Stratigraphic Distribution of Some Pennsylvanian Fusulinidae from Brown and Coleman Counties, Texas

GEOLOGICAL SURVEY PROFESSIONAL PAPER 315-C

Prepared in cooperation with the Bureau of Economic Geology, The University of Texas

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By DONALD A. MYERS

PENNSYLVANIAN AND LOWER PERMIAN ROCKS OF PARTS OF WEST AND CENTRAL TEXAS

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STRATIGRAPHIC DISTRIBUTION OF SOME PENNSYLVANIAN FUSULINIDAE FROM BROWN AND COLEMAN COUNTIES, TEXAS

By DONALD A. MYERS

ABSTRACT

The stratigraphic succession of Pennsylvanian rocks that crop out in Brown and Coleman Counties contains oil and gas in the subsurface in central Texas and is equivalent to rocks that contain large reservoirs of petroleum in western Texas.

The Pennsylvanian rocks that crop out in Brown and Coleman Counties include the upper part of the zone of *Fusulina*, represented in the Strawn group undifferentiated, and the zone of *Triticites*, represented in the rocks of the Canyon and Cisco groups. The zone of *Triticites* extends upward into the Wichita group of Permian age. The fusulinid faunas are abundant and varied. Within the zone of *Triticites* each limestone bed or group of limestone beds contains a distinctive assemblage of fusulinids. The genus *Triticites* exhibits a general evolutionary series embracing the small thin-walled and relatively simple species in the lower part of the Canyon group, and the large ventricose thick-walled species in the upper part of the Cisco group. The gradation between species is believed to proceed at a more or less uniform rate, and by comparing evolutionary stages it is possible to make correlations of the containing rock units.

INTRODUCTION

In recent years the study of fusulinids has become increasingly important because of the large amounts of oil and gas produced from rocks belonging to the Pennsylvanian and Permian systems. The fossils belonging to the family Fusulinidae have widespread geographic distribution and generally are found in considerable abundance in rocks of these systems. They first appeared in Late Mississippian time. The fusulinids flourished during Pennsylvanian and most of Permian time and became extinct slightly before the end of the Permian period. Within this timespan, evolutionary changes were continuous and great. The widespread geographic distribution, the great abundance of specimens, and the rapid evolution within the family, serve to make the genera and species of fusulinids valuable for correlating the rock units that contain them.

Use of fusulinids as a stratigraphic tool depends upon knowledge of their distribution in time. This, in turn, depends upon knowledge of the stratigraphic sequence of the rocks in areas from which fusulinid collections have been made. D. Hoye Eargle (1960) has recently studied and described the stratigraphic succession of Pennsylvanian and lower Permian rocks in Brown and Coleman Counties. His nomenclature, used throughout this report, provides a convenient frame of reference for the description of the stratigraphic distribution of the fusulinids. Recent detailed geologic mapping by the U.S. Geological Survey has provided information on the lateral continuity of lithologic units in the Pennsylvanian and lower Permian sequence, and has made it possible to obtain abundant collections of fusulinids from precisely defined positions in the stratigraphic sequence.

Much of the stratigraphic correlation in the Permian basin of western Texas and elsewhere in areas of Pennsylvanian and Permian rocks is based on age relations determined by the study of fusulinids. In some of the limestone masses, such as the subsurface Horseshoe Atoll in the Midland basin of western Texas, correlation of rock units is largely dependent upon faunal evidence. Because fusulinids are small enough to be preserved intact in well cores and as identifiable fragments in cuttings, they provide an excellent tool to aid in determining the stratigraphic succession within the atoll (Myers, Stafford, and Burnside, 1956). Knowledge of the stratigraphic distribution of the various genera and species of fusulinids in the atoll was derived from studies of their distribution in the Pennsylvanian and lower Permian rocks that crop out in central and western Texas.

The rocks that crop out in the area of this report have been assigned to the Strawn, Canyon, and Cisco groups of Pennsylvanian age and to the Wichita group of Permian age. Fusulinids have been found in most of the limestone beds and in a few of the shale beds in this rock sequence. The zone of *Fusulina* is in the Strawn group, and the zone of *Triticites* is in the Canyon and Cisco groups and extends upward into the Wichita group. The fusulinid faunas in these rocks are abundant and varied.

Collections of fusulinids were made during 1949–55 from several hundred localities in Brown and Coleman Counties. Only material of undoubted stratigraphic position was used. Specimens of fusulinids were prepared by standard methods. Typical and unusual fusulinids from each locality are illustrated in this report and indexed to appropriate positions on a generalized columnar section. Unnamed species, or those with uncertain affinities, are designated by letters.

The gradation between species is the factor that makes the fusulinids a valuable tool in correlation of rock units. This gradation often represents a continuous evolutionary series and therefore the line of demarcation between species, and between genera in some cases, can be vague. Many features of the fusulinid which exhibit change have been found to be constant at any given stratigraphic horizon.

This report describes and illustrates the characteristics and stratigraphic distribution of fusulinids in the rocks of Pennsylvanian age in Brown and Coleman Counties. The taxonomic descriptions of these fusulinid faunas are the subject of a detailed study, now in progress, of the Fusulinidae of north-central Texas by Lloyd G. Henbest, Donald A. Myers, and Raymond C. Douglass.

The morphologic principles upon which the taxonomic differentiation in this report is based are outlined by Dunbar and Henbest (1942, p. 35–56, fig. 5–8) and by Thompson (1948, p. 8–22, fig. 1–4).

LOCATION OF THE AREA

The area lies entirely within the Colorado River drainage basin in central Texas. It is bounded to the north by the Brown-Eastland County line, to the south by the Colorado River, to the east by the western edge of the overlapping Cretaceous rocks in Brown County, and to the west by the base of the Permian Waldrip shale member of the Pueblo formation in southeastern Coleman and northwestern Brown Counties, which is the line shown as the contact between the Cisco and Wolfcamp (fig. 9).

PREVIOUS INVESTIGATIONS

Little information has been published on the fusulinids from rocks of the Canyon and Cisco groups. Dunbar and Condra (1928) described several species from the Graham formation in the Brazos River drainage basin, north of the area of this report. M. P. White (1932) described and illustrated several species of fusulinids from central Texas, and briefly discussed the stratigraphic distribution of the species; his report, however, is mainly concerned with taxonomy. Henbest (Lee and others, 1938) published some notes on the ranges and species of fusulinids in the Cisco group in the Brazos River drainage basin. Thompson (1945, p. 452, pl. 1, fig. 5; pl. 2, figs. 11–18) described a fusulinid from the Ricker Station limestone of Cheney (1949), which crops out in the area of this report. Stewart (1958) described several fusulinids from the upper part of the Strawn group in Texas, including some from the area of this report. Henbest's notes constitute the only published report relating the fusulinid fauna to the stratigraphic sequence in the upper part of the Pennsylvanian system of central Texas.

METHODS OF STUDY

All fusulinid-bearing rock units of the Pennsylvanian system in Brown and Coleman Counties, Tex., are represented in the fossil collections that were studied for this report. Several hundred collections were made, generally in conjunction with geologic mapping, and the locations of the more important collections are shown on figure 9. Most of the fossiliferous material was taken from rock in place, but a few collections were made from anthills so situated that there was no possibility of contamination from other rock units.

Most of the fusulinids illustrated in this report were taken from blocks of limestone. The blocks were sawed into slabs about a quarter of an inch thick, generally parallel to the bedding. These slabs were immersed in water and examined with a binocular microscope. From each locality, 40 to 50 representative fusulinids were selected and marked for cutting. In the process of selection, the specimens of each type of fusulinid whose long axis was most nearly parallel to the cut surface were used. The marked specimens were cut from the rock, leaving matrix around the specimen equal to or greater than the diameter of the fusulinid. The resulting chips of limestone were completed as thin sections in the manner described by Dunbar and Henbest (1942, p. 65–74). More than 6,000 oriented thin sections were prepared and examined between 1950 and 1955.

Twenty or more oriented axial thin sections were prepared for each locality, and care was taken to obtain a representative suite of fossils. Representative and unusual fusulinids were selected from each prepared collection and were photographed with transmitted light at a standard magnification of $\times$ 10. Small fusulinids, such as *Schubertella* and *Staffella?*, were photographed at a magnification of $\times$ 30. These photographs were mounted in a looseleaf binder, containing no more than one locality to a page, in stratigraphic sequence. This method provides a ready reference to the collections of prepared fusulinids. The fusulinids illustrated in this report (pls. 15 through 24) were selected from this file.

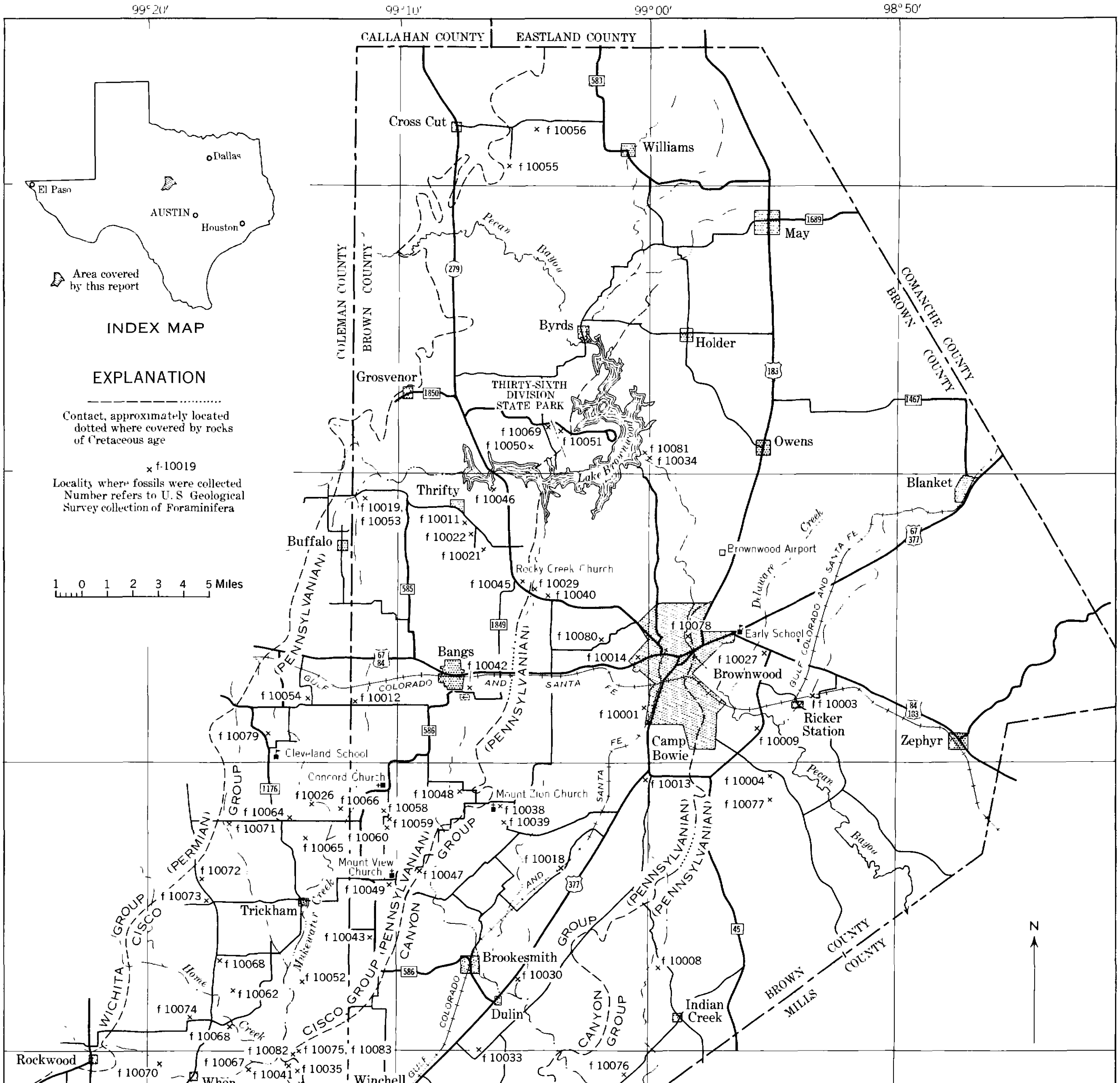

FIGURE 9.—Index map of Brown and Coleman Counties, Tex., showing location of fusulinid collections and approximate contacts between stratigraphic units in the Pennsylvanian system.

These fusulinid illustrations are keyed to a generalized columnar section (fig. 10), and the stratigraphic distribution of the fusulinid faunas are summarized in a check list (table 1).

ACKNOWLEDGMENTS

The stratigraphic nomenclature used in this report is the revised terminology prepared by D. Hoye Eargle (1960), which is based on geologic mapping in Brown and Coleman Counties by Eargle, Philip T. Stafford, Robert T. Terriere, and the writer, from 1949–55. The stratigraphic study of fusulinids in the Pennsylvanian strata of Texas was begun by Keith A. Yenne, and much of the material prepared for him has been used by the writer. Yvonne M. Kahanek and Patricia A. Black prepared most of the specimens and assisted with the photography.

TABLE 1.—*Distribution of Fusulinidae in the Strawn, Canyon, and Cisco groups in Brown and Coleman Counties, Texas*

[Cf. is used where the fossil is very similar to the named species; at most the difference is subspecific]

Group, formation, and member	Species																																																					
	Fusulina aff. *F. acme* Dunbar and Henbest, 1942	*F.* aff. *F. megista* Thompson, 1934	*F.* aff. *F. eximia* Thompson, 1934	*F. cappsensis* Stewart, 1958	*F? rickerensis* Thompson, 1945	*F.* sp. A	*Kansanella* ex gr. *K. osagensis* Newell, 1934	*K.* cf. *K. neglectus* Newell, 1934	*Triticites irregularis* (Schellwien and Staff), 1912	*T.* aff. *T. irregularis* (Schellwien and Staff), 1912	*T.* ex gr. *T. irregularis* (Schellwien and Staff), 1912	*T. nebraskensis* Thompson, 1934	*T. ohioensis* Thompson, 1936	*T.* ex gr. *T. ohioensis* Thompson, 1936	*T.* aff. *T. consobrinus* White, 1932	*T.* cf. *T. secalicus* (Say), 1833	*T.* aff. *T. secalicus* (Say), 1833	*T.* ex gr. *T. secalicus* (Say), 1833	*T.* cf. *T. newelli* Burma, 1942	*T.* aff. *T. newelli* Burma, 1942	*T. cullomensis* Dunbar and Condra, 1927	*T.* cf. *T. cullomensis* Dunbar and Condra, 1927	*T.* aff. *T. cullomensis* Dunbar and Condra, 1927	*T.* cf. *T. oryziformis* Newell, 1934	*T. plummeri* Dunbar and Condra, 1927	*T.* cf. *T. plummeri* Dunbar and Condra, 1927	*T.* aff. *T. plummeri* Dunbar and Condra, 1927	*T.* aff. *T. ventricosus* (Meek and Hayden), 1858	*T.* ex gr. *T. ventricosus* (Meek and Hayden), 1858	*T. beedei* Dunbar and Condra, 1927	*T.* cf. *T. beedei* Dunbar and Condra, 1927	*T.* aff. *T. beedei* Dunbar and Condra, 1927	*T.* cf. *T. subventricosus* Dunbar and Skinner, 1937	*T.* aff. *T. subventricosus* Dunbar and Skinner, 1937	*T.* aff. *T. moorei* Dunbar and Condra, 1927	*T.* sp. A	*T.* sp. B	*T.* sp. C	*T.* sp. D	*T.* sp. E	*T.* sp. F	*T.* sp. G	*T.* sp. H	*T.* sp. I	*T.* sp. J	*T.* sp. K	*T.* sp. L	*Dunbarinella* cf. *D. ervinensis* Thompson, 1942	*D.* sp. A	*D.* sp. B	*D.* sp. C	*D.* sp. D	*Millerella?* sp.	*Staffella* sp.	*Schubertella* sp. A
Cisco																																																							
Thrifty:																																																							
Chaffin limestone																									X				X			X	X		X																	?			
Breckenridge limestone																		X							X				X					X												X	X								
Speck Mountain limestone																		X							X				X																					X	X				X
Graham:																																																							
																												X				X																							
Ivan limestone																							?						X			X													X			X							
																													X			X																							
Wayland shale																													X		X	X												X											
																									X				X	X		X																							
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Gunsight limestone																							X						X																									X	
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Bluff Creek shale																						X				X	X		X																										
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															cf.	X																																						X	
Canyon																																																							
Caddo Creek:																																																							
Home Creek limestone															X	X																				X	X	X																X	
Colony Creek shale																																																							
Brad:																																																							
Ranger limestone																			X			X																	X																
Placid shale																				X																	cf.			X															
Winchell											X																																										X	X	
														X																										cf.															
Graford:																																																							
Cedarton shale																																																							
Adams Branch limestone							X	X					X																																										
Brownwood shale									X	X	X	X																																											
Strawn																																																							
Capps limestone lentil [1]	X	X	X	X		X																																																	
Ricker Station limestone [2]					X																																																		

[1] Of Plummer and Moore (1921).
[2] Of Cheney (1949).

