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EARLY CRETACEOUS MAMMALS FROM NORTHERN TEXAS

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ABSTRACT. A new triconodont, *Astroconodon denisoni,* based on lower jaws, and an undetermined mammal, represented by an incomplete humerus, are described from a locality in the upper part of the Trinity Sand, near Forestburg, Montague County, Texas. This is the first locality yielding Early Cretaceous mammals found in America and the second in the world. *Astroconodon* is more advanced than Late Jurassic triconodontines, particularly in the tongue and groove interlocking of the lower molars. The angle between the long axes of the proximal and distal ends of the undetermined humerus is considerably greater than in the Theria. The specimens were found, accompanied by numerous fragmentary remains of fishes, frogs and reptiles, in small pockets, believed to have been laid down under near-shore conditions. The occurrence is of early Albian age.

ONE of the pleasant features of paleontology is that so many of its discoveries are accidental. The exciting find here reported is of this sort, a totally unexpected by-product of a search for turtles that was planned with no expectation of finding a new and promising locality for Mesozoic mammals.

Prior to attending the Annual Meeting of The Geological Society of America at El Paso, Texas, in November of 1949, Dr. Rainer Zangerl and Dr. Robert H. Denison undertook a brief reconnaissance of some exposures in the Early Cretaceous Trinity Sand near the town of Forestburg in Montague (pronounced Mon-taig) County, Texas. Dr. Zangerl's interest had been aroused in this area as a possible source of Early Cretaceous turtles by Mr. Glen L. Evans, Assistant Director of the Texas Memorial Museum. Mr. Evans, in turn, had been informed of the possibilities of the region by Mr. Louis H. Bridwell, lepidopterist and entomological collector, of Forestburg. Drs. Zangerl and Denison, guided by Mr. Bridwell, were examining some exposures about two and a half miles from the town when they both noticed a concentration of small bone fragments on the surface. After a few minutes' search, Dr. Denison picked up the fragmentary lower jaw of a triconodont —the first Early Cretaceous mammal to be found in the New World. (The only other known Early Cretaceous mammalian occurrence is in the English Wealden, a formation which has yielded a few isolated teeth, all either multituberculate or indeterminate.) This specimen was brought on to El Paso, examined and determined under a binocular microscope and the discovery briefly reported on before The Society of Vertebrate Paleontology.

The incomplete humerus described below was also discovered during this first visit, but its mammalian affinities were not realized until it was re-examined in the laboratory.

Following the meetings, Drs. Zangerl and Denison, accompanied by Dr. and Mrs. George Gaylord Simpson and myself, returned to Forestburg for a stay of three days. During this time, a number of bone-bearing pockets were found, and Dr. Denison further distinguished himself by finding a second—and better—triconodont jaw. In addition to the mammals, the pockets yielded fragmentary remains of many vertebrates: small sharks, pycnodonts and various undetermined fishes; frogs; turtles; small lizards; crocodiles; carnosaur and ornithopod dinosaurs; and an occasional fragment of a pterosaur. Outside the pockets, fragmentary remains of ornithopod dinosaurs were encountered. Before leaving, some sacks of matrix were taken from the two pockets that had yielded the triconodont jaws. These were washed and sifted in the laboratory and the "concentrate" carefully sorted over. This patient toil resulted in the finding of numerous additional specimens of the forms just mentioned above.

A brief, preliminary note on the discovery by Zangerl and Denison, now in press, will have appeared by the time this article is in print. A program of co-operative field work in the Trinity Sand of northern Texas by the Texas Memorial Museum and the Chicago Natural History Museum will be carried out during the present year.

To all those persons mentioned above, to Mr. Vergil Greenwood, owner of the land on which the specimens were found, and to Mr. Douglas Tibbetts, who made the drawings, I wish to express my sincere thanks.

Order Triconodonta

Family Triconodontidae

Subfamily Triconodontinae

Astroconodon[1] gen. nov.

