are obscure and inconspicuous, but a few specimens have shown 10 alveoli to occupy a space of 0.130 mm. to 0.150 mm.

Axial section.—The fluting is very slight or absent in the middle of the chambers and moderate to pronounced toward the ends. The chomata are moderately strong in all specimens, extending to the fourth whorl in some specimens and to the sixth in others but usually they are weak or lacking in the last whorl.

The tunnel is somewhat curved in some specimens and opens with an increasingly greater angle toward the outer whorls. The tunnel angles vary from 13° to 22° in the first whorl, 19° to 32° in the second, 20° to 38° in the third, 21° to 41° in the fourth, 30° to 56° in the fifth, and 32° to 75° in the sixth.

Septal pores are relatively few and are present only in the fifth and sixth whorls. They are large for species of this size, measuring 0.02 mm. or more in diameter.

The form ratio increases with growth of the test, having an average of 1.45:1 for the first whorl, 1.9:1 for the second, 2.1 :1 for the third, 2.55:1 for the fourth, 3.0:1 for the fifth, and 3.2:1 for the sixth.

Discussion.—This form is evidently closely related to the group of *Triticites irregularis.* This group shows considerable variety and range in America, but our species apparently occurs at horizons considerably higher than those from Texas, Kansas, Nebraska and Missouri. It differs from the type of *Triticites irregularis* selected by Dunbar and Condra mainly in its smaller size, lower form ratio, and slightly thinner walls.

It differs from *T. irregularis* (Schellwien and Staff) first form M. P. White in being slightly smaller, in having more septa, thinner walls in the later whorls, and smaller tunnel angles.

It differs from *T. irregularis* (Schellwien and Staff) second form. M. P. White in being slightly larger, having higher volutions, greater septal count, and larger proloculum.

From *T. irregularis* (Schellwien and Staff) third form M. P. White it differs in being smaller, in having a slightly higher form ratio, lower volutions, fewer septa, and a smaller proluculum.

From *T. irregularis* (Schellwien and Staff) fourth form M. P. White it differs in being smaller, and in having coarser septal pores.

It is distinguished from *T. neglectus* Newell by its smaller size, lower form ratio, and less intense septal fluting.

Occurrence Close to the top of the Magdalena formation in Fresnal Canyon in the Sacramento Mountains near High Rolls and in Cedro Canyon in the Manzano Mountains east of Albuquerque.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 3.0, P 3.1, P 3.2, P 3.3, P 3.4 (cotypes) ; the figured specimens are Nos. P 3.0, P 3.1, and P 3.3 from near High Rolls, Otero County, along the highway.

TRITICITES RHODESI Needham, n. sp.

Plate VII, *figs.* 1-4

Exterior.—The test is medium in size. Adults have a length of 5.0 mm. to 6.5 mm., a diameter of 2.0 mm. to 3.0 mm. and a form ratio of 1.9:1 to 2.3:1. An average typical specimen is about 6 mm. in length, 2.9 mm. in diameter and has a form ratio of about 2.1 :1.

The shape of the test is ventricose or inflated with straight axis and moderately steep, concave slopes on most specimens.

The ends are rounded to somewhat acute. Septal furrows are moderate in depth.

Equatorial section.—Mature individuals have seven and one-half to eight and one-half volutions. The heights of the volutions are 0.035 mm. to 0.05 mm. in the first ; 0.06 mm. to 0.08 mm. in the second ; 0.10 mm. to 0.12 mm. in the third, 0.18 mm. to 0.20 mm. in the fourth, 0.22 mm. to 0.26 mm. in the fifth, 0.26 mm. to 0.30 mm. in the sixth, and 0.29 mm. to 0.35 mm. in the seventh, as measured near the end of each volution.

The septal count is 10 to 12 in the first volution, 14 to 17 in the second, 15 to 19 in the third, 17 to 22 in the fourth, 18 to 23 in the fifth, 21 to 24 in the sixth, and 23 to 25 in the seventh. The proloculum has an outside diameter of 0.09 mm. to 0.12 mm.

The wall has a thickness of about 0.015 mm. in the first volution, 0.025 mm. to 0.03 mm. in the second, 0.03 mm. to 0.04 mm. in the third, 0.035 mm. to 0.05 mm. in the fourth, 0.06 mm. to 0.07 mm. in the fifth, 0.065 mm. to 0.08 mm. in the sixth, and 0.065 mm. to 0.085 mm. in the seventh, as measured near the end of each volution.

The wall is composed of tectum and keriotheca which has 10 alveoli in 0.155 mm. to 0.16 mm.

Axial section.—The fluting is slight across the mid-zone and pronounced in the ends. Chomata are prominent in all volutions except the last.

The tunnel angles are 19° to 21° in the first volution, 20° to 23° in the second, 21° to 24° in the third, 22° to 27° in the fourth, 27° to 31° in the fifth, and 29° to 36° in the sixth.

Septal pores have been observed in only a very few specimens.

The form ratio increases rather slowly with growth. In the second volution the ratio is 1.55:1 to 1.65:1 and increases but little until the seventh volution is reached.

Discussion.—Triticites ventricosus inflates Galloway and Ryniker is a larger form, the early volutions are higher, the septa are more numerous, the walls are thicker, and the keriotheca is coarser. *T. consobrinus* Galloway and Ryniker has more volutions, its volutions are not so high, and its slopes are not so typically concave. *T. beedei* Dunbar and Condra has a slightly lower form ratio, greater number of septa, and a different shape.

This species is named in honor of the late Eugene Manlove Rhodes, noted New Mexican author, near whose childhood home the types of this species were collected.

Occurrence.—Upper black limestones of the Magdalena formation, 400 to 500 feet below the Abo red beds, in Rhodes Canyon, San Andres Mountains, southeastern Socorro County ; also in the upper part of the Magdalena formation about ten miles southeast of Santa Fe, near U. S. Highway 66. At this locality all but a

small part of the Magdalena formation is faulted out against pre-Cambrian crystalline rocks. Our collection comes from arkosic limestones about one-eighth mile east of the fault.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 31.0, P 31.1, P 31.2, P 31.3 (cotypes) ; the figured specimens are Nos. P 31.0, P 31.1, and P 31.3 from Rhodes Canyon, and P 30.1 from near Santa Fe.

TRITICITES sp. A
Plate VII, figs. 5, 6

Exterior.—The test is medium in size. Our specimens are 4.3 mm. to 5.5 mm. in length, 1.9 mm. to 2.6 mm. in diameter and have a form ratio of 1.9 :1 to 2.1 :1. The shape of the test is ventricose with coarsely rounded ends, straight axis, and rather steep convex lateral slopes.

Equatorial section.—Adults have seven to eight whorls. The heights of the whorls are 0.037 mm. to 0.04 mm. in the first whorl, 0.055 mm. to 0.065 mm. in the second, 0.08 mm. to 0.095 mm. the third, 0.12 mm. to 0.15 mm. in the fourth, 0.17 mm. to 0.25 mm. in the fifth, 0.20 mm. to 0.30 mm. in the sixth, and 0.24 mm. to 0.30 mm. in the seventh, as measured near the end of each whorl. The septa number 10 to 11 in the first whorl, 16 to 18 in the second, 19 to 20 in the third, 22 to 24 in the fourth, 22 to 29 in the fifth, and 24 to 32 in the sixth. The proloculum has an outside diameter of 0.09 mm. to 0.12 mm. The thickness of the wall is about 0.02 mm. in the first whorl, 0.02 mm. to 0.028 mm. in the second, 0.028 mm. to 0.032 mm. in the third, 0.03 mm. to 0.04 mm. in the fourth, 0.045 mm. to 0.06 mm. in the fifth, 0.05 mm. to 0.065 mm. in the sixth, and 0.065 mm. to 0.07 mm. in the seventh, as measured near the end of each whorl. The wall is composed of thin tectum and keriotheca, which has 10 alveoli in 0.17 mm. to 0.185 mm. as measured in the later whorls.

Axial section.—The fluting is slight to moderate across the mid-zone and pronounced near the poles. Chomata are present to the final whorl. The tunnel has a width of 19° to 20° in the first and second whorls, 20° to 30° in the third, 23° to 30° in the fourth, 26° to 32° in the fifth, 29° to 34° in the sixth, and 34°to 37° in the seventh. Septal pores appear to be lacking.

Discussion.—As only a few poorly preserved specimens were available for study it is considered unwise to make a final determination of this form at this time. It is possible that it is a variety of *Triticites ventricosus,* inasmuch as it checks rather closely with that species in shape, form ratio, and height of volution. However, it differs from the typical form of *T. ventricosus* in having thinner walls, stronger fluting, and a somewhat smaller

proloculum. According to Ryniker,[1] typical *T. ventricosus* does not extend into the Big Blue group of Permian age as has been stated by some investigators. He states that the *Triticites* of the Big Blue group have thinner walls, more prominent fluting, stronger chomata, and a smaller proloculum than typical *T. ventricosus.* It is noted that our Yeso forms differ virtually in the same respects from typical *T. ventricosus.* It is believed that the close resemblance of the Yeso forms to the Big Blue forms affords a reliable correlation of the Yeso formation with some part of the Big Blue group.

Our Yeso collection is also interesting in that it represents the only Permian fusulinids that we have found north of the general latitude of the Texas-New Mexico state line, although dozens of outcrops have been searched.

Occurrence.—Sparingly from limestones in the Yeso formation in the Coyote Hills, about ten miles northeast of Socorro.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are No. P 20.3 from the Coyote Hills, Socorro Co.

Genus SCHWAGERINA Willer, 1877

SCHWAGERINA EMACIATA (Beede)

Plate VII, figs. 7-9

Fusulina emaciata Beede, Ind. Univ. Studies, vol. 3, No. 29, p. 14, 1916.

Fusulina emaciata Dunbar and Condra, Nebr. Geol. Survey Bull. 2, ser. 2, p. 116, pl. 10, figs. 1-3, 1927.

Triticites emaciatus M. P. White, Univ. of Texas Bull. 3211, p. 44, pl. 3, figs. 4-6, 1932.

Exterior.—The test is medium in size. The specimens examined are 6.15 mm. to 8.0 mm. in length and 1.75 mm. to 2.6 mm. in diameter. The form ratio varies from 3.0:1 to 3.94:1 and averages 3.3:1.

The shape of the test is elongate-fusiform with straight axis, rounded ends, and very gentle slopes. The antetheca increases slightly in height from the middle of the shell to the ends. Septal furrows are shallow.

Equatorial section.—Adult specimens have five to seven whorls. The heights of the whorls are 0.045 mm. to 0.05 mm. in the first whorl, 0.08 mm. to 0.085 mm. in the second, 0.13 mm. to 0.15 mm. in the third, 0.19 mm. to 0.22 mm. in the fourth, 0.28 mm. to 0.31 mm. in the fifth, and 0.30 mm. to 0.32 mm. in the sixth, as measured near the end of each whorl. The septal count is 12 to 14 in the first whorl, 17 to 18 in the second, 19 to 21 in the third, 21 to 24 in the fourth, 22 to 25 in the fifth, and 24 to 31 in the sixth. The proloculum has an outside diameter of 0.09 mm. to

[1] Ryniker, Charles, Personal communication, 1936.

0.14 mm. The thickness of the wall is 0.02 mm. to 0.022 mm. in the first whorl, 0.025 mm. to 0.03 mm. in the second, 0.04 mm. to 0.045 mm. in the third, 0.05 mm. to 0.06 mm. in the fourth, and 0.07 mm. to 0.075 mm. in the fifth and sixth, as measured near the end of each whorl. The wall is composed of thin tectum and keriotheca which has 10 alveoli in 0.175 mm. to 0.185 mm.

Axial section.—The septa are fluted throughout, although slightly more in the ends than in the middle. The folds of adjacent septa meet basally to subdivide the meridional chambers into cell-like chamberlets. Chomata are weak and are present only to the second or third whorl. The tunnel angle has a value of 20° to 23° in the first whorl, 22° to 26° in the second, 23° to 28° in the third, and 24° to 33° in the fourth. In the development of the organism the form ratio is less than 2.0 :1 in the first two whorls. Thereafter, it increases gradually with growth, attaining a ratio of 2.0:1, or slightly more than this, about the third whorl, then increasing to near 3.0 :1 in the sixth or seventh whorl.

Discussion.—Only a very few specimens have been available for our study, but the few sections made from them agree so closely with previous descriptions of *Schwagerina emaciata* (Beede) that this identification appears justified.