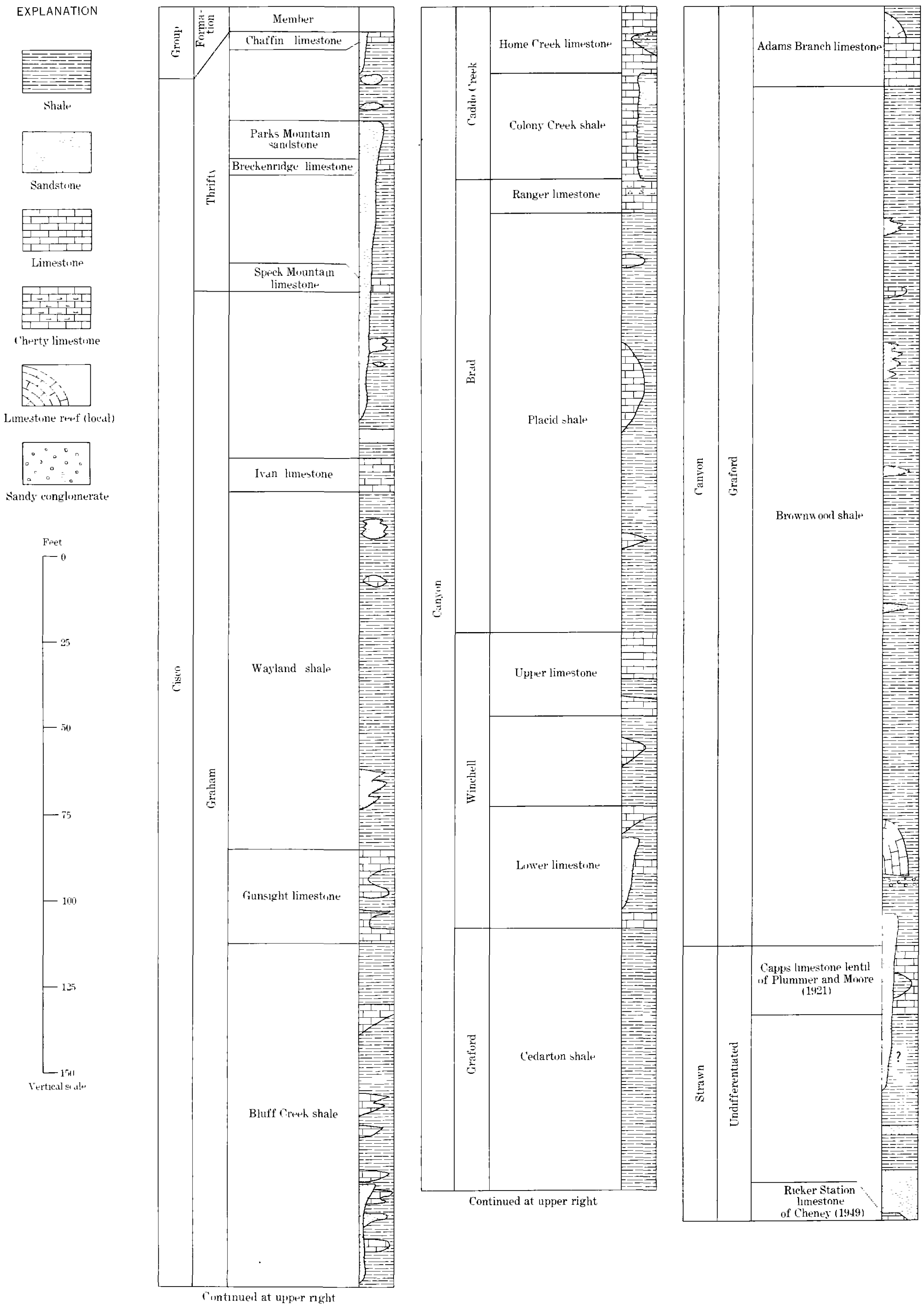

Figure 10.—Generalized columnar section of the Pennsylvanian rocks that crop out in Brown and Coleman Counties, Tex. (After Eargle, 1960.)

STRATIGRAPHY

The Paleozoic rocks that crop out in the area have been assigned to the Strawn, Canyon, and Cisco groups of the Pennsylvanian system, and to the Wichita group of the Permian system. The generalized areal distribution of rocks of the Strawn, Canyon, and Cisco groups in Brown and Coleman Counties is shown on the index map (fig. 9). Exposed rocks belonging to the Pennsylvanian system have a thickness of approximately 1,065 feet and a general regional dip to the west-northwest, ranging from 50 to 80 feet per mile (Eargle, 1960). The nomenclature and generalized lithology of the Pennsylvanian rocks are shown on the columnar section (fig. 10).

Rocks of the Strawn group are chiefly shale and sandstone, and small amounts of limestone (fig. 10). These rocks have an average thickness of 80 feet between the base of the Ricker Station limestone of Cheney (1949) and the top of the Capps limestone lentil of Plummer and Moore (1921).

The rocks of the Canyon group are predominantly shale containing several massive beds of limestone and lesser amounts of sandstone. The Canyon group has been subdivided into 4 formations containing 7 named members (fig. 10). It has an average thickness of 620 feet.

The Cisco group has been subdivided into 2 formations and 7 named members. It consists chiefly of shale in which are found several channel-fill deposits of chert conglomerate and sandstone and numerous thin beds of limestone. Many of these thin limestone beds, especially those in the lower part, are not laterally persistent. The rocks of the Cisco group have an average thickness of 365 feet.

Rocks of the Wichita group of the Permian system were not examined for this report.

STRATIGRAPHIC DISTRIBUTION OF THE FUSULINIDS

STRAWN GROUP UNDIFFERENTIATED

The Strawn group, undifferentiated, has been defined by D. Hoye Eargle (1960) as including, in Brown County, all exposed Pennsylvanian rocks that stratigraphically underlie the Brownwood shale member of the Graford formation. The stratigraphy of the Strawn in the area of this report is complex, and exposures are scarce, owing to extensive alluvial cover. It therefore seems impracticable to recognize and map formational or smaller units of the Strawn in the area covered by this report, as has been done in the Brazos River drainage basin. Most of the strata belonging to the Strawn group in Brown County is sandstone and shale which have no characteristically different mineral or faunal assemblages to aid in their recognition. Two limestone beds, however, the Ricker Station limestone of Cheney (1949) and the Capps limestone lentil of Plummer and Moore (1921), contain fusulinid faunas that are sufficiently different to allow differentiation of the limestones.

RICKER STATION LIMESTONE OF CHENEY (1949)

The Ricker Station limestone of Cheney (1949) generally ranges from 2 to 4 feet in thickness. It contains a species of fusulinid which resembles a primitive species of *Fusulina*, *F.? rickerensis* Thompson, 1945. (See pl. 15, figs. 15–21 and pl. 24, fig. 1.) The relationship of this species to those found in the younger Capps limestone lentil of Plummer and Moore (1921) is not certain. The fusulinid found in the Capps represents a more advanced species of *Fusulina*. The gap in evolutionary sequence between the fusulinid in the Ricker Station limestone of Cheney (1949) and the fusulinid in the Capps limestone lentil is so great that it suggests a hiatus in that part of the stratigraphic sequence in the area.

CAPPS LIMESTONE LENTIL OF PLUMMER AND MOORE (1921)

The Capps limestone lentil of Plummer and Moore (1921) is the uppermost bed of the Strawn group. In Brown County, the bed attains a maximum thickness of 30 feet and averages about 20 feet. Fusulinids belonging to the genus *Fusulina* have been found throughout the bed. It is not yet known if the various species of *Fusulina* are restricted to definite zones. Fusulinids from the Capps are illustrated on plate 15, figures 1–14.

CANYON GROUP

The Canyon group, approximately 620 feet thick, contain 4 formations: Graford, Winchell, Brad, and Caddo Creek. The rocks of the Canyon group, in the area of this report, contain about 83 percent shale, 15 percent limestone, and 2 percent sandstone. The limestone beds contain the most numerous fusulinid faunas, although in a few places, the shales contain beds that are almost a coquina of fusulinids. A fusulinid bed in the Brownwood shale member of the Graford formation, exposed at locality f10014 (fig. 9) west of Brownwood, is a good example of such a bed. Fusulinids were not found in the sandstones.

The change in fusulinid faunas between the Capps limestone lentil of Plummer and Moore (1921) of the Strawn group and the overlying Brownwood shale member of the Graford formation in the Canyon group is very striking. The change is from a generally large species of *Fusulina* with highly fluted septa and a four-layered wall in the Capps, to a small species of *Triticites* with weakly fluted septa and a two-layered wall in the Canyon. Fusulinids found in the rocks of the Canyon group in this area can be differentiated from those found in rocks of the Strawn group on the basis of wall structure alone.

GRAFORD FORMATION

The Graford formation has a total thickness of about 275 feet. It includes the Brownwood shale member at the base and the Adams Branch limestone member and the Cedarton shale member at the top.

BROWNWOOD SHALE MEMBER

Fusulinids were collected from two beds in the Brownwood shale member. The lower fusulinid-bearing bed contains, in a thin limestone lentil, a fauna composed of *Triticites irregularis* (pl. 16, figs. 11–17). The upper fusulinid-bearing bed is about 60 feet below the top of the Brownwood shale member. *Triticites nebraskensis* Thompson, 1934 (pl. 2, figs. 9 and 10) is found in great abundance and forms lenses of coquina. This is the "fusulinid-bearing limestone" of Lee and others (1938, p. 102).

The fusulinid "*Wedekindellina*" *ultimata* Newell and Keroher, 1937, which has been found in the lower part of the Missouri series in the midcontinent region has not been found in rocks that crop out in central Texas. The most primitive fusulinid found in the exposed rocks of the Canyon group is *Triticites irregularis* (Schellwien and Staff), 1912, which first appears in the Brownwood shale member of the Graford formation. These triticite fusulinids are characterized by moderately thin spirotheca, weakly fluted septa, elongate shape, pointed to blunt ends, small proloculus, and somewhat fusulinelloid chomata.

ADAMS BRANCH LIMESTONE MEMBER

The Adams Branch limestone member contains a characteristic triticite fauna. The fauna is composed of *Triticites ohioensis* Thompson, 1936 (pl. 16, figs. 1–4), *T.* ex. gr.[1] *Kansanella osagensis* (Newell), 1934 (pl. 16, figs. 7 and 8), and *Kansanella* cf. *K. neglectus* (Newell), 1934 (pl. 16, figs. 5 and 6). *Triticites ohioensis* is similar to but is somewhat larger and more cylindrical than *T. irregularis*. *Kansanella* ex gr. *K. osagensis* from this area is typically a large cigar-shaped fusulinid with moderately thick spirotheca and highly, but irregularly fluted septa. *Kansanella* cf. *K. neglectus* and *Kansanella* ex gr. *K. osagensis* are probably restricted to the lower part of the Adams Branch, however, available stratigraphic evidence is not sufficient to establish the position from which collections containing these species were made.

CEDARTON SHALE MEMBER

The Cedarton shale member, which overlies the Adams Branch limestone member, is not known to contain fusulinids in the area of this report.

WINCHELL LIMESTONE

The Winchell limestone was defined by Eargle (1960) as including two main sequences of resistant limestone beds separated by shale, and as having a total thickness of about 100 feet. The limestone sequences, which account for about one-third of the formation, were called lower limestone member and upper limestone member.

The lower limestone member generally contains three or more limestone beds separated by shale and sandstone. The upper limestone member contains two limestone beds separated by shale and sandstone.

Fusulinids are generally rare in the Winchell. A few free specimens were found near the lowermost limestone bed at the Lake Brownwood spillway (f10034); however, as the material from this part of the Winchell was not found in place, it is not illustrated. The lowest part of the upper limestone member at the Lake Brownwood spillway (f10081) contains fusulinids in considerable abundance. They have also been found at a similar stratigraphic position at one other locality (f10080) a few miles to the south (fig. 9).

Three species belonging to three different genera of fusulinids have been found in the upper limestone member of the Winchell. *Triticites*, the most common genus in the fauna, is represented by a species which belongs to the group of *T. irregularis* (pl. 17, figs. 19, 20, 22–24). The other two genera are *Millerella*? sp. (pl. 17, fig. 21) and *Staffella*? sp. (pl. 17, fig. 25). The association of *Millerella*? and *Staffella*? with *Triticites* of the type figured here may be significant; however, until more collections are made from the Winchell, the meaning of this assemblage will remain open to question. The species of *Triticites* from the Winchell are smaller than those found in beds above and below the formation.

BRAD FORMATION

The Brad formation includes the Placid shale member overlain by the Ranger limestone member. The formation has a thickness of about 130 feet in the southwestern part of Brown County (Eargle, 1960) but becomes somewhat thinner to the north.

[1] "Cf." and "aff." and "ex gr." are used in the sense employed by Schenk and McMasters (1936, p. 23). "Cf." has been used where the fossil is very similar to the named species. At most the difference between the two is subspecific. "Aff." has been used for fossils that are related to or similar to the named species. The difference between the two is specific. The term "ex gr." (ex grupo) is used throughout this report to refer to species belonging to the same group or lineage of a previously described species. The species are not sufficiently similar, however, to warrant the use of "cf." or "aff." in conjunction with the specific name.

PLACID SHALE MEMBER

The Placid shale member contains 3 limestone lentils, but only in the lentil near the middle have a few fusulinids been found. Fusulinids are rare or absent in the shale. The fauna from the limestone consists of species that are related to *Triticites newelli* Burma, 1942 (pl. 17, fig. 17), and two unnamed species of *Triticites* (pl. 17, figs. 14–16 and 18) that are somewhat ventricose forms and may be forerunners of the group of *Triticites ventricosus.*

RANGER LIMESTONE MEMBER

Fusulinids are generally uncommon in the Ranger limestone member. Locally, however, they may be numerous. Representative specimens of the three triticite species from the Ranger are shown on plate 17: *Triticites* cf. *T. cullomensis* Dunbar and Condra, 1927 (fig. 13); *Triticites* cf. *T. newelli* (fig. 12); and *Triticites* sp. D (figs. 10 and 11).

CADDO CREEK FORMATION

The Caddo Creek formation as defined by Eargle contains the Colony Creek shale member below and the Home Creek limestone member above. Eargle ascribes a thickness of 55 to 75 feet to this formation in Brown County.

COLONY CREEK SHALE MEMBER

The Colony Creek shale member probably does not contain fusulinids in the area. In southeastern Coleman County, however, along Home Creek, the shale interval between the Ranger limestone member of the Brad formation and the overlying Home Creek limestone member of the Caddo Creek formation grades laterally into limestone. Deposition of limestone in this area may have been continuous from Ranger through Home Creek time. Fusulinids that show affinities to those in the Ranger are found scattered throughout the lower part of this interval of rocks (pl. 24, figs. 14–16). Fusulinids have not been found in the central part of this sequence; those found in the upper part are much like the Home Creek fauna (pl. 24, figs. 4–13). Because of the uncertain time and stratigraphic relations of the rocks at this place, the fusulinids illustrated are shown separately on plate 24.

HOME CREEK LIMESTONE MEMBER

The Home Creek limestone member is the uppermost unit of the Canyon group. *Triticites* from the type section of the Home Creek are somewhat ventricose and have rather thin spirotheca. The septa are weakly to moderately plicated in the outer whorls. The triticite fauna consists of *Triticites* aff. *T. consobrinus* White, 1932 (pl. 17, figs. 1 and 2), and *Triticites* sp. A. (pl. 17, fig. 3). Also found in the type section are a few specimens of the primitive genus *Staffella*? (pl. 17, fig. 5). *Triticites* cf. *T. secalicus* (Say), 1833 (pl. 17, figs. 7–9), has been found in the Home Creek, but not in the type section. *Triticites* sp. B (pl. 17, fig. 4), and *Triticites* sp. C (pl. 17, fig. 6) have also been found in the Home Creek.

