

THE RECURRENT BRACHIOPODS OF THE LOWER CRETACEOUS OF NORTHERN TEXAS.

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The Lower Cretaceous, or Comanchean, rocks of Texas and the Southwest contain brachiopods of the genus and species generally known as *Kingena wacoensis* (Roemer), which have been reported from practically all localities where the Washita strata, or their equivalents, are exposed. Locally at Austin, on the Colorado River, and to the south and west of this stream, they are confined to a comparatively narrow horizon near the middle of the Washita beds. North of the Colorado, and especially north of the Brazos where the strata are well developed and may be differentiated easily, they occur at several widely separated horizons. At three of these their abundance is particularly marked. This recurrence of the brachiopods in the northern part of the State, and their restricted range in Southern Texas, is accounted for by the varying conditions of sedimentation prevailing in the Washita Sea, which caused them to migrate to and fro with an oscillating strand line.

Most of the Washita strata, with the exception of some sand phases of the Pawpaw formation, consist of alternating beds of hard and soft calcareous material. Limestone ledges separated by marl beds are characteristic of the rocks throughout Northern Texas. The thickness of the individual strata varies from a few inches to many feet. The basal limestone is as much as sixty feet thick in Denton County, while the indurated layers of the Fort Worth formation in the same locality are only six to eight inches thick, and some of the marl seams have a thickness of an inch or less. Sudden changes in the character of the sediments are more numerous in the upper part of the Washita than near the base, and they are more characteristic of the Northern Texas area than of the central and western regions. The lower formations thin rapidly toward the south, while the upper portions of the series are thinner in Northern Texas and become thicker in their southward extensions. The thicker beds represent periods of unvarying marine conditions; the thinner, alternating layers of limestone and marl indicate periods of rapidly changing conditions. The shore line of the fluctuating sea in which these

sediments were deposited is interpreted as oscillating in a general southeast-northwest direction. Although elevation of the land to the northward may have been a contributing factor in bringing about the sudden alternations of the strata, it is believed that movements of the sea bottom and of the shore line were the chief causes of their variable character. These factors, through their influence on the marine environment, are considered as having affected notably the life and activities of the brachiopods, as well as the rest of the faunas, inhabiting the Washita Sea.

The origin of *Kingena wacoensis* and the means by which the forms reached the Lower Cretaceous sea of the Southwest are not known, and there is little information on which to base an hypothesis. They first appear quite suddenly in the lower part of the Duck Creek formation, or basal Washita, where they have been reported as occurring locally in Grayson and Tarrant Counties.¹ The first important horizon of abundant occurrence lies in a marl member of the upper part of this formation. The second is in the Denton formation, near the middle of the Washita column. The third and last zone, which is the most extensive, lies in the Main Street Limestone near the top of the Washita beds. The accompanying diagram, Fig. 1, shows the relationships of the various formations.

Kingena had no more than established the first colonies in the basal Duck Creek when a shifting of the sea floor caused it to move its habitat. The sea, formerly transgressive, turning back and slowly withdrawing toward the southeast forced a corresponding retreat of the brachiopods, whose abode necessarily was located at a favorable distance from the shore. This retreat continued until the locality of the first zone of abundance in the Duck Creek Marl was reached at Fort Worth. There ensued somewhat later a brief period of farther southward migration followed by a return to the Fort Worth locality in a zone a few feet higher in the marl. The important horizon of the Duck Creek is the lower one, occupying in the Fort Worth locality a soft limestone layer about twenty-five feet above the base of the formation. This extremely prolific zone has its greatest concentration in the southwestern part of the city near the campus of Texas Christian University. The area of abundant occurrence may be limited by a circle of about six miles radius, with its center

¹Winton, W. M., Univ. of Texas, Bureau of Economic Geology, Bull. 1931, p. 45, and Bull. 2544, p. 54.

at the University campus, where the concentration is greatest. The numbers decrease gradually as the periphery is approached, but the horizon may be recognized wherever the Duck Creek Marl is exposed.