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[1] αδζήξ a star (lone) + ἀξη point + δούς tooth; named for the state in which it was found and with analogy to related forms. The trivial name is in honor of Dr. Robert H. Denison, discoverer of the specimens.

Type species: *A. denisoni*[1] sp. nov.

Distribution: Early Cretaceous, Texas.

Diagnosis: Differing from the Late Jurassic *Triconodon*, *Priacodon* and *Trioracodon* as follows: posterior cingulum cusp of P_4 larger, pointed and projecting posteriorly; posterior cingulum cusp of lower molars larger and higher; anterior cingulum cusp of lower molars completely incorporated in anterior groove; this structure better developed than in Jurassic forms, involving entire anterior face of tooth and extending down into anterior root; necks of cheek teeth cement covered, cement on molars forming posterior spur projecting into anterior groove of tooth following. Lower molars completely interlocking. Internal mandibular groove very faint.

Astroconodon denisoni sp. nov.

Type: CNHM no. PM 542, portion of right ramus with roots of penultimate premolar, incomplete last premolar, $M_{1\text{-}2}$, anterior root of M_3; a fully adult individual with well worn teeth.

Hypodigm: Type and CNHM no. PM 541, portion of left ramus with roots of last premolar, incomplete M_1, M_2, incomplete anterior alveolus of M_3; an old individual with deeply worn, somewhat abraded teeth.

Horizon: Exact position in rock and time uncertain, but occuring within the upper 100 feet of the Trinity Sand, and hence somewhere in the early Albian; discussion below.

Locality: Approximately 2½ miles southwest of Forestburg, Montague County, Texas.

Diagnosis: As for the genus. Size comparable to that of most Late Jurassic species; measurements below.

Since the two known specimens are old individuals with worn teeth, knowledge of the few teeth that are preserved is far from complete. Enough of the structure is shown to reveal that *Astroconodon* is distinct from and more advanced in some respects than any of the Jurassic species, but not enough to permit full comparison with the little-worn teeth that are known in these forms (Simpson 1925, 1928a, 1929).

MORPHOLOGY

The last premolar of the type is unfortunately broken through the middle, and the central main cusp (cusp b of Simpson 1925, protoconid of Butler 1939b) is almost entirely missing; no idea of the height of this tooth relative to the molars can be gained. It is slightly longer than M_1. There is a prominent anterior cingulum cusp (anterior cusp of Butler, 1939b), nearly worn away in the specimen, that stood free of the anterior slope of the main cusp and appears to have been larger than in any of the Jurassic forms. The posterior main cusp (posterior accessory cusp of author's, cusp C of Simpson, 1925) is heavily worn and was undoubtedly more distinct in earlier stages of wear. In its present state, it merely forms a convexity on the internal side of the posterior slope of the main cusp and is barely visible externally. The posterior cingulum cusp (posterior cusp of Butler, 1939b) is well developed and sharply pointed; it projects straight posteriorly well beyond the posterior root and toward the deep groove in the anterior face of M_1. A well defined and quite broad cingulum runs forward from the apex of the posterior cingulum cusp; in all probability, this reached to the anterior cingulum cusp, although breakage prevents certainty on this point. There is no trace of an external cingulum. The roots

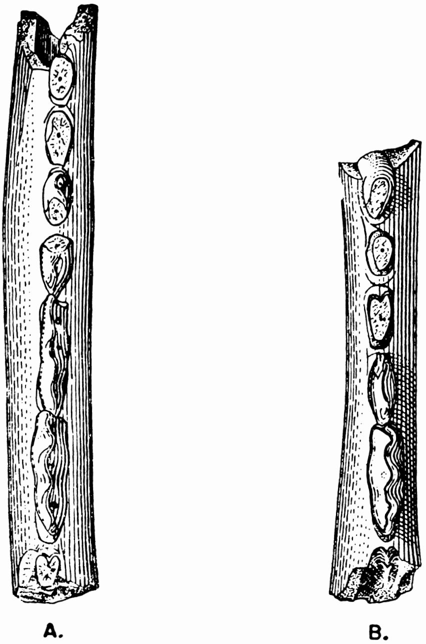

Fig. 1. *Astroconodon denisoni* gen. et sp. nov. Crown views of: A, type, CNHM no. PM 542; B, referred specimen, CNHM no. PM 541. X6.

are oval in section and somewhat longer than in the molars; those of the penultimate premolar indicate that this tooth was very nearly equal in size to the last of the series.