This species is smaller than *S. longissimoidea,* has lower volutions, a lower form ratio, and a smaller proloculum. It is larger than *S. emaciata* var. *jarillaensis* n. var., has higher volutions, and a higher form ratio.

Occurrence.—Occurs sparingly in limestones of Hueco age (Lower Permian) in the eastern foothills of the Jarilla Mountains Otero County, near Oro Grande. In the same beds *S. emaciata* var. *jarillaensis* n. var. and *Pseudoschwagerina morsei* n. sp. are found.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos.. P 1.000 and P 1.23 from the Jarilla Mountains about four miles north of Oro Grande, Otero County.

SCHWAGERINA EMACIATA var. JARILLAENSIS Needham, n. var.

Plate VII, figs. 10, 11; Plate VIII, figs. 1-4

Exterior.—The test is of medium size. Adult specimens attain a length of 4.3 mm. to 6.3 mm. and a diameter of 1.4 mm. to 2.3 mm., giving a form ratio varying from 2.5:1 to 3.3:1 and averaging 2.93 :1 for fifteen specimens.

The shape of the test is fusiform to elongate-elliptical, with rounded to rather pointed ends and straight axis. The antetheca increases slightly in height from the middle of the shell to the poles. The septal furrows are moderately deep.

Equatorial section.—Adult specimens have five to seven volutions. The heights of the volutions are 0.03 mm. to 0.037 mm. in the first volution, 0.05 mm. to 0.065 mm. in the second, 0.07 mm. to 0.10 mm. in the third, 0.11 mm. to 0.14 mm. in the fourth, 0.15 mm. to 0.20 mm. in the fifth, 0.20 mm. to 0.23 mm. in the sixth, and 0.23 mm. to 0.28 mm. in the seventh, as measured near the end of each volution.

The septa number 10 to 13 in the first volution, 13 to 19 in the second 17 to 24 in the third, 19 to 27 in the fourth, 21 to 30 in the fifth and 22 to 32 in the sixth. The proloculum is small, measuring 0.07 mm. to 0.12 mm. in outside diameter. The thickness of the spiral wall is 0.015 mm. to 0.022 mm. in the first whorl, 0.022 mm. to 0.03 mm. in the second, 0.03 mm. to 0.045 mm. in the third, 0.040 mm. to 0 :06 mm. in the fourth, 0.045 mm. to 0.06 mm. in the fifth, 0.05 mm. to 0.065 mm. in the sixth, and 0.06 mm. to 0.07 mm. in the seventh, as measured near the end of each whorl. The wall is composed of thin tectum and coarse keriotheca, which has 10 alveoli in 0.150 mm. to 0.170 mm. as measured in the outer whorls.

Axial section.—The septa are fluted throughout, but less so in the mid-zone than in the ends. Tangential sections show that the folds of adjacent septa meet basally to subdivide the meridional chambers into cell-like chamberlets. Chomata are weak, seldom present beyond the fourth whorl. What appear to be rather persistent chomata in some specimens are found on close observation to be merely small septal loops bordering the tunnel. The tunnel is rather narrow, having a value of 17° to 25° in the first whorl, 22°to 30° in the second, 22° to 35° in the third, 28° to 40° in the fourth, and 30° to 45° in the fifth and sixth. Septal pores are fairly numerous in some specimens and apparently lacking in others. The individual pores are about 0.008 mm. in diameter. The form ratio increases gradually with growth, being near 1.5:1 for the first whorl, about 2.0:1 for the second, 2.4:1 for the third, 2.6 :1 for the fourth, and increasing to 3.0 :1 in the late whorls.

Discussion.—This form bears close resemblance to *Schwagerina emaciata* (Beede) , but it is believed that the differences are sufficiently great to warrant its being described as a variety of that species ; it differs mainly in its smaller size, its lower form ratio and lower volutions.

This variety is smaller than *S. longissimoidea* (Beede) and *S. huecoensis* (Dunbar and Skinner) . It also has a lower form ratio and a much smaller proloculum than either of the above species.

Occurrence.—In limestones of Hueco age, Lower Permian, along the east flanks of the Jarilla Mountains, Otero County, near

Oro Grande. In the same beds are found *Pseudoschwagerina morsei,* n. sp. and *Schwagerina emaciata* (Beede).

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 1.00, P 1.9, P 1.11, P 1.12, P 1.13, P 1.17, P 1.20, P 1.21 (cotypes) ; the figured specimens are Nos. P 1.00, P 1.9, P 1.17, P 1.20 and P 1.21 from about four miles north of Oro Grande, Otero County.

SCHWAGERINA HUECOENSIS (Dunbar and Skinner)

Plate VIII, figs. 5, 6

Pseudo fusulina huecoensis Dunbar and Skinner, Am. Jour. Sci., Vol. 22, p. 252, p1. 1, *figs.* 3-6b, 1931.

Exterior.—The test is large in size. Our specimens have a length of 9.7 mm. to 15.0 mm., a diameter of 2.3 mm. to 3.6 mm., and a form ratio varying from 3.3:1 to 4.2:1. The shape of the test is elongate-fusiform with straight axis, very gentle lateral slopes, and bluntly rounded to somewhat pointed ends. The septal furrows are rather deep.

Equatorial section.—Adults have five and one-half or six whorls. The heights of the whorls are 0.10 mm. to 0.15 mm. in the first whorl, 0.16 mm. to 0.22 mm. in the second, 0.28 mm. to 0.33 mm. in the third, 0.30 mm. to 0.35 mm. in the fourth, and 0.32 mm. to 0.38 mm. in the fifth, as measured near the end of each whorl. The septa number 10 to 12 in the first whorl, 20 to 22 in the second, 22 to 24 in the third, 25 to 28 in the fourth, 30 to 33 in the fifth, and 31 to 34 in the sixth. The proloculum measures about 0.30 mm. in outside diameter. The thickness of the wall is 0.045 mm. to 0.06 mm. in the first whorl, 0.05 mm. to 0.07 mm. in the second, 0.07 mm. to 0.095 mm. in the third, 0.10 mm. to 0.13 mm. in the fourth, and 0.11 mm. to 0.14 mm. in the fifth and sixth, as measured near the end of each whorl. The wall is composed of tectum and keriotheca, which has 10 alveoli in 0.18 mm. to 0.21 mm.

Axial section.—The septa are intensely and regularly fluted throughout, the septal folds of adjacent septa meeting basally to subdivide the meridional chambers into a series of cell-like chamberlets. The chomata are very weak.

Discussion.—This species is distinguished from *Schwagerina longissimoidea* (Beede) mainly by its higher volutions and thicker walls. Also, on the average, it is a longer and thicker form.

Occurrence.—In the Hueco limestone, Lower Permian, along the Texas-New Mexico state line in the Hueco Mountains. In some sections it is reported to occur in abundance, but, unfortunately, the writer was able to find only a few specimens, and

they were not in the best state of preservation. In the same beds are found *Pseudoschwagerina fusulinoides* (Schellwien) , *P. uddeni* (Beede) , and *Schwagerina thompsoni,* n. sp.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos. P 32.7 and P 32.8, from about two miles northeast of Hueco Tanks. El Paso County, Texas.

SCHWAGERINA THOMPSONI Needham, n. sp.
Plate VIII, figs. 7-10

Exterior.—The test is of medium size. Adults have a length of 4.8 mm. to 6.4 mm., and a diameter of 1.8 mm. to 3.0 mm. The form ratio varies from 2.2 :1 to 2.7 :1 and averages near 2.5 :1.

The shape of the test is fusiform. The ends are somewhat pointed to rather blunt and are considerably twisted in many specimens. The antetheca is nearly uniform in height throughout. Septal furrows are prominent.

Equatorial section.—Adult specimens have five to six and one-half whorls. The whorls expand gradually and have heights of 0.025 mm. to 0.03 mm. in the first, 0.04 mm. to 0.05 mm. in the second, 0.075 mm. to 0.09 mm. in the third, 0.14 mm. to 0.17 mm. in the fourth, 0.20 mm. to 0.27 mm. in the fifth, and 0.24 mm. to 0.30 mm. in the sixth, as measured near the end of each whorl.

There are 9 to 10 septa in the first whorl, 10 to 12 in the second, 12 to 14 in the third, 15 to 17 in the fourth, 18 to 21 in the fifth, and 19 to 23 in the sixth. The proloculum has an outside diameter of 0.09 mm. to 0.15 mm.

The spiral wall has a thickness of 0.01 mm. to 0.02 mm. in the first whorl, 0.015 mm. to 0.022 mm. in the second, 0.022 mm. to 0.032 mm. in the third, .032 mm. to 0.045 mm. in the fourth, 0.05 mm. to 0.07 mm. in the fifth, and 0.06 mm. to 0.075 mm. in the sixth, as measured near the end of each whorl. The wall is composed of thin tectum and keriotheca, which has 10 alveoli in 0.16 mm. to 0.17 mm., as measured in the outer whorls.

Axial section.—The septa are strongly 'fluted throughout, and the opposed folds of adjacent septa meet near the base, subdividing the lower part of the meridional chambers into chamber-lets.

The chomata have slight development, being confined to the first two or three whorls. The median tunnel is rather wide, having angles of 20° to 25° in the first whorl, 30° to 40° in the second, 35° to 45° in the third, and 40° to 50° in the fourth. Septal pores are generally plentiful in the fourth and fifth whorls. The form ratio changes but slightly with growth of the organism. After the first whorl is passed, the form ratio at each stage of growth varies but little from that of the mature form.

Discussion.—This species is considerably smaller than *Schwagerina emaciata* (Beede) , *S. longissimoidea* (Beede) , and *S. huecoensis* (Dunbar and Skinner) . It resembles *S. emaciata jarillaensis* n. var. in many respects, but it differs from that form in having a lower form ratio, fewer septa, a wider tunnel, and different growth development.

This species is named for Dr. M. L. Thompson.

Occurrence.—In the Hueco limestone (Lower Permian) along the Texas-New Mexico state line in the Hueco Mountains. In the same beds are found *Schwagerina huecoensis* (Dunbar and Skinner), *Pseudoschwagerina fusulinoides* (Schellwien) and *P. uddeni* (Beede) .

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 32.000, P 32.9, P 32.10, P 32.11 (cotypes) ; the figured specimens are Nos. P 32.000, P 32.9, and P 32.10, from about two miles northeast of Hueco Tanks, El Paso County, Texas.

Genus PSEUDOSCHWAGERINA, Dunbar and Skinner, 1936

PSEUDOSCHWAGERINA FUSULINOIDES (Schellwien)

Plate VIII, *fig.* 11; Plate IX, figs. 1-4

Schwagerina fusulinoides Schellwien, Paleontographia, vol. 39, p. 259, pl. 21, *figs.* 1-4, 8, 1892.

Schwagerina fusulinoides, Beede and Kniker, Univ. of Texas Bull. 2433, p. 19, pl. 1, *fig.* 4; pl. 3, figs. 1-4, 8; p1. 7, *fig.* 1-3, 1924.

Schwagerina fusulinoides Dunbar and Condra, Nebr. Geol. Survey Bull. 2, ser. 2, p. 121, pl. 14, figs. 1-4, 1927.

Schwagerina fusulinoides M. P. White, Univ. of Texas Bull. 3211, p. 81, p1. 8, figs. 10-12, 1932.

Exterior.—The test is large. Adult forms range from 7.5 mm. to 10.4 mm. in length and from 2.7 mm. to 4.3 mm. in diameter. The form ratio varies from 2.0 :1 to 3.1 :1 and averages 2.73 :1.

The shape is fusiform. The elongate forms are much more plentiful. The lateral slopes are moderately steep. The ends are rounded to rather pointed, and the axis is straight. The antetheca is of uniform height from the middle to the ends. The septal furrows are shallow.

Equatorial section.—Adult specimens have five and one-half to seven whorls. The heights of the whorls are 0.07 mm. to 0.12 mm. in the first whorl, 0.12 mm. to 0.30 mm. in the second, 0.25 mm. to 0.75 mm. in the third, 0.43 mm. to 0.50 mm. in the fourth, 0.34 m. to 0.47 mm. in the fifth, 0.26 mm. to 0.38 mm. in the sixth, and 0.24 mm. to 0.26 mm. in the seventh, as measured near the end of each whorl. It is noticed that extreme variation exists in the heights of the whorls in different specimens because the same

degree of inflation did not take place at the same growth stage. In most specimens inflation becomes pronounced in the third whorl, and that whorl is the highest in the organism. However, in many specimens maximum inflation is not attained until the fourth whorl. Decline in the heights of the whorls is generally rather rapid through the fifth, sixth, and seventh whorls.

The septal count is 11 to 15 in the first whorl, 16 to 23 in the second, 17 to 28 in the third, 18 to 30 in the fourth, 20 to 32 in the fifth, and 22 to 20 in the sixth. Generally a reduction in the number of septa begins in the third or fourth whorl where maximum inflation is reached. The proloculum has an outside diameter varying from 0.14 mm. to 0.215 mm.

The thickness of the wall is 0.025 mm. to 0.04 mm. in the first whorl, 0.03 mm. to 0.04 mm. in the second, 0.04 mm. to 0.06 mm. in the third, 0.06 mm. to 0.10 mm. in the fourth, 0.065 mm. to 0.105 mm. in the fifth, and 0.075 mm. to 0.11 mm. in the sixth, as measured near the end of each whorl. Considerable variation exists in wall thickness in the same whorl of the same specimen as well as much variation among individuals.

The wall is composed of thin tectum and keriotheca, which has 10 alveoli in 0.150 mm. to 0.185 mm., as measured in the outer whorls. The septa are short and thick in the first whorls, then they become very thin, long, and somewhat wavy. Finally, in the last whorls they become shorter and thicker again.

Axial section.—The septa are fluted throughout, moderately so in the middle of the chambers and stronger towards the ends. Chomata are weak and are usually confined to the first two or three whorls. The tunnel is moderately wide, having a value of 21° to 30° in the first whorl, 32° to 45° in the second, 37° to 48° in the third. Septal pores are numerous toward the poles in many specimens and apparently lacking in others. The pores are fairly large, measuring about 0.015 mm. in diameter.

The form ratio increases with growth through the second whorl then declines during the inflation of the third or fourth whorl, after which it increases again in the late whorls.

Discussion.—These Pseudoschwagerina from the Hueco Mountains agree closely with the types described by Schellwien from the Carnic Alps, and the writer has followed the usual practice in considering the species conspecific with Schellwien's. However, some question may be raised as to whether they are actually conspecific. Schellwein states that in his types the form ratio is, as a rule, 2.0:1, although considerable variation exists. Our collection from the Hueco Mountains very seldom yields a specimen having a form ratio this low, and the average is much higher. According to Beede, this is a protean species, but, even so, the difference in form ratio alone between specimens from the

Carnic Alps and those from the Hueco Mountains makes one doubt that they are conspecific.

This species is compared with *P. uddeni* under the description of that species.

Occurrence.—In the Hueco Mountains along the Texas-New Mexico state line in the Hueco limestone (Lower Permian) .

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos. P 32.0, P 32.4, P 32.5, and P 32.6 from near Hueco Tanks, El Paso County, Texas.

PSEUDOSCHWAGERINA UDDENI (Beede and Kniker)

Plate IX, *fig.* 5; Plate X, figs. 1-4

Schwagerina uddeni Beede and Kniker, Univ. of Texas Bull. 2433, p. 27, p1. 1, figs. 1, 2; p1. 4, *fig.* 14; Pl. 6, figs. 1, 2, 4-7; 1924.

Schwagerina uddeni Dunbar and Condra, Nebr. Geol. Surv. Bull. 2, ser. 2, p. 119, pl. 13, figs. 1-3, 1927.

Schwagerina uddeni M. P. White, Univ. Texas Bull. 3211, p. 83, pl. 8, figs. 16-18, 1932.

Exterior.—The test is rather large. Adult individuals have length of 7.2 mm. to 8.7 mm. and a diameter of 4.1 mm. to 5.3 mm. The form ratio varies from 1.43:1 to 1.85:1 and averages 1.6:1.

The shape of the test is strongly inflated so as to appear subspherical. The ends are broadly rounded and the axis is straight. The antetheca is of even height from the middle to the ends of the chambers. Septal furrows are shallow. The poles are somewhat extended.

Equatorial section.—Adults have five to six whorls. The heights of the whorls vary greatly in different specimens because of the differences in the rate of inflation in the middle whorls. The first two whorls are low and have heights of 0.065 mm. to 0.10 mm. in the first whorl and 0.11 mm. to 0.18 mm. in the second. The third whorl shows marked inflation with a height of 0.45 mm. to 0.55 mm. The fourth whorl is normally the highest and has a height approaching 1.0 mm. in some specimens although it is generally slightly less than this. The gerontic reduction in the height of the whorls begins gradually about the fifth whorl and becomes quite pronounced in the sixth whorl, where the height in average specimens is only 0.30 mm. to 0.40 mm. These values apply to measurements taken near the end of each whorl.

The septal count is 10 to 12 in the first whorl, 14 to 16 in the second, 18 to 20 in the third, 14 to 16 in the fourth, 22 to 26 in the fifth, and 29 to 33 in the sixth. The proluculum has an outside diameter of 0.14 mm. to 0.215 mm.

The thickness of the wall is 0.022 mm. to 0.035 mm. in the first whorl, 0.037 mm. to 0.045 mm. in the second, 0.022 mm. to

0.04 mm. in the third, 0.045 mm. to 0.06 mm. in the fourth, 0.09 mm. to 0.10 mm. in the fifth and sixth, as measured near the end of each whorl. It is to be noted that the thinning of the walls in the third whorl takes place at the same time that inflation becomes pronounced. The wall is composed of thin tectum and coarse keriotheca, which has ten alveoli in 0.185 mm. to 0.195 mm.

Axial section.—The fluting of the septa is slight in the middle of the chambers and moderate in the ends. Chomata are very slightly developed and are generally present only in the first two or three whorls. The tunnel angle has a value of 15° to 20° in the first whorl and 24° to 30° in the second. Septal pores have not been observed in our specimens.

The development of this species passes through two distinct stages, one in which the form ratio increases with growth and generally reaches a maximum value about the third whorl, and a second stage during which the form ratio decreases. This is shown by the following measurements on a rather typical specimen : first whorl, ratio 1.15 :1; second 1.75 :1; third 1.92 :1; fourth and fifth 1.5:1.

Discussion.—Somewhat elongate individuals of this species may be confused with gibbous specimens of *P. fusulinoides.* But this species on the whole is much more inflated, is not fusiform, has less septal fluting, and shows rapid instead of gradual inflation after the second whorl.

Occurrence.—This species with *P. fusulinoides,* characterizes a prominent zone in the lower part of the Hueco limestone of Lower Permian age in the Hueco Mountains along the New Mexico-Texas state line. In the same beds *Sehwagerina thompsoni,* n. sp., is found.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources ; the figured specimens are Nos. P 32.00, P 32.1 and P 32.2 from near Hueco Tanks, El Paso Co., Texas.

PSEUDOSCHWAGERINA MORSEI Needham, n. sp.

Plate X, figs. 5-7; Plate XI, figs. 1-4

Exterior.—The test is medium in size. Adult individuals have a length of 6.0 mm. to 7.7 mm. and a diameter of 3.2 mm. to 4.5 mm. The form ratio varies from 1.65 :1 to 2.1 :1 and averages 1.85 :1 for nine typical specimens.

The shape is ellipsoidal in most specimens but in some it is rather fusiform. The axis is straight, the lateral slopes are gentle, and the ends are blunt to coarsely rounded. In some specimens the poles are slightly extended to give the shell a lemon-shaped appearance. The antetheca is of uniform height from the middle of the test to the ends. Septal furrows are shallow.

Equatorial section.—Adults have six and one-half to eight whorls. As in all *Pseudoschwagerina* considerable variation exists in the dimensions of different individuals in the same growth stage. The heights of the whorls are 0.03 mm. to 0.04 mm. in the first whorl, 0.05 mm. to 0.067 mm. in the second, 0.09 mm. to 0.135 mm. in the third, 0.14 mm. to 0.18 mm. in the fourth, 0.25 mm. to 0.87 mm. in the fifth, 0.40 mm. to 0.69 mm. in the sixth, 0.31 mm. to 0.54 mm. in the seventh, and 0.34 mm. to 0.41 mm. in the eighth, as measured near the end of each whorl. A distinctive feature of this species is that inflation begins gradually in the fourth or fifth whorl and reaches its maximum generally in the sixth whorl. However, if inflation begins in the fourth whorl the maximum may be reached in the fifth ; also, in occasional specimens the maximum is not attained until the seventh whorl.

The thickness of the wall is 0.008 mm. to 0.015 mm. in the first whorl, 0.015 mm. to 0.025 mm. in the second, 0.03 mm. to 0.045 mm. in the third, 0.037 mm. to 0.06 mm. in the fourth, 0.045 mm. to 0.07 mm. in the fifth, and 0.06 mm. to 0.075 mm. in the sixth, as measured near the end of each whorl.

The septal count is 10 to 14 in the first whorl, 14 to 16 in the second, 16 to 18 in the third, 19 to 22 in the fourth, 18 to 21 in the fifth, 17 to 25 in the sixth, and 20 to 26 in the seventh. It is noted that the septa are reduced in number during the stages of pronounced inflation.

The wall is composed of thin tectum and keriotheca which has 10 alveoli in 0.155 mm. to 0.170 mm. The proloculum has an outside diameter of 0.075 mm. to 0.11 mm.

Axial section.—The fluting is slight to moderate in the middle of the chambers and somewhat more intense in the ends. The septal folds across the mid-zone are low, and in some axial sections these folds may be missed by the section and fail to show under the microscope. This has the effect of making the fluting appear more shallow than it really is.

Chomata are weak but are generally present through the fourth whorl, or even into the fifth. The tunnel has a width of 16° to 26° in the first whorl, 20° to 28° in the second, 21° to 29° in the third, 30° to 57,° in the fourth, and 32° to 49° in the fifth.

In the development of the organism, the first whorl is nearly spherical. From the second to about the fifth, the form ratio increases and reaches a value of about 2.0 :1 near the fifth whorl. In the sixth whorl, and in some cases in the seventh, the ratio drops slightly, then rises again in the final whorl.

Discussion.—Elongate forms of this species may be confused with specimens of *Pseudoschwagerina fusulinoides* (Schellwien) . It is distinguished from that species, however, by generally having about one more whorl, lower volutions in the early stages of growth, thinner walls, a smaller proloculum, a lower average form ratio, slightly stronger chomata, and later maximum

inflation. From *P. uddeni* Beede it is distinguished by its having one and one-half to two more whorls, lower volutions in the early whorls, thinner walls, maximum inflation in later whorls, a smaller proloculum, and stronger chomata.

This species is named for Dr. W. C. Morse.

Occurrence.—Rather abundant in limestones of Hueco age Lower Permian, in the eastern foothills of the Jarilla Mountains, Otero County, near Oro Grande. Associated with it are *Schwagerina emaciata* (Beede) and *S. emaciata* var. *jarillaensis* n. var.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources, Nos. P 1.0, P 1.3, P 1.18, P 1.19, P 1.24 (cotypes) ; the figured specimens are Nos. P 1.0, P 1.3, P 1.19, and P 1.24 from the Jarilla Mountains about four miles north of Oro Grande, Otero County.

Genus PARAFUSULINA Dunbar and Skinner, 1931

PARAFUSULINA DUNBARI Needham, n. sp.

Plate XI, figs. 5-11; Plate XII, figs. 1, 2

Exterior.—Two collections have been made of material containing this species, one from the Delaware Mountain sandstone at Guadalupe Point, Texas, the other from the Dog Canyon limestone in Last Chance Canyon, New Mexico. The form from Guadalupe Point has been selected as the type for the species, because it is probable that the fauna from the south side of the Capitan reef developed in a normal marine environment, whereas that from the Dog Canyon limestone may have developed in a restricted environment. Each collection will be described, so that the essential differences may be noted.

The tests from both groups are very large. Those from the first group (type locality) attain a length up to about 22 mm. and a diameter up to 4 mm. The form ratio ranges from 4.0:1 to 6.25 :1 and averages 5.4:1. Those of the second group attain a length up to about 18 mm. and a diameter up to 3.5 mm. Most specimens, however, fall considerably short of these maximum dimensions. The form ratio varies from 3.4:1 to 5.5:1 and averages 4.5:1.

The shape is the same in both collections, being elongatefusiform to subcylindrical. The axis is straight to slightly curved, and the ends are blunt to somewhat pointed. The slopes are nearly straight. The septal furrows are shallow.

Equatorial section.—Adult specimens have seven to eight and one-half whorls, or rarely nine. The heights of the whorls in the first collection are 0.06 mm. to 0.10 mm. in the first whorl, 0.092 mm. to 0.135 mm. in the second, 0.12 mm. to 0.155 mm. in the third, 0.155 mm. to 0.20 mm. in the fourth, 0.17 mm. to 0.24 mm. in the fifth, 0.185 m. to 0.30 mm. in the sixth, and 0.22 mm. to 0.37

mm. in the seventh and eighth, as measured near the end of each whorl. The same set of measurements for the second group is 0.046 mm. to 0.075 mm. in the first whorl, 0.068 mm. to 0.125 mm. in the second, 0.092 mm. to 0.185 mm. in the third, 0.10 mm. to 0.23 mm. in the fourth, 0.155 mm. to 0.29 mm. in the fifth, 0.20 mm. to 0.31 mm. in the sixth, 0.25 mm. to 0.31 mm. in the seventh and eighth.

The septal count for the first group is 13 to 17 in the first whorl, 25 to 30 in the second, 27 to 34 in the third, 32 to 38 in the fourth, 34 to 40 in the fifth, 35 to 45 in the sixth, 43 to 46 in the seventh, and 46 to 48 in the eighth. In the second group the count is 14 to 17 in the first whorl, 22 to 23 in the second, 29 to 30 in the third, 33 to 35 in the fourth, 36 to 38 in the fifth, and 39 to 40 in the sixth.

The proloculum is large, having an outside diameter ranging from 0.25 mm. to 0.50 mm. In some specimens it is nearly spherical ; in others it is very irregular in shape and may be nearly twice as long as wide.

The thickness of the wall for the first group is 0.025 mm. to 0.03 mm. in the first whorl, 0.03 mm. to 0.037 mm. in the second, 0.037 mm. to 0.045 mm. in the third, 0.045 mm. to 0.06 mm. in the fourth, 0.052 mm. to 0.070 mm. in the fifth, sixth, seventh and eighth. For the second group the thickness is 0.02 mm. to 0.025 mm. in the first whorl, 0.025 mm. to 0.03 mm. in the second, 0.03 mm. to 0.045 mm. in the third, 0.037 mm. to 0.045 mm. in the fourth, 0.045 mm. to 0.07 mm. in the fifth, and 0.055 mm. to 0.075 mm. in the sixth and seventh, as measured near the end of each whorl.

The wall is composed of a thin tectum and keriotheca, which, in both groups, has 10 alveoli in 0.185 mm. to 0.20 mm., as measured in the mid-zone of the outer whorls.

Axial section.—The septa are evenly and strongly fluted throughout, but the folds tend to expand slightly toward the poles. In both collections 22 to 25 folds occupy a space of 5 mm. along the mid-zone. The opposed folds of adjacent septa are united near their base so as to subdivide the meridional chambers into a series of chamberlets. Each septum is perforated by a row of basal foramina. In tangential sections the inner sutures are seen to run transverse to the axis. Chomata, parachomata, axial filling, and accessory tunnels are lacking ; septal pores have not been observed.

The tunnel is of moderate width, having a value in both groups of 38° to 50° in the outer whorls. Because of the lack of chomata the tunnel is much less conspicuous than in *Triticites.* The form ratio increases gradually with growth. Both groups show essentially the same development. For the first whorl, the form ratio is 1.4:1 to 1.8 :1; for the third and fourth,

2.7 :1 to 3.2 :1; for the fifth and sixth, 3.5 :1 to 3.9 :1; for the seventh and eighth, 4.0:1 to 5.5:1.

Discussion.—This species bears resemblance to *Parafusulina wordensis* Dunbar and Skinner in general size and form ratio. However, it is somewhat shorter and thinner on the average than that species. It also has lower chambers, thinner walls, fewer septa, and the chamberlets formed by the folding of the septa are not so coarse.

Superficially, this species also resembles species of *Polydiexodina.* However, the presence of accessory tunnels in *Polydiexodina* makes that genus easily distinguished from *Parafusulina.* This species is named for Dr. C. 0. Dunbar.

Occurrence.—Abundant in the upper part of the Delaware Mountain sandstone, 800 to 1000 feet below the Capitan limestone along the Carlsbad-Van Horn Highway at Guadalupe Point, Texas, and near the middle of the Dog Canyon limestone along Last Chance Canyon, Eddy Co., New Mexico.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources Nos. P 14.1, P 14.2, P 14.3, P 14.4, P 14.5 (cotypes) ; the figured specimens are Nos. P 14.1 and P 14.4 from Guadalupe Point, Texas, and Nos. P 12.0 and P 12.3 from Last Chance Canyon, Eddy Co., New Mexico.

Genus POLYDIEXODINA Dunbar and Skinner, 1931

POLYDIEXODINA GUADALUPENSIS Needham, n. sp.

Plate XII, *figs.* 3-7

Exterior.—The test is very large, attaining an extreme length of about 30 mm. and a diameter up to 3.8 mm. The form ratio varies from 6.6:1 to 9.8:1 and averages about 8.0:1. The shape is sub-cylindrical, very slender and elongate. The ends are acute, and the axis is curved in most specimens. The septal furrows are rather shallow.

Equatorial section.—Adult specimens have 10 to 12 whorls. The heights of the whorls are 0.062 mm. to 0.10 mm. in the first whorl, 0.092 mm. to 0.11 mm. in the second, 0.10 mm. to 0.12 mm. in the third, 0.11 mm. to 0.125 mm. in the fourth, 0.12 mm. to 0.135 mm. in the fifth, 0.14 mm. to 0.155 mm. in the sixth, 0.15 mm. to 0.175 mm. in the seventh, 0.17 mm. to 0.185 mm. in the eighth, 0.185 mm. to 0.21 mm. in the ninth, 0.21 mm. to 0.25 mm. in the tenth and eleventh, as measured near the end of each whorl. The septal count is 14 to 16 in the first whorl, 27 to 31 in the second, 29 to 37 in the third, 32 to 41 in the fourth, 32 to 42 in the fifth, 40 to 43 in the sixth and seventh, 44 to 48 in the eighth, 54 to 63 in the ninth, 56 to 66 in the tenth, and 59 to 68 in the eleventh. The proloculum is large and distorted, having a length and diameter varying from 0.33 mm. to 0.80 mm. The walls show

only slight increase in thickness with growth of the organism, being 0.03 mm. to 0.04 mm. thick in the early whorls, increasing to about 0.05 mm. in the fifth whorl and showing only a very slight increase thereafter. The wall is composed of thin tectum and keriotheca, which has 10 alveoli in 0.175 mm. to 0.180 mm.

Axial section.—The fluting is intense and regular throughout. The opposed folds of adjacent septa are united near their base so as to subdivide the meridional chambers into a series of chamberlets. In a distance of 5 mm. along the middle of the shell are 23 to 30 septal folds. Each septum is perforated by a row of regularly arranged basal foramina, each opening being at the tip of a septal fold. The basal sutures run around the shell, though the individual septum runs axially. The median tunnel is narrow, the tunnel angle varying from 20° to 27°. Also several pairs of supplementary tunnels perforate the septa. These begin to appear about the fifth or sixth whorl, and a pair is given off at each whorl thereafter, each pair being offset in the direction of the poles. Each of these supplementary tunnels generally dies out before the final whorls are reached. Chomata are lacking. However, the axial zone contains considerable secondary filling. Septal pores have not been observed.

Discussion.—This species resembles *P. shumardi* Dunbar and Skinner in many respects but is distinguished from that species by its greater length and breadth, slightly higher form ratio, more volutions, and coarser keriotheca. It is easily separated from *P. capitanensis* Dunbar and Skinner by its greater length, much higher form ratio, and its acute ends.

Occurrence.—Abundant in the dark limestone at the top of the Delaware Mountain formation and in the base of the Capitan limestone at Guadalupe Point, Texas. To date, it has not been found by the writer in New Mexico, but its discovery may be expected in some of the deep canyons in the Guadalupe Mountains along the Texas-New Mexico line.

It is probable that this species occurs at a slightly higher horizon than *P. shumardi* described by Dunbar and Skinner from the Delaware Mountain formation in the southern end of the Delaware Mountains.

Repository.—New Mexico School of Mines, State Bureau of Mines and Mineral Resources Nos. P 13.0, P 13.1, P 13.2, P 13.3, P 13.4 (cotypes) ; the figured specimens are Nos. P 13.0, P 13.3, and P 13.4 from Guadalupe Point, Texas.

TABLE 1.—Showing Range of Species.

	Lower Magdalena	Middle Magdalena	Upper Magdalena	Lower Permian	Middle Permian	Upper Permian
Staffella atokensis	X					
Ozawainella sp.	X					
Fusulina taosensis	X					
F. euryteines	XX					
F. novamexicana	X					
F. socorroensis	XX					
Wedekindellina euthysepta	X					
W. excentrica	X					
Triticites nebraskensis		X				
T. fresnalensis			XX			
T. wellsi		X				
T. gallowayi			X			
T. cuchilloensis		X				
T. jemezensis			X			
T. kellyensis			X			
T. rhodesi			X			
T. ventricosus			XX			
T. ventricosus sacramentoensis			X			
T. sp. A				X		
Pseudoschwagerina morsei				X		
P. fusulinoides				X		
P. uddeni				X		
Schwagerina emaciata				X		
S. emaciata jarillaensis				X		
S. huecoensis				X		
S. thompsoni				X		
Parafusulina dunbari					X	
Polydiexodina guadalupensis						X

TABLE 2.—Correlation of the Pennsylvanian and Permian Formations of New Mexico.

Central New Mexico.	Hueco Mts.	Northern Guadalupe Mts.	Southern Guadalupe Mts.	Delaware Mts.	Glass Mts.	Texas.	Kansas.	Illinois.	Western Colorado	
			Absent		Absent					
Absent		Absent	Capitan	Castile	Capitan					Zone of Polydiexodina
				Delaware						
		DogCanyon	Delaware		Word					Zone of Parafusulina
San Andres	?	San Andres	Bone Springs	Bone Springs	Leonard					
Yeso	Hueco	Yeso			Absent	Clear Fork Wichita	Big Blue			
					Wolf Camp					Base of Zone Schwagerina and Pseudoschwagerina
Abo							Absent			
Absent	Absent				Absent	Cisco	Virgil			Zone of Triticites
Magdalena	Magdalena				Gaptank	Canyon	Missouri	? McLeansboro	?	Top of Zone Fusulina
								Carbondale	Hermosa and McCoy	
					Haymond	Strawn	Des Moines	Pottsville		
Absent	Bend					Bend	Morrow			

Plates

PLATE II

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1, 2. *Staff ella atokensis* Thompson ----------20

Axial sections, x 30. Lower Magdalena formation, Kingston, New Mexico.

3. *Ozawainella* sp. ---------- 20

Axial section, x 40. From piece of float of lower Magdalena formation, 10 miles northeast of Socorro, New Mexico.

4, 5. *Fusulina euryteines* Thompson ----------21

4. Axial section, x 10. Lower Magdalena formation about 17 miles east of Taos, New Mexico.

5. Equatorial section, x 10. Same locality as the last.

6-10. *Fusulina socorroensis* Needham, n. sp. ---------- 22

6, 7. Axial sections, x 10. Lower Magdalena formation, Socorro Mountains 8 miles northwest of Socorro, New Mexico.

8, 9, 10. Equatorial sections, x 10. Fig. 8 is slightly oblique ; *fig.* 10 is slightly eccentric. Lower Magdalena formation, Socorro Mountains $3^1/_2$ miles northwest of. Socorro, New Mexico.