CISCO GROUP

The Cisco group, approximately 370 feet thick, contains two formations: the Graham formation at the base and the Thrifty formation at the top. The Cisco is approximately 67 percent shale, 16 percent limestone, and 17 percent sandstone. During the Permian period (Wolfcamp time), channels were cut into rocks of the Cisco group and subsequently filled with sandstone. As these channel deposits are of variable thickness and cannot always be separated from similar rocks of the Cisco group, the sandstone percentage given above is merely an approximation. Fusulinids are most common in the limestones and less common in the shales and have not been found in the sandstone.

The fusulinid faunas from the lower part of the Cisco group differ little from those of the upper part of the Canyon group. Two primitive genera, *Staffella*? and *Millerella*, have been found as high in the sequence as the Gunsight limestone member of the Graham formation. The younger species of *Triticites*, in general, become progressively more complex in their internal structure. In the lowermost rocks of the Cisco group, they have slightly more highly fluted septa, slightly greater wall thickness, and somewhat larger proloculi than those found in the Canyon. Two forms of triticite become apparent in the lower part of the Cisco. One form is the somewhat elongate, generalized form of the group of *Triticites secalicus*; the other is suggestive of *Triticites ventricosus* (Meek and Hayden), 1858.

The evolution of the triticite fauna in the Cisco group is manifested by a general increase in size, wall thickness, and diameter of proloculus. Complexity of septal fluting shows a slight increase, but it is not proportional to the change in the other characteristics.

Two genera make their first appearance in the Cisco of Brown and Coleman Counties. The first to appear is *Dunbarinella*, which has been found in the upper part of the Bluff Creek shale member of the Graham formation. The other is *Schubertella*, which is quite common in the Speck Mountain limestone member of the Thrifty formation where it is associated with *Triticites plummeri* Dunbar and Condra, 1927, and *Dunbarinella* spp.

GRAHAM FORMATION

The Graham formation has been divided into the following members in descending order:

Shale overlying the Ivan limestone member
Ivan limestone
Wayland shale

Gunsight limestone
Bluff Creek shale

Eargle (1960) states that the Graham formation is about 265 feet thick in southeastern Coleman County and about 290 feet thick in northern Brown County The formation overlies the Home Creek limestone member of the Caddo Creek formation and is overlain by the Speck Mountain limestone member of the Thrifty formation.

The Graham formation is about 75 percent shale, 20 percent limestone, and 5 percent sandstone. Much sandstone is locally present as channel fill. The limestone, most of which contains a fusulinid fauna, is found as numerous thin beds spaced at irregular intervals throughout the sequence. Fusulinids have also been found in some of the more calcareous facies of the shale.

BLUFF CREEK SHALE MEMBER

The Bluff Creek shale member contains as many as six beds of limestone, most of which are discontinuous and of variable thickness. Fusulinids from these limestones are very similar. Differences in the faunas can sometimes be observed by detailed examination of large collections, but correlation of the various limestone beds on the basis of fusulinid faunas cannot generally be made.

The lower three limestone beds in the Bluff Creek shale member have in the past been correlated with the White Ranch limestone of Bullard and Cuyler (1935) in McCulloch County, south of the Colorado River, and with the Gonzales limestone of Ross (1921) and North Leon limestone of Reeves (1922) members of the Graham formation of the Brazos River drainage basin. Use of these names, however, is discouraged until detailed stratigraphic studies and geologic mapping of key areas have been accomplished (D. Hoye Eargle, 1960). These 3 limestone beds contain 2 genera and 3 species of fusulinids: *Triticites* cf. *T. consobrinus* (pl. 18, figs. 20 and 22); *Triticites* cf. *T. secalicus* (pl. 18, figs. 21 and 23); and a species of *Staffella*? (pl. 18, fig. 19) that is relatively large for the genus.

The two limestone beds near the middle of the Bluff Creek shale member contain 3 genera and 5 species of fusulinids. They are *Millerella*? sp. (pl. 18, fig. 11), *Staffella*? sp. (pl. 18, fig. 12), *Triticites* aff. *T. secalicus* (pl. 18, figs. 13 and 14), *Triticites* sp. F (pl. 18, figs. 10, 16–18), and *Triticites* sp. G (pl. 18, fig. 15). *Triticities* sp. F. belongs to the group of *T. ventricosus*; *Triticites* sp. G is related to the group of *T. secalicus.*

The uppermost limestone bed (Bunger limestone member of the Graham formation) contains a triticite fauna composed of three species: *Triticites* cf. and aff. *T. plummeri* (pl. 18, figs. 4 and 5); *Triticites* cf. *T. cullomensis* (pl. 18, figs. 6–8); and *Triticites* ex gr. *T. ventricosus* (pl. 18, fig. 9).

Fusulinids have been found at the top of the Bluff Creek immediately below the Gunsight limestone member. Notable is the first occurrence of *Dunbarinella* (pl. 18, fig. 1), which is here associated with *Triticites* cf. *T. oryziformis* Newell, 1934 (pl. 18, figs. 2 and 3).

GUNSIGHT LIMESTONE MEMBER

The Gunsight limestone member (*Campophyllum* bed of earlier workers) consists of as many as four limestone beds separated by shale. The Gunsight limestone member ranges in thickness from 13 to 25 feet.

Fusulinids from the lower, middle, and upper parts of the Gunsight limestone member are figured. Two genera and three species have been found in the lower part of the Gunsight. The fauna consists of *Dunbarinella* cf. *D. ervinensis* Thompson, 1942 (pl. 19, fig. 15); *Triticites* cf. or aff. *T. secalicus* (pl. 19, figs. 10, 11, 13 and 16); *Triticites* ex gr. *T. ventricosus* (pl. 19, fig. 14); and *Triticites*? sp. (pl. 19, fig. 12).

The middle part of the Gunsight contains *Staffella*? sp. (pl. 19, fig. 9); *Triticites* aff. *T. cullomensis* (pl. 19, fig. 8); and *Triticites* ex gr. *T. ventricosus* (pl. 19, figs. 6 and 7).

The upper part of the Gunsight contains *Triticites cullomensis* (pl. 19, fig. 5); *Triticites* aff. *T. cullomensis* (pl. 19, fig. 1); *Triticites* ex gr. *T. ventricosus* (pl. 19, figs. 2 and 3); and *Triticites* sp. H (pl. 19, fig. 4).

WAYLAND SHALE MEMBER

The Wayland shale member ranges in thickness from about 100 feet along the Colorado River in southern Brown and Coleman Counties to 75 feet near the center of Brown County. Terriere (1960) reports the Wayland to have an estimated thickness of 140 feet in the southern part of the Grosvenor quadrangle (northwestern Brown County), and about 65 feet in the northern part of the quadrangle. Fusulinids are not widely distributed throughout the Wayland, but they are found in a few places in two zones. Where they occur, they are present in great numbers. One of these fusulinid-bearing zones is 5 to 15 feet above the base of the Wayland, and the other, a lentil of argillaceous limestone, is about 28 feet below the Ivan limestone member. The lower fauna contains *Triticites beedei* Dunbar and Condra, 1927 (pl. 20, figs. 5 and 7); *Triticites* aff. *T. beedei* (pl. 20, figs. 6 and 9); *Triticites plummeri* (pl. 20, fig. 8); and *Triticites* ex gr. *T. ventricosus* (pl. 20, fig. 10). The fauna from the lentil of argillaceous limestone contains *Triticites* cf. *T. beedei* (pl. 20, fig. 1), *Triticites* aff. *T. beedei* (pl. 20, fig. 3), *Triticites* ex gr. *T. ventricosus* (pl. 20, fig. 2), and *Triticites* sp. I (pl. 20, fig. 4).

IVAN LIMESTONE MEMBER

The Ivan limestone member (*Bellerophon* bed of earlier workers) is a lenticular limestone that changes laterally into calcareous sandstone and shale within short distance (Eargle, 1960). Locally it is as much as 18 feet thick. In places the Ivan consists of two distinct beds of limestone separated by shale.

Fusulinids are not everywhere present in this member and are apparently confined to its calcareous facies. In the lower part of the member, two species of fusulinids have been found; these species are *Triticites* aff. *T. beedei* (pl. 21, figs. 10 and 11) and *Triticites* ex gr. *T. ventricosus* (pl. 21, fig. 12).

Fusulinids have also been collected from a shaly facies near the middle of the Ivan at locality f10012. This fauna consists of 2 genera and 5 species: *Dunbarinella* cf. *D. ervinensis* Thompson, 1942 (pl. 21, fig. 5), *Triticites* sp. J. (pl. 21, fig. 6), *Triticites* aff. *T. beedei* (pl. 21, fig. 7), *Triticites* aff. *T. cullomensis*? (pl. 21, fig. 8), and *Triticites* ex gr. *T. ventricosus* (pl. 21, fig. 9).

The upper part of the Ivan contains a fusulinid fauna composed of two species of *Triticites*: *Triticites* aff. *T. beedei* (pl. 21, figs. 1 and 4) and *Triticites* aff. *T. ventricosus meeki* (pl. 21, figs. 2 and 3).

SHALE OVERLYING THE IVAN LIMESTONE MEMBER

The shale which overlies the Ivan limestone member ranges in thickness from 25 to 65 feet. Fusulinids have not been found in this shale.

THRIFTY FORMATION

The Thrifty formation has been redefined by Eargle (1960) to include the following members in descending order:

Chaffin limestone
Parks Mountain sandstone
Breckenridge limestone
Speck Mountain limestone

The formation contains two persistent beds of limestone (the Speck Mountain and Chaffin limestone members), a less persistent bed of limestone (the Breckenridge limestone member), and a lenticular sandstone (the Parks Mountain sandstone member). Relatively nonresistant unnamed beds of shale with minor amounts of sandstone occupy the intervals between the more resistant limestone and sandstone beds listed above.

The Thrifty formation, from the base of the Speck Mountain to the top of the Chaffin, ranges in thickness from about 55 feet in southern Coleman County to about 95 feet in northern Brown County.

Distribution of the fusulinids in the Thrifty formation is similar to that in the Graham formation. They are most commonly found in the limestone beds and less commonly in the shales and have not been found in the sandstones.

SPECK MOUNTAIN LIMESTONE MEMBER

The Speck Mountain limestone member is generally a continuous bed from 1 to 6 feet thick. Fusulinids are commonly found wherever this member is exposed. The assemblage for this member is distinctive and usually consists of *Triticites plummeri*, *Dunbarinella* spp., and *Schubertella* sp. A (pl. 22, fig. 13), which resembles *Schubertella kingi* Dunbar and Skinner, 1937. In addition to this distinctive assemblage, several other species of *Triticites* have been found; these are *Triticites* ex gr. *T. ventricosus* and *Triticites* ex gr. *T. secalicus*. The fusulinid fauna from the Speck Mountain is shown on plate 22, figures 7 through 15, and the relative sizes of *Triticites*, *Dunbarinella*, and *Schubertella* are shown on plate 24, figures 2 and 3.

BRECKENRIDGE LIMESTONE MEMBER

The Breckenridge limestone member is separated from the Speck Mountain limestone member by about 30 feet of shale and sandstone that contain very few fusulinids, none of which are figured here.

The Breckenridge is typically a nodular-weathering limestone ranging from 1 to more than 3 feet in thickness. Its outcrop is principally continuous as far south as the vicinity of Home Creek in southeastern Coleman County. Locally, however, the position of the Breckenridge is occupied by channel-fill sandstone and conglomerate. Fusulinids are most common in the Breckenridge in the northern part of the area; they are rare in the southern part.

Fusulinids from the member belong to the genus *Triticites*. The fauna consists of *Triticites* sp. K (pl. 22, fig. 1); *Triticites plummeri* (pl. 22, fig. 2); *Triticites* aff. *T. subventricosus* Dunbar and Skinner, 1937 (pl. 22, figs. 3 and 6); *Triticites* sp. L (pl. 22, fig. 4); and *Triticites* ex gr. *T. secalicus* (pl. 22, fig. 5).

INTERVAL BETWEEN THE BRECKENRIDGE AND CHAFFIN LIMESTONE MEMBERS

The rocks between the Breckenridge and the Chaffin limestone members are shale and lenticular bodies of sandstone, including the Parks Mountain sandstone member. The Parks Mountain fills channels that have been cut into and locally through the Breckenridge and Speck Mountain limestone members. Fusulinids have not been found in these shales or sandstones.

CHAFFIN LIMESTONE MEMBER

The Chaffin limestone is generally persistent throughout the area. It is about 15 feet thick at the type section, immediately south of the Colorado River in McCulloch County. In northern Brown County the member is only 1 to 2 feet thick. Fusulinids are found in most outcrops of the Chaffin. Most of the fusulinids are large and ventricose and in many respects resemble those found in the Permian rocks of the area, a resemblance suggested by the very thick spirotheca, the large proloculus, and the massive chomata present in most forms.

The fusulinid fauna of the Chaffin is composed of *Triticites* cf. *T. subventricosus* (pl. 23, figs. 1–3); *Triticites* aff. *T. beedei* (pl. 23, figs. 4, 6, 7, and 9); *Triticites plummeri* (pl. 23, figs. 5 and 12); *Triticites* aff. *T. moorei* Dunbar and Condra, 1927 (pl. 23, fig. 7); *Triticites* sp. M (pl. 23, fig. 8); *Triticites* ex gr. *T. ventricosus* (pl. 23, figs. 10 and 11); and *Dunbarinella?* sp. D (pl. 23, fig. 13). The larger, more ventricose species of *Triticites* are common in the Chaffin limestone member in this area: *Dunbarinella?* sp. D is rare.

SUMMARY

The Pennsylvanian rocks of Brown and Coleman Counties lie mostly within the zone of *Triticites* although an older zone, that of *Fusulina*, is represented in the Strawn group undifferentiated. The zone of *Triticites* is represented in the rocks of the Canyon and Cisco groups of Pennsylvanian age but extends upward into the Wichita group of Permian age.

The fusulinid faunas are abundant and varied. The genus *Triticites* exhibits a general evolutionary series that embraces the small, thin-walled, and relatively simple species in the lower part of the Canyon group and the large ventricose thick-walled species in the upper part of the Cisco group.

Within the zone of *Triticites*, each limestone or group of limestones contains a distinctive assemblage of fusulinids. These assemblages are such that they may be used for purposes of local correlation. For distant correlations, such as with the subsurface of the Midland basin of west Texas, the assemblages herein reported on should be used only by comparing evolutionary development of similar fusulinid faunas in the two areas.

The influence of sedimentary facies on the fusulinids is not known. It is believed that it may play an important part in the distribution of species or varieties. However, because of the extreme variability within the species of a fusulinid group, and because of the lack of knowledge concerning the influence of environment on a species, it is not known which characteristics are due to environmental adaptation and which are due to variation within the species itself. The gradation, or state of development, between species is believed by this writer to proceed at a more or less uniform rate; and by comparing evolutionary stages, it is possible to make correlations of the containing rock units.

COLLECTING LOCALITIES

The following register of collecting localities has been compiled in large part from notes taken by the collector. These localities have been plotted on county road maps prepared by the Texas State Highway Planning Commission (fig. 9). No adequate base map exists for the entire area, and these maps represent the best available for this purpose.

The localities listed on the register are arranged in stratigraphic sequence starting with the oldest units. Localities from the same bed have been placed in numerical order.

The "f" numbers refer to the U.S. Geological Survey collection of Foraminifera.

The letters "AMS" used in association with quadrangle names refer to publication of that quadrangle by the Army Map Service. Grid references on these maps are to a military grid superimposed on the base map, with measurements given in decimal fractions from the northwest corner of the grid.

Ricker Station limestone of Cheney (1949)

f10003. Brown County. Limestone occurring as large blocks along the west side of the road, 600 ft south of Ricker Station on the Gulf, Colorado, and Santa Fe RR., about 5 miles east of Brownwood. Collected by D. H. Eargle and K. A. Yenne, Apr. 18, 1951.

f10004. Brown County. In bed of abandoned road just south of present road, 5.7 miles southeast of Brownwood, Tex., courthouse on the Elkins road, which is a continuation of Brownwood's Austin Ave.; 1.7 miles southeast of intersection with paved road. Collected by D. H. Eargle and K. A. Yenne, Apr. 19, 1951.

f10077. Brown County. Limestone about 1 ft thick, weathers into boulders. At this locality it disappears beneath overlying Cretaceous conglomerate. Zephyr quadrangle, AMS ser. V782, sheet 6247–III. Grid 507.5, 501.1, 0.9 of a mile south of BM 1401 on the Brownwood-Elkins road, 6.5 miles S. 33° E. of intersection of U.S. Highways 84, 67, and 377 at Brownwood. Collected by D. H. Eargle, June 29, 1950.

Capps limestone lentil of Plummer and Moore (1921)

f10008. Brown County. Anthills containing fusulinids, 10 miles south-southwest of Brownwood, 2 miles north-northwest of Indian Creek; east slope of peak (Cretaceous outlier) about 1,000 ft east of crest of peak, 500 ft west of earth stock tank. Collected by D. H. Eargle, 1951.

f10009. Brown County. Shale in the Strawn group immediately below the Capps limestone lentil. On slope of hill just west of road, half a mile south of Pecan Bayou bridge on military road to Camp Bowie; 4.2 miles S. 44° E. of intersection of U.S. Highways 84, 67, 377, and 183 at Brownwood. Collected by D. H. Eargle, 1951.

f10027. Brown County. On north-facing hill just east of Delaware Creek and south of U.S. Highway 84, 3.45 miles N. 80° E. of the courthouse at Brownwood; 1.4 miles S. 60° E. of the Early School. Collected by D. H. Eargle, Nov. 18, 1950.

f10076. Brown County. Mercury quadrangle, AMS ser. V782, sheet 6146–I. SE. cor., SW¼ grid 498–499, 484–485; on southeast side of hill 1441, at approximately 1,400 ft elevation; 0.9 mile S. 68° W. of USBM 1297, 1.1 miles N. 30° E. of Keys Crossing on the Colorado River. Collected by D. H. Eargle, Feb. 23, 1952.

f10078. Brown County. Fusulinids from upper part of an 18-inch pale-gray limestone. In livestock yard 1½ miles west of the Early School, 1½ miles northeast of the Brownwood courthouse. Collected by D. H. Eargle, July 11, 1951.

Brownwood shale member of the Graford formation

f10014. Brown County. Collected from a 6-in. limestone bed that is a fusulinid coquina, 53 ft below top of member; 2 miles northwest of Brownwood. Roadcut of U.S. Highways 67 and 84 in steep hill overlooking Brownwood. Considered by Eargle to be type locality of the Brownwood shale member. Collected by D. H. Eargle, Apr. 20, 1950.

f10030. Brown County. Lower part of the Brownwood shale member. Gray limestone containing many fragments of fossils; loose part contains many fusulinids. Upper 1 ft is pebbly and apparently disturbed; lower 6 in. is solid, hard limestone containing rounded limestone pebbles. One mile northeast of Dulin on U.S. Highway 377. In wall of gully east of road. Collected by D. H. Eargle and P. Katich, Jan. 3, 1952.

f10031. Brown County. Gray limestone that weathers yellow and contains fusulinids; 1 mile east of Winchell in southern Brown County on north side of road, where the road trend changes from north to east, more or less paralleling the Colorado River. Collected by D. H. Eargle, May 3, 1951; revisited and recollected by D. A. Myers, May 7, 1953.

f10032. Brown County. Fusulinids occur in gray-weathering limestone. 2.1 miles S. 85° E. of Winchell in southern Brown County, north of east-trending road in bandland-type of topography. Collected by D. A. Myers, May 8, 1953.

f10033. Brown County. Limestone slightly above the middle of the Brownwood shale member; 3.8 miles N. 55° E. of Winchell, 3.4 miles S. 15° E. of Brookesmith on old Brownwood-Brady highway; 0.7 mile northeast of right-angle bend on highway. Collected by D. H. Eargle and D. A. Myers, May 7, 1953.

Adams Branch limestone member of the Graford formation

f10001. Brown County. Floor of abandoned part of quarry along south side of drainage ditch. In quarry of Waco-Tex Material Co., a mile west of Brownwood, Tex. Collected by D. H. Eargle, Mar. 18, 1950.

f10013. Brown County. Collection from near base of 20–26 ft of limestone in quarry, 4.9 miles south-southwest of the courthouse at Brownwood. Half a mile west of Brownwood Country Club in quarry on hillcrest. Collected by D. H. Eargle, Mar. 29, 1950.

f10018. Brown County. About 3 ft of limestone exposed. Anthill between road and bed of dry stream on top of limestone contains abundant long, cigar-shaped fusulinids; 5 miles northeast of Brookesmith on southwest-trending county road. Collected by D. H. Eargle, July 9, 1951.

f10028. McCulloch County. Lower part of the Adams Branch limestone member. Mercury quadrangle, AMS ser. V782, sheet 6146–I. Grid 482–483, 479–480. On tip of a sharp bend of the Colorado River to the south, 1.95 miles S. 45° W. of USBM 1345 at Winchell across the river from Adams Ranch (formerly Bud Rice Ranch). Collected by D. A. Myers, May 10, 1954.

Winchell formation

f10034. Brown County. Lowermost limestone of the Winchell formation. Spillway of Lake Brownwood dam on east side of lake at junction of spillway with Pecan Bayou, 8.1 miles N. 10° W. of triangle intersection of U.S. Highways 67, 84, and 377 at Brownwood. Collected by D. H. Eargle and W. A. Heck, Apr. 7, 1950.

f10080. Brown County. Lower bed of upper limestone member in the Winchell. Fusulinids were found in the lower 4 ft of an approximately 30-ft-thick bed of limestone, which forms the hill top. The limestone is smooth weathering and somewhat ferruginous. Hillslope on north side of secondary road, 3.2 miles N. 76° W. of the intersection of U.S. Highways 67, 84, and 377 at Brownwood; 1.5 miles (airline) southwest of State Road 279. Collected by P. T. Stafford, R. T. Terriere, and D. A. Myers, Mar. 10, 1955.

f10081. Brown County. Lower bed of upper limestone member in the Winchell. Fusulinids were found in the lower 1 ft of a massive limestone that crops out on the south side of Lake Brownwood spillway above a low concrete wall. The spillway is on the east side of the lake, 8.1 miles N. 10° W. of the intersection of U.S. Highways 67, 84, and 377 at Brownwood. Collected by D. A. Myers, Mar. 10, 1955.

Placid shale member of the Brad formation

f10035. Coleman County. Unnamed limestone lentil in shale at foot of escarpment of Ranger limestone member of the Brad formation and Home Creek limestone member of the Caddo Creek formation. Mercury quadrangle, 3.0 miles N. 50° W. from southeast corner of Coleman County, 1,000 ft west-northwest from USBM 1322 on Home Creek; 1.4 miles N. 23° W. from mouth of Home Creek on the Colorado River. Collected by D. H. Eargle and D. A. Myers, June 4, 1953.

f10036. McCulloch County. Unnamed limestone lentil in the Placid shale member, about 40 ft below the Ranger limestone member. Mercury quadrangle, AMS ser. V782, sheet 6142–I; grid 478.7, 482.0 just west of mouth of McDowell Creek on small knoll overlooking the Colorado River and McDowell Creek. 1.4 miles N. 70° W. of intersection of the Brown-Coleman County line with the Colorado River. Collected by D. H. Eargle, Feb. 24, 1952.

Ranger limestone member of the Brad formation

f10037. Coleman County. Basal part of Ranger limestone member. Mercury quadrangle 1,200 ft N. 27° W. of USBM 1309, which is 4,400 ft west of the Coleman-Brown County line, and 600 ft north of the Colorado River; 1.3 miles N. 50° W. of the southeast corner of Coleman County, and 0.75 mile northwest of the junction of Home Creek with the Colorado River on the west side of the hill; 3.45 miles N. 85° W. of USBM 1345 (southeast corner of rock fence around first house south of U.S. Post Office) at Winchell. Collected by D. A. Myers, June 3, 1953.

f10038. Brown County. Ranger limestone member, 4½ miles west of Cedarton, 300 yd east of Mt. Zion Church, in a caliche pit south of east-trending road. Collected by D. H. Eargle, July 10, 1951.

f10039. Brown County. On west side of north-northeast-trending county road, 3.6 miles S. 87° W. of Cedarton; 9.4 miles S. 53° W. of triangle intersection of U.S. Highways 67, 84, and 377 at Brownwood. Collected by D. A. Myers and D. H. Eargle, May 11, 1953.

Home Creek limestone member of the Caddo Creek formation

f10029. Brown County. North side of Farm Road 279, 6 miles N. 65° W. of triangle intersection, U.S. Highways 67, 84, and 377 at Brownwood. Collected by D. H. Eargle, July 24, 1951.

f10040. Brown County. Anthills just below the Home Creek limestone member on a hillside east of State Highway 279, where it crosses the cuesta formed by the Home Creek limestone member, about 5½ miles northwest of the courthouse at Brownwood. Collected by D. H. Eargle, July 24, 1951.

f10041. Coleman County. First limestone below the yellow limestone at head of northeast-trending gully that drains into Home Creek. Type area of member. Mercury quadrangle, AMS ser. V782, sheet 6146-1, center NE¼SE¼, grid 483-4, 476-7; 2.9 miles N. 60° W. of junction of Coleman, Brown, and McCulloch Counties, 0.4 mile N. 54° E. of house BM 1471, on western edge of map; 1.1 miles N. 40° W. from junction of Home Creek with the Colorado River. Collected by D. H. Eargle and D. A. Myers, June 4, 1953.

Bluff Creek shale member of the Graham formation

Lower beds

f10047. Brown County. Shale in hillslope south of road, 4.1 miles N. 45° W. of Brookesmith; 7.6 miles S. 20° W. of main-road intersection on east side of Bangs; 1.2 miles N. 75° E. of Mount View Church. Collected by D. H. Eargle, Jan. 5, 1952.

f10048. Brown County. 4.6 miles S. 9° E. of junction of Farm Road 586 with U.S. Highways 84 and 67 at Bangs, on right-angle bend in road in southern end of Janellen oil field. Collected by D. H. Eargle, Jan. 23, 1951.

Middle beds

f10045. Brown County. West of Rocky Creek Church, 0.4 mile on top of hill, 7½ miles northwest of Brownwood on State Highway 279. Collected by D. H. Eargle, July 24, 1951.

f10049. Brown County. Limestone bed in the lower part of the Bluff Creek shale member about 30 ft. above earthen livestock tank; 4½ miles northwest of Brookesmith, about 0.2 mile west of the road at Mount View Church. Collected by D. H. Eargle, May 5, 1952.

f10050. Brown County. Grosvenor quadrangle. On west side of a dirt farm road that goes south from Park Road 15, 3.7 miles N. 50° E. of Thrifty. Locality is 1.1 airline miles south of Park Road 15. Collected by R. T. Terriere, August 1952.

f10051. Brown County. Grosvenor quadrangle. On southwest side of Park Road 15, 0.7 mile (by road) east of road intersection at old Weedon's school. Collected by R. T. Terriere, August 1952.

Upper beds

f10042. Brown County. 1.0 mile S. 45° E. of intersection of U.S. Highways 84 and 67 and Farm Road 586 in Bangs (main intersection); 0.35 mile east of the Bangs (?) cemetery on an east-trending country road. Collected by D. H. Eargle and D. A. Myers, May 11, 1953.

f10043. Brown County. Anthills and slabs of limestone from uppermost limestone bed in the Bluff Creek shale member. Approximately 0.4 mile south of triangulation station "Shields." On Farm Road 586, 4½ miles north-northwest of its intersection with U.S. Highway 377. Collected by D. H. Eargle, Jan. 3, 1951.

f10046. Brown County. Uppermost limestone bed in the Bluff Creek shale member, 1½ miles N. 60° E. of Thrifty. On north side of hill on Frank Bucy Ranch in a small draw on the south side of the Jim Ned Creek arm of Lake Brownwood. Collected by D. H. Eargle, Aug. 9, 1950.

f10052. Coleman County. Bluff Creek shale member immediately below the Gunsight limestone member. N. 49° E. 5.9 miles from Whon; S. 3° E. 3.0 miles from Trickham. Exposed in a gully 3-5 ft deep on a north-facing hill on a draw tributary to Mukewater Creek. Collected by D. H. Eargle, Jan. 21, 1952.

Gunsight limestone member of the Graham formation

f10021. Brown County, Tex. Anthills south of road on the upper part of the Gunsight limestone member. At first right-angle bend on road to Thrifty from State Highway 279, 2.1 miles southeast of Thrifty. Collected by D. H. Eargle and K. A. Yenne, Mar. 18, 1951.

f10022. Brown County, Tex. Lower part of the Gunsight limestone member with many large fusulinids and "*Campophyllum*." 1 mile southeast of Thrifty, southwest of road to Thrifty from State Highway 279. In creekbed below bridge. Collected by D. H. Eargle, Mar. 18, 1951.

f10058. Brown County, Tex. On Bangs-Brookesmith road, 0.8 mile south of Concord Church; 5.9 miles S. 25° W. of intersection of U.S. Highway 84 and Farm Road 586 at Bangs. Upper part of the Gunsight limestone member. Collected by D. H. Eargle, Jan. 23, 1951.

f10059. Brown County, Tex. Gray limestone that weathers brown. 5.1 miles S. 23° W. of intersection of U.S. Highway 84 and Farm Road 586 at Bangs; 5.5 miles N. 30° W. of Brookesmith. At east end of east-trending jog in north-trending road, 1.1 miles south of Concord Church. Collected by D. H. Eargle and D. A. Myers, May 11, 1953.

f10060. Brown County, Tex. Lower part of the Gunsight limestone member just below the coral-bearing ("*Campophyllum*") beds. 6.4 miles S. 23° W. of intersection of U.S. Highway 84 and Farm Road 586 at Bangs; 6.4 miles N. 36° W. of Brookesmith, on north-trending road, near bottom of hill; 0.2 mile south of east-trending jog in road. Collected by D. H. Eargle, Jan. 5, 1952.

f10061. Coleman County, Tex. Upper part of the Gunsight limestone member. 3 ft of gray limestone which overlies about 4 ft of clay. 3.5 miles N. 25° E. of Trickham, on east-trending road, about 0.7 mile west of intersection with Farm Road 586, west of small creek in north bank of road. Just west of Brown-Coleman County line. Collected by D. H. Eargle, Jan. 7, 1952.

f10067. Coleman County, Tex. Unnamed limestone bed in the lower part of the Gunsight. Limestone weathers yellow and is blue black on fresh surface. In creek crossing road on Gill Ranch. Waldrip quadrangle, 2.4 miles due east of Whon; 0.5 mile south of Home Creek in northeast corner of Waldrip quadrangle; below an outlier of the Gunsight on north slope of north end of outlier. Collected by D. A. Myers and D. H. Eargle, June 4, 1953.

f10068. Coleman County, Tex. Near top of Gunsight limestone member from bed at water level (about 8 in. below road level at crossing) in slabby gray limestone that breaks into lenticular splinters ½ to 1 in. thick. Gunsight in bed of Home Creek at road crossing west of ranch; locality is 5.4 miles S. 30° W. of Trickham, 2.9 miles N. 42° E. of Whon. Collected by D. A. Myers, June 5, 1953.

f10069. Brown County, Tex. Quarry in "*Campophyllum*" bed. 0.4 mile south of Park Road 15, to 36th Division State Park on Lake Brownwood, on Weedon's Ranch; 4.6 miles N. 50° E. of Thrifty. Fusulinids very common to abundant in marly limestone. Large ventricose fusulinids weather from outcrop. Collected by D. A. Myers and Helen Beikman, Oct. 3, 1954.

Wayland shale member of the Graham formation

f10011. Brown County, Tex. Near base of Wayland shale member. In field west of road, 0.8 mile southeast of Thrifty. Collected by D. H. Eargle, July 20, 1950, Apr. 18, 1951.

f10065. Coleman County, Tex. Limestone lentil in Wayland shale member. 2.7 miles N. 2° E. of Trickham, 0.5 mile south of east-trending road. Collected by L. G. Henbest, D. H. Eargle, R. C. Douglass, and D. A. Myers, Oct. 19, 1952.

f10066. Coleman County, Tex. 2½ ft of limestone, which is nodular in the upper part, slabby and solid in lower 6 in. 0.25 mile north of east-trending road, at f10061 (Gunsight); 3.8 miles N. 24° E. of Trickham, just west of Brown-Coleman County line. Collected by D. H. Eargle, Jan. 7, 1951.