At least three molars were present, of which M_3 is represented by only the incomplete anterior root in the type and by part of the anterior alveolus in PM 541. As in the Jurassic triconodontines, $M_{1\text{-}2}$ are similar in structure, and M_2 is longer than M_1. M_2 is considerably wider than its predecessor. The labial margins of both teeth are in line, up until a very advanced stage of wear is reached (M_1 of PM 541), but the lingual margin of M_1 is inset relative to that of M_2. Both teeth are essentially even in width across the main cusps, *i.e.* for most of their lengths, but, due to the prominence of the posterior cingulum cusp, taper posteriorly to a greater extent than would appear to be the case in the Jurassic forms.

Crown structure is seen most clearly in M_2 of the type, the least worn tooth available. In common with the Jurassic forms, there are three main cusps arranged in an antero-posterior line; the central cusp may have been slightly larger and higher than the anterior (anterior accessory cusp of authors; cusp a of Simpson, 1925; paraconid of Butler, 1939b) and posterior, but the degree of wear prevents certainty on this point. Between these cusps, on the lingual side and no doubt originally on the labial, are well defined grooves that extend to and taper toward the base of the crown. The notch separating the central and posterior cusps is, in the present state of wear at least, rather deeper than that between the central and anterior. The posterior cingulum cusp is unfortunately damaged on this tooth and badly worn on the others, but it was evidently larger, perhaps higher and certainly produced farther posteriorly than in the Jurassic genera. The anterior cingulum cusp is incorporated into the anterior vertical groove. This remarkable structure, foreshadowed in Jurassic triconodontines (Simpson 1925, p. 150; 1928a, p. 81), is a deep channel occupying most of the anterior face of the tooth for its entire height. Beneath, it continues into the root as a V-shaped slot that received a sharp crest projecting from the anterior wall of the alveolus. The sides of the crown portion of the groove are formed by the antero-external part of the anterior main cusp labially, and by the anterior edge of this cusp, plus the anterior cingulum cusp, lingually. The reasons for believing that the anterior cingulum cusp participated here are that the lingual side of the groove is larger and extends farther anteriorly than the labial and that the internal cingulum runs forward to a point where a cingulum cusp is known to occur in some Jurassic triconodontines (Simpson 1925, p. 150; Butler 1939b, fig. 8d). The posterior end of each molar crown forms a tongue that fits snugly into the groove of the tooth following and this is also true of the extra-alveolar part of the posterior root, as pointed out below. The entire molar series thus forms a single, interlocked, uninterrupted cutting edge. Although the anterior groove of M_1 is as perfectly formed as that of M_2, the posterior portion of the last premolar is by no means completely adjusted to it, and there is no indication that this lack of good fit has been brought about by post-mortem displacement. This is a point of some general interest, and will be discussed further in the succeeding section.

The labial face of the tooth under description is heavily worn, nearly plane anteriorly and slightly concave behind the central cusp, where it was in occlusion with the anterior part of M^2. The cutting edge, which of course follows the notches between the main cusps, is decidedly sinuous; as shown by the other available teeth, this edge becomes straighter as wear proceeds and the notches are progressively eliminated. Due to the type of occlusion in triconodonts, the edge is maintained throughout practically the entire life of the tooth. Small pits on the sides of the main cusps on this face mark where wear has reached the pulp cavity with resulting deposition of secondary dentine (fig. 2c).

There is no trace of an external cingulum. The internal cingulum is rounded rather than sharp, fairly straight for most of its length but turning up abruptly toward the posterior end of the tooth to terminate at the cutting edge in the posterior cingulum cusp.

The roots of the molars, particularly the anterior ones of each tooth, differ considerably from those of the premolars. The anterior is the shorter of the two and narrows to a blunt edge posteriorly; the anterior groove described above gives to the section a shape somewhat resembling that of a conventional heart. The posterior root is rounded anteriorly and tapers to a sharper edge posteriorly.

The extra-alveolar portion of the roots—the neck of the tooth—is heavily invested by cement in the molars, and to some extent in the premolars also. This is particularly well shown in the type, less so in the more abraded referred specimen. The

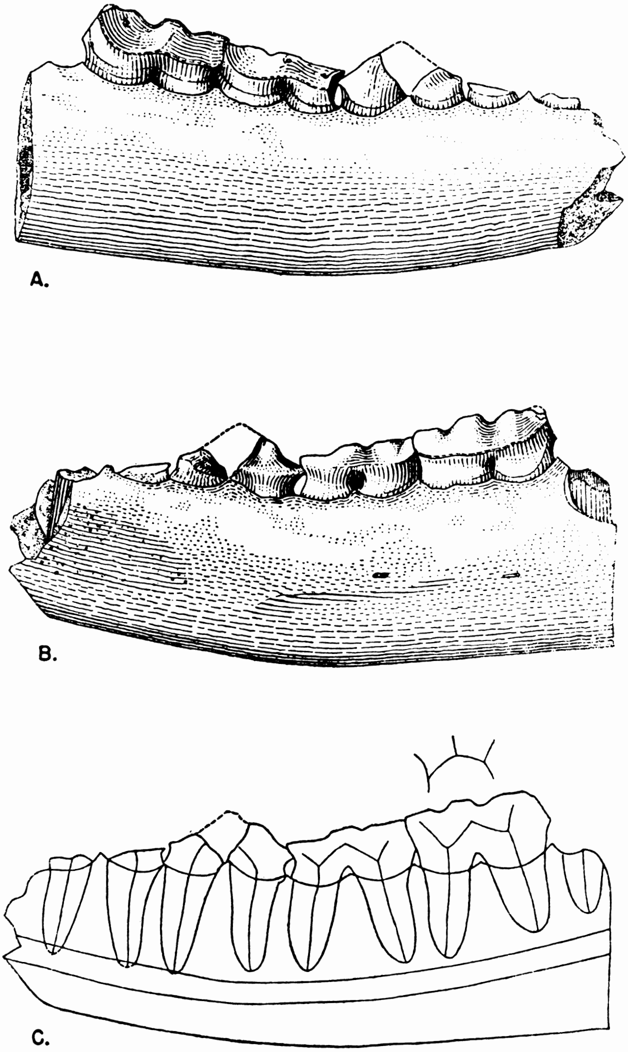

Fig. 2. *Astroconodon denisoni* gen. et sp. nov. A and B, external and internal views of type, CNHM no. PM 542. C, diagram based on X-ray of type showing roots, pulp cavities and mandibular canal; inset shows upper part of pulp cavity of M_2 of referred specimen. CNHM no. 541. Offsets in the roots at the alveolar border in C are due to the thickness of the extra-alveolar cement covering. X6.

cement on the molars fills the space between the roots, forms a shelf on either side beneath the enamel line and curves abruptly up posteriorly, where it forms a blunt, posteriorly projecting spur. This extraordinary structure, seen on both molars of the type, fits into the anterior groove of the tooth following, and is hence a part of the interlocking mechanism described above.

An X-ray of the two specimens reveals (fig. 2c) that the pulp cavity in each molar root goes up approximately to the enamel border, and there bifurcates to form a Y. The adjacent arms of each Y unite under the central main cusp, the other two going under the anterior and posterior main cusps. In the last premolar, although the details are not as clear as could be desired, there is apparently no bifurcation, only the union under the central cusp. The X-ray also reveals the relations of the roots to the large mandibular canal; anteriorly, due to the increasing shallowness of the ramus, the roots of the premolars pass down outside the canal, displacing it medially. In PM 541, the roots are somewhat longer than in the type, and there is a prolongation of the pulp cavity above the junction of the arms of the Y in M_2.

The ramus is stout compared to the widths of the teeth, and is, in the type at least, rather wider across the premolars than the molars. It becomes progressively shallower from M_1 forward, and the ventral border is gently curved, a point in which *Astroconodon* resembles *Priacodon* more than it does either of the other two triconodontine genera, to judge from published figures. There is no clear trace of an internal mandibular groove, the only possible indication of one being a wide, faint depression running forward from beneath M_3 to beneath the anterior end of M_2 in both specimens. Beneath the penultimate premolar and running forward, there is a rather flat, slightly roughened and pitted area that does not extend down to the ventral margin of the jaw. It is not at all clear what this area was; it could hardly have formed part of the symphysis. There is a small foramen on the internal side beneath the posterior root of M_1 about midway between the alveolar border and ventral margin, and another, slightly lower, beneath the posterior root of M_2; the anterior foramen of this pair, at least, is absent in the referred specimen. No mental foramen is present in either jaw; as in *Triconodon* and

Trioracodon, this opening, or openings, was more anterior in position.

Measurements in mm.

	PM 542, type	*PM 541*
L. penultimate premolar roots at alveolar level	2.58	——
L. last premolar crown	2.71	——
L. last premolar roots at alveolar level	2.59	2.28
L. M_1 crown	2.44	——
L. M_1 at alveolar level	2.37	2.35
W. M_1	.59	——
L. M_2 crown	2.80	2.41
L. M_2 roots at alveolar level	2.58	2.24
W. M_2	.78	.70
Depth of ramus below anterior end of last premolar	3.26	2.92
Depth below posterior end of M_2	3.80	3.74
Width of ramus across anterior end of last premolar	1.84	1.54

DISCUSSION

Astroconodon is clearly a member of the Triconodontinae, and equally clearly is distinct from the Jurassic members of the subfamily. It is unfortunately not now possible to go beyond these simple statements in a discussion of its affinities. Until something is known of the dental formula, or even of the structure of unworn cheek teeth, there will be no grounds for forming an opinion as to which of its known predecessors this form is most closely related. As Zangerl and Denison (in press) point out, *Astroconodon* extends the range of the Triconodonta from the Late Jurassic into the Early Cretaceous, a most welcome addition to our knowledge of the order.

One other, and very interesting, feature revealed by this latest triconodontine is that the group was by no means a static one, but underwent a considerable amount of change between the close of the Jurassic and the time of deposition of the upper part of the Trinity Sand. During this time, the evolution of the peculiar tongue and groove relationship of the molars must have gone on at a fairly rapid rate. This structure was certainly adaptive; every one of the diagnostic characters shown by the molars and last premolars is concerned in it. The reason for its development seems clear. The triconodontines, despite their great age, possessed, as Simpson (1933, p. 157) has remarked, one of the most perfectly carnivorous dentitions ever evolved. As he has further pointed out, the lower molars do not simply shear vertically past the uppers, but instead rake obliquely upward, inward and backward against them; great pressure must accordingly have been exerted on these teeth and a correspondingly great strain put upon the lowers. Movements of individual lower molars would certainly have impaired the efficiency of this mechanism. Wood's review and discussion of individual tooth movement and interaction of adjacent teeth (1938) demonstrates that such phenomena are more widespread in mammals than is perhaps generally realized. The insertion and close fit of the tongue formed by the posterior cingulum cusp and the cement spur of each *Astroconodon* molar in the anterior groove of the tooth following would have prevented independent movement of the individual teeth of the series. The groove in the anterior root and the tongue formed by the ridge of the anterior alveolus wall would have almost entirely eliminated play of the series as a whole, which otherwise would have been possible due to the elasticity of the periodontal membrane (it may be noted in this connection that the roots of all cheek teeth of *Astroconodon* fall far short of filling their alveoli).[2]

It was mentioned above that the anterior groove of M_1 is as fully formed as that of M_2, whereas the posterior end of the last premolar is by no means perfectly fitted to it. Every biologist is continually impressed by the intricate interrelationship of parts of animals in structure and function. It is customary on the part of some, a practice perhaps more prevalent in the past than now, to proceed from a proper appreciation of such marvels of nature to the gratuitous assumption that natural selection is altogether too crude a mechanism to have brought them about. In *Astroconodon*, it seems to me that we have an example of such an intricate interrelationship in the making, but one not yet perfected by selection. There is evidence (Butler, 1939a; Patterson, 1949) that genetic factors affect the molar series as a whole; the development of the anterior groove in M_1 is in accord with this interpretation. This groove being present—ready and waiting, so to speak—any expression in the last premolar of the factors bringing

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[2] The subject of individual tooth movement is one that has attracted little attention among paleontologists, the Wood brothers being notable exceptions. Aitchison has shown (1946) that the dagger-like canines of *Muntiacus, Hydropotes, Tragulus,* etc., which are used either for slashing from below or stabbing downward from above, have considerable freedom of movement within their alveoli, and that special adaptations are associated with such movement. This observation should be of particular interest to paleomammalogists, who are confronted with a considerable variety of creatures armed with such weapons.

about elongation of the posterior cingulum cusp would at least not be selected against. In *Astroconodon*, this cusp is definitely longer than in earlier genera but its complete adjustment to the groove has not yet come about. Later Cretaceous descendants of this form, if such there were, in all probability would have carried the trend to completion.

Mammalia of uncertain ordinal position
Gen. et sp. indet.

PM 543. Left humerus, incomplete. Data as for *Astroconodon denisoni* sp. nov.; in same pocket as **PM 541.**

The specimen consists of the greater part of the diaphysis, which, prior to burial, had suffered some breakage, chipping and abrasion. This is the fourth mammalian humerus thus far found in the Mesozoic and the first that has come to light in America. Despite its fragmentary condition, the bone yields a number of facts of interest.

MORPHOLOGY

The proximal end, as preserved, is not broken but is a somewhat abraded epiphysial surface that descends for a short distance on to the upper part of the delto-pectoral crest, precisely as in many later mammals. A typically mammalian epiphysis was obviously present. The shaft is somewhat bowed outward and is relatively robust compared to its length. The delto-pectoral crest is partially broken away but was evidently a prominent feature of the bone, extending antero-laterally well beyond the main body of the shaft. It terminates distally

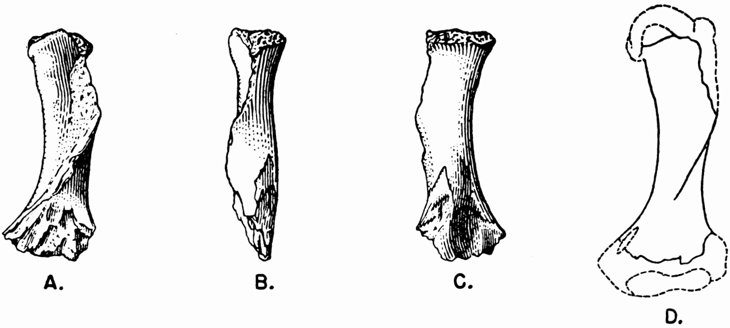

Fig. 3. Undetermined mammal of uncertain ordinal position. A, B, C, anterior, medial and posterior views of incomplete shaft of left humerus. D, tentative reconstruction in anterior view. X2.

at the center of the anterior face, two-thirds of the way down the preserved portion of the shaft. The parts preserved do not suggest an expanded delto-pectoral area but, rather, a single, fairly sharp crest. There is no clearly defined ridge distal to the lesser tuberosity, the rounded median border curving evenly over into the wide and deep bicipital groove. Vague markings and swellings in the appropriate position suggest that abrasion has removed attachment scars for the mm. latissimus dorsi and teses major. No trace of an entepicondylar foramen remains. Enough of the humerus is preserved to have shown some trace of this foramen if it had pierced a major portion of the distal end, as is the case in therapsids, monotremes and the Stonesfield humerus. If present, as is extremely probable, it must have been bridged by a relatively thin bar of bone, as in primitive Theria generally. The olecranon fossa extends far up the posterior face of the shaft, to a point almost on a level with the termination of the delto-pectoral crest; it is triangular in outline, so far as preserved, moderately deep and encloses a gently convex area medio-distally.

Although nothing remains of the epicondyles, enough of the distal end is present to show the general direction of the long axis of this part of the bone. The positions of the tuberosities are clear, and these reveal the general direction of the long axis of the proximal end. It is therefore possible to make a reasonable estimate of the angle between these axes and to compare it with the similar angle in the Stonesfield humerus on the one hand and in the therian mammals on the other. Simpson (1928a, pp. 154-160) has shown that in the Stonesfield humerus, the angle is 75°, considerably larger than in cynodonts and almost as large as in the monotremes; in *Didelphys*, taken as an example of the generalized Theria, it is 10°. The angle in the Forestburg humerus is approximately 45°, an estimate that is probably correct to within 5° either way. It is very nearly intermediate, therefore, between the Stonesfield[3] humerus and the generalized Theria; the advance between the Mid Jurassic and the Forestburg humeri in this and other respects being perhaps comparable to that between the Stonesfield[3] and Purbeck femora (Simpson 1928a, p. 154).

[3] It should be noted that this comparison, while morphologically valid, may have no phyletic significance. The Stonesfield limb bones may not be mammalian. Simpson (1938, p. 146) has noted that the humerus may have belonged to *Stereognathus,* now known to be the last recorded survivor of the Therapsida, and this possibility applies also to the femur.

The width of the bone across the distal end of the delto-pectoral crest is 3.84 mm.

DISCUSSION

As in the case of the Jurassic limb bones, the affinities of this humerus are quite uncertain. It was found, to be sure, in the same pocket as a triconodont jaw with no admixture of other mammalian remains, but to proceed from this to the assumption that the specimen is referable to the Triconodonta would be premature, to say the least. In the present state of knowledge, this can only be regarded as one of several possibilities. The heavy shaft of the Forestburg humerus, with its prominent delto-pectoral crest, presents a rather different appearance from the Jurassic humeri, which, in addition to the distinctions already mentioned, are more slender relative to length, and possess a well defined crest distal to the lesser tuberosity and a somewhat less prominent delto-pectoral crest. The multituberculatae humerus, known from the Late Cretaceous *Djadochtatherium* (Simpson 1928b, pp. 9-11) and the Mid Paleocene *Ptilodus* (Gidley 1909, p. 620; Simpson 1937, p. 92), differs in its more slender structure, less developed delto-pectoral crest, prominent crest below the lesser tuberosity, presence (in *Djadochtatherium*) of a third crest on the postero-median part of the bone, and less extensive olecranon fossa. There is nothing that would suggest reference of the Forestburg humerus to the Multituberculata or to the group or groups represented by the Jurassic humeri. Too much weight should not be attached to this purely negative evidence, however, for the humerus is a bone peculiarly liable to adaptive modification. Were moles and shrews, to take an extreme example, known from humeri alone, the degree of their relationship would hardly be suspected.

AGE AND CONDITIONS OF DEPOSITION OF THE MAMMAL-BEARING DEPOSIT

The very brief nature of the visits paid to the locality where the specimens were found allowed little time for stratigraphic observations. Fortunately, however, the geology of the area is fairly well known, so that the position of the specimens in the sequence can be established with reasonable accuracy.

The Trinity Sand (formerly known as Antlers Sand), the marginal transgressing facies of the Trinity Group, covers most of the eastern part of Montague County. Bullard and Cuyler (1930) show it as having a gentle dip to the southeast, and describe it as "a fine, white to yellow pack sand occurring in massive beds 25 to 40 feet in thickness." In their published sections, they note cross-bedding and the occurrence of sands with many iron concretions. Well records reveal a thickness of some 600 feet (Bullard and Cuyler, 1930, p. 71). The sand at the Forestburg locality matches this account very well, as would be expected. Some cross-bedding was noted and there are innumerable iron concretions, ranging from pinhead size to irregular masses a foot or two in the largest dimension. Fossil wood is fairly abundant in the surrounding area.

In the easternmost part of the county, ridges formed by the Goodland Limestone and an equivalent of the Walnut Shale, both of the Fredericksburg Group, overlie the Trinity. Forestburg is situated on one of these ridges and the locality is a mile or so from its base, very nearly on the line of Bullard and Cuyler's section (1930, plate 3). A sight estimate, made at the time of the second visit, that the mammal locality is within 100 feet from the top of the Trinity Sand in this region seems reasonable.

As mentioned at the beginning of this paper, the fossil remains at the locality investigated are concentrated in small pockets, a yard or so across, all at essentially the same stratigraphic level. Apart from the presence of bone fragments, nothing was noted at the time that would distinguish the pockets from the surrounding sand. The fragments, many of them abraded, were presumably concentrated by current action. Mammalian remains are very definitely in the minority in these pockets, only three specimens having been recovered from among literally hundreds representing fishes, amphibians and reptiles. Some, at least, of the fishes — pycnodonts and small sharks—were marine, but the majority of the vertebrate remains are of land or freshwater types. The pockets clearly indicate near-shore deposition and suggest shore conditions similar in general to those at Stonesfield and Purbeck (Simpson 1928a), thus raising the hope that remains of other mammals, such as accompanied the triconodonts at these localities, will be found. An even closer comparison, perhaps, is with conditions in the German Rhaetic, as interpreted by Ehrat (1920, quoted by Simpson 1928a, p. 186; original not seen), the only difference being that at the Forestburg locality, the vertebrate remains occur in pockets rather than in lenticular bone beds. The occurrence of numerous frog remains is a unique feature of the new locality. Their presence may reflect an unstable shore line and consequent rapid changes in the salinity of nearby freshwaters that were fatal for the frog populations living there. It may be noted in passing that some at least of these frogs appear to have been of leptodactylid affinities, a most important datum if confirmed by further study and, it is to be hoped, better specimens than those now in hand.

Stephenson *et al.* (1942) correlated the Trinity Sand with the early part of the Albian. The Forestburg locality is therefore considerably later than the Wealden, which is of Neocomian age. A glance at table 1 will reveal that this new

TABLE 1

Chart showing the relation of the Forestburg discovery to previously known Mesozoic horizons or localities that have yielded mammals (data from Simpson, Lull and Wright, Stephenson *et al.*, Parrington, Kühne). The German Rhaetic is omitted due to serious doubt concerning the right of the haramyids to inclusion in the Mammalia.

			North America	Old World
Cretaceous	Late	Maestrichtian	Lance Edmonton	
		Campanian	Belly River	Djadochta
		Santonian		
		Coniacian		
		Turonian		
		Cenomanian		
	Early	Albian	FORESTBURG	
		Aptian		
		Neocomian		Wealden
Jurassic	Late	Tithonian	Morrison	Purbeck, Tendaguru
		Kimmeridgian		
		Oxfordian		
		Callovian		
	Middle	Bathonian		Stonesfield
		Bajocian		
	Early	Liassic		Fissure filling in Wales
Triassic		Rhaetic		Fissure fillings in England and Switzerland

discovery occupies a place in the section almost ideally intermediate in time between the comparatively well-known Purbeck and Morrison faunas and those of the Late Cretaceous. If therian mammals occur at Forestburg, significant advances in our knowledge of mammalian taxonomy and phylogeny should follow.

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