11-15. *Fusulina novamexicana* Needham, n. sp. ---------- 23

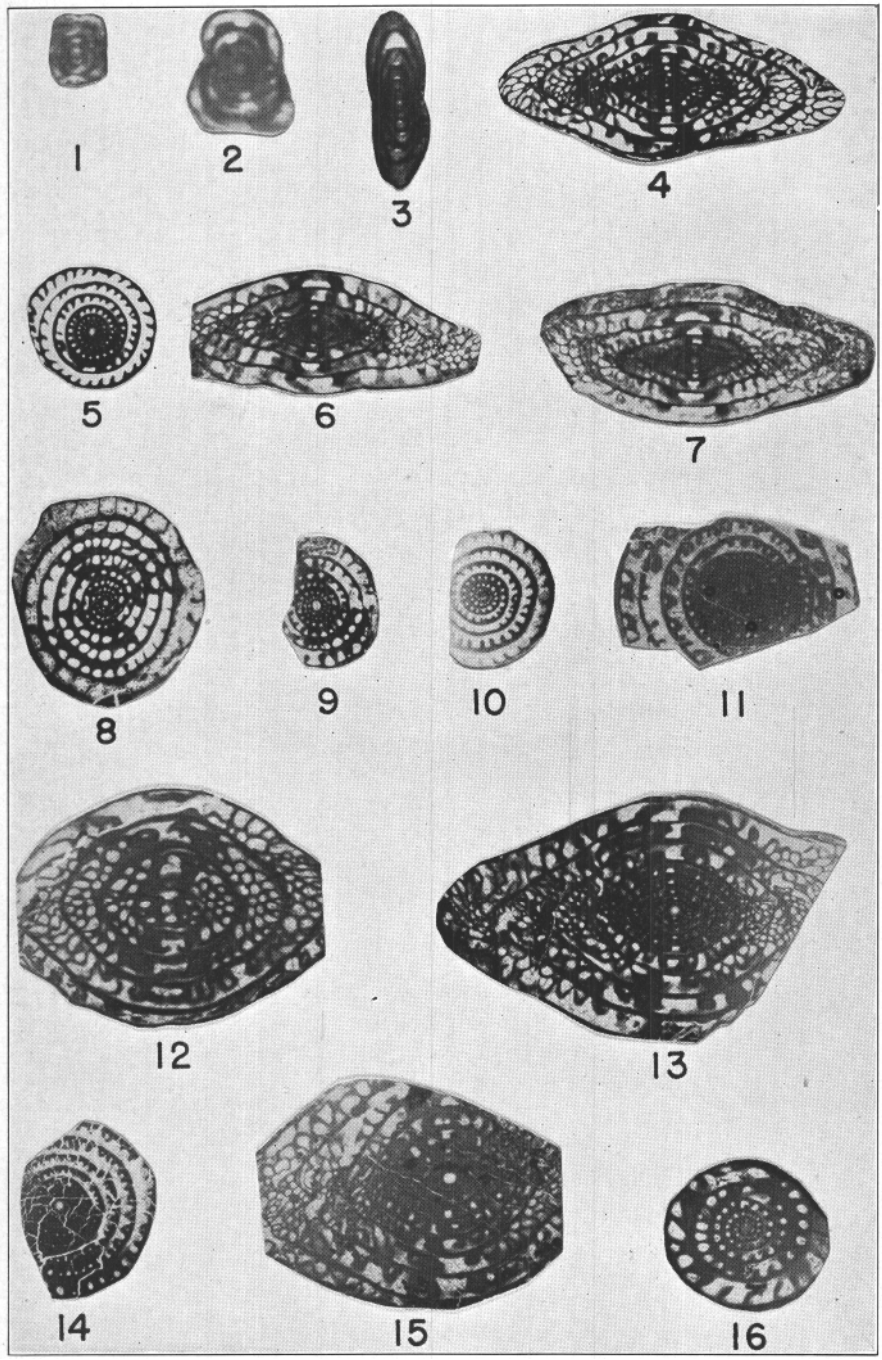
11, 14. Equatorial sections, x 10. Lower Magdalena formation, Socorro Mountains 3 miles west of Socorro, New Mexico.

12. Tangential section, x 10. Same locality as the last.

13, 15. Axial sections, x 10. Same locality as the last.

16. *Fusulina taosensis* Needham, n. sp. ---------- 25

Equatorial section, x 20. Lower Magdalena formation about 8 miles east of Taos, New Mexico.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1, 2. *Fusulina taosensis* Needham, n. sp. ---------- 25

Axial sections, x 20. Lower Magdalena formation about 8 miles east of Taos, New Mexico.

3-5. *Fusulina pattoni* Needham, n. sp. ---------- 26

3, 5. Axial sections, x 20. Hermosa formation, Archuleta County, Colorado.

4. Equatorial section, x 20. Same locality as the last.

6-8. *Wedekindellina euthysepta* (Henbest)---------- 27

6. Polished median surface, x 20. Lower Magdalena formation in Tijeras Canyon 13 miles east of Albuquerque, New Mexico.

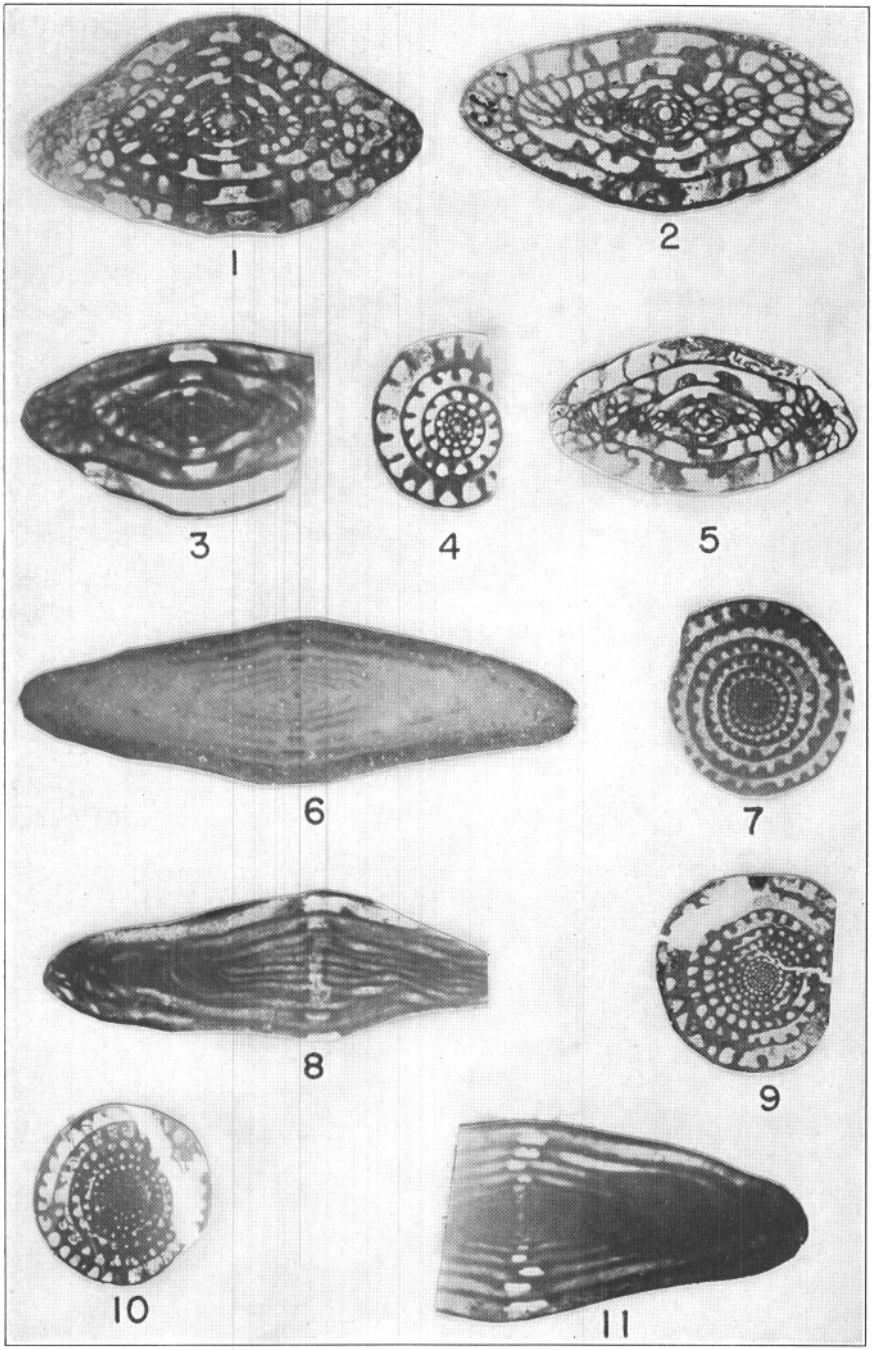
7. Equatorial section, x 20. Lower Magdalena formation, \Montezuma Hot Springs, New Mexico.

8. Tangential section, x 20. Same locality as the last.

9-11. *Wedekindellina excentrica* (Roth and Skinner) ---------- 29

9, 10. Equatorial sections, x 20. Lower Magdalena formation in Tijeras Canyon 13 miles east of Albuquerque, New Mexico.

11. Axial section, x 20. Same locality as the last.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1. *Wedekindellina excentrica* (Roth and Skinner) ---------- 29
Axial section, x 20. Lower Magdalena formation in Tijeras Canyon 13 miles east of Albuquerque, New Mexico.

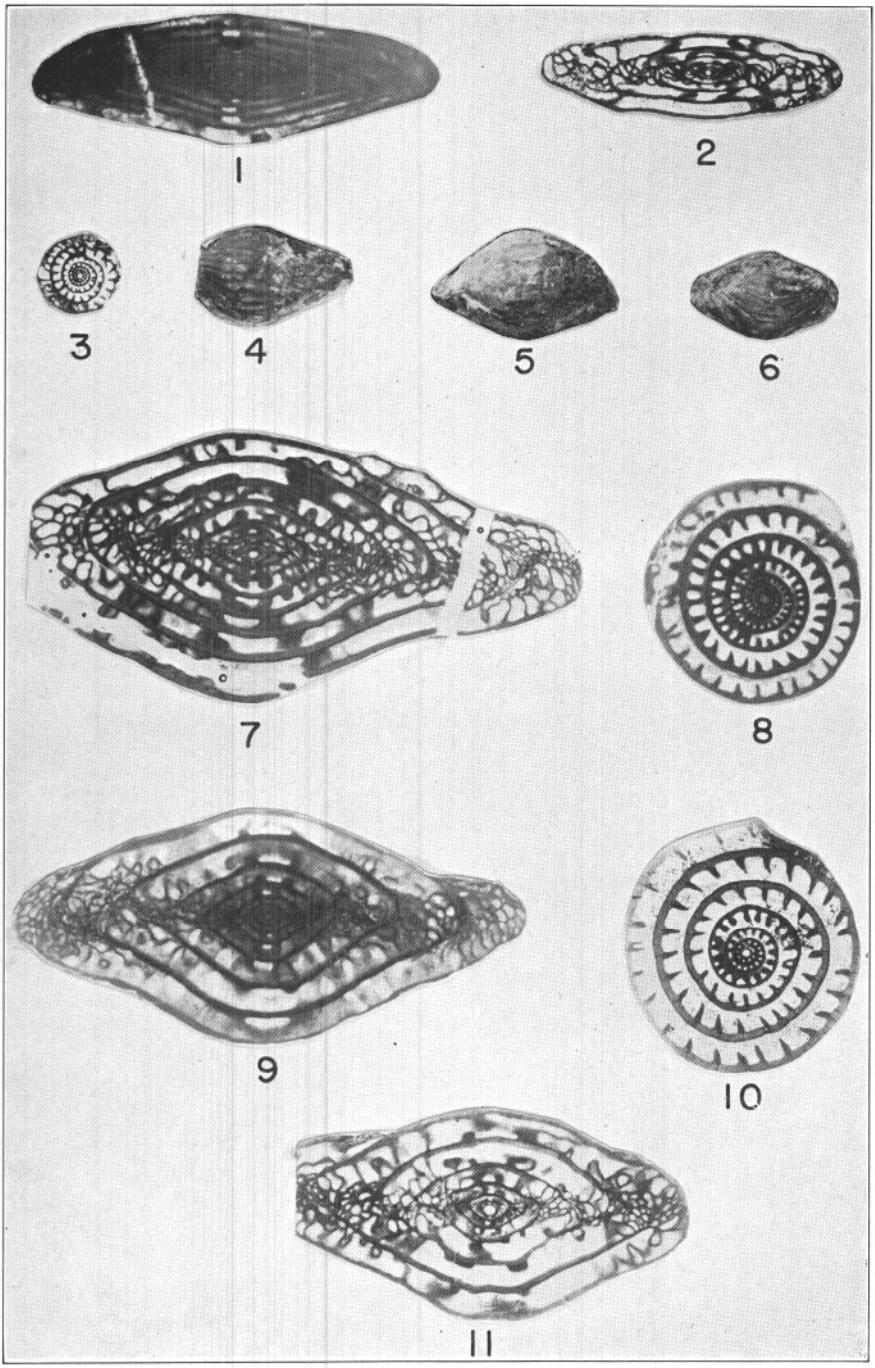
2, 3. *Triticites nebraskensis* Thompson ---------- 30
2. Axial section, x 10. Middle Magdalena limestones near the north end of the Los Pinos Mountains along Highway 60, Socorro County, New Mexico.
3. Equatorial section, x 10. Same locality as the last.

4. *Trititicites ventricosus* (Meek) ---------- 32
External view, x 4. Upper Magdalena limestones in Fresnal Canyon, Otero County, New Mexico.

5, 6. *Triticites ventricosus sacramentoensis* Needham, n. var. ---------- 33
External views, x 4. Same locality as the last.

7-9. *Triticites ventricosus* (Meek) ---------- 32
7. Axial section, x 10. Same locality as the last.
8. Equatorial section, x 10. Same locality as the last.
9. Axial section, x 10. Top of Magdalena formation in Cedro Canyon 15 miles east of Albuquerque, New Mexico.

10, 11. *Triticites ventricosus sacramentoensis* Needham, n. var. ------- 33
10. Equatorial section, x 10. Upper Magdalena limestones in Fresnal Canyon, Otero County, New Mexico.
11. Axial section, x 10. Same locality as the last.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1. *Triticites ventricosus sacramentoensis* Needham, n. var. ---------- 33
Axial section, x 10. Upper Magdalena limestones in Fresnal Canyon, Otero County, New Mexico.

2-5. *Triticites kellyensis* Needham, n. sp. ---------- 35

2. Equatorial section, x 15. Near top of Magdalena formation, Kelly, Socorro County, New Mexico.

3. External view, x 4. Top of Magdalena formation, Jemez Springs, New Mexico.

4. Axial section, x 10. Near top of Magdalena formation, Kelly, New Mexico.

5. Equatorial section, x 10. Same locality as the last.

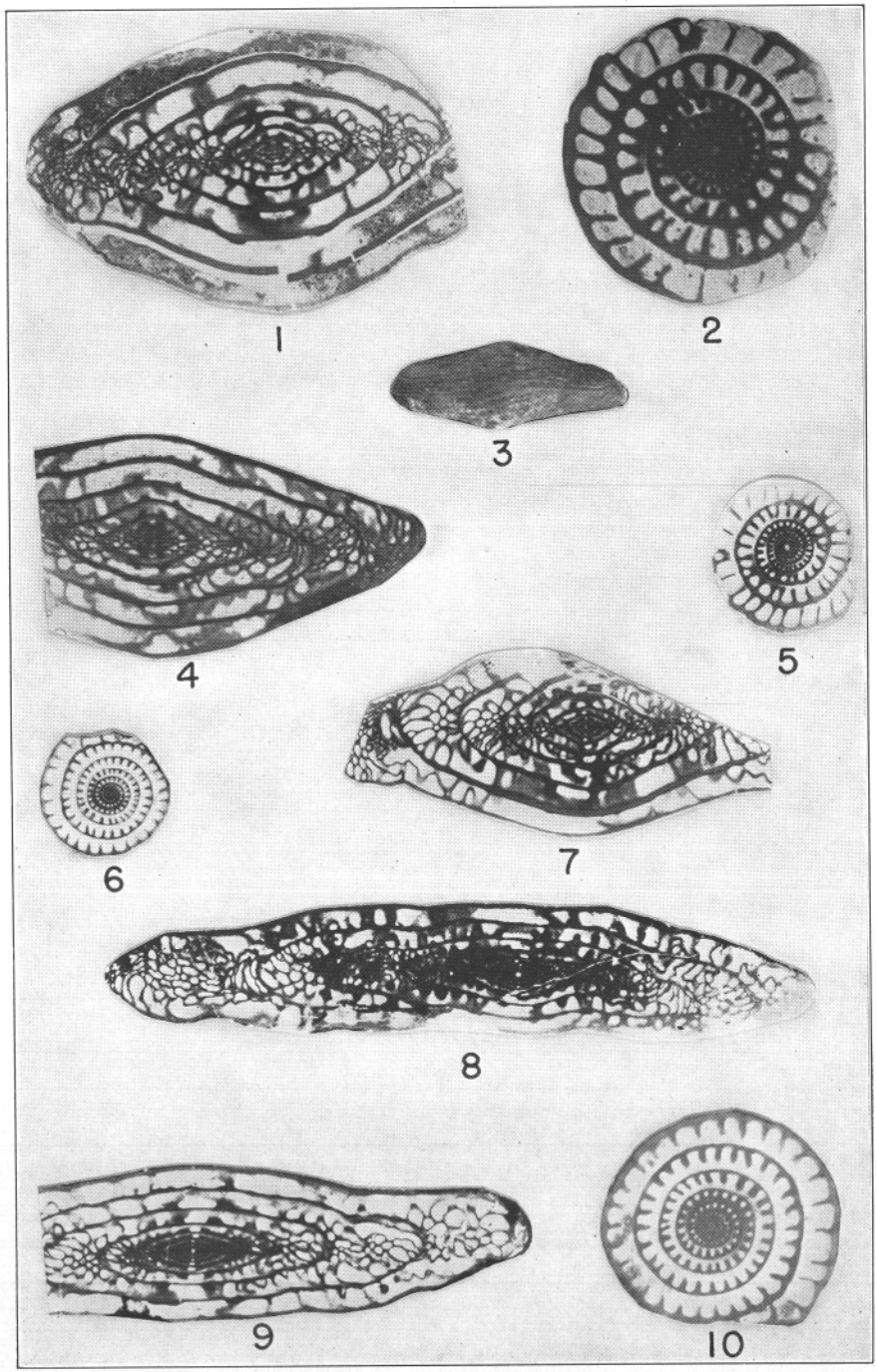
6. *Triticites cuchilloensis* Needham, n. sp. ---------- 36
Equatorial section, x 10. Middle Magdalena limestones about 6 miles east of Chloride, Sierra County, New Mexico.

7. *Triticites kellyensis* Needham, n. sp. ---------- 35
Axial section, x 10. Top of Magdalena formation, Jemez Springs, New Mexico.

8-10. *Triticites cuchilloensis* Needham, n. sp. ----------36

8, 9. Axial sections, x 10. Middle Magdalena limestones about 6 miles east of Chloride, Sierra County, New Mexico.

10. Equatorial section, x 15. Same locality as the last.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1-3. *Triticites wellsi* Needham, n. sp. ---------- 37

1, 2. Axial sections, x 10. Middle Magdalena limestones 1½ miles east of Barton, Santa Fe County, New Mexico.

3. Equatorial section, x 10. Same locality as the last.

4-7. *Triticites gallowayi* Needham, n. sp.---------- 39

4. Equatorial section, x 10. Upper Magdalena limestones about 2 miles east of La Luz, Otero County, New Mexico.

5, 6, 7. Axial sections, x 10. Same locality as the last.

8-11. *Triticites jemezensis* Needham, n. sp. ---------- 40

8. Axial 'section, x 10. Top of Magdalena formation, Jemez Springs, New Mexico.

9. Equatorial section, x 10. Same locality as the last.

10. Tangential section, x 10. Same locality as the last.

11. External views of five specimens ranging from sub-mature to mature, x 4. Same locality as the last.

12-17. *Triticites fresnalensis* Needham, n. sp. ---------- 42

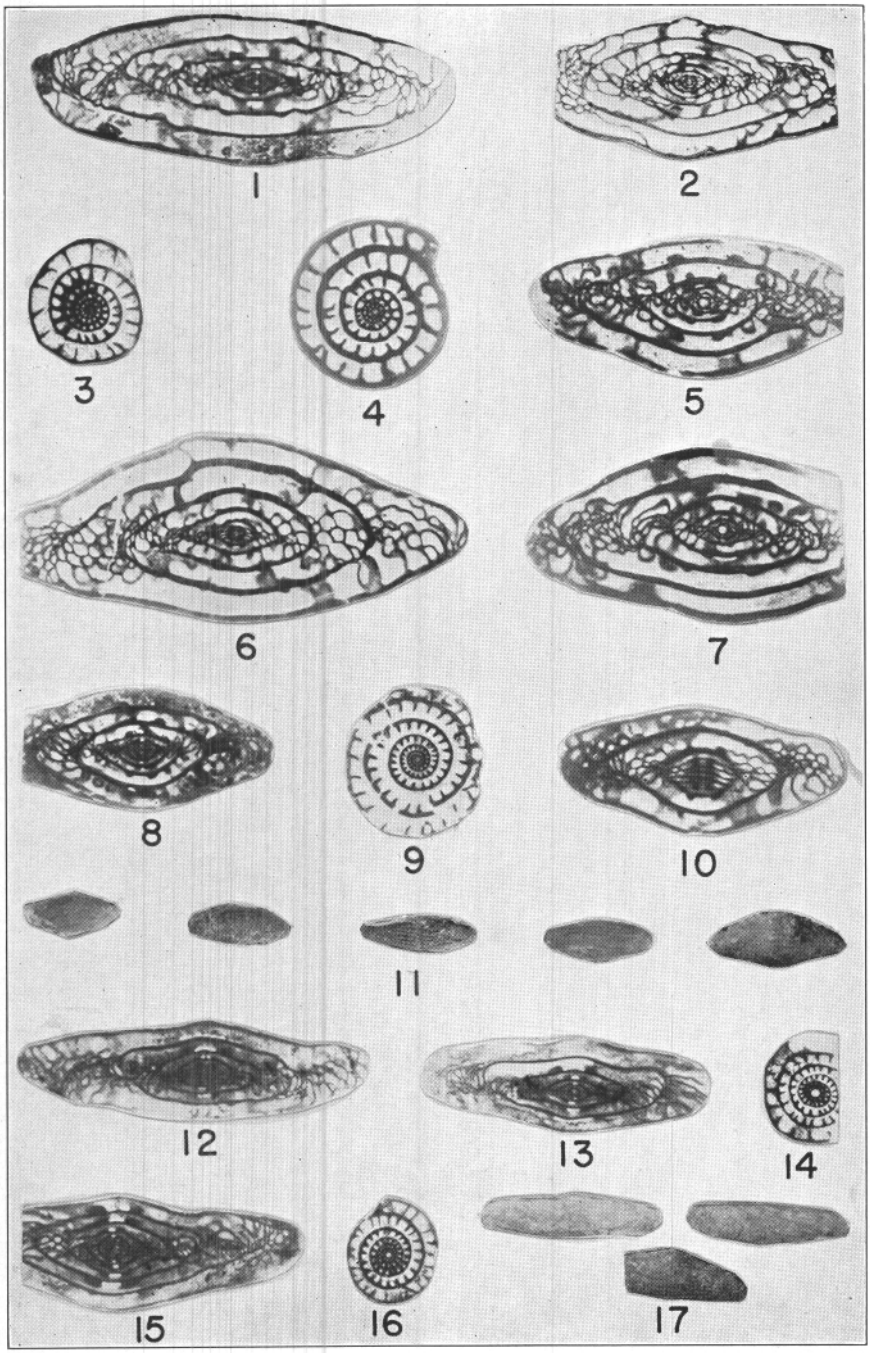
12, 13. Axial sections, x 10. Top of Magdalena formation in Fresnal Canyon near High Rolls, Otero County, New Mexico.

