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Studies in the distribution of Orbitolina walnutensis Carsey

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Department:

STUDIES IN THE DISTRIBUTION OF *ORBITOLINA WALNUTENSIS CARSEY*.

By

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A

THESIS

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Professor of Economic Geology.

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Shirley A. Lynch.

INTRODUCTION.

The foraminifer Orbitolina walnutensis Carsey is described by Mrs. Carsey[1] as follows:

" Orbitolina walnutensis n. sp.

Test very finely agglutinated, quite calcareous, conical, slightly higher than broad in most instances; surface smooth; base of shell flad to slightly concave; chambers numerous, disposed in multilocular rings, each chamber porous, thus communicating with surrounding ones, outer chambers subdivided.

Diameter up to 5 mm.

In parts of the Walnut clay this species exists in some abundance. The shell is readily

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1. Carsey, Dorothy Ogden, Forminifera of the Cretaceous of Central Texas; Univ. of Texas Bulletin No. 2612, 1926, p.23.

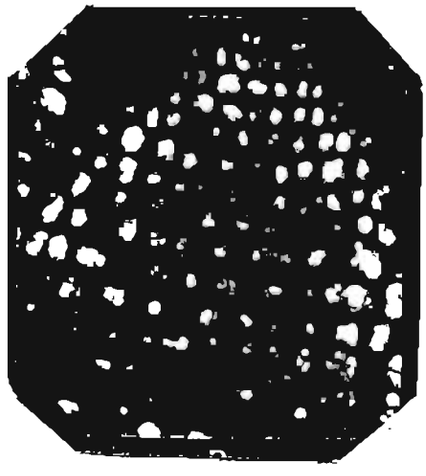

Figure 1. A cross-section of Orbitolina walnutensis Carsey (magnification 55 diameters). This illustration is the exact one used to accompany the original description, as it was extracted from Univ. of Texas Bulletin No. 2818, Plate VIII, Figure 3.

distinguished from Orbitolina texana due to is shape and smaller size."

Figure I shows a cross section to Orbitolina walnutensis Carsey as figured by Mrs. Carsey, this cut being extracted from Plate VIII of her publication[1]. It is exceedingly unfortunate that

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1.

Idem.

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the original description is accompanied by only one illustration. Illustrations of the complete foraminifer would undoubtedly give great aid in its recognition.

The diameter is given as up to 5mm. but the writer has failed to find any specimen reaching that size, although several thousand specimens were examined. The maximum size noted was about 3 mm. and the average size was approximately 1 mm.

There has been some discussion of the accuracy of the generic name of the fossil and the writer has sent specimens and thin sections to Dr. T. Wayland Vaughan for a determination of this name. Dr. Vaughan is director of Scripps Institution of Oceanography, La Jolla, California and is an author-

ity of world renown, hence his determination of the generic name of this fossil will undoubtedly be unquestioned. He has written that he is working on this determination, but to date has not completed it. This paper will contain the name Orbitolina walnutensis Carsey with the understanding that the generic name may be changed or confirmed before publication.

The purpose of this paper is to give the results of the study of the distribution of Orbitolina walnutensis Carsey within thirteen counties of central and north central Texas. Beginning with Cooke county at the Red River and extending southward to Bexar, these counties form a belt marking the eastern exposure of rocks of lower Comanchean age. This Lower Cretaceous belt and the counties from which the material was studied are shown in Figure 2.

Since Mrs. Carsey has described the foraminifera of the Cretaceous of central Texas, but mentions Orbitolina walnutensis Carsey

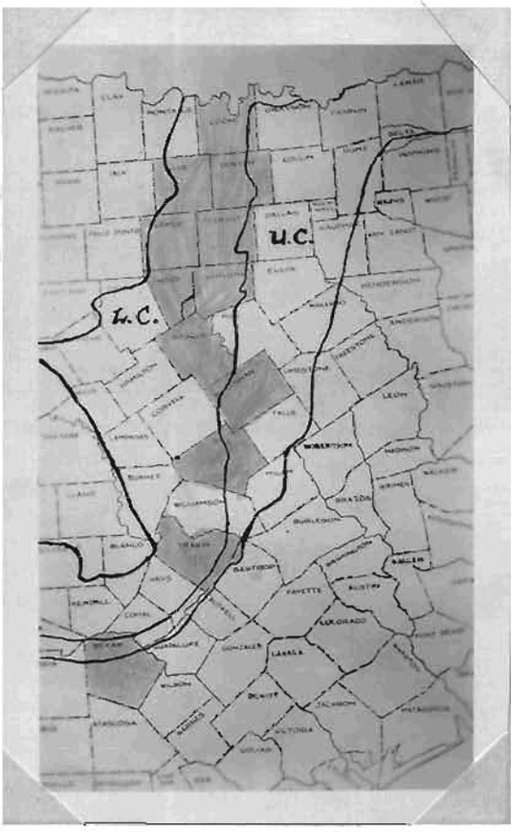

Figure 2. Map showing the divisions of the Cretaceous in the area (shaded) of the paper. U.C. is Upper Cretaceous and L.C. is Lower Cretaceous.

only in her discussion of the Walnut formation, it is assumed that she did not find it elsewhere. The name walnutensis also suggests that it might be limited to the Walnut formation. However, well cores and surface samples from other formations have yielded O. walnutensis so abundantly that a thorough study of the foraminifera seems justified.

Orbitolina walnutensis Carsey has been found by Mr. N. L. Thomas in the Goodland formation near Fort Worth, Texas and in the Fredericksburg near Crawford, Texas. With this as a basis, the present study was made of the Fredericksburg division of the Lower Cretaceous from the Red River to San Antonio, a distance of three hundred fifty miles.

The samples are from the counties of Cooke, Denton, Wise, Parker, Tarrant, Hood, Johnson, Sommervell, Bosque, McLennan, Bell, Travis and Bexar. The Tarrant county section was used as a beginning of study because of its proximity to the writer's residence and because it is so well described by

Adkins and Winton[1].

1. Winton, W. M. and Adkins, W. S., The Geology of Tarrant County; Univ. of Texas Bulletin No. 1931, 1919.

ACKNOWLEDGEMENTS.

To Mr. N. L. Thomas, paleontologist of Fort Worth laboratory of the Pure Oil Company, Fort Worth, Texas, the writer desires to express deep appreciation. Not only did Mr. Thomas suggest a problem that he probably would have used for publication, but he also gave his time and experience in guiding the writer toward its solution.

Further, thanks are due Dr. T. Wayland Vaughan, Director of Scripps Institution of Oceanography, La Jolla, California, for his work on the specific determination of the foraminifer that at present is known as Orbitolina walnutensis Carsey. To Dr. G. A. Muilenburg, and O. R. Grawe, members of the department of geology of Missouri School of Mines and Metallurgy, Rolla, Missouri, the writer wishes to express thanks for their constructive criticism and suggestions in the preparation of this manuscript. Lastly, to the members of the departments of chemistry and agriculture of the North Texas Agricultural College who have graciously loaned the laboratory equipment, the writer expresses appreciation.

SAMPLING.

The method of sampling varied to suit conditions of the outcrop. Channel samples were taken of clays and marls. The majority of samples are composite samples, made up of many chips taken along the same stratum. Since both fresh and weathered material were used in the same composite sample, they are believed to be truly representative. With three exceptions, all are from mapped areas where the sections previously have been described and zoned on the basis of their macrofossils. Samples of clay, and marl partings between the limestone members were kept separate.