The uncertainties of the stage marked by the overlying Fort Worth formation caused the brachiopods again to resume migration. While they sought a favorable environment farther removed from the disturbances of the northern border of the sea numerous temporary stands were established, as the scattered occurrences of the forms ranging through the

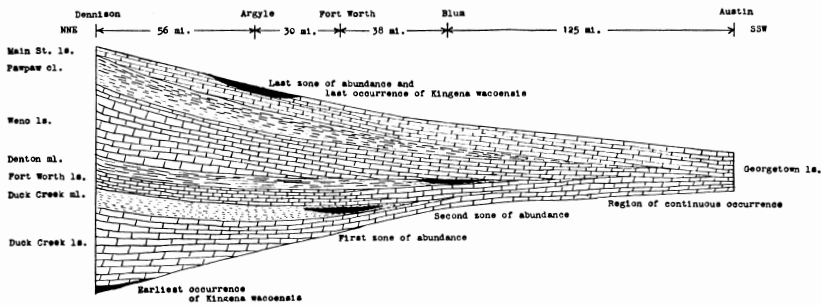


Fig. 1. Diagram showing convergence of strata and migrations of the brachiopod *Kingena wacoensis*.

Fort Worth Limestone in Johnson County indicate, but not until a brief static period in late Denton time were they able again to establish a colony of any considerable proportions. This colony is represented by a zone of abundance near Blum in northern Hill County. During this favorable period *Kingena* developed some individuals of large size and became very numerous. They are not of widespread occurrence here; for this zone of unusual abundance is limited by a circle approximately ten miles in diameter, outside of which the brachiopods are exceedingly rare. As in the Duck Creek zone there is a gradual decrease in numbers as the extremities are approached. The occurrence of a very few forms some distance below the top of the formation at an outcrop near the southern boundary of Hill County adds to the evidence that here the brachiopods range upward from the Duck Creek to their later habitat at the top of the Denton formation.

After they had experienced their unusual development in the Denton, another general change in environmental conditions instituted a third period of unrest during which the *Kingena*

ranged through the Weno and Pawpaw formations of North-Central Texas into the Main Street Sea. During this time the waters of the Washita Sea probably reached their greatest extent, and the ensuing favorable environment in Northern Texas was extremely conducive to the development of the brachiopods. That this was true is indicated by the large size of the shells, by their great abundance, and by their widespread occurrence in the Main Street Limestone and its equivalents of the Southwest. At this horizon the brachiopods are concentrated in definite zones of abundance just as they are at each of their earlier habitats. The best known zone of concentration is in southern Denton County. Here again the limits are marked roughly by a circle, in this instance having a radius of about five miles, with its center at Argyle, a station on the Texas and Pacific Railroad thirty miles north of Fort Worth. Here *Kingena wacoensis* flourished so vigorously that the forms are very closely distributed throughout an entire layer of limestone two feet thick. The indications are that the brachiopods reached the climax of their development at this time, and then died out, disappearing from the Cretaceous rocks as suddenly as they first made their appearance in the basal part of the Duck Creek Limestone.

While the brachiopods of Northern Texas were experiencing the vicissitudes of a variable environment, those in the region of Central and Southwestern Texas lived in a uniformly favorable habitat. Removed from the shore, as they were, their food supply must have been less copious, but it seems to have been sufficient to maintain a sparse population of the forms over a wide area for a long period of time. This is shown by their widespread occurrence south and west of the Colorado River in the Georgetown Limestone, which is equivalent in age to all the North Texas strata from Duck Creek through the Main Street.

Summing up, it may be seen that in Northern Texas the entire history of the brachiopods was marked by disturbing factors, with only three periods when they attained special importance. These are near the middle of the Duck Creek, late in the Denton, and late in the Main Street. Establishment of colonies at these horizons was favored by a good supply of food swept out from nearby shores, and clear-water conditions which prevailed for periods of some duration. To the southward, farther removed from the shores, where food was not

so plentiful and where the environment was more static, the forms were less abundant, but lived continuously throughout the time represented by the rocks from Duck Creek through Main Street in Northern Texas. Such a region was a source of stock for replenishing the northern colonies after unfavorable periods, or, as Winton has suggested, it served as a "reservoir." The proximity of the large brachiopod colonies to the shore made them susceptible to disturbances at every oscillation of the fluctuating Washita Sea, and, in an effort to remain continuously in a favorable environment, they were forced to migrate with the shifting strand line. As they moved backward and forward they locally ranged through successively younger formations. Habitats which were especially suitable are marked by zones of abundance in the Fort Worth locality, the locality near Blum, and at Argyle. At the close of Main Street time *Kingena wacoensis* disappeared entirely from the Cretaceous Sea of the Southwest, probably because the waters became too shallow and turbid for the continuance of a favorable environment. The migrations and their relationship to recurrence of the fossils, as interpreted in the light of the evidence set forth here, are shown diagrammatically in Fig. 1.

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