Ivan limestone member of the Graham formation

f10012. Brown County, Tex. On east-trending country road south of the Gulf, Colorado, and Santa Fe Railroad. Approximately three-eighths of a mile east of Coleman County line; 4 miles west-southwest of Bangs and 1½ miles southwest of Amarada. On south side of a new roadcut through hill; the old road made a jog to south around hill. Collected by D. H. Eargle, Nov. 15, 1950.

f10026. Coleman County, Tex. 3.8 miles north of Trickham, 1½ miles east-northeast of Mukewater School; one-third of a mile north of small oil field; southwest of Mukewater Creek on dip slope of Ivan limestone member. Collected by D. H. Eargle, Jan. 8, 1952.

f10062. Coleman County, Tex. Hard massive yellowish-gray limestone on point of hill facing broad valley of Home Creek to the southwest. 0.7 mile east of bridge over Home Creek on road from Santa Anna to Whon. About 4.6 miles S. 39° W. of Trickham; about 3.6 miles N. 23° E. of Whon. Collected by D. H. Eargle, Dec. 16, 1950.

Speck Mountain limestone member of the Thrifty formation

f10025. Brown County. In pasture on slope of southwest-facing hill. Collection from shale 20–30 ft above dark-gray limestone. 0.8 mile east of Grosvenor, 0.35 mile east of crossroad. North of county road from Farm Road 279 to Grosvenor. Collected by D. H. Eargle, Nov. 13, 1950.

f10063. Coleman County, Tex. Fusulinids rare in poorly exposed 1½ ft of pale-yellowish-brown limestone near base of mountain. Type area of member. On northeast side of Speck Mountain, 4.6 miles N. 13° E. of Whon, 4.4 miles S. 54° W. of Trickham; southeast of junction of road from Trickham to Whon (east-trending road) with road from Santa Anna to Whon (north-trending road). Collected by D. H. Eargle, Oct. 28, 1951.

f10064. Coleman County, Tex. In roadcut at east edge of Speck Mountain escarpment, on north side of road. 0.4 mile east of Mukewater School, 3.3 miles N. 10° W. of Trickham. Collected by D. H. Eargle, Jan. 9, 1952; by D. A. Myers and R. T. Terriere, Aug. 4, 1953.

f10070. Coleman County, Tex. Algal (?) limestone containing fusulinids in zones toward the top of the outcrop. Bed of Camp Creek on Rockwood-Whon road at point where road meets (but does not cross) creek. 2.8 miles east of junction of Waldrip road with U.S. Highway 283 in Rockwood; 1.4 miles N. 65° W. of Whon on Rockwood-Whon road. Collected by D. A. Myers and R. T. Terriere, Aug. 3, 1953.

f10073. Coleman County, Tex. Speck Mountain limestone member in ditch along west side of Santa Anna-Whon road just north of junction of road that goes due east from Trickham. 4.0 miles due west of Trickham. Collected by D. A. Myers and R. T. Terriere, Aug. 4, 1953.

Breckenridge limestone member of the Thrifty formation

f10053. Brown County, Tex. Very fossiliferous nodular limestone in small gully in flat at base of hill. On west edge of old Fry oil field, 3.8 miles N. 83° W. of Thrifty, south of cemetery, at foot of 60-ft hill. Collected by D. H. Eargle, Mar. 8, 1951; by D. A. Myers and R. T. Terriere, Nov. 18, 1954.

f10054. Coleman County, Tex. Limestone bed near south edge of Santa Anna oil field; 6.5 miles S. 73° E. of intersection of U.S. Highways 283 and 84 in Santa Anna: 1.1 miles east of intersection of secondary road with Farm Road 567, south of Santa Anna oil field, 0.4 mile north of this secondary road. Approximately 6 miles west-southwest of Bangs. Collected by D. H. Eargle and M. G. Cheney, March 1950.

f10055. Brown County, Tex. Cross Plains quadrangle. In Cross Cut oil field, 2.6 miles S. 52° E. of Cross Cut. 2.3 miles east along road between State Highway 279 at Cross Cut and Farm Road 583; and 1.75 miles south along a secondary road, where limestone goes beneath drainage in bed of intermittent stream. Collected by P. T. Stafford, Aug. 6, 1952.

f10056. Brown County, Tex. Cross Plains quadrangle, 3.3 miles S. 87° E. from Cross Cut, 0.5 mile due south of east-trending gravel road which junctions, 3.4 miles west, with paved road at Cross Cut. Collected from limestone where it goes beneath drainage in bed of intermittent stream. Collected by P. T. Stafford, Aug. 14, 1952.

Chaffin limestone member of the Thrifty formation

f10019. Brown County, Tex. 6-in. bed of limestone about 15 ft below top of section on west edge of Fry oil field south of cemetery at bottom of 10-ft hill. About one-half of a mile east of Coleman-Brown County line; 0.9 mile south of Jim Ned Creek; south side of east-trending road. Collected by D. H. Eargle, Mar. 8, 1951; D. A. Myers and R. T. Terriere, Nov. 18, 1954.

f10057. McCulloch County. Chaffin limestone member at old Chaffin coal mine on Little Elm Creek in northeast McCulloch County, 1 mile east of Waldrip (present site), 0.7 mile south-southeast of Chaffin cemetery, 0.7 mile southwest of Chaffin crossing on the Colorado River. Type area of member. Collected by L. G. Henbest, D. H. Eargle, R. C. Douglass, and D. A. Myers, Oct. 19, 1952.

f10071. Coleman County, Tex. Outcrop of Chaffin limestone member in ditch on east-trending road about 300 ft east of Hay Creek, 4.4 miles N. 43° W. of Trickham; 2.2 miles west of Mukewater School along east-trending road. Collected by D. A. Myers and R. T. Terriere, Aug. 4, 1953.

f10072. Coleman County, Tex. Near base of outcrop of Chaffin limestone member in ditch on east side of Santa Anna-Whon road. 4.2 miles N. 78° W. of Trickham, at north end of bend in road convex to west. Collected by D. A. Myers and R. T. Terriere, Aug. 4, 1953.

f10079. Coleman County, Tex. Upper part of Chaffin on hillslope west of tank. 0.2 mile northeast of old house on bend in road; 6.0 miles S. 50° E. from intersection of U.S. Highways 67 and 84 with U.S. Highway 283 at Santa Anna. 0.8 mile northwest of Cleveland School. Collected by D. A. Myers and D. H. Eargle, May 12, 1953.

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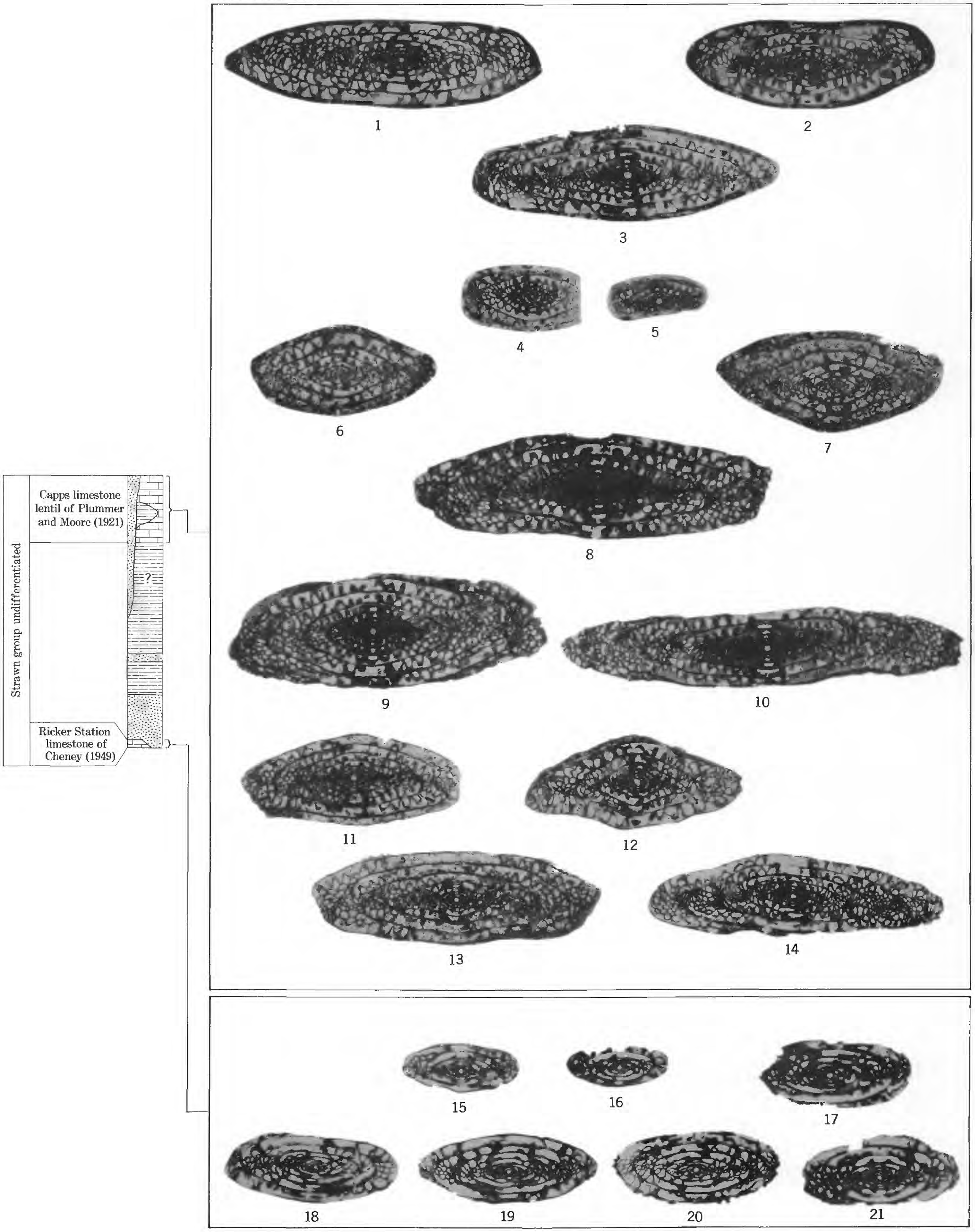
PLATES 15–24

PLATE 15

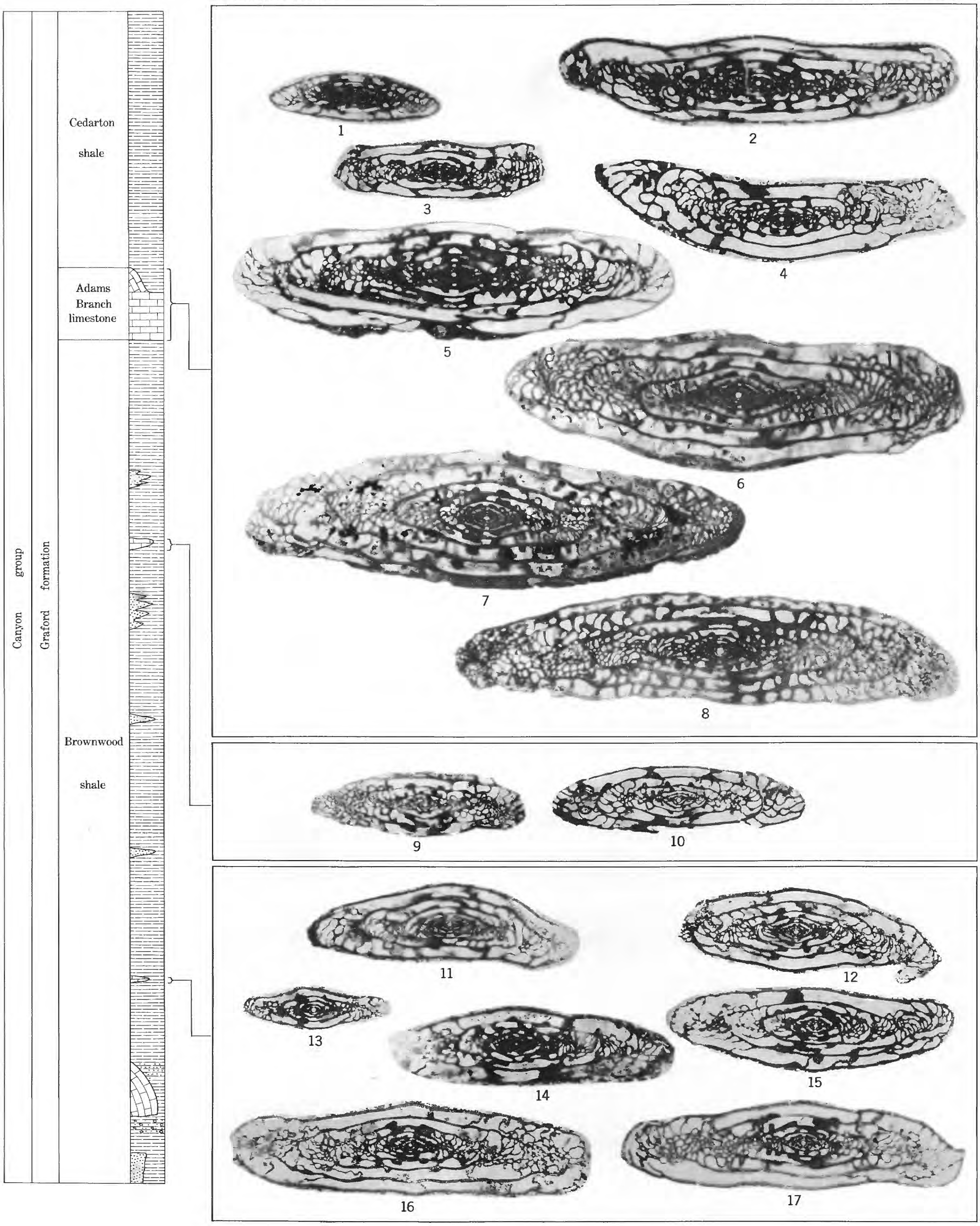
[All figures × 10. Scale of columnar section, 1 in=40 ft]

FIGURES 1–14. Fusulinidae from the Capps limestone lentil of Plummer and Moore (1921).
1–3. *Fusulina* aff. *F. acme* Dunbar and Henbest, 1942.
1. USNM 120031, from USGS locality f10027, slide 3.
2. USNM 120032, from USGS locality f10027, slide 5.
3. USNM 120033, from USGS locality f10027, slide 4. Type area of the Capps limestone lentil.
4. *Fusulina* sp. USNM 120034, from USGS locality f10078, slide 1.
5. *Fusulina* sp. USNM 120035, from USGS locality f10078, slide 2.
6–7. *Fusulina* sp. A.
6. USNM 120036, from USGS locality f10076, slide 2.
7. USNM 120037, from USGS locality f10076, slide 3.
8–9. *Fusulina* aff. *F. megista* Thompson, 1934.
8. USNM 120038, from USGS locality f10008, slide 2.
9. USNM 120039, from USGS locality f10008, slide 1.
10. *Fusulina* aff. *F. eximia* Thompson, 1934. USNM 120040, from USGS locality f10008, slide 5.
11–14. *Fusulina cappsensis* Stewart, 1958.
11. USNM 120041, from USGS locality f10009, slide 6.
12. USNM 120042, from USGS locality f10009, slide 1.
13. USNM 120043, from USGS locality f10009, slide 3.
14. USNM 120044, from USGS locality f10009, slide 4.

15–21. Fusulinids from the Ricker Station limestone of Cheney (1949).
Fusulina? *rickerensis* Thompson, 1945.
15. USNM 120045, from USGS locality f10004, slide 8.
16. USNM 120046, from USGS locality f10077, slide 1.
17. USNM 120047, topotype, from USGS locality f10003, slide 1.
18. USNM 120048, from USGS locality f10004, slide 7.
19. USNM 120049, from USGS locality f10004, slide 5.
20. USNM 120050, from USGS locality f10077, slide 3.
21. USNM 120051, topotype, from USGS locality f10003, slide 3.



FUSULINIDAE FROM THE STRAWN GROUP UNDIFFERENTIATED



FUSULINIDAE FROM THE GRAFORD FORMATION

PLATE 16

[All figures × 10. Scale of columnar section, 1 in=40 ft]

FIGURES 1–8. Fusulinids from the Adams Branch limestone member.

1. *Triticites ohioensis*? Thompson, 1936, juvenile.
   USNM 120052, from USGS locality f10028, slide 1.

2–4. *Triticites ohioensis* Thompson, 1936.
   2. USNM 120053, from USGS locality f10028, slide B–1.
   3. USNM 120054, from USGS locality f10028, slide 2.
   4. USNM 120055, from USGS locality f10028, slide 6.

5–6. *Kansanella* cf. *K. neglectus* (Newell), 1934.
   5. USNM 120056, from USGS locality f10018, slide 31.
   6. USNM 120057, from USGS locality f10013, slide 2.

7–8. *Kansanella* ex gr. *K. osagensis* (Newell), 1934.
   7. USNM 120058, from USGS locality f10001, slide 15.
   8. USNM 120059, from USGS locality f10001, slide 20.

9–17. Fusulinids from the Brownwood shale member.

9–10. *Triticites nebraskensis* Thompson, 1934.
   9. USNM 120060, from USGS locality f10014, slide 4.
   10. USNM 120061, from USGS locality f10014, slide 5.

11–12, 14–15. *Triticites* ex gr. *T. irregularis* (Schellwien and Staff), 1912.
   11. USNM 120062, from USGS locality f10030, slide 2.
   12. USNM 120063, from USGS locality f10030, slide 6.
   14. USNM 120064, from USGS locality f10032, slide 2.
   15. USNM 120065, from USGS locality f10032, slide 3.

13. *Triticites* aff. *T. irregularis* (Schellwien and Staff), 1912.
   USNM 120066, from USGS locality f10031, slide 5.

16–17. *Triticites irregularis* (Schellwien and Staff), 1912.
   16. USNM 120067, from USGS locality f10033, slide 2.
   17. USNM 120068, from USGS locality f10033, slide 3.

PLATE 17

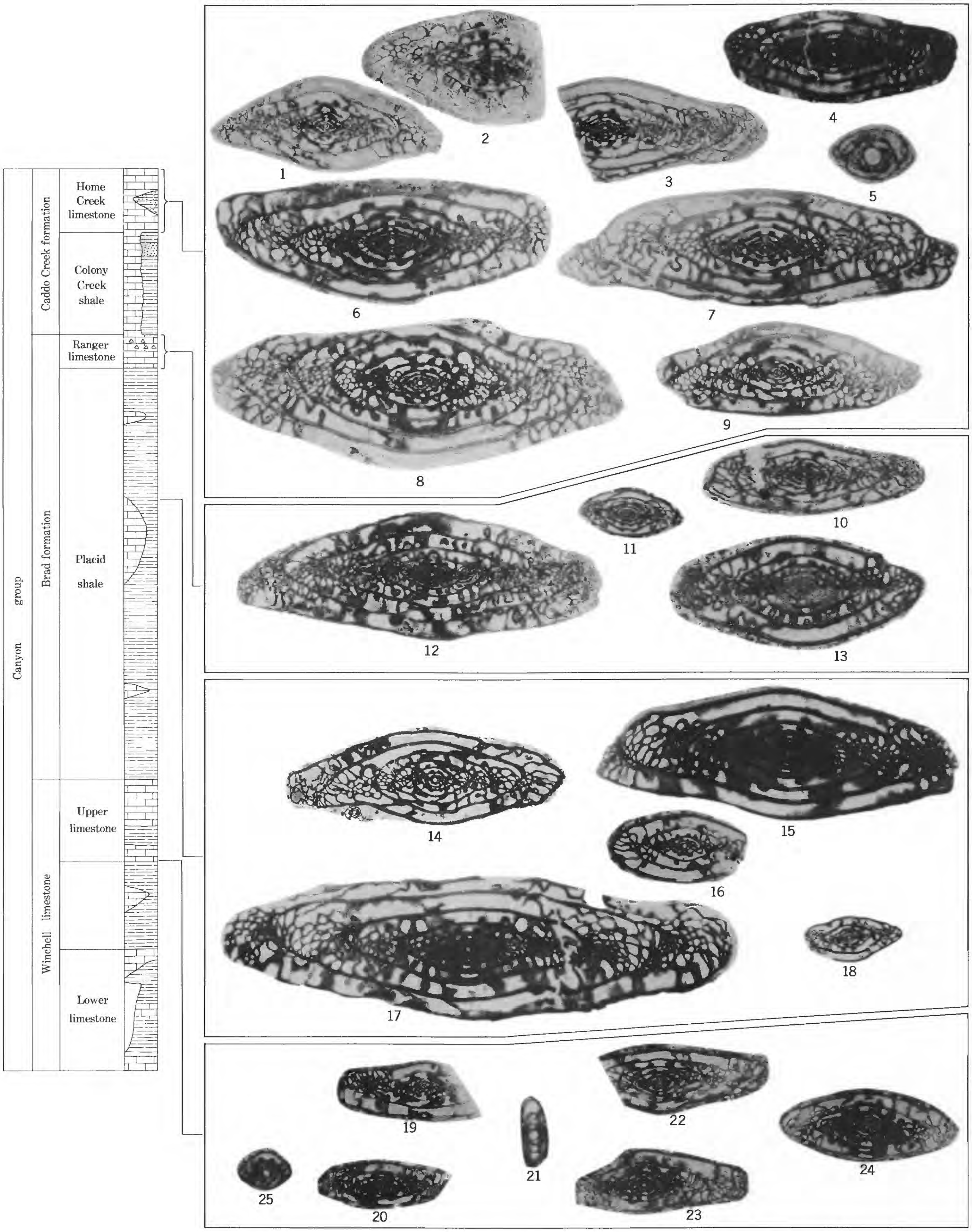
[All figures × 10, unless otherwise indicated. Scale of columnar section, 1 in=40 ft]

FIGURES 1–9. Fusulinids from the Home Creek limestone member of the Caddo Creek formation.
- 1–2. *Triticites* aff. *T. consobrinus* White, 1932.
  - 1. USNM 120069, from USGS locality f10041, slide 1. Type area of member.
  - 2. USNM 120070, from USGS locality f10041, slide 5. Type area of member.
- 3. *Triticites* sp. A. USNM 120071, from USGS locality f10041, slide 2. Type area of member.
- 4. *Triticites* sp. B. USNM 120072, from USGS locality f10040, slide 5.
- 5. *Staffella*? sp. (× 30) USNM 120071, from USGS locality f10041, slide 2. Type area of member.
- 6. *Triticites* sp. C. USNM 120073, from USGS locality f10040, slide 2.
- 7–9. *Triticites* cf. *T. secalicus*, (Say) 1833.
  - 7. USNM 120074, from USGS locality f10029, slide 1.
  - 8. USNM 120075, from USGS locality f10029, slide 6.
  - 9. USNM 120076, from USGS locality f10029, slide 5.

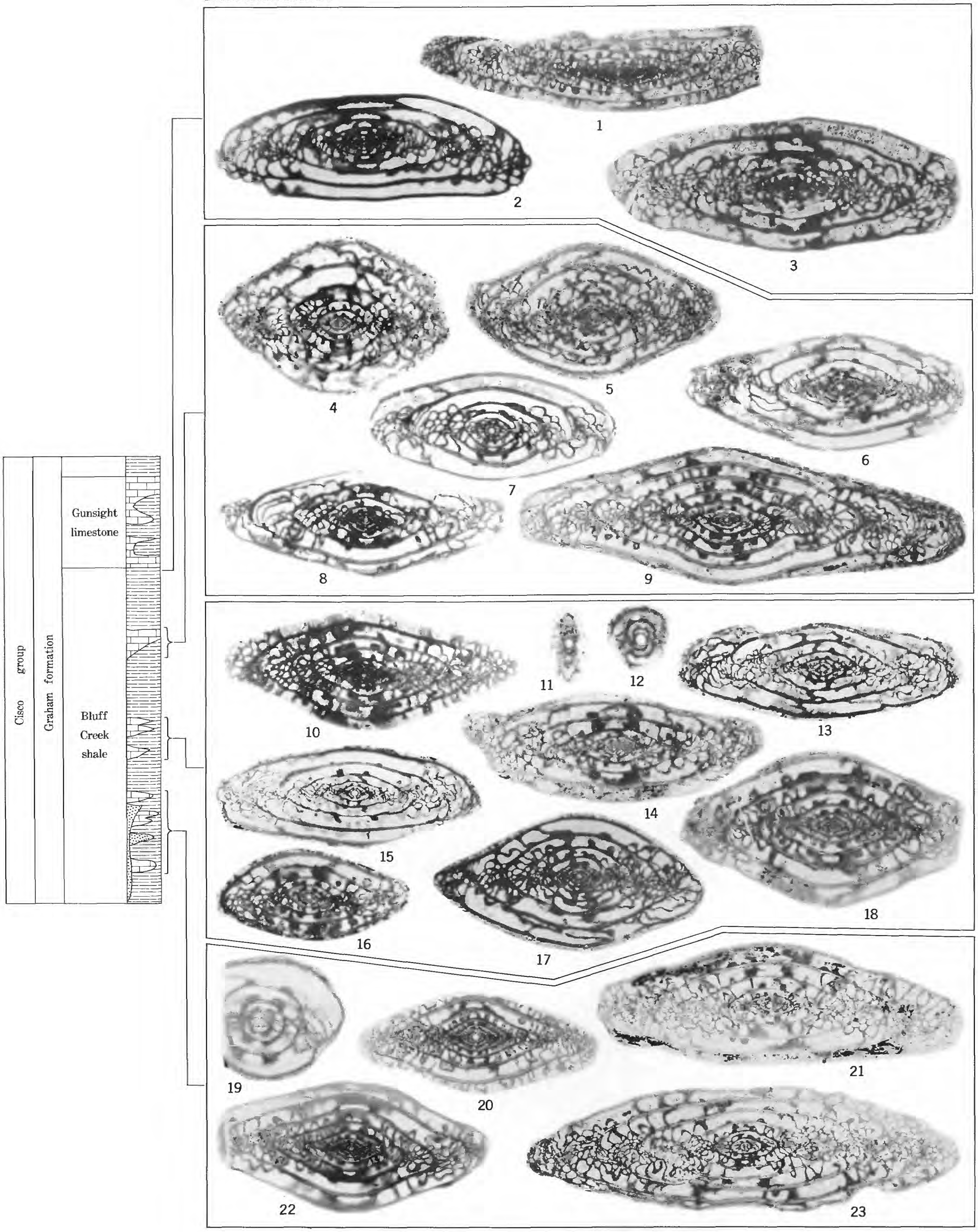
10–13. Fusulinids from the Ranger limestone member ot the Brad formation.
- 10–11. *Triticites* sp. D.
  - 10. USNM 120077, from USGS locality f10037, slide 1.
  - 11. USNM 120078, from USGS locality f10037, slide 3.
- 12. *Triticites* cf. *T. newelli* Burma, 1942. USNM 120079, from USGS locality f10038, slide 1.
- 13. *Triticites* cf. *T. cullomensis* Dunbar and Condra, 1927. USNM 120080, from USGS locality f10039, slide 5.

14–18. Fusulinids from the Placid shale member of the Brad formation.
- 14, 16, 18. *Triticites* sp. E.
  - 14. USNM 120081, from USGS locality f10035, slide 1.
  - 16. USNM 120082, from USGS locality f10035, slide 3. Juvenile specimen.
  - 18. USNM 120083, from USGS locality f10035, slide 2. Juvenile specimen.
- 15. *Triticites* cf. *T.* sp. B. USNM 120084, from USGS locality f10036, slide 3.
- 17. *Triticites* aff. *T. newelli* Burma, 1942. USNM 120085, from USGS locality f10036, slide 1.

19–25. Fusulinids from the Winchell limestone.
- 19–20, 22–24. *Triticites* ex gr. *T. irregularis* (Schellwien and Staff), 1912.
  - 19. USNM 120086, from USGS locality f10081, slide 4.
  - 20. USNM 120087, from USGS locality f10080, slide 5.
  - 22. USNM 120088, from USGS locality f10081, slide 3.
  - 23. USNM 120089, from USGS locality f10080, slide 3.
  - 24. USNM 120090, from USGS locality f10081, slide 1.
- 21. *Millerella*? sp. (× 30). USNM 120091, from USGS locality f10081, slide 5.
- 25. *Staffella*? sp. (× 30). USNM 120092, from USGS locality f10080, slide 6.



FUSULINIDAE FROM THE WINCHELL, BRAD, AND CADDO CREEK FORMATIONS



FUSULINIDAE FROM THE BLUFF CREEK SHALE MEMBER OF THE GRAHAM FORMATION

PLATE 18

[All figures × 10, unless otherwise indicated. Scale of columnar section, 1 in=40 ft]

FIGURES 1–3. Fusulinids from a shale bed just below the Gunsight limestone member.
- 1. *Dunbarinella* sp. A. USNM 120093, from USGS locality f10052, slide 3.
- 2–3. *Triticites* cf. *T. oryziformis* Newell, 1934.
  - 2. USNM 120094, from USGS locality f10052, slide 6.
  - 3. USNM 120095, from USGS locality f10052, slide 4.

4–9. Fusulinids from a limestone bed (Bunger limestone member of the Graham formation) in the upper part of the Bluff Creek shale member.
- 4. *Triticites* cf. *T. plummeri* Dunbar and Condra, 1927. USNM 120096, from USGS locality f10042, slide 2.
- 5. *Triticites* aff. *T. plummeri* Dunbar and Condra, 1927. USNM 120097, from USGS locality f10042, slide 3.
- 6–8. *Triticites* cf. *T. cullomensis* Dunbar and Condra, 1927.
  - 6. USNM 120098, from USGS locality f10043, slide 1.
  - 7. USNM 120099, from USGS locality f10043, slide 4.
  - 8. USNM 120100, from USGS locality f10043, slide 3.
- 9. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858. USNM 120101, from USGS locality f10046, slide 1.

10–18. Fusulinids from a group of limestone beds in the central part of the Bluff Creek shale member.
- 10. *Triticites* sp. F. USNM 120102, from USGS locality f10045, slide 6.
- 11. *Millerella*? sp. (× 30) USNM 120103, from USGS locality f10045, slide 1.
- 12. *Staffella*? sp. (× 30) USNM 120104, from USGS locality f10050, slide 2.
- 13–14. *Triticites* aff. *T. secalicus* (Say), 1833
  - 13. USNM 120105, from USGS locality f10045, slide 4.
  - 14. USNM 120106, from USGS locality f10045, slide 2.
- 15. *Triticites* sp. G. USNM 120107, from USGS locality f10050, slide 3.
- 16–18. *Triticites* cf. *T.* sp. F.
  - 16. USNM 120104, from USGS locality f10050, slide 2.
  - 17. USNM 120108, from USGS locality f10049, slide 2.
  - 18. USNM 120109, from USGS locality f10045, slide 3.

19–23. Fusulinids from a group of limestones in the lower part of the Bluff Creek shale member.
- 19. *Staffella*? sp. (× 30). USNM 120110, from USGS locality f10048, slide 2.
- 20, 22. *Triticites* cf. *T. consobrinus* White, 1932.
  - 20. USNM 120111, from USGS locality f10047, slide 2.
  - 22. USNM 120112, from USGS locality f10047, slide A–1.
- 21, 23. *Triticites* cf. *T. secalicus* (Say), 1833
  - 21. USNM 120113, from USGS locality f10047, slide 1.
  - 23. USNM 120114, from USGS locality f10047, slide A–4.

PLATE 19

[All figures × 10, unless otherwise indicated. Scale of columnar section, 1 in=40 ft]

FIGURES 1–5. Fusulinids from the upper part of the Gunsight limestone member.

1. *Triticites* aff. *T. cullomensis* Dunbar and Condra, 1927. USNM 120115, from USGS locality f10061, slide 4.

2–3. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858

2. USNM 120116, from USGS locality f10058, slide 1.

3. USNM 120117, from USGS locality f10061, slide 6.

4. *Triticites* sp. H. USNM 120118, from USGS locality f10021, slide 1.

5. *Triticites cullomensis* Dunbar and Condra, 1927. USNM 120119, from USGS locality f10021, slide 3.

6–9. Fusulinids from the middle part of the Gunsight limestone member.

6–7. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858.

6. USNM 120120, from USGS locality f10059, slide 6.

7. USNM 120121, from USGS locality f10059, slide 5.

8. *Triticites* aff. *T. cullomensis* Dunbar and Condra, 1927. USNM 120122, from USGS locality f10059, slide 3.

9. *Staffella*? sp. (× 30). USNM 120123, from USGS locality f10059, slide 11.

10–16. Fusulinids from the lower part of the Gunsight limestone member.

10–11. *Triticites* cf. *T. secalicus* (Say), 1833.

10. USNM 120124, from USGS locality f10069, slide 3.

11. USNM 120125, from USGS locality f10067, slide 5.

12. *Triticites*? sp. USNM 120126, from USGS locality f10067, slide 6.

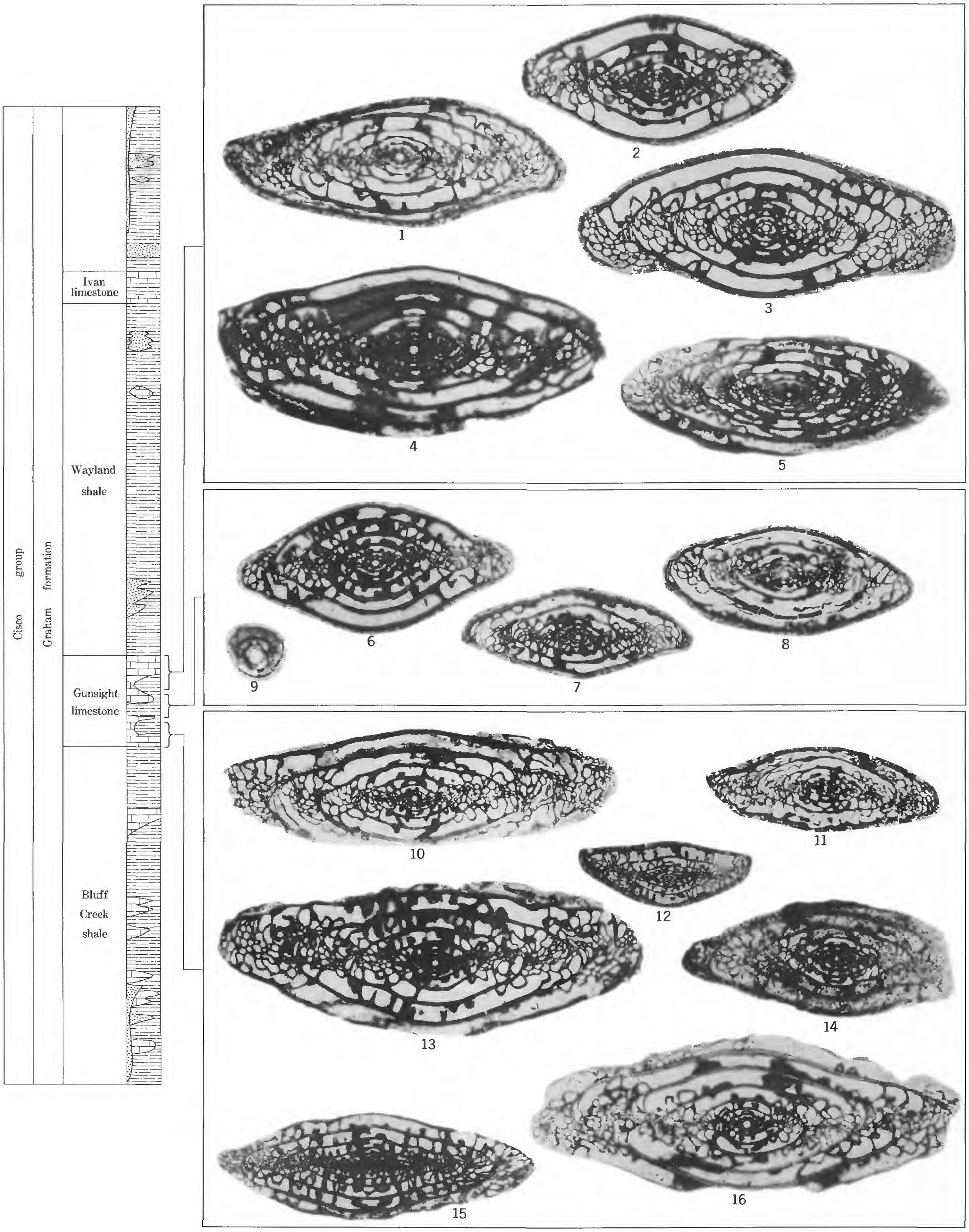
13, 16. *Triticites* aff. *T. secalicus* (Say), 1833.

13. USNM 120127, from USGS locality f10060, slide 1.

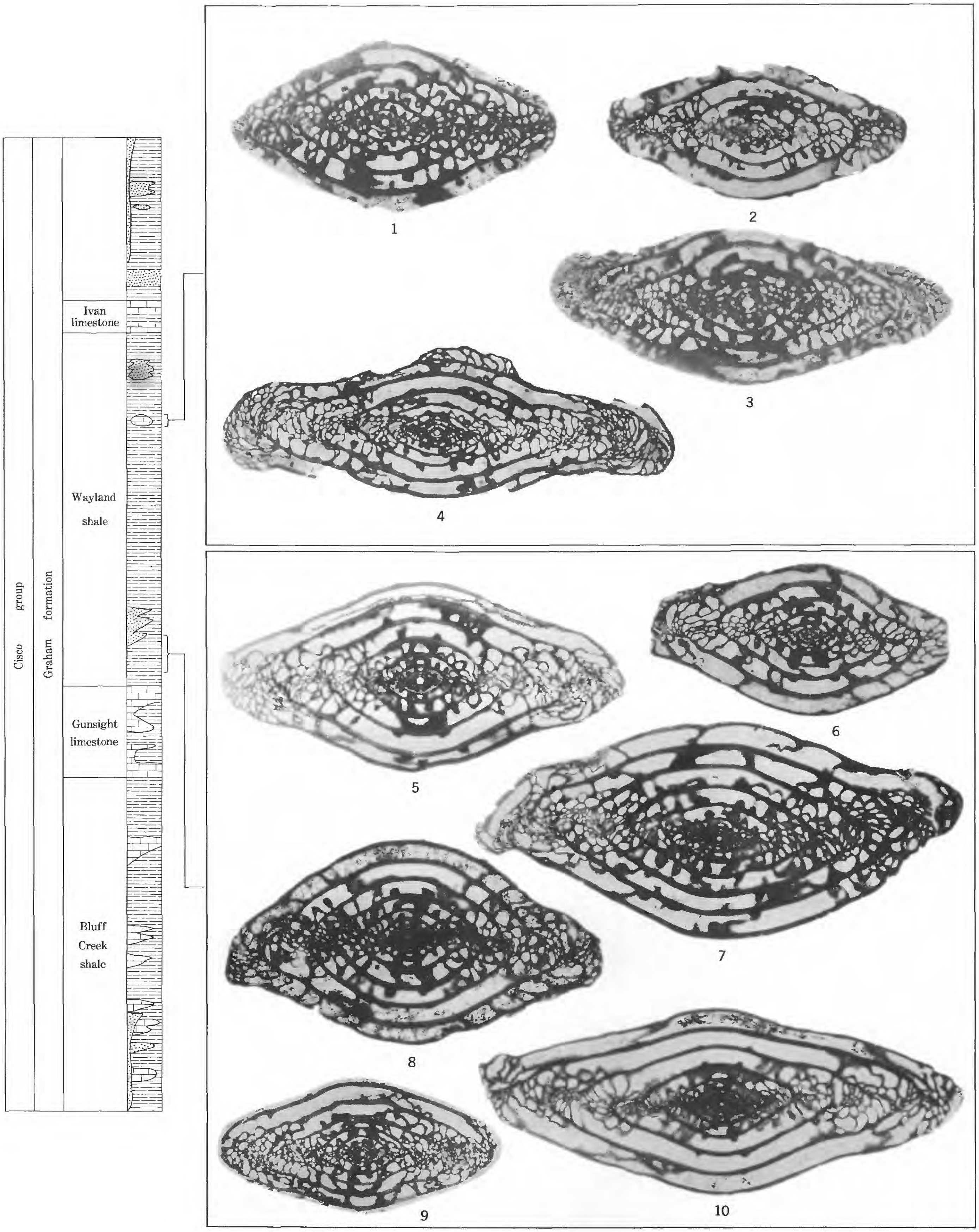
16. USNM 120128, from USGS locality f10069, slide 2.

14. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858. USNM 120129, from USGS locality f10069, slide 6.

15. *Dunbarinella* cf. *D. ervinensis* Thompson, 1942. USNM 120130, from USGS locality f10060, slide 2.



FUSULINIDAE FROM THE GUNSIGHT LIMESTONE MEMBER OF THE GRAHAM FORMATION



FUSULINIDAE FROM THE WAYLAND SHALE MEMBER OF THE GRAHAM FORMATION

PLATE 20

[All figures × 10. Scale of columnar section. 1 in.=40 ft.

FIGURES 1–4. Fusulinids from the upper part of the Wayland shale member.

1. *Triticites* cf. *T. beedei* Dunbar and Condra, 1927. USNM 120131, from USGS locality f10065, slide 5.
2. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858. USNM 120132, from USGS locality f10065, slide M–5.
3. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927. USNM 120133, from USGS locality f10065, slide 1.
4. *Triticites* sp. I. USNM 120134, USGS locality f10065, slide 2.

5–10. Fusulinids from the lower part of the Wayland shale member.

5, 7. *Triticites beedei* Dunbar and Condra, 1927.
- 5. USNM 120135, from USGS locality f10011, slide 3.
- 7. USNM 120136, from USGS locality f10011, slide 13.

6, 9. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927.
- 6. USNM 120137, from USGS locality f10066, slide 4.
- 9. USNM 120138, from USGS locality f10066, slide 1.

8. *Triticites plummeri* Dunbar and Condra, 1927. USNM 120139, from USGS locality f10011, slide 1.

10. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858. USNM 120140, from USGS locality f10011, slide 15.

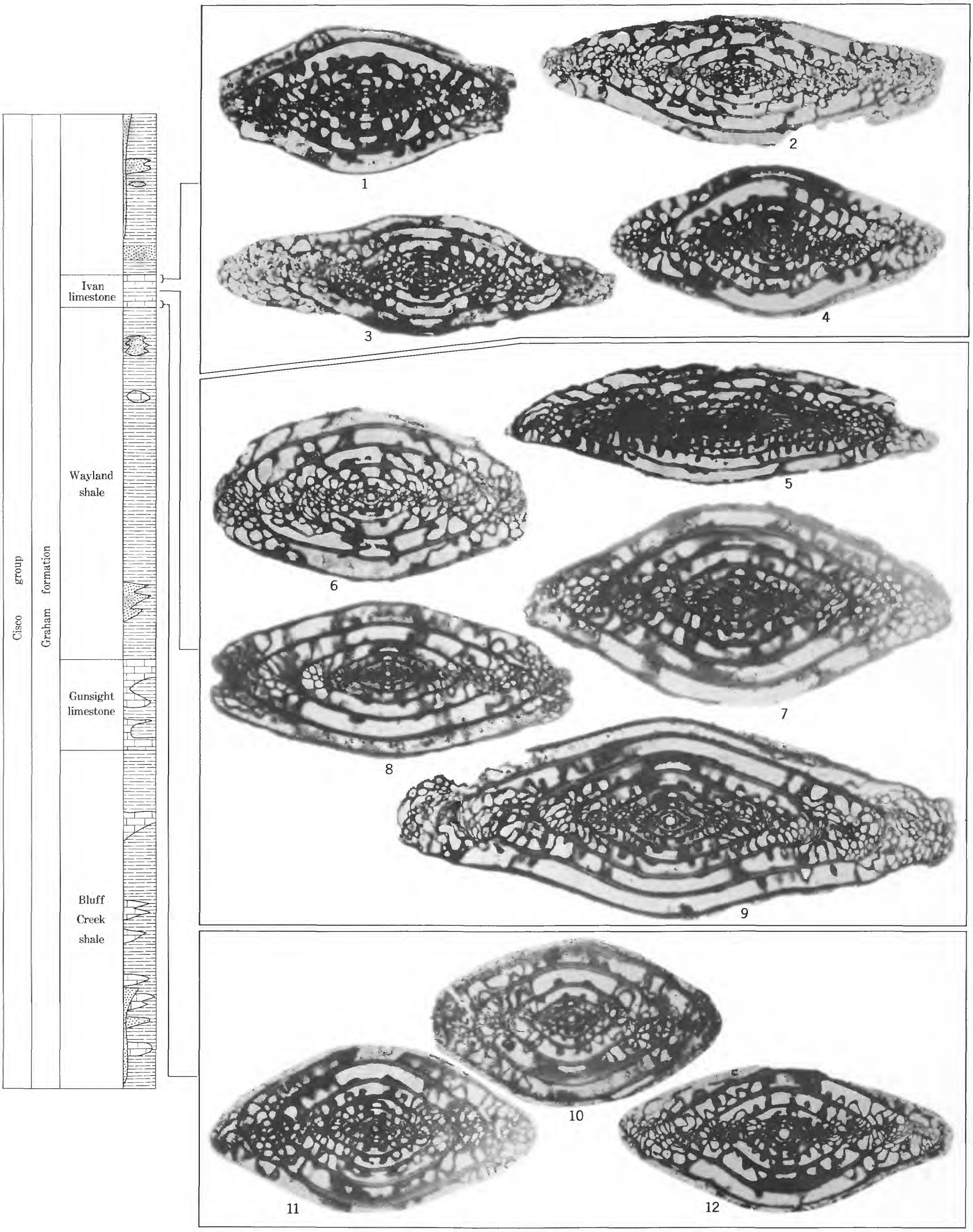
PLATE 21

[All figures × 10. Scale of columnar section, 1 in=40 ft]

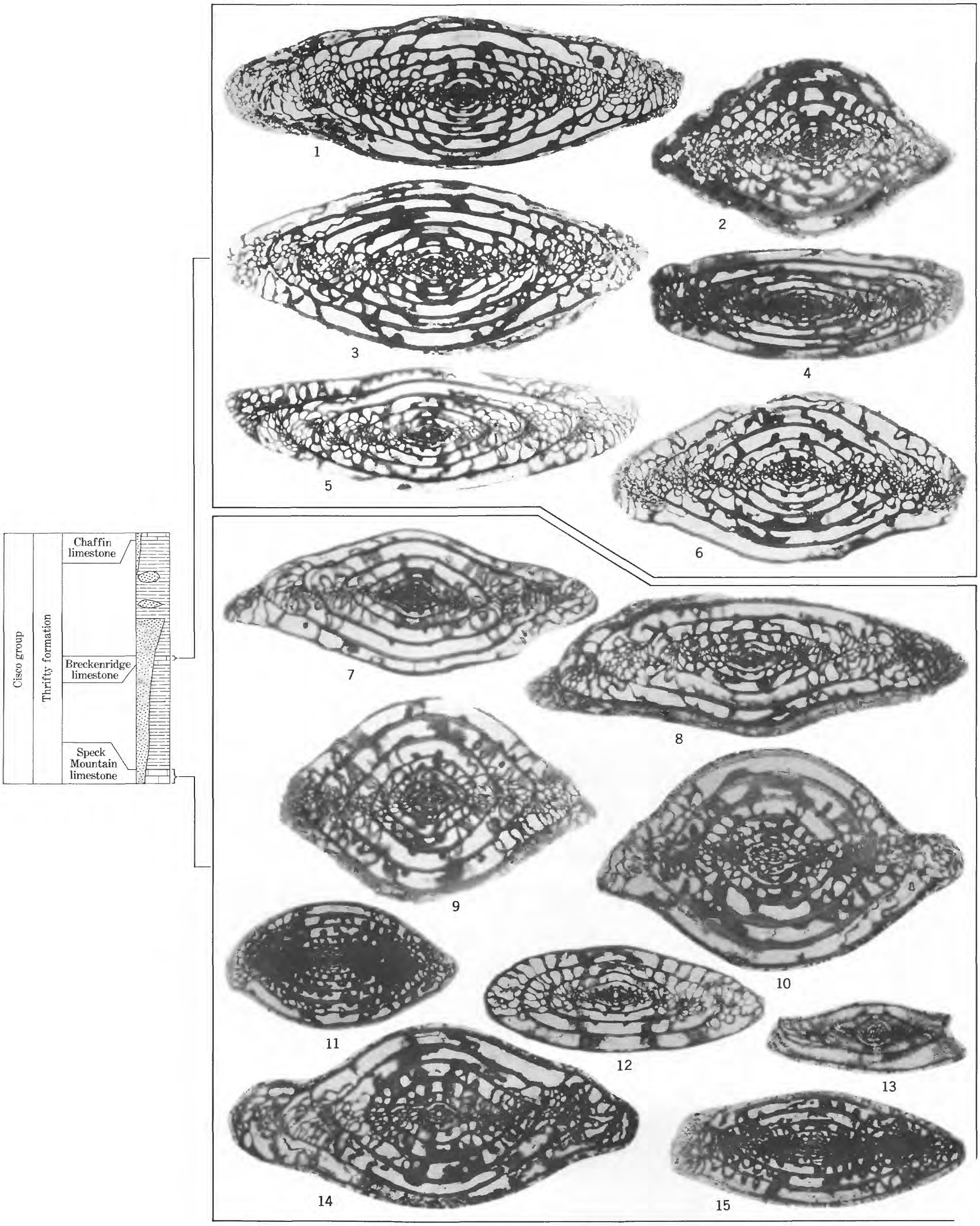
FIGURES 1–4. Fusulinids from the upper part of the Ivan limestone member.
- 1, 4. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927.
  - 1. USNM 120141, from USGS locality f10026, slide 12.
  - 4. USNM 120142, from USGS locality f10026, slide 8.
- 2, 3. *Triticites* aff. *T. ventricosus* (Meek and Hayden) *meeki* (Moller), 1879.
  - 2. USNM 120143, from USGS locality f10026, slide 2.
  - 3. USNM 120144, from USGS locality f10026, slide 10.

5–9. Fusulinids from the middle part of the Ivan limestone member.
- 5. *Dunbarinella* cf. *D. ervinensis* Thompson, 1942. USNM 120145, from USGS locality f10012, slide 8.
- 6. *Triticites* sp. J. USNM 120146, from USGS locality f10012, slide 6.
- 7. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927. USNM 120147, from USGS locality f10012, slide 10.
- 8. *Triticites* aff. *T. cullomensis*? Dunbar and Condra, 1927. USNM 120148, from USGS locality f10012, slide 5.
- 9. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858. USNM 120149, from USGS locality f10012, slide 4.

10–12. Fusulinids from the lower part of the Ivan limestone member.
- 10–11. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927.
  - 10. USNM 120150, from USGS locality f10062, slide 4.
  - 11. USNM 120151, from USGS locality f10062, slide 2.
- 12. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858 USNM 120152, from USGS locality f10062, slide 1



FUSULINIDAE FROM THE IVAN LIMESTONE MEMBER OF THE GRAHAM FORMATION



FUSULINIDAE FROM THE SPECK MOUNTAIN AND BRECKENRIDGE LIMESTONE MEMBERS OF THE THRIFTY FORMATION

PLATE 22

[All figures × 10, unless otherwise indicated. Scale of columnar section, 1 in=40 ft]

FIGURES 1–6. Fusulinids from the Breckenridge limestone member.

1. *Triticites* sp. K. USNM 119882, from USGS locality f10055, slide 3–A.
2. *Triticites plummeri* Dunbar and Condra, 1927. USNM 119884 from USGS locality f10053, slide 16.

3, 6. *Triticites* aff. *T. subventricosus* Dunbar and Skinner, 1937.

3. USNM 120153, from USGS locality f10056, slide 2
6. USNM 120154, from USGS locality f10056, slide 1.

4. *Triticites* sp. L. USNM 120155, from USGS locality f10054, slide 3.
5. *Triticites* ex gr. *T. secalicus* (Say), 1833. USNM 120156 from USGS locality f10055, slide 4–B.

7–15. Fusulinids from the Speck Mountain limestone member.

7–8. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858.

7. USNM 120157, from USGS locality f10025, slide 3.
8. USNM 120158, from USGS locality f10025, slide 6.

9–10, 14. *Triticites plummeri* Dunbar and Condra, 1927.

9. USNM 120159, from USGS locality f10025, slide 8.
10. USNM 120160, from USGS locality f10074, slide 1.
14. USNM 120161, from USGS locality f10063, slide 4.

11. *Dunbarinella* sp. B. USNM 119891, from USGS locality f10070, slide 4.
12. *Triticites* ex gr. *T. secalicus* (Say), 1833. USNM 120162, from USGS locality f10025, slide 4.
13. *Schubertella* sp. A. (× 30). USNM 119894, from USGS locality f10064, slide 4.
15. *Dunbarinella* sp. C. USNM 119893, from USGS locality f10064, slide 1.

PLATE 23

[All figures × 10. Scale of columnar section, 1 in=40 ft]

FIGURES 1–3. *Triticites* cf. *T. subventricosus* Dunbar and Skinner, 1937.
1. USNM 120163, from USGS locality f10071, slide 4.
2. USNM 120164, from USGS locality f10071, slide 3.
3. USNM 120165, from USGS locality f10071, slide 2.

4, 6, 9. *Triticites* aff. *T. beedei* Dunbar and Condra, 1927.
4. USNM 120166, from USGS locality f10072, slide 2.
6. USNM 120167, from USGS locality f10019, slide 6.
9. USNM 120168, from USGS locality f10057, slide 34. Type area of member.

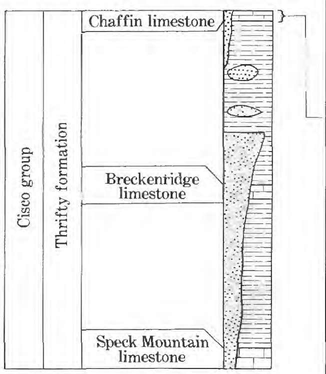
5, 12. *Triticites plummeri* Dunbar and Condra, 1927.
5. USNM 120169, from USGS locality f10019, slide 16.
12. USNM 120170, from USGS locality f10057, slide 39. Type area of member.

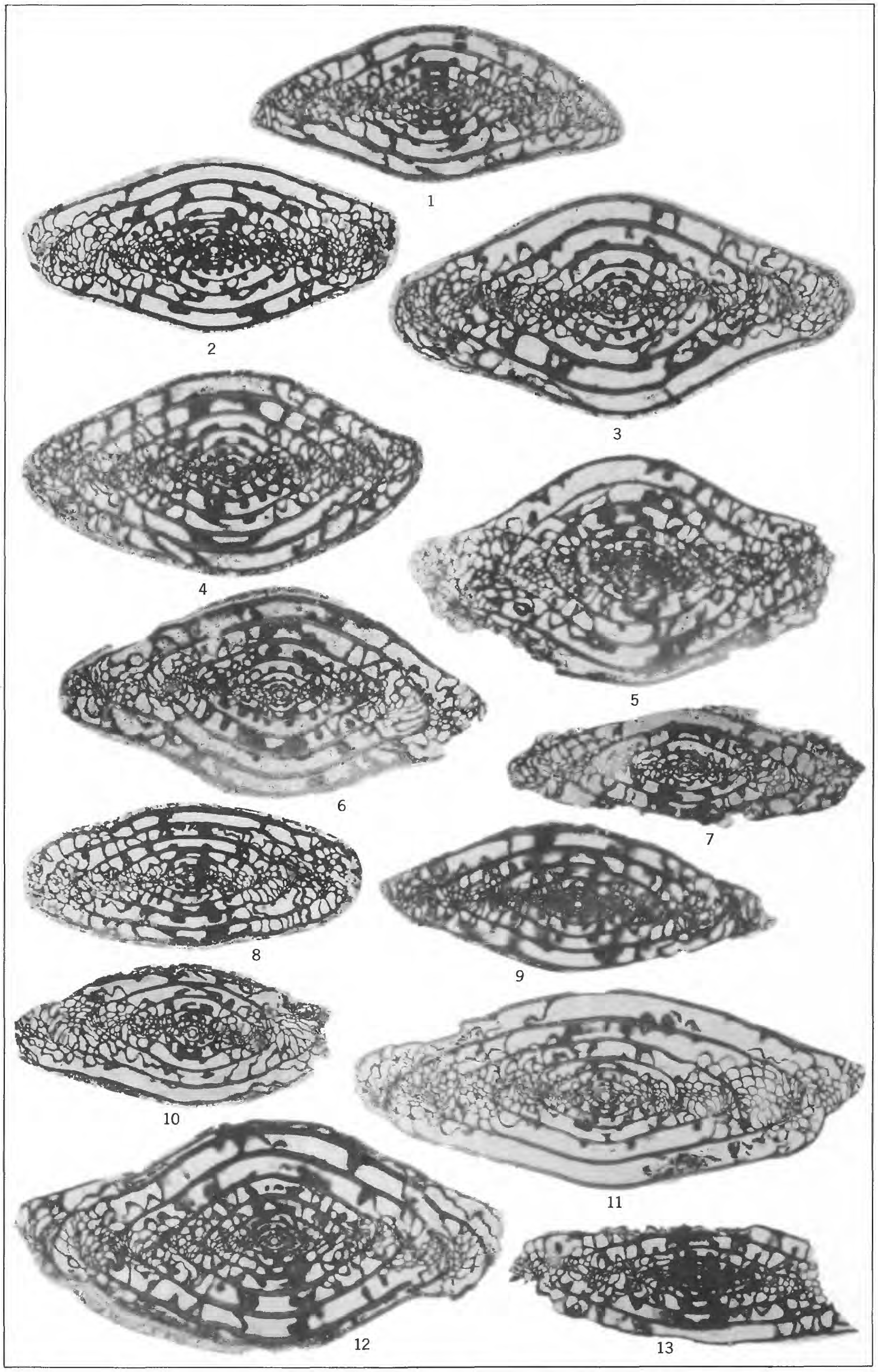
7. *Triticites* aff. *T. moorei* Dunbar and Condra, 1927. USNM 120171, from USGS locality f10019, slide 4.

8. *Triticites* sp. M. USNM 120172, from USGS locality f10079, slide 2.

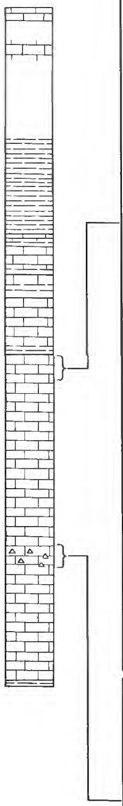
10–11. *Triticites* ex gr. *T. ventricosus* (Meek and Hayden), 1858.
10. USNM 120173, from USGS locality f10057, slide 44. Type area of member.
11. USNM 119869, from USGS locality f10057, slide 10. Type area of member.

13. *Dunbarinella*? sp. D. USNM 119868, from USGS locality f10057, slide 22. Type area of member.

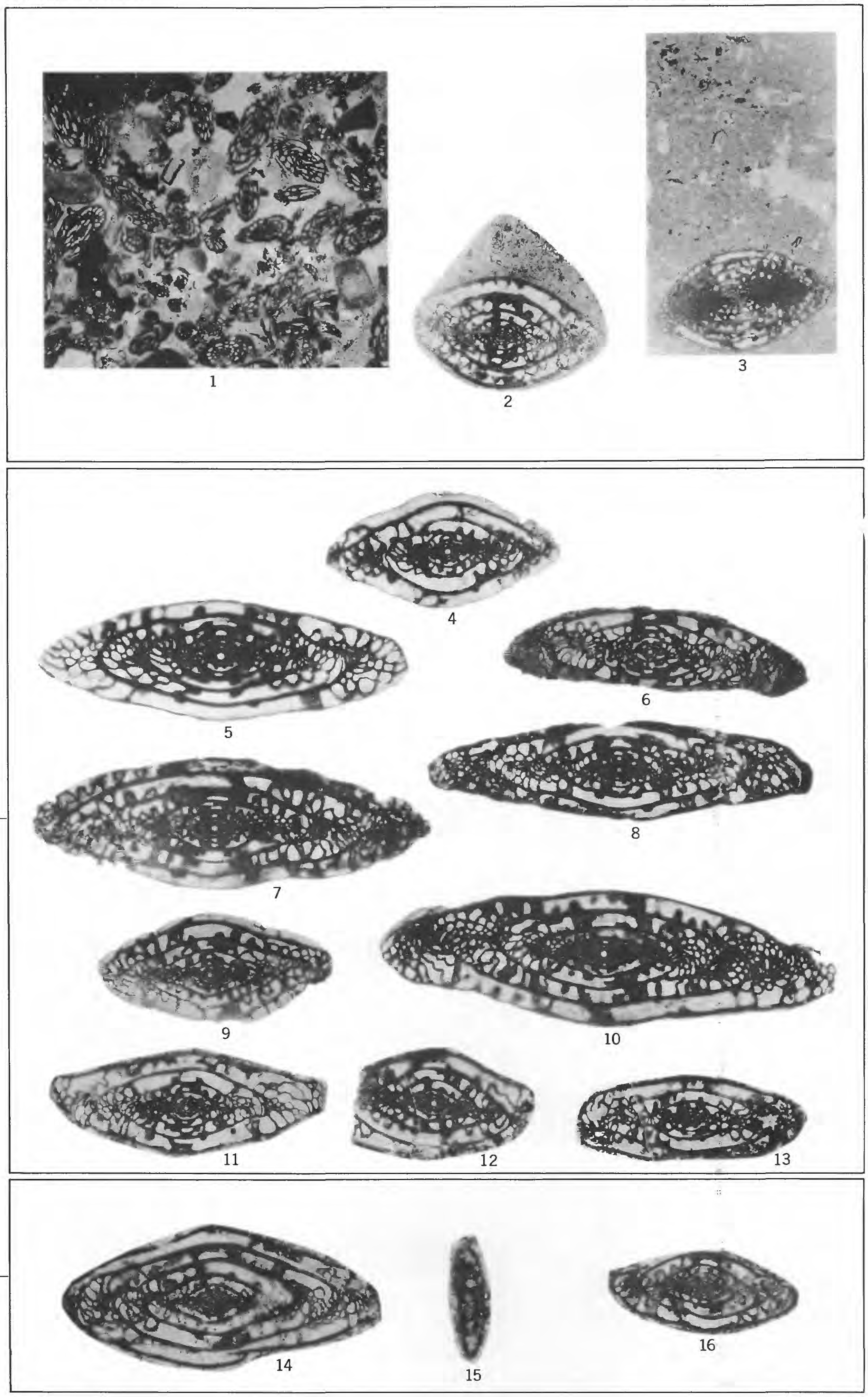




FUSULINIDAE FROM THE CHAFFIN LIMESTONE MEMBER OF THE THRIFTY FORMATION



Ranger limestone member of the Brad formation and the Colony Creek shale member and the Home Creek limestone member of the Caddo Creek formation of the Canyon group



MISCELLANEOUS FUSULINIDAE FROM THE PENNSYLVANIAN OF BROWN AND COLEMAN COUNTIES, TEXAS

PLATE 24

[All figures $\times$ 10, unless otherwise indicated. Columnar data supplied by R. T. Terriere. Scale of columnar section, 1 in=40 ft]

FIGURES 1–3. Fusulinids from the Ricker Station limestone of Cheney (1949) and the Speck Mountain limestone member of the Thrifty formation.

1. *Fusulina*? *rickerensis* Thompson, 1945. ($\times$ 5). USNM 120174, from USGS locality f10004, slide X. This figure shows the abundance in which fusulinids are sometimes found. From the Ricker Station limestone of Cheney (1949).
2. *Triticites* sp. associated with Schubertella sp. ($\times$ 7.5). USNM 120175, from USGS locality f10064, slide X. The *Schubertella* is the very small, imperfectly oriented fusulinid above and slightly to the left of the tunnel of *Triticites*. From the Speck Mountain limestone member of the Thrifty formation.
3. *Dunbarinella* sp. associated with *Schubertella* sp. ($\times$ 7.5). USNM 119891, from USGS locality f10070, slide 4. The *Dunbarinella* is also shown on pl. 8, fig. 11. The *Schubertella* may be found in the middle of the photograph, just below the upper margin. From the Speck Mountain limestone member of the Thrifty formation.

4–16. Fusulinids from the Ranger limestone member of the Brad formation and the Colony Creek shale member and Home Creek limestone member of the Caddo Creek formation.

The fauna illustrated in figs. 4–13 contain elements that are found in the Home Creek and Ranger limestone members elsewhere in the area. The fauna more nearly resembles that of the Home Creek than it does that of the Ranger.

4, 9, 11, 12. *Triticites* aff. *T. consobrinus* White, 1932.
- 4. USNM 120176, from USGS locality f10075, slide 30.
- 9. USNM 120177, from USGS locality f10075, slide 26.
- 11. USNM 120178, from USGS locality f10083, slide 2
- 12. USNM 120179, from USGS locality f10083, slide 3.

5. *Triticites* aff. *T.* sp. C. USNM 120180 from USGS locality f10075, slide 17.

6. *Triticites* sp. USNM 120181, from USGS locality f10075, slide 27.

7, 8, 10. *Triticites* aff. *T. secalicus* (Say), 1833.
- 7. USNM 120182, from USGS locality f10075, slide 23.
- 8. USNM 120183, from USGS locality f10075, slide 33.
- 10. USNM 120184, from USGS locality f10075, slide 37.

13. *Triticites* cf. *T.* sp. D. USNM 120185, from USGS locality f10083, slide 1.

14–16. The fusulinids figured here more closely resemble those found elsewhere in the Ranger limestone member.

14. *Triticites* sp. USNM 120186, from USGS locality f10082, slide 3.
15. *Millerella*? sp. ($\times$ 30). USNM 120187, from USGS locality f10082, slide 4.
16. *Triticites* sp. USNM 120188, from USGS locality f10082, slide 2.

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