PREPARATION OF THE SAMPLES.

Only one half of each sample was used, care being taken to use a portion of each chip. This partial retention of material proved beneficial in checking critical samples. The hard samples were crushed, not ground, in an iron mortar with a steel pestle. Some of the small fossils were broken but all fragments were retained by subsequent screenings. This method was preferred to the study of the fossils in thin sections for the following reasons: (a) crushing, not grinding, has been found most successful in nearly all subsurface laboratories; (b) good thin sections cannot be made easily from weathered and unindurated rocks like clays and marls; (c) many thousand separate thin sections would be required for a proper study of the six hundred composite samples; (d) the amount of rock in a thin section is too small for sampling properly; (e) crushing produced very few fragments of broken foraminifera and many hundreds of good specimens were obtained.

After crushing, the samples were sieved through four screens, having openings of approximately 2, 1, 0.4, 0.2 mm. Although the foraminifera ranged in size from .2 to 3 mm., the various screen sizes were very helpful in segregating the fossils for only a few samples presented gradation in size from the smallest to the largest. The average sample contained two sizes, the smaller ones ranging from 0.2 to 0.5 mm. and the larger ones from 1.3 to 3 mm.

The material of each screen size was thoroughly washed by decantation to remove silt and pulverized limestone. It was then dried and filed in new clean manilla envelopes, preparetory to microscopic examination. To guard against the loss of very small foraminifera some of the finest material from each locality was washed, decanted and examined under a binocular microscope. In only a few cases did this fine, powdery material yield any foraminifera.

The material of each sample was studied under a low power binocular microscope using a magnification of 10 to 40 diameters. With a fine sable brush the foraminifera were transferred from the sample to small glass bottles and later they were mounted on small cardboard slides having a black background. Glue, thinned with water and glycerine was found to be the best mounting medium.

STRATIGRAPHY.

The formations under consideration in this paper are all of Comanchean age, Glenn Rose to Kiamitia, inclusive. A typical section published by Adkins[1] is given on the following page.

1. Adkins, W. S., Geology and Mineral Resources of McLennan County; Univ. of Texas Bulletin No. 2340, 1923, p. 20.

	Waco	Austin	Fort Worth
Recent	Soil		
Pleisto-cene	River terraces	River Terraces	River Terraces
	Unconformity		
Upper Cretaceous	Taylor	Taylor	Taylor
	Austin	Austin	Austin
	Eagleford	Eagleford	Eagleford
	Woodbine	.....	Woodbine
	Unconformity		
Washita Division	Buda	Buda	.....
	Del Rio	Del Rio	Grayson Mainstreet Pawpaw Wanc Denton Fort Worth Duck Creek Kiamitia
	Georgetown series (7 members).	Georgetown	
Fredericks-burg Division	Edwards	Edwards	Goodland
	Comanche Peak	Comanche Peak	
	Walnut	Walnut	Walnut
Trinity Division	.....	.....	Paluxy
	Glenn Rose	Glenn Rose	Glenn Rose
	Basal sand	Travis Peak	Basement sand
	Unconformity		
Penna. Series	Bend series	.....	.....

FREDERICKSBURG SERIES

The Fredericksburg series is of particular interest in this paper since a preliminary study showed that O. walnutensis is confined to this division. This division of the Lower Cretaceous is composed of both hard crystalline and soft chalky limestones, much marl and considerable clay. Fossils occur abundantly in parts of the clays, in the marls and in the marly limestones. Some fossils occur at such definite intervals that they may be grouped into horizons which remain constant over considerable distance. These horizons are of great value in identifying formations in areas where their vertical transition is too gradual to show sharp contacts. In some areas, as in western Bell county, the lithology of the Comanche Peak varies so slightly from that of the overlying Edwards and the underlying Walnut that it is impossible to draw a sharp contact. In such localities, contacts have been mapped on the basis of fossil horizons and naturally writers have rather conflicting opin-

ions regarding these contacts. At present the limits of the formation of the Fredericksburg division of the Comanchean are the subject of considerable study. Within the limits of the area studied, the Fredericksburg series outcrops in a slightly northeast-southwest direction. North of the Brazos River this division is represented by the Walnut and the Goodland formations. South of the Brazos River, the Goodland is replaced by two formations, the Comanche Peak and the Edwards. This variation is described by Winton and Scott[1] as a gradual transition,

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1. Winton, W. M. and Scott, G., The Geology of Johnson County; Univ. of Texas Bulletin No. 2229, 1922, p. 14.

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marked by continuous exposures and perfect fossil sequence.

WALNUT FORMATION

Name. Walnut was the name applied by Hill[1] to the clays and non-chalky limestones at the base of the Fredericksburg.

1. Hill, R. T., The Comanche Series of the Texas-Arkansas Region. Geological Society of America, Vol. 2, 1891, pp. 503-512.

Distribution. The writers knowledge of the distribution of the Walnut formation is confined to observations made while collecting samples. The formation in Denton County was observed only in the cores of the Pure Oil Company's wells, Parker #1 and Caddell #1. In north-eastern Wise County, the formation outcrops in a belt five to ten miles wide, striking north and south. Samples from this belt were obtained in locality N. In W. ½, N. W. ¼, Tarrant County, Walnut outcrops predominate, forming the area described as locality X. The Walnut in the extreme western part of Johnson County is described as locality V. The

wide fertile valleys along the Lampasas River and its tributaries in western Bell County are in the Walnut formation.

Thickness. The formation varies in thickness from a few feet at the Red River to over a maximum of 100 feet in Tarrant County and then again thins southward, being only 15 feet at Austin, and completely vanishing farther south. In general, the Walnut formation is a series of sands, clays, marls and non-chalky limestones.

Lithology. The character of the formation changes greatly within the limits of the area studied. In North Texas, it is marked by a thick conglomerate of shells of the fossil oyster, Gryphea marcoui, Hill and Vaugh, the shell layer attaining a thickness of 16 to 18 feet. Sands, sandstone ledges and clay seams, all barren of fossils, underly the shell conglomerate. Further south, thin compact layers of limestone are noted, underlain by marly white and buff limestone carrying few fossils.

Stratigraphic relations. In North Texas the Walnut rests on the Paluxy sands, the parting between the sands of lower Walnut and upper Paluxy being nearly indistinguishable. Farther south, the Paluxy is absent and the Walnut lies directly on the Glenn Rose limestone, the contact being quite conspicuous. In North Texas the upper contact is well defined, the change from the shell conglomerate to the Goodland limestone being unmistakable, but in areas south of the Brazos, the shell conglomerate lenses out and the nodular impure limestone, the limy marl and the clays of the Walnut grade into the overlying Comanche Peak with no sharp line of demarcation between them.

Paleontology. The most outstanding fossil of the Walnut formation is Gryphea marcoui, Hill and Vaughn. Many other fossils are listed by various writers, but the more abundant ones noted by the present writer include the following:

Gryphea marcoui, Hill and Vaughn

Cyprimeria texana (Roemer)

Exogyra texana Roemer

GOODLAND FORMATION.

Name. The Goodland limestone was named by Hill[1] from the town of Goodland, Choctaw County,

1. Hill, R. T., The Comanche Series of the Texas-Arkansas Region, Geological Society of America, Vol. 2, 1891, pp. 502-514.

Oklahoma, where it is well exposed. The name Goodland is applied to the upper part of the Fredericksburg in all areas north of the Brazos River.

Distribution. Within the area studied, the Goodland was noted in the western half of Cooke County; in the extreme northwest corner of Denton county and along the Denton-Wise County line; in the west portion of Tarrant County, and in the southwestern corner of Johnson County.

Thickness. The Goodland is 20 to 30 feet thick in Cooke County and thickens southward to 117 feet at Fort Worth. Farther south, near the Brazos River it is nearly 140 feet thick.

Stratigraphic relations. The Goodland is easily distinguished from the overlying brown marl and limestone of the Kiamitia. The basal limestone contains some marl, yet the contact with the underlying Walnut shell conglomerate is sharp.

Paleontology. The more common fossils noticed and collected by the writer include:

Hemiaster whitei Clark

Enallaster texanus (Roemer)

Schloenbachia acutocarinata (Shumard)

Pecten irregularis Bose

Parasmilia

Lima waccoensis Roemer

Tylostoma sp.

A typical section of Goodland is exposed just north of the east end of the dam at Lake Worth, Fort Worth, Texas. This section, with its characteristic fossil sequence follows.

LAKE WORTH SECTION OF THE FREDERICKSBURG DIVISION[1]

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1. Winton, W. M., and Adkins, W. S., The Geology of Tarrant County; University of Texas Bulletin No. 1931, 1919, p. 29.

	Feet	Inches
Duck Creek Limestone	40	
(The lower two feet of this limestone is the Hamites ledge.)		
Kiamitia marl: Brown marl containing Gryphea navia and Exogyra plexa, forming grassy slope above cliff	31	6
Fredricksburg Division:		
9. Chalky limestone, sparsely fossiliferous	26	9
This contains the following strata:		
9h. Massive limestone in 4 layers	6 ft.	
9g. Marly fragmented limestone ..	8	

9f. Blue marl 1

9e. Three marl layers interbedded with thin limestone layers.....3

9d. Fragmented limestone....4

9c. Blue marl with 2 limy layers.....2

9b. Chalky limestone. Echinoid zone.....2

9a. Blue marl.....0.75

These strata are rather barren in the upper 16 feet but contain especially in the lower part; Hemiaster whitei, Enallaster texanus, Diplopodia taffi, S. acutocarinata, Cinulia, Schloenbachia sp. aff. belknapi, Lima, Pecten irregularis, Gryphea marcoui, Exogyra texana, Pinna sp. aff. comanchesanus, Cyprimeria, Lunatia, Parasmilia, Trochosmilia and many other fossils.

8. Massive chalky limestone 5 3

This massive and distinct band contains Hemiaster whitei, Lima waccensis, Lima sp. Enallaster texanus, Pecten subalpina, P. irregularis, Exogyra texana, E. plexa, Engenoceras, Schloenbachia acutocarinata, S. sp. aff. belknapi, Tylostoma sp.

7. Blue calcareous marl..... 5 6

This distinct marl band is conspicuous and contains: Turritella, Pholadomya, Lima, Trigonia, Cyprimeria, Exogyra plexa, Enallaster texanus.

6. Massive chalky limestone 13 0

Hemiaster whitei, Hemiaster sp. Gryphea marcoui, Lima waccensis, Schloenbachia acutocarinata, sheets of celestite.

5. Blue marl 7 0

Hemiaster, Lima, Pecten irregularis, Enallaster texanus and many other fossils.

4. Chalky limestone	10	0
The bottom of this layer is about at the level of the approach to the dam.		
3. Massive impure fragmented chalky limestone, marly at the base	43	0
2. Massive chalky limestone overlying the walnut shell conglomerate and seen in the channel below the dam.....	5	0
Total.....	117	0
1. Walnut Conglomerate: Massive blue gray shell conglomerate composed mainly of Gryphea marcoui shells.....	5	0

COMANCHE PEAK FORMATION.

Name. South of the Brazos River the Goodland is divided into two parts. Hill called the lower part the Comanche Peak and the upper part the Edwards. The type section from Comanche Peak Butte, Hood County, is included in the description of locality K.

Distribution. The Comanche Peak formation is exposed in the extreme northwestern part of McLennan County along the Middle Bosque River and its largest tributary, Bluff Creek. Throughout the western half of Bell County, the Comanche Peak is exposed on steep hillsides where it is overlain by the hard Edwards cap rock, and underlain by the soft Walnut clay which occurs in the valleys.

Thickness. Near the Brazos River, the formation is approximately 65 feet thick. Farther south the lithology becomes similar to that of the overlying Edwards and few attempts have been made to measure the thickness of the Comanche Peak as a separate formation.

Lithology. The Comanche Peak of McLennan County differs slightly from the Goodland of Tarrant County. The chief difference is the increase in purity of the Comanche Peak limestone farther south. Still farther south, in Bell County, the Comanche Peak limestone is more nodular and firm, with less marl. The bedding is very poor, causing difficulty in distinguishing it from the underlying poorly bedded Walnut formation.

Stratigraphic relations. The Comanche Peak grades so completely into the Walnut that the only distinction is the greater proportion of marl in the latter formation. The Comanche Peak in most localities is distinguished from the overlying Edwards limestone by its fossils, its flinty nodules and its tendency to form in more massive beds.

Paleontology. The most common fossils include the following:

Hemiaster Whitei Clark

Enallaster texanus (Roemer)

Schloenbachia acutocarinata (Shumard)

Protocardia texana (Conrad)

EDWARDS FORMATION

Name. The formation, earlier named Barton Creek limestone by Hill was called Edwards by Hill and Vaughn[1] in 1898. The type locality is the Canyons of the Nueces, Edwards County, Texas.[2]

1. Hill, R. T., and Vaughn, T. W., U. S. G. S., Folio 42 (Nueces), 1898.

2. Hill, R. T. and Vaughn, T. W., Canyons of the Nueces, Edwards County, Texas; U. S. G. S., 18th Annual Report, Part II, p. 234.

Distribution. Within the limits of the area studied, the Edwards formation forms the cap rock in the northwestern part of McLennan County and the western part of Bell County. Another outcrop occurs in the north half of Bexas County.

Thickness. Near the Brazos River, this formation is only 40 feet thick, but it gradually thickens southward to over 600 feet at the Rio Grande, and it is still thicker in Mexico.

Lithology. The Edwards limestone, although thin, is largely a firm, ringing limestone, so resistant to erosion that it caps the hills and divides and forms overhanging bluffs. In McLennan County, Adkins[1] says, "Along Bluff Creek and elsewhere, the stream is deeply intrenched in a canyon with vertical walls, cut through a flat Edwards plain, and the topography has every aspect of the entrenched streams in the Edwards canyon region near Del Rio and in Trans Pecos Texas."

1. Adkins, W. S., Geology and Mineral Resources of McLennan County; Univ. of Texas Bulletin No. 2340, 1923, p. 33.

Near China Springs, in McLennan County, Adkins[2] describes the uppermost Edwards as "Almost pure calcium carbonate and consists of a twisted mass of Ichthyosarcolites, Requienia, Chondronta munseni (Hill), and numerous other fossils. These fossils occur in vast numbers and make up the bulk of the upper strata of the Edwards. The

2. Idem.

horizon in this region can be traced over the entire Edwards outcrop."

In a very recent publication describing the geology of Bell County[1], Adkins and Arick describe three common phases of lithology of the Edwards:

(1) A dense, ringing limestone with few fossils, but having soft layers containing rudistids in close proximity to it.

(2) "A shell coquina of rudistids, caprinids, pelecypods, gastropods, corals and other fossils cemented into a perous or cavernous mass of shell agglomerate and debris. This rock is a part of the rudistid reef facies. At some localities the rock is entirely calcareous; at others the fossils are partly silicified and the matrix only slightly so. Upon weathering the fossils become disengaged. This rock generally bears considerable iron oxids, and weathers to a dark

1. Adkins, W. S., and Arick, M. B., Geology of Bell County, Texas; Univ. of Texas Bulletin No. 3016, 1930, p. 338.

red color."

(3) The type "excellently exposed at the Santa Fe quarry three miles northwest of Belton, is a coquina of comminuted shell fragments (with some entire shells) of the rudistid reef facies. It is a white or bluish-gray, entirely crystalline, soft, calcareous deposite, with a composition of 3 percent or less of silica and the rest practically pure rudistids (Eoradiolites and others), caprinids, corals, gastropods, pelecypods, bryozoa, worms, and other groups."

Stratigraphic relations. The top of the Edwards in Bell County is marked by well-bedded, thin, hard limestone, but beneath the top are some layers of softer, marly or nodular limestone with abundant rudistids. These soft breaks correspond in stratigraphic position to the "adobe" at the top of the Edwards at Luling and elsewhere in the coastal region. The Edwards is conformable with the formations overlying and underlying it in all parts of the area studied except in Bexar County, where the Kiamitia is missing and the Duck Creek lies unconformably on the Edwards.

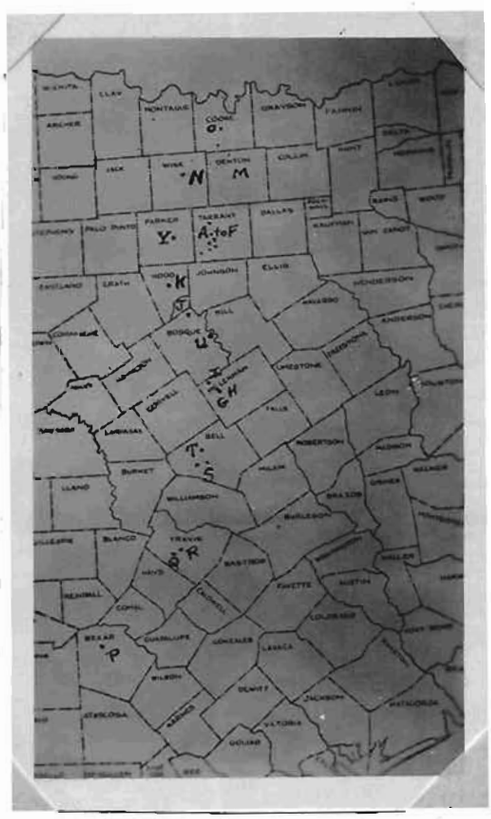

Figure 3. Map showing localities from which samples were taken. Letters represent localities and correspond with description.

DESCRIPTION OF LOCALITIES.

All localities are located in those Texas counties which are shaded in the map, Figure 2. To facilitate comparisons, localities in the same county are grouped together. The alphabtical order in which the localities were studied.

LOCALITY A. (Tarrant County)

The extention of Byers Avenue in west Fort Worth leads to the Westover Hills Subdivision. When developed, the location will be about 5600-5800 West Byers Avenue. At present a splendid section of the Lower Duck Creek limestone, all of the Kiamitia marls and shales, and the upper one half of the Goodland are exposed in a hillside along the north side of the road.

Twelve samples of Goodland were taken between the culvert at the foot of the hill and the Goodland-Kiamitia contact. Figures 4, 5, 6, and 7 show the position of these samples in the section.

Figure 4. Lowest exposure of Goodland limestone, Locality A, Tarrant County.

Figure 5. Lower exposure of Goodland, Locality A, Tarrant County. Sample 3 yielded G. walnutensis . Numbers correspond to samples from the section. Note the typical alteration of limestone and marl.

Figure 6. Contact of Goodland limestone with the Kiamitia marl, Locality A, Tarrant County. Numbers correspond to samples described from this locality.

Figure 7. Goodland limestone, Locality A, Tarrant County. The middle part of the exposure is shown here. Numbers correspond to samples from this section.

Orbitolina walnutensis Carsey were abundant in sample 2. They were exceeding small, averaging about 0.4 mm. in diameter, but most of them were perfect specimens. Sample No. 2 was taken from the massive limestone and the calcareous marl above it, about thirty feet from the Goodland-Kiamitia contact. Only the limestone contained the fossils.

LOCALITY B. (Tarrant County)

Along Crestline Road, north of the intersection of Byers Avenue and Crestline Road, the Lower Duck Creek, all of the Kiamitia and the upper part of the Goodland are exposed in the road cut. This section is equivalent to that of Locality A, which is one fourth mile west. No more than the upper one fifth of the Goodland is exposed, (Figures 8 and 9). Seven samples of both the limestone and marl failed to yield and O. walnutensis.

LOCALITY C. (Tarrant County).

Upper Goodland is exposed in a deep railroad cut one and three miles west of the new Texas and

Figure 8. Goodland limestone, exposure nearly covered by float. Locality B, Tarrant County. Samples barren.

Figure 9. Goodland limestone, near top. Locality B, Tarrant County. Approximately the same level as seen in Figure 6. Samples barren.

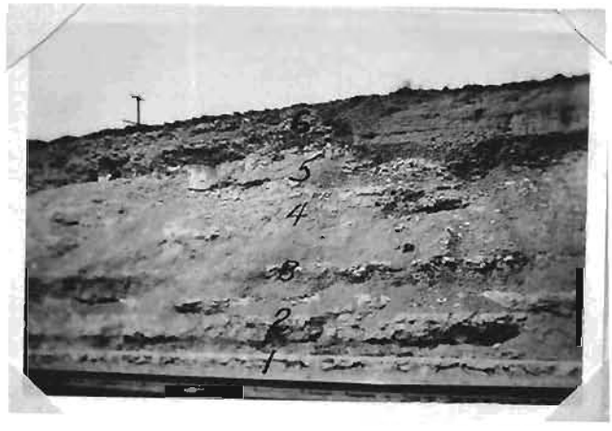

Figure 10. Goodland limestone, near top, as seen in Locality C, Tarrant County. Numbers correspond to samples from this section. O. walnutensis found in upper limestone, sample 5, as shown.

Figure 11. Goodland limestone, same as that of Figure 10, but a few hundred feet distant.

Pacific shops, Fort Worth. This exposure occurs on the north side of the railroad, within fifty yards of the "Stove Foundry Road". Six samples were taken as shown in Figures 10 and 11. Orbitolinae were found in sample No. 5 from the upper 20 feet of the Goodland. The foraminifera were very small, ranging from 0.3 to 0.5 millimeters in diameter.

Sample 181

LOCALITY D. (Tarrant County).

This place, locally known as "Cragin Knobs", is on the "Stove Foundry Road" three miles west of the new Texas and Pacific Railroad shops at Fort Worth. It is the type locality for Flabellammina alexandri Cushman, and is described by Alexander[1] as follows:

"'The Knobs' are two low, rounded hills on the north side of the road and are truncated by the road cut. Limestone ledges alternate with

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1. Alexander, C. I., Ostracods of the Cretaceous of North Central Texas; Univ. of Texas Bulletin, No. 2907, 1929, p. 17.

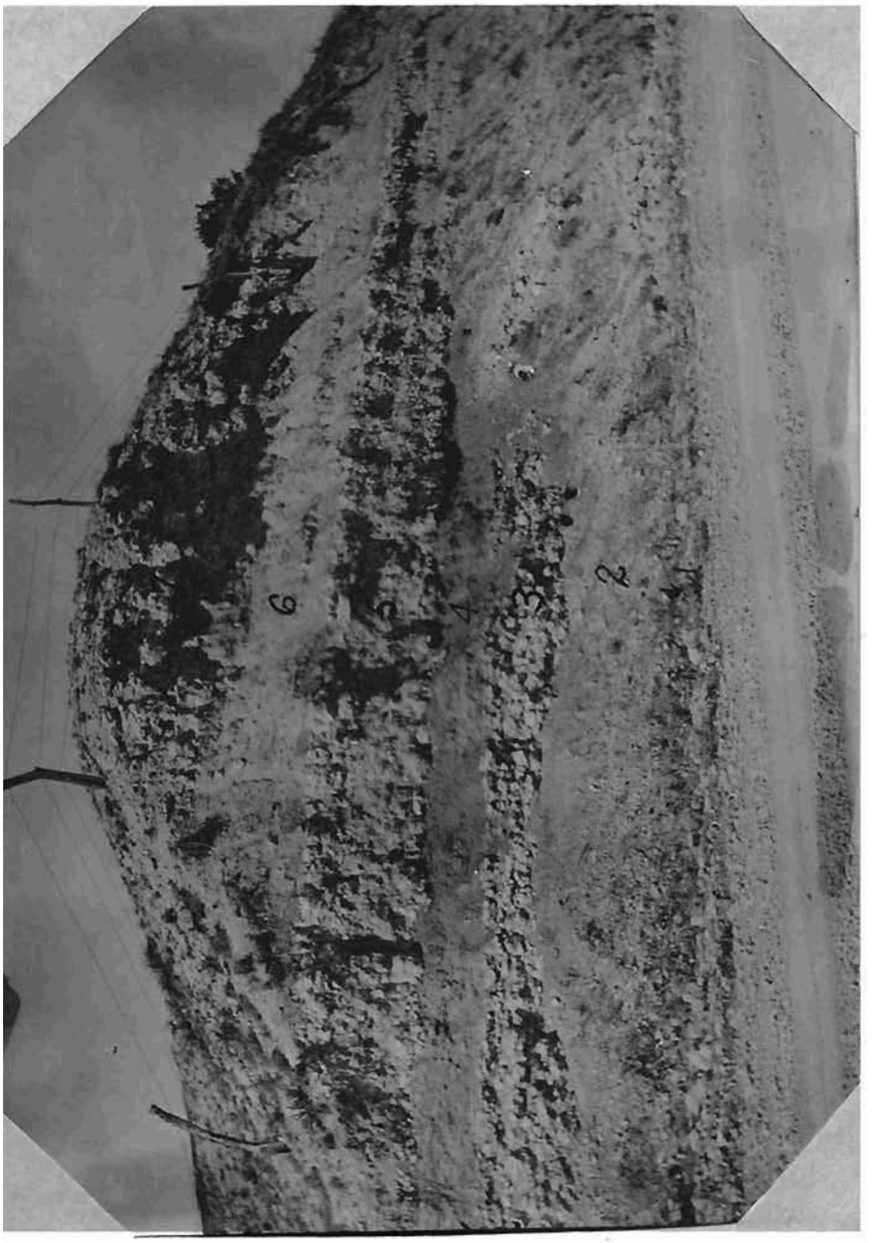

Figure 12. Upper Goodland, as seen at " Cragin Knobs ",Locality D,Tarrant County. Both the upper limestone and the next lower limestone yielded O. walnutensis abundantly. Numbers correspond to samples.

thick marl seams." Six samples were taken as shown in Figure 12. Sample 5 yield several Orbitolinae and sample 7 yielded many of the same foraminifer. Again, the thick marl seam, sample 6, did not contain the desired fossil. This section occurs in the upper thirty five feet of the Goodland, sample 7 having been obtained about fifteen feet from the top of the Goodland.

LOCALITY E. (Tarrant County).

One fourth mile north of the intersection of White Settlement Road and Seventh Street-Lake Road, Farmers Creek intersects the latter road. Due to undercutting, the south bank of the creek exposes a 15 foot section of Goodland, including marls, shales and some limestone. This section is shown in Figure 14. Four samples were taken here, chiefly to test the occurrence of Orbitolina walnutensis Carsey in clays and marls. However, it was not found in either the limestone or the softer material.

LOCALITY F. (Tarrant County).

Just north of the east end of the Lake Worth dam is an abandoned quarry in which is exposed all

Figure 13. " Cragin Knobs ",Locality D,Tarrant County. Goodland-Kiamitia contact indicated by arrow.

Figure 14. Goodland,chiefly marl,as seen in Locality E,Tarrant County.

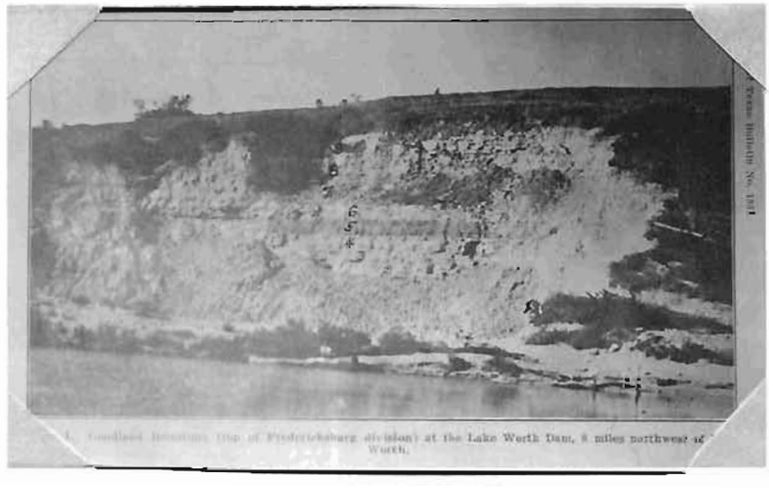

Figure 15. Goodland limestone, Locality F, Tarrant County. Copied from Univ. of Texas Bulletin No. 1931. Numbers correspond to samples taken from this section.

But the lower part of the Goodland formation, the Kiamitia, and the lower part of the Duck Creek. This section is described in detail by Winton and Adkins [1] Nine samples were taken at this local-

1. Winton, W. M. and Adkins, W. S., The Geology of Tarrant County; Univ. of Texas Bulletin, No. 1931, 1919, p. 29.

ity as shown in Figure 15. Only sample 9 from the uppermost six feet of limestone yielded Orbitolina walnutensis Carsey. These were very small, about 0.3 mm. in diameter. Since the upper ledge was productive, a check series of samples of the overlying Kiamitia marl was taken to determine the presence of the foraminifer in the younger formation. None was found.

LOCALITY L. (Tarrant County).

Less than one fourth mile south of Locality F, at Lake Worth, a second series of samples was taken. A foot path from the south picnic pavillion leads down the hill, reaching the bottom a few hundred yards below the dam. Samples of limestone

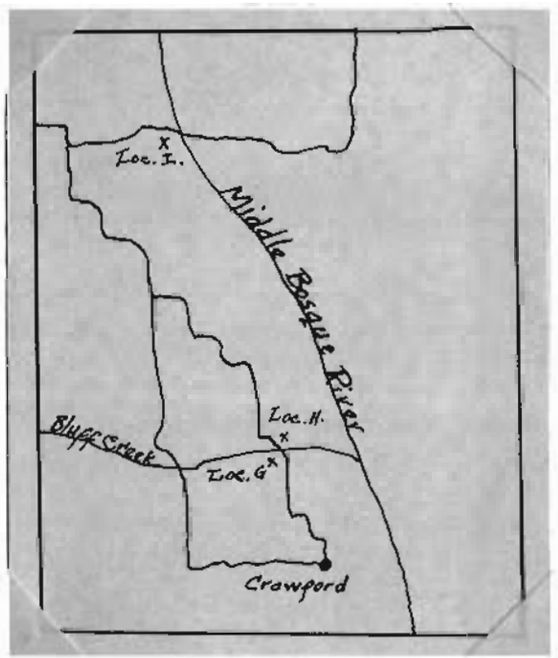

Figure 16. Sketch map, showing Localities G, H and I in McLennan County.

Figure 17. Edwards and Comanche Peak, northwest of Crawford, Texas. Edwards forms the upper overhanging ledge which protects the softer underlying Comanche Peak. Typical topography of the Edwards plateau region. Illustration copied from Univ. of Texas Bulletin No. 2340.

were taken from the ledges along this path. These were not representative of the complete section, since no samples of marl were taken, but by this time the restriction of Orbitolina walnutensis Carsey to the limestone, in this area, had been established.

The results are in agreement with those obtained at the nearby locality F, Orbitolina walnutensis Carsey being found only in the upper sample (5½ ft.) of the Goodland. Samples of the Walnut shell conglomerate taken from the Trinity River bed below the dam failed to yield the desired foraminifer.

LOCALITY G. (McLennan County)

A typical exposure of the Edwards and Comanche Peak is found at the west crossing of Bluff Creek, three and one half miles northwest of Crawford, Texas. This locality is described and figured by Adkins[1] and Figures 16 and 17 are from this

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1. Adkins, W. S., Geology and Mineral Resources of McLennan County; Univ. of Texas Bulletin No. 2340, 1923, p. 35.

publication. Figure 17 shows the characteristics of the hard Edwards cap rock and the softer receding Comanche Peak. Samples were taken from the next road crossing downstream from the place shown. Eight nearly equally spaced samples were taken from hill crest to water level in the creek at the foot of the hill. The upper 15 feet of rather hard, crystalline, massive limestone was barren. The next 15 feet, represented by samples 6 and 5, contained many Orbitolina walnutensis Carsey. They were so abundant that over 100 were picked from a sample of less than 15 grams.

Continuing down the section, samples 4 and 3 were taken from softer, white limestone and the last two samples, 2 and 1, from bridge level to water level, were composed of massive nodular limestone. These lower four samples contained many O. walnutensis ranging from under 0.2 to 0.5 mm. in diameter. None of the larger ones were found in these four lower samples. These small foraminifera were in every way similar to

those of the Fort Worth area. Nearly 50 feet of the 60 feet in the section contained Orbitolina walnutensis Carsey.

LOCALITY H. (McLennan County).

A series of samples were taken from the north side of Bluff Creek to check results of Locality G. The section was not as complete as that of the previous locality but the same sequence of occurrence of Orbitolina walnutensis Carsey were found. Again the lower portion contained the O. walnutensis of smaller diameter, the middle part contained the larger ones and the two upper samples were devoid of O. walnutensis. See Figure 16 for the location of this locality.. The intermediate sizes would probably have been found if a more complete set of screens had been available.

LOCALITY I. (McLennan County)

In the extreme northwest part of McLennan County, west of Valley Mills, on the west bank of the Middle Bosque River, recent blasting for a road has exposed an 85 foot section of Fredericksburg. This section was measured by a hand level and each of the

15 samples taken represents about five and one half feet. Description of the samples is shown in the following:

Sample No.

15, 14, 13 upper strata, rather hard, coarsely crystalline, white limestone. Barren.

12 Limestone, many small cavities. O. walnutensis to 1.3 mm. diameter.

11 Limestone. O. walnutensis 0.8 to 1.2 mm. diameter.

10 White limestone. Many O. walnutensis 0.6 to 1.2 mm. diameter.

9 White limestone. O. walnutensis 0.8 to 1.1 mm. diameter.

8 Limestone. O. walnutensis very abundant, 0.4 to 1.8 mm. diameter. Hand samples show many of them to the naked eye.

7 Very soft limestone. O. walnutensis found, but all specimens were very small. Hand samples show sections of larger foraminifera and conical cavities from which the foraminifera have been expelled

by the breaking of the rock. The larger specimens were too soft to hold together during the screening and thus were not found in the washed sample. This sample appears in the section as a soft "break" between two hard limestone layers.

6. Hard limestone. Many O. walnutensis 0.6 to 1.1 mm. diameter. Hand samples show both whole and broken specimens on the fractured face.

5. Softer limestone, with small cavities. O. walnutensis up to 1.3 mm. diameter.

4 White compact limestone, fragments of the O. walnutensis.

3 Hard, coarsely crystalline limestone, much calcite, containing splendid specimens of 1 mm. diameter.

2,1 Dense, white limestone of the lower part of the section. Repeated checking proved these samples to be barren.

This section resembles the previously described typical Bluff Creek section. Both Comanche Peak and

Edwards are mapped at this place. Orbitolina walnutensis Carsey are found in all samples from 3 through 15 as shown above, representing a vertical range of a little over 50 feet. However, this portion is in the middle of the section and is probably about equally divided between the Comanche Peak and the Edwards.

LOCALITY J. (Bosque County). Sample 187

Edwards, Comanche Peak and Walnut are exposed on a hillside east of the Walnut Springs-Glenn Rose road three and one half miles north of Walnut Springs. Massive hard Edwards caps the ridge and O. walnutensis of 1 mm. diameter are found in the lower part of these ledges. Underlying this hard cap rock are soft layers which recede to such an extent that rock shelters and stalactites are found. Rudistids were found in one of these rock shelters. Samples of the soft limestone yielded Orbitolina walnutensis Carsey ranging from 0.5 to 1.2 mm. diameter. A sample

of Comanche Peak 15 feet lower yielded several O. walnutensis of medium size. Samples of the Walnut shell conglomerate exposed in a small creek bed nearby contained no O. walnutensis. Since much of the outcrop of the hillside was talus and soil covered, the interval between samples is irregular. The chief advantage of this locality is to check the area lying between the known points of occurrence in McLennan and Hood Counties.

LOCALITY K. (Hood County)

An outlier of Comanche Peak and Edwards forms a well known mark seven miles southwest of Granbury known as "Comanche Peak". This section as described by Hill[1] is given on the following page.

1. Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas; U. S. G. S., 21st Annual Report, 1899-1900, p. 204.

SECTION OF THE FREDERICKSBURG DIVISION OF THE COMANCHE SERIES FROM THE TOP OF COMANCHE PEAK (ALTITUDE 1,250 FEET) TO TOP OF PALUXY SANDS.

		Feet
Edwards limestone:		
7.	i. Hard, chalky limestone, character uniform throughout. Fossil Rudistes, occurring very irregularly. Forms cap rock of mountain.....	33
Comanche Peak beds:		
6.	h. Slightly softer, chalky limestone. More variable in hardness than the Edwards (Caprina), thus forming slopes.....	66
	g. Hard limestone, which carrys numerous small Gryphaea at the upper edge	3
	f. Friable, marly limestone, containing Gryphaea.....	8

	Feet
e. Ledge of hard limestone.....	1
d. Marly limestone, weathering easily; contains Gryphaea.....	5
c. Harder limestone layer.....	1
b. Marly lime, exhibiting chalky character in the upper portion.....	15
a. Flaggy limestone, containing Gryphaea.....	1
	133

Walnut Formation:

5. Arenaceous and argillaceous lime marl with layers of harder limestone:	
e. Argillaceous lime marl, grading downward into arenaceous laminated marl in the basal portion.....	20
d. Compact, argillaceous limestone...	2
c. Argillaceous lime marl with Gryphaea	3
b. Thin, compact limestone.....	1
a. White marly limestone.....	5
	31
4. Bedded Gryphea breccia.....	10
	41

On the surface, after long weathering, this rock appears as a yellow or light-buff friable marl. In fresh exposures it is a compact light-blue limestone with softer thin layers of marly lime intervening between the harder and thicker strata.

3. Yielding argillaceous lime marl, bearing numerous individuals of G. pitcheri 14

2. Marly and hard layers of limestone alternating:

g. Hard Gryphaea limestone..... 2

f. Marly lime on weathered surface. 4

e. Thin layer of compact limestone. 1

d. Marly limestone, friable on weathered surface..... 2

c. Limestone ledges with Gryphaea. 3

b. Marly limestone with many Gryphaea and Exogyra texana; weathers readily into soft material..... 4

a. Persistent layer of limestone...2

18

1. Arenaceous lime marls with Gryphaea...	15
	88

Samples were taken from the east side of the north ridge. A composite sample of the upper 30 feet (Edwards) yielded several O. walnutensis ranging from 0.5 to 1.3 mm. diameter. The second sample from the top, 30 to 40 feet down, contained the desired fossil of approximately the same size. Samples at regular intervals down through the Comanche Peak failed to yield any O. walnutensis. However, about 200 feet from the summit, in undoubted Walnut, a few small O. walnutensis were found.

LOCALITY M. (Denton County).

Cores furnished by the Lure Oil Co., Fort Worth, as follows:

Parker No. 1 from depths of 682 to 762 feet.

Caddell No. 1 from depths of 469 to 540 feet.

Neither the writer nor the staff of the Company laboratory found any Orbitolina walnutensis Carsey in these cores, although they were undoubtly from Goodland limestone.

LOCALITY N. (Wise County).

State highway No. 39 from Decatur to Krum

crosses the outcrop of the Walnut formation at about right angles. Many samples of this formation were taken from road cuts along this highway from Decatur, but no Q. walnutensis were found.

LOCALITY O. (Cooke County)

Goodland is exposed in the western part of the county along Elm Creek and its largest tributary, Dry Elm Creek. Samples were taken from the Goodland three miles east of Lindsay where the Lindsay-Myra road crosses Dry Elm Creek. Other samples of Goodland were obtained from its outcrop two miles west of Myra at the intersection of the road and Brushy Elm Creek. This section is given on the following page.

A series of samples were taken from the described section found below the bridge on Elm Creek, 2 miles south of Myra. These samples are believed to be representative of the Goodland of this area, but no Orbitolina walnutensis Carsey were found.

SECTION OF THE GOODLAND LIMESTONE BELOW BRIDGE ON ELM CREEK TWO MILES SOUTH OF MYRA COOKE COUNTY, TEXAS[1]

1. Bybee, H. P., and Bullard, F. M. The Geology of Cooke County, Texas. University of Texas Bulletin No. 2710, 1927, p. 16.

Kiamichi Clay (Kiamitia)

Goodland Limestone

	Feet	Inches
Hard massive limestone, white to gray, contains Cypritella sp., Gryphea sp., and Schloenbachia acutecarinata.....	6	0
Alternating beds of blue shale and salt gray limestone, which form terraces near the top of the Goodland.....	2	6
Massive, bluish-white, hard limestone--very fossiliferous.....	2	6
Blue shale.....	0	6
Massive limestone weathering into small angular fragments. Many large S. acutecarinata.....	4	6

	Feet	Inches
Soft yellow calcareous clay containing *Gryphaea* and small *Exogyra* resembling *E. plexa*..	0	1
Massive gray limestone weathering into angular fragments and some small *S. acutecarinata*.....	4	0
Blue shale and brown clay.....	0	6
Light gray limestone containing numerous shell fragments including *Gryphaea* and *Neithea*...	2	4
Yellow arenaceous irregular limestone. Few fossils.....	0	4
Hard, massive bluish-gray limestone, containing *echinoids*, *Gryphaea*, *Pecten*, *Turritella*.....	6	3
Gryphea agglomerate	0	1
Massive limestone weathering into large irregular fragments containing yellow spots on weathered surface. Many fossils...	2	3
White to blue sandy shale, few *Gryphaea*.....	0	10

Light yellow nodular limestone having large Pinna, Neithea, Gryphea, echinoids, Zyloetoma, and gastropods.....	2	6
Yellow argillaceous, nodular limestones having Gryphea and Turritella in great abundance; also contains Artica, echinoids, and a large Ostrea.....	2	0
Nodular blue sandy limestone resting directly upon blue-yellow (walnut) clay.....	0	10
Total.....	38	2

LOCALITY P. (Bexas County).

A few samples of Edwards were taken at Helotes and along the bluff on the south side of the road between Helotes and the Fredericksburg Road. This locality is mentioned by Sellards[1] in the Bexar

1. Sellards, E. H., The Geology and Mineral Resources of Bexar County; Univ. of Texas Bulletin, No. 1932, 1919, p. 27.

County report in the following statement. "The right bank of Helotes Creek below the Bandera Road crossing affords a good exposure of this (Edwards) formation. The Creek here follows on or near the main fault line separating the Glenn Rose and the Edwards formations."

Samples from the above mentioned bluff were taken, but no O. walnutensis were found.

LOCALITY Q. (Travis County).

Locality Q is about 12 miles west of Austin at what is locally known as Rob Roy Butte. This is one of the type localities of Orbitolina walnut-

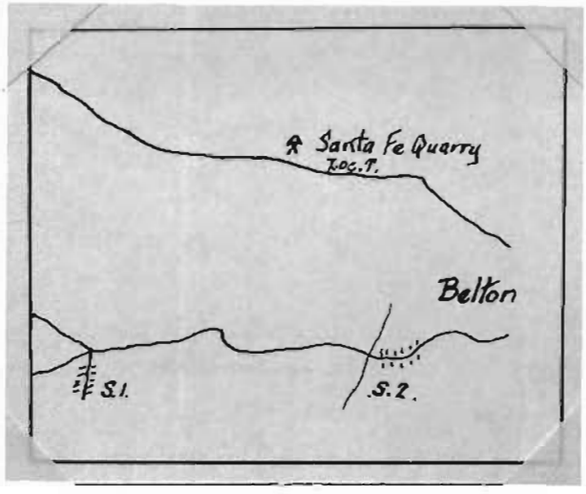

Figure 18. Sketch map, showing Localities S - 1 and S - 2, Bell County.

Figure 19. Locality J, showing Edwards capping the ridge.

ensis Carsey and as would be expected, these foraminifera are very abundant.

LOCALITY R. (Travis County).

This locality is on the west side of Mt. Barker, within two miles of Austin. Again, this is a type locality of the foraminifer Orbitolina walnutensis Carsey. It is very abundant, averaging about 1.3 mm. diameter. This and the previous locality were used since they are the type areas used by Carsey[1].

1. Carsey, Dorothy Ogden, Foraminifera of the Cretaceous of Central Texas; Univ. of Texas Bulletin, No. 2612, 1926, p. 19.

LOCALITY S. (Bell County).

Samples were taken from two separate sections, but they are within a short distance of each other and the results are the same, making it best to list them under a single locality.

No. 1 is on a north and south section line road, four miles west of Belton on the Nolanville Road. Walnut shell conglomerate is exposed in an un-named creek at the intersection of these

roads. Continuing south up the hill, Comanche Peak and Edwards outcrop, the Edwards capping the hill. The upper 15 feet of Edwards as exposed here was barren of O. walnutensis. These samples were taken from soft and flinty layers of Edwards. Continuing downward, Orbitolina walnutensis Carsey occurs throughout the next 50 feet of lower Edwards and upper hard nodular Comanche Peak limestone. Lower Comanche Peak and Walnut shell conglomerate were devoid of this species of foraminifer.

No. 2 is on the Belton-Nolanville road as shown in figure 21. Walnut is exposed in a small un-named creek. It is overlain by Comanche Peak with Edwards capping the hill. Again no O. walnutensis were noted in the Walnut , but they were found abundantly in upper Comanche Peak and Lower Edwards.

LOCALITY T. (Bell County).

This locality is in the Santa Fe quarry, three miles north west of Belton. The peculiar lithology of this facies of the Edwards is described by Adkins

and Arick in the bulletin on Bell County[1].

1. Adkins, W. S. and Arick, M. B., Geology of Bell County, Texas; Univ. of Texas Bulletin No. 3016, 1930, p. 35.

An extract of this description is found on page 32. It should be noted that an analysis of this rudistid reef facies shows a content of three percent or less of silica and the remainder practically pure calcium carbonate. O. walnutensis is found in all local phases. The foraminifera are large, some 3 mm. in diameter, having been dug from Santa Fe quarry wall with pen knife.

LOCALITY U. (Bosque-Hill County).

Limestone is exposed in the banks of the Brazos River near the bridge on the Hillsboro-Meridan road. This limestone resembles the Goodland of farther north. Samples from the crest of the west bluff yielded O. walnutensis abundantly.

LOCALITY V. (Johnson County).

Five miles west of Bono is a scarp locally known as "The Mountain". No Orbitolina walnutensis Carsey were found in samples of the Kiamitia or in samples of either upper or middle Goodland.

LOCALITY W - 1. (Sommervell County)

Just east of Bono, 10 samples of Walnut clays and shell conglomerate were taken but no O. walnutensis were found. The clay was sampled by channels.

LOCALITY W - 2. (Sommervell County).

On the Glenn Rose - Grenbury road, just north of Glenn Rose, samples were taken of the Glenn Rose formation. Since the Glenn Rose contains both Orbitolina texana Roemer and Orbitolina whitneyi Carsey[1], it was deemed advisable to investigate

1. Carsey, Dorothy Ogden, Foraminifera of the Cretaceous of Central Texas; Univ. of Texas Bulletin, No. 2612, 1926, p. 23.

the possibility of the occurence of Orbitolina walnutensis Carsey. However, none were found.

LOCALITY Y. (Parker County)

About five miles west of Weatherford on the Dennis road, samples of the upper Glenn Rose were taken. Again, no O. walnutensis were found. Since this locality, as well as the previous one, was devoid of the desired fossil and there is no record of any having been found in the Glenn Rose, it seems evident that this foraminifer did not live in Glenn Rose times.

LOCALITY X. (Tarrant County)

This locality consists of about 35 miscellaneous samples, a majority of which are of the Walnut as seen around the west side of Lake Worth and near Azle. Since Orbitolina walnutensis Carsey has not been found ~~north of~~ in Walnut the Brazos River, these samples were taken to make additional checks of the Walnut in the Tarrant County section. These samples were selected from as great a range as possible. None of them yielded the desired foraminifer. Samples of the Goodland from the section on Azle road, nine miles northwest of Fort Worth, contained Orbitolina walnutensis Carsey in the upper 10 feet of the

Figure 20. Walnut shell conglomerate as seen along the west side of Lake Worth, Tarrant County. No O. walnutensis found.

Figure 21. Walnut as seen at the 8 ½ mile post, west side of Lake Worth, Tarrant County. No O. walnutensis found .

Goodland, checking the findings in the Goodland at Lake Worth. Figures 20 and 21 show areas from the west side of Lake Worth where samples were taken.

SUMMARY AND CONCLUSIONS.

This paper has shown the stratigraphic and geographic range of the foraminifer, Orbitolina walnutensis Carsey. Samples from sections in thirteen counties in north and north central Texas have been studied. Many geologists have previously studied these sections in detail, correlated them and published the results.

A study of samples from these areas leads to the following conclusions:

(1) Within this area, as studied from the outcrops, the species Orbitolina walnutensis Carsey is limited to the Fredericksburg division of the Comanchean. In the southern part of the area it is in the lower Edwards, in the Comanche Peak and in the Walnut formation. In the northern part of the area it is found in the middle and upper Goodland.

(2) The fossil is widely distributed horizontally which makes it useful for general corre-

lation over wide areas.

(3) It occurs only in limestone, reaching maximum size in a soft limestone containing about ninety sever percent calcium carbonate.[1]

1. Adkins, W. S., Geology of McLennan County; Univ. of Texas Bulletin, No. 2340, 1923, p. 37.

The marl and clays between two fossiliferous limestones are barren.

(4) The occurrence is very spotty or irregular. The greatest development of O. walnutensis Carsey was found in localities in which the limestone is nearly pure. Since the Fredericksburg division contains many alternating limestones and clays, with O. walnutensis in the limestone only, this spotty occurrence is to be expected. The conditions of sedimentation producing clays, shales and marls were unfavorable for the development of the foraminifera Orbitolina walnutensis Carsey.

(5) Since O. walnutensis is easily recognized, and is small enough to be preserved by almost any kind of drilling and since it occurs over a wide

spread area with rather limited vertical range, it possesses the qualities of an index fossil for subsurface work. It has already proved useful along the Powell-Mexia fault line.[1]

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1. Thomas, N. L., Personal Conversation.

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