14. Equatorial section, x 10. Same locality as the last.

15. Axial section, x 10. Same locality as the last.

16. Equatorial section, x 10. Same locality as the last.

17. External views of three specimens, x 4. Same locality as the last.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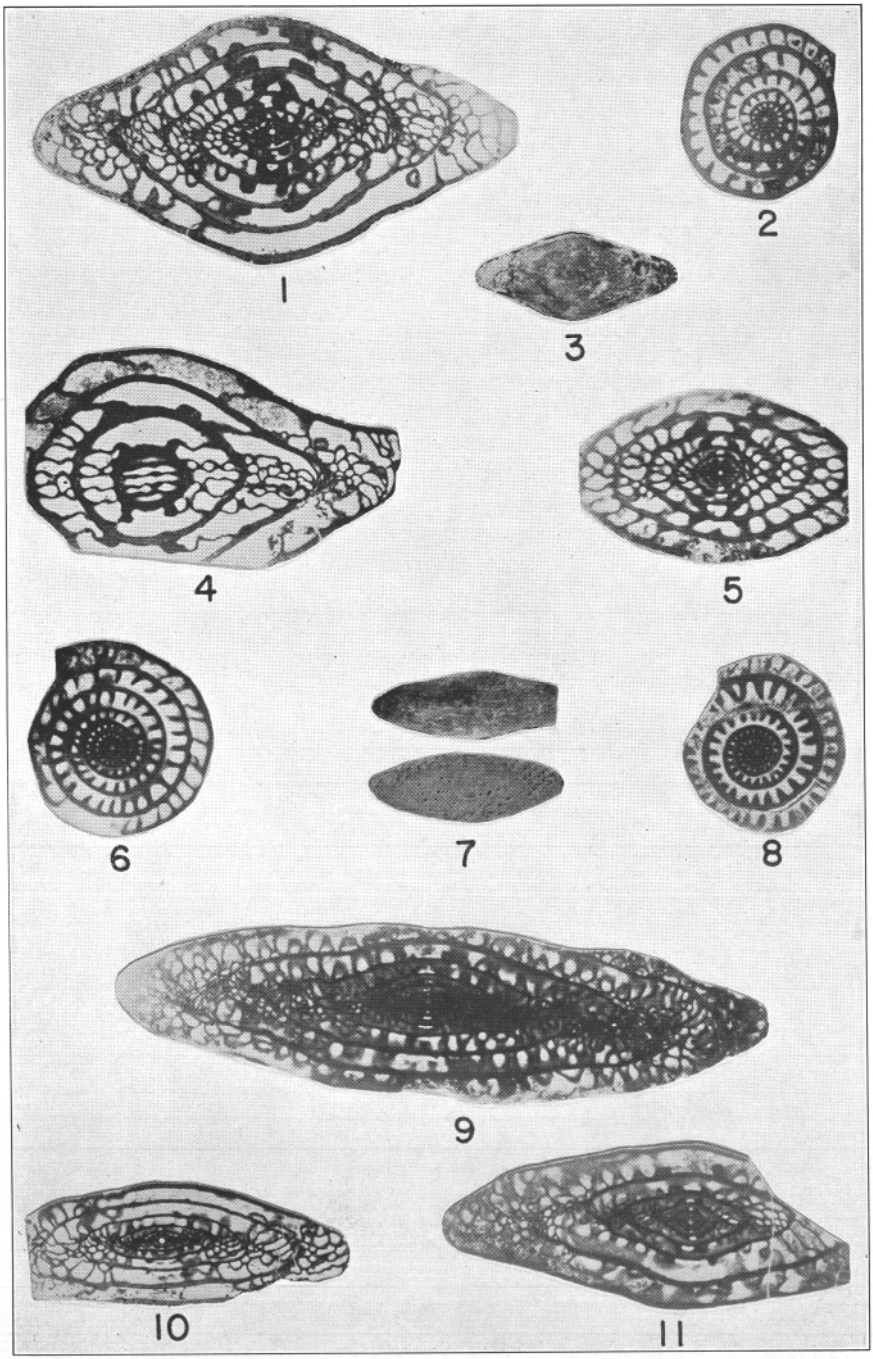
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PLATE VIII

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1-4. *Schwagerina emaciata jarillaensis* Needham, n. var. ---------- 47

1. Polished tangential surface, x 10. Hueco limestone about 4 miles north of Oro Grande, Otero County, New Mexico.
2. Axial section, x 10. Same locality as the last.
3. Equatorial section, x 10. Same locality as the last.
4. External views of three specimens, x 4. Same locality as the last.

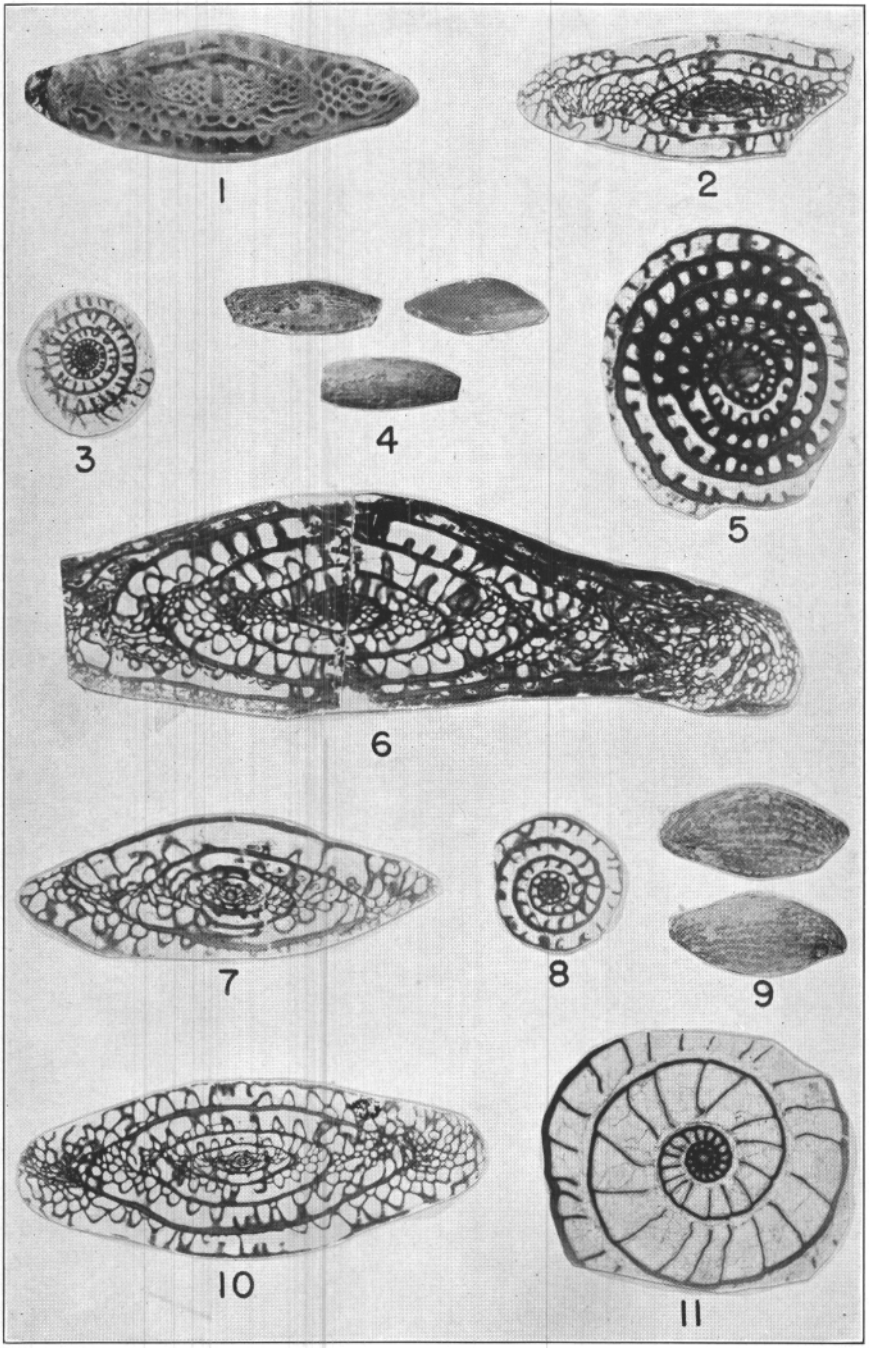
5, 6. *Schwagerina huecoensis* (Dunbar and Skinner) ---------- 49

5. Equatorial section, x 10. Hueco limestone about 2 miles northeast of Hueco Tanks, El Paso County, Texas.
6. Axial section, x 10. A restored specimen broken through the proloculum. Same locality as the last.

7-10. *Schwagerina thompsoni* Needham, n. sp. ---------- 50

7. Axial section, x 10. Hueco limestone about 2 miles northeast of Hueco Tanks, El Paso County, Texas.
8. Equatorial section, x 10. Same locality as the last.
9. External views of two specimens, x 4. Same locality as the last.
10. Axial section, x 10. Same locality as the last.

11. *Pseudoschwagerina fusulinoides* (Schellwien)---------- 51
Axial section, x 10. Same locality as the last.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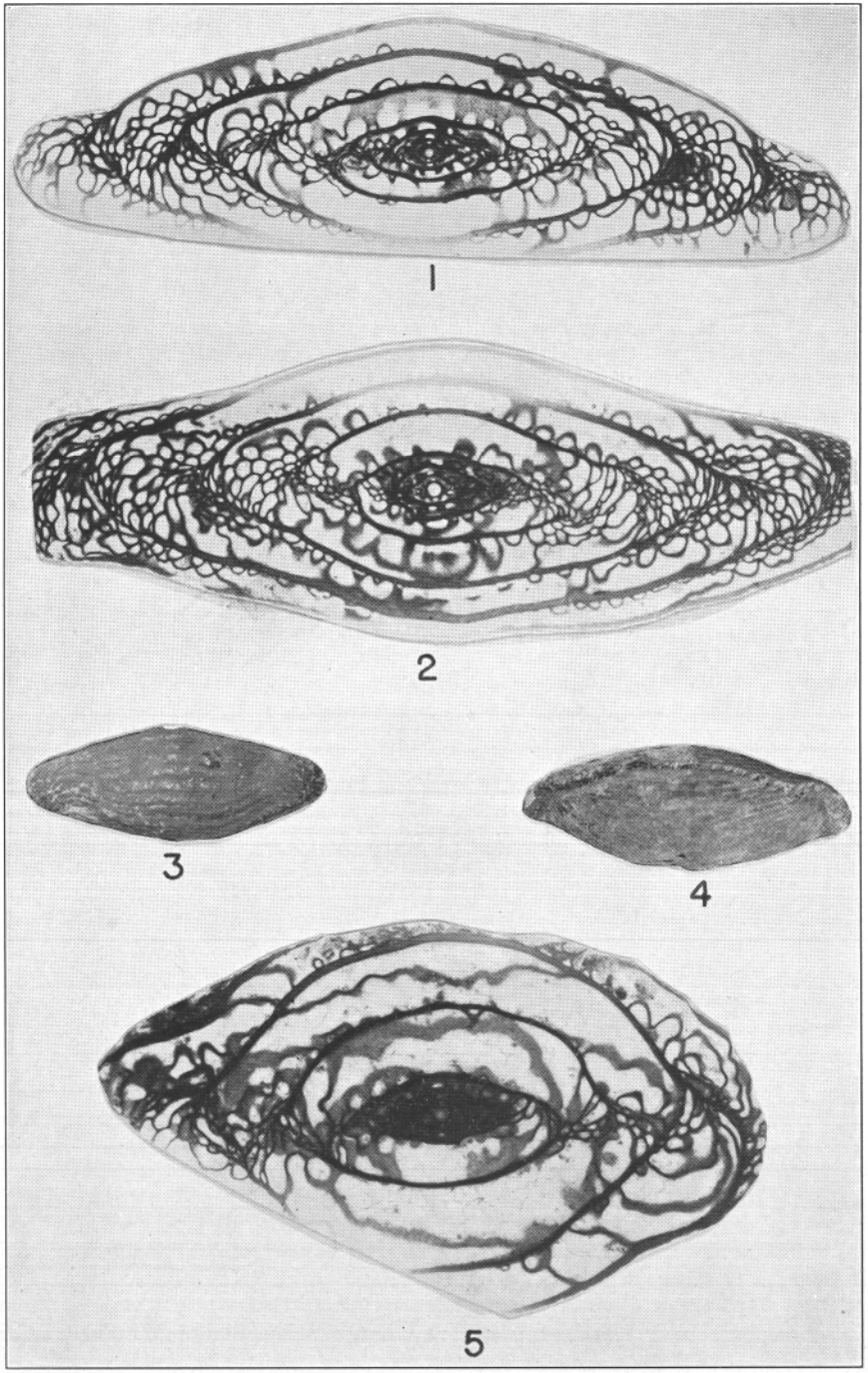
1-4. *Pseudoschwagerina fusulinoides* (Schellwien) ---------- 51
1, 2. Axial sections, x 10. Hueco limestone about 2 miles northeast of Hueco Tanks, El Paso County, Texas.
3, 4. External views, x 4. Same locality as the last.

5. *Pseudoschwagerina uddeni* (Beede and Kniker) ---------- 53
Axial section, x 10. Same locality as the last.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1-4. *Pseudoschwagerina uddeni* (Beede and Kniker) ---------- 53

1, 2. Equatorial section, x 10. Hueco limestone about 2 miles northeast of Hueco Tanks, El Paso County, Texas.

3. Axial section, x 10. Same locality as the last.

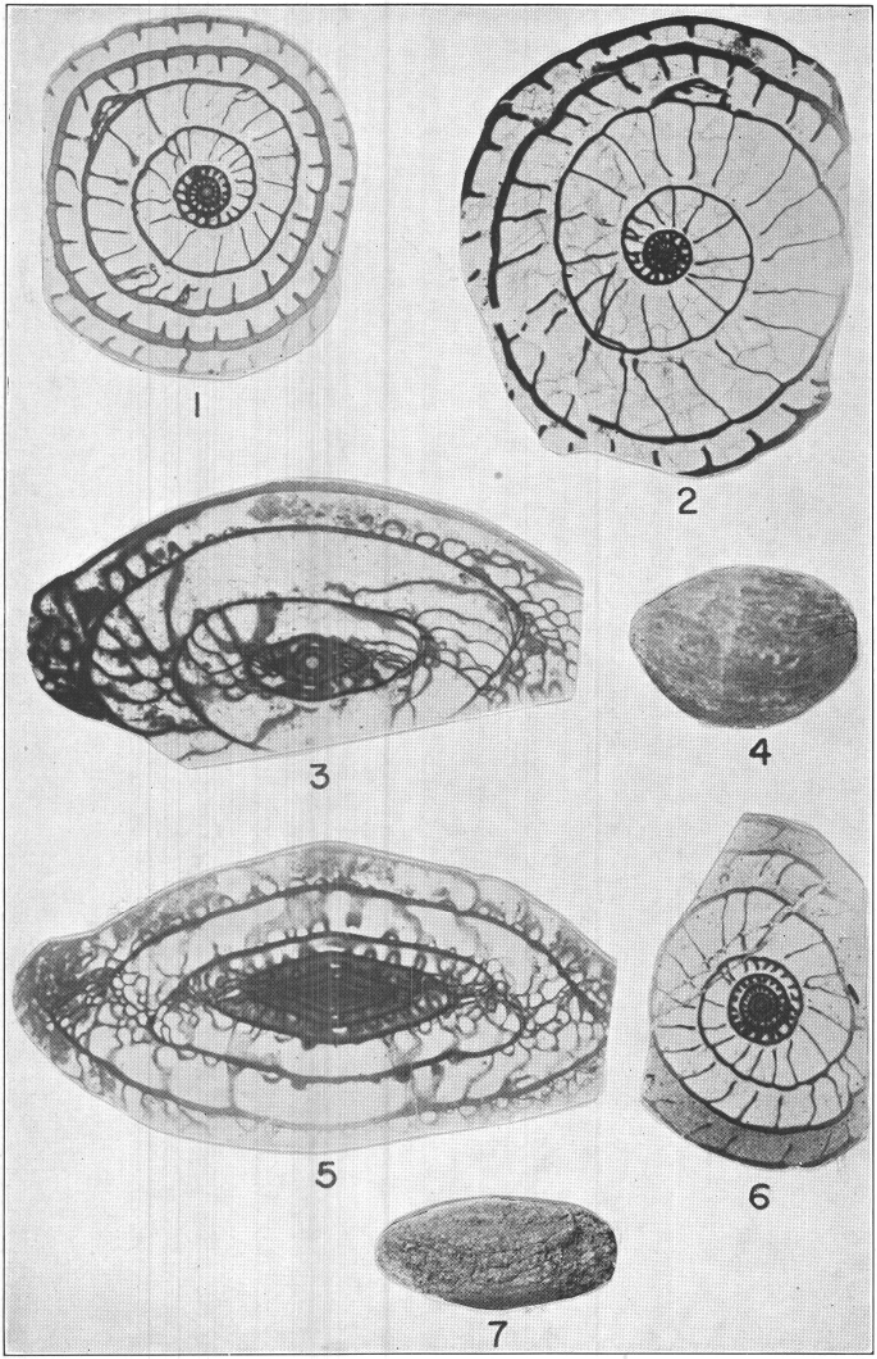
4. External view, x 4. Same locality as the last.

5-7. *Pseudoschwagerina morsel,* Needham, n. sp. ---------- 54

5. Axial section, x 10. Hueco limestone about 4 miles north of Oro Grande, Otero County, New Mexico.

6. Equatorial section, x 10. Same locality as the last.

7. External view, x 4. Same locality as the last.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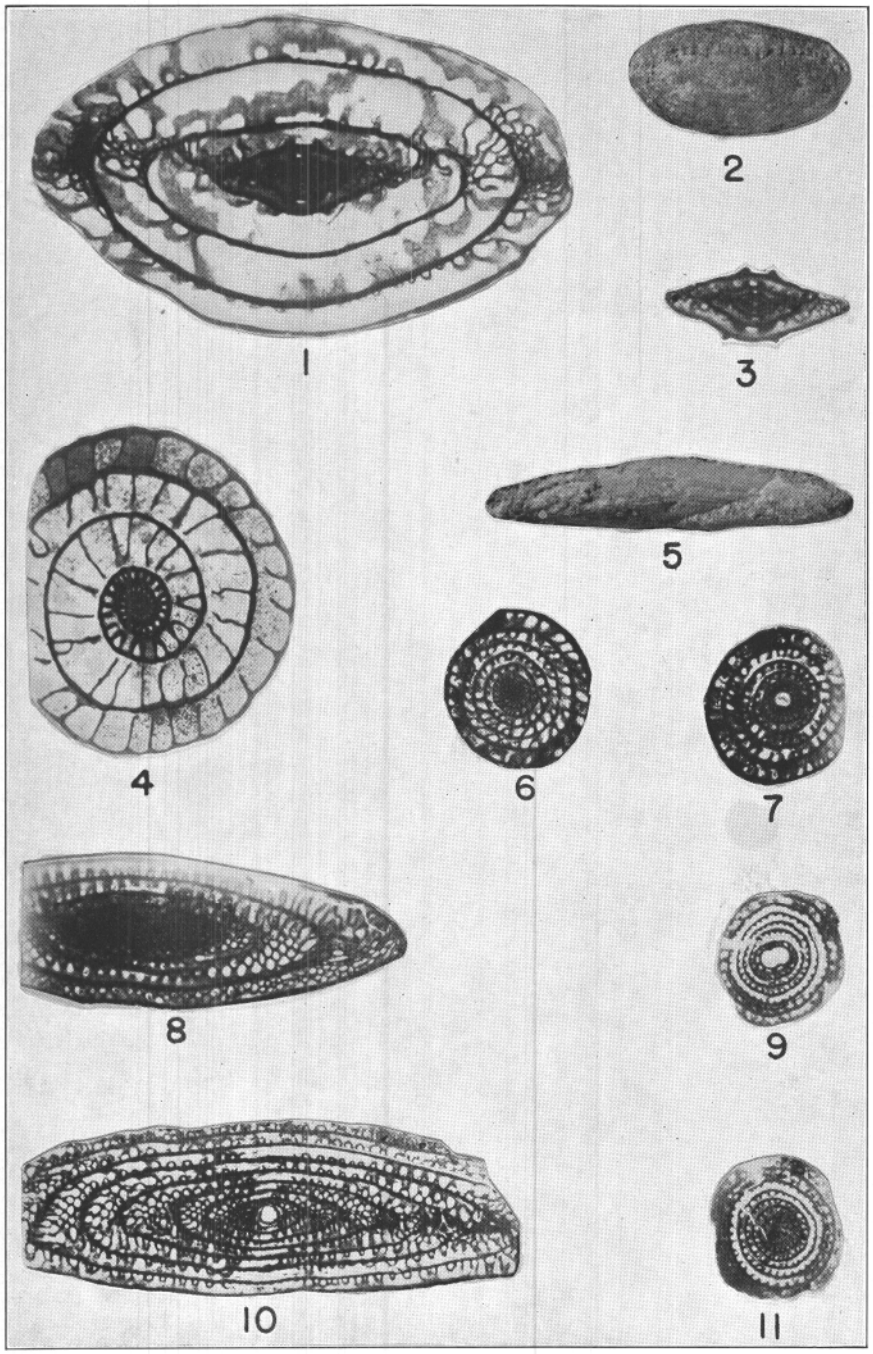
1-4. *Pseudoschwagerina morsei* Needham, n. sp. ---------- 54

1. Axial section, x 10. Hueco limestone about 4 miles north of Oro Grande, Otero County, New Mexico.
2. External view, x 4. Same locality as the last.
3. Axial section of the juvenarium, x 10. Same locality as the last.
4. Equatorial section, x 10. Same locality as the last.

5-11. *Parafusulina dunbari* Needham, n. sp. ---------- 56

5. External view, x 4. Middle Dog Canyon limestones in Last Chance Canyon, Eddy County, New Mexico.
6. Eccentric section, x 8. Same locality as the last.
7. Equatorial section, x 8. Same locality as the last.
8. Tangential section, x 8. Same locality as the last.
9. Equatorial section, x 8. Delaware Mountain sandstone under Guadalupe Point, Texas.
10. Axial section, x 8. Same locality as the last.
11. Eccentric section, x 8. Same locality as the last.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1, 2. *Parafusulina dunbari* Needham, n. sp. ---------- 56

1. Axial section, x 8. Delaware Mountain sandstone under Guadalupe Point, Texas.

2. Equatorial section, x 8. Middle Dog Canyon limestones in Last Chance Canyon, Eddy County, New Mexico.

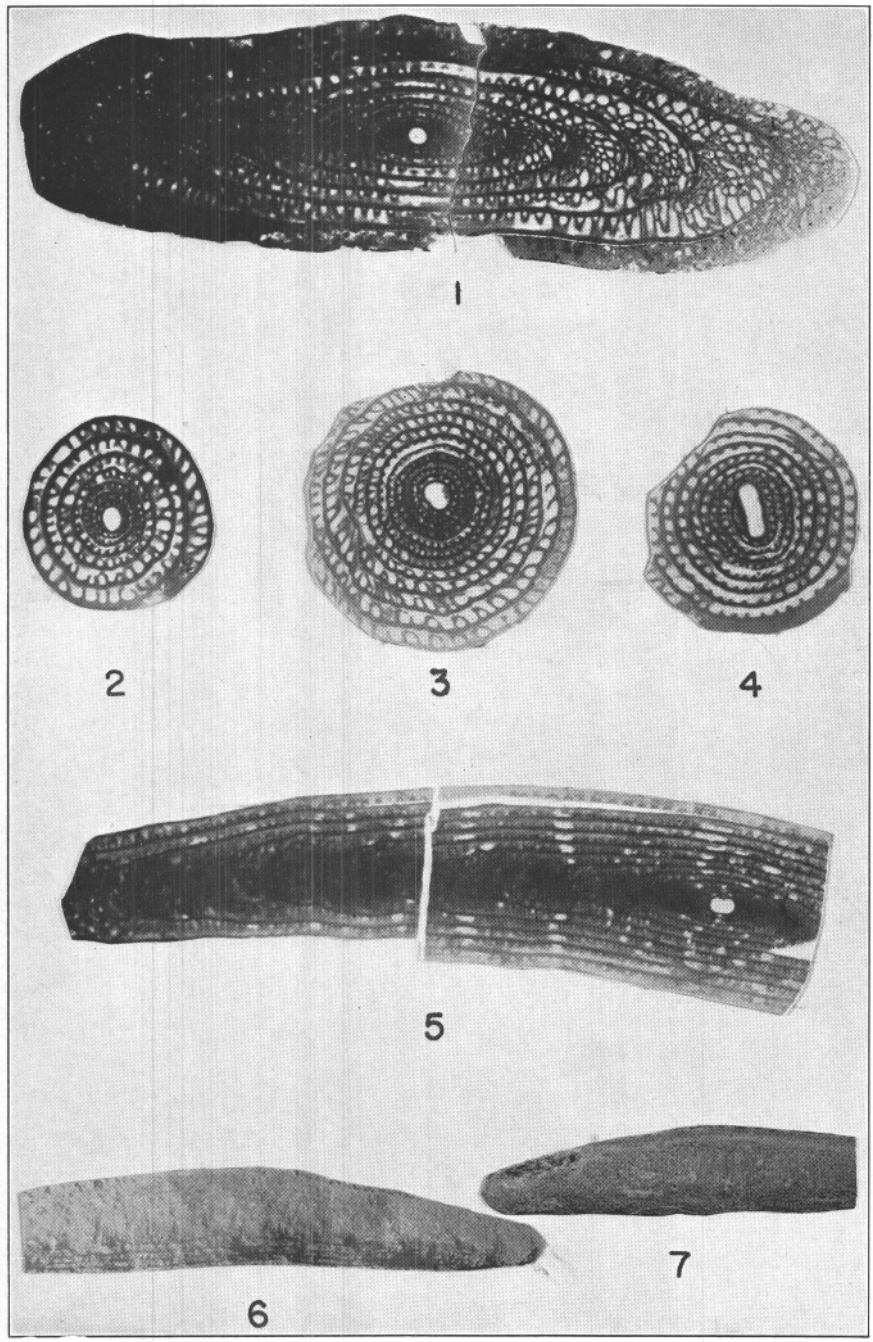
3-7. *Polydiexodina guadalupensis* Needham, n. sp. ---------- 58

3, 4. Equatorial sections, x 10. Lower Capitan limestones at Guadalupe Point, Texas.

5. Axial section, x 8. Same locality as the last.

6. External view, x 4. Same locality as the last.

7. Polished tangential surface, x 4. Same locality as the last.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