

genus, *Tetraodon*. Taxonomists have relegated *Tetrodon* to synonymy, but this misspelled term is still deeply entrenched in medical literature. The author recommends the use of the correct spelling, tetraodon, when referring to this type of poisoning. The word "fugu" is the common name used by the Japanese to designate the puffer. The poison would be termed tetraodon toxin or puffer poison.

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A New Boxturtle from the Pleistocene of Southwestern Kansas

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THE existence of a warm interglacial fauna in southwestern Kansas during the Pleistocene is indicated by the remains of a large boxturtle. Its occurrence extends the geographic range of the *Terrapene carolina* group to the northwest, and is also a northwestward extension of the known range of the Pleistocene genus *Terrapene*.

The major part of the specimen was collected in the summer of 1950 by one of the field parties of the Museum of Paleontology of the Univer-

sity of Michigan under the direction of Dr. Claude W. Hibbard; other members of the party were James Rogers, Thomas Sparrow, Dwight Taylor, and the author. Fragments of the specimen, however, had been found the previous year by Irving Vogt of Meade, Kansas.

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tions and for the loan of a series of Recent turtle specimens and skeletal material which were used for comparison with the fossil specimen; to Dr. David H. Dunkle, of the United States National Museum, for permission to study numerous fossil specimens of *Terrapene*, and to Dr. George Gaylord Simpson, of the American Museum of Natural History, for the loan of a fossil turtle. Gratitude is also expressed to Messrs. Horace G. Adams II and Horace G. Adams III for their generosity in allowing the excavation of this specimen from their property.

HISTORY OF FOSSIL MEMBERS OF THE GENUS *Terrapene*

Few species of fossil boxturtles have been described from North America. Most of them are from the Pleistocene and the majority of the Pleistocene specimens have been from Florida and Texas. The others were isolated finds in Maryland, Indiana, Pennsylvania, and New Mexico.

Two species of boxturtles have been described from the Pliocene: one from Florida, the other from Kansas. One of these, *Terrapene putnami* Hay, 1906, was dredged from the Alifi River in Florida. It is distinguished by its large size and the thickness of its plastron and carapace; the thickness of the hypoplastron is nearly one-third of its length. This turtle does not resemble any of the living species. The other, *Terrapene longinsulae* Hay, 1908b, from the Lower Pliocene of Long Island, Phillips County, Kansas, is a nearly complete plastron and carapace with a skull, but it is an aberrant specimen in both osteological characters and scutellation. Hay said that it resembled *T. ornata* (Agassiz) more than *T. carolina* (Linnaeus) in being broader and not having a median carina. The specimen is almost identical in size and shape with the Recent *T. ornata*.

Of the Pleistocene forms, Hay described *Terrapene canaliculata* (1907), *T. formosa*, *T. antipex*, and *T. inoxia* (1916b) from Florida. C. W. Gilmore (1927), when he described a new boxturtle, *T. singletoni*, made *T. antipex* synonymous with *T. canaliculata* and showed that the differences between them were merely those of degree. The type of *T. antipex*, No. 8820, United States National Museum, is only a posterior lobe of the plastron; it could not be distinguished from a large number of posterior

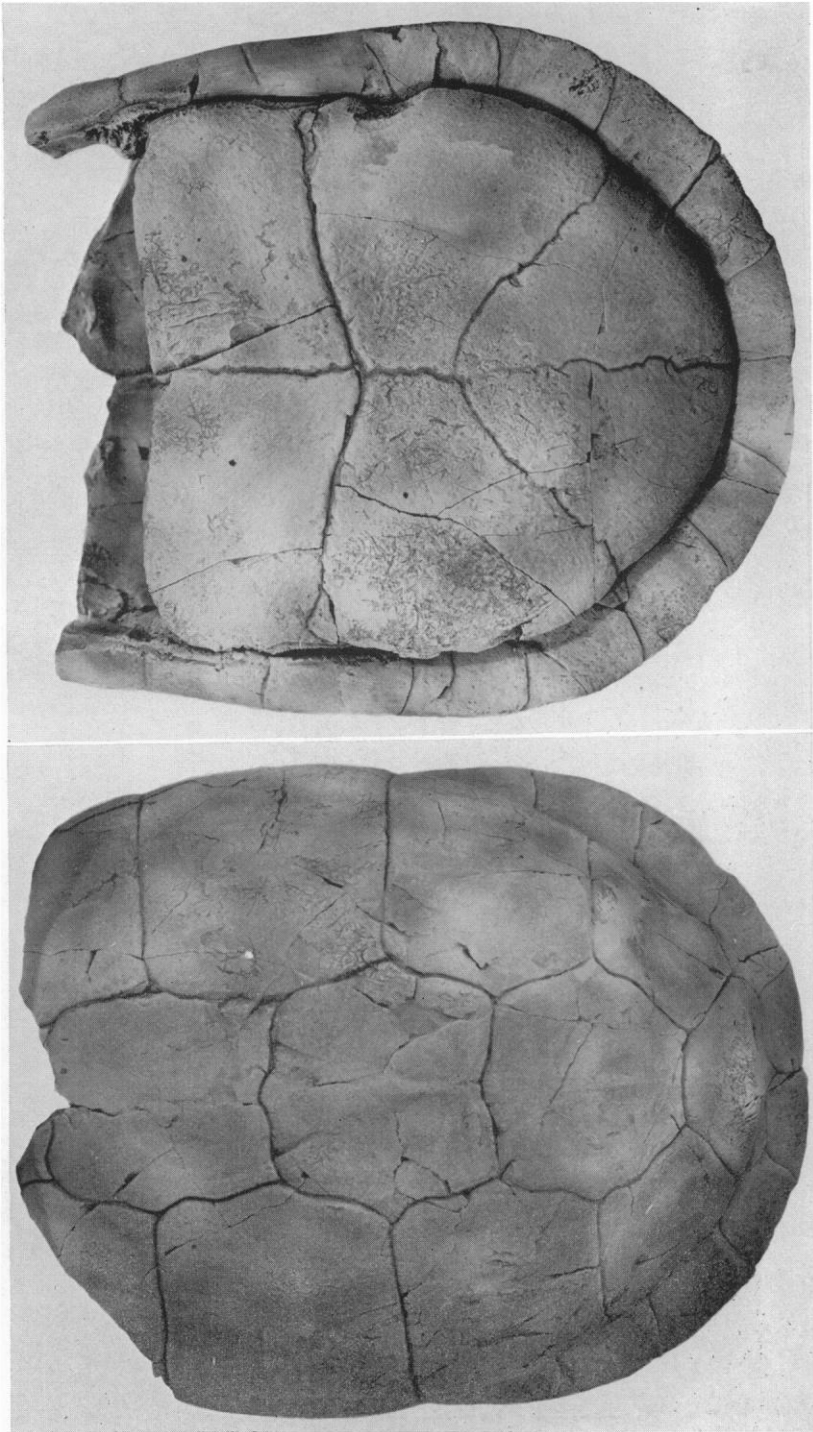
plastral lobes of *T. canaliculata* which were examined.

Barbour and Stetson (1931) revised the Pleistocene boxturtles from Florida and considered that *Terrapene canaliculata*, *T. formosa*, *T. inoxia*, and *T. singletoni* could be duplicated among the variations of an extensive series of Recent *Terrapene major* (Agassiz). They stated that, "*T. major* is generally considered to be the direct descendent of the Pleistocene form [*T. canaliculata* as it pre-dates all other names]. It differs in no way, except in size, as far as the carapace goes. . . . Variations of shape and proportion, in themselves alone, are not sufficient to warrant the erection of new species." The characters which may be assigned to *T. canaliculata* are a broad carapace, a distinct dorsal carina, a well-developed lateral keel, strongly flaring peripherals, and an urn-shaped first vertebral. The vertebral scutes are narrow and the carapace is about twice the size of Recent species.

After examining the types and other more complete specimens of *T. canaliculata*, *T. singletoni*, *T. formosa*, and *T. inoxia*, the author finds it hard to believe that these can all be synonymous with *T. canaliculata* as suggested by Barbour and Stetson. *T. canaliculata* is distinct in its breadth, its large size, its dorsal and lateral keels, and in the thickness of its carapace. *T. singletoni* can at once be distinguished by its elongation, its smooth surface, its narrow vertebral series, and the thickness of its carapace. These characters are consistent in the three specimens examined, USNM 11838 (the type), 11181, and 11913. The types of *T. inoxia* and *T. formosa*, although very small specimens, are both distinctive and obviously immature.

Cope (1869) described a boxturtle from the Maryland Pleistocene as *Cistudo eurypygia*. It is characterized by its general resemblance to *Terrapene carolina*, but differs from it specifically in that the tenth peripheral scute borders the fifth vertebral. Cope (1889) described a specimen as *Toxaspis anguillulatus* from the Port Kennedy Bone Bed in Pennsylvania. Hay (1902b) placed *Cistudo* and *Toxaspis* in the genus *Terrapene* Merrem. Later (1908a) he placed *T. anguillulatus* in synonymy with *T. eurypygia*.

Four species of boxturtles have been described from the Pleistocene of Texas. *Cistudo marnochi*



Terrapene lanensis Oelrich, sp. nov.

Upper: Ventral view of holotype, No. 26957, Museum of Paleontology, University of Michigan.

Lower: Dorsal view of same specimen.



Lone Tree Arroyo, the locality of *Terrapene llanensis*

Upper: Locality UM-K2-47, T34S, R29W, Sec. 32, Meade County, Kansas. The arrow indicates where the specimen was found.

Lower: Upstream from locality UM-K2-47. The arrow indicates the contact of the Pleistocene stream deposit with the overlying alluvium.

Cope (1878) is known from a posterior lobe of the plastron and, as described by Cope, is entirely flat on its ventral surface. The specimen is lost. Hay located in the Cope collection a specimen of a carapace which he referred to *T. marnochi* (1908a), and suggested that it resembles the Recent *T. major*.

Hay (1916a) described a species of boxturtle from Austin, Texas as *Terrapene whitleyi*, and wrote that its "carapace [is] broad and high; with broad vertebral scutes and with no dorsal keel. Plastron with lateral hinges equal to one third of the length of the hind lobe; femoral half as long as abdominal; and one half the length of the hind lobe." The description of the posterior lobe of the plastron resembles that of the type of Cope's *T. marnochi*.

Hay (1920) described *Terrapene bulwerda* from fragmentary remains of several individuals. The fifth vertebral scute in these specimens was described as being wider than any of the preceding vertebrae. At the present time these fragmentary remains of the type of *Terrapene bulwerda*, USNM 9221, do not have a complete fifth vertebral. They resemble *T. whitleyi*. Associated with them is a xiphiplastral element which is somewhat pointed and resembles that of "*Terrapene antiipex*" (*T. canaliculata* of Gilmore). Both are small turtles comparable in size to Recent species.

Hay (1924) described and figured a fragmentary boxturtle, *Terrapene impensa*. The holotype is a small elongate anterior lobe of the plastron. It is characterized by deep sulci separating the scutes. Earlier, in 1911, he had recorded a fossil specimen of *Terrapene carolina* from post-Wisconsin Pleistocene deposits of Laurence County, Indiana. He said that it differed in no way from individuals of *T. carolina* then living in that locality. The specimen is a natural mold.

Stock and Bode (1936) recorded a fossil specimen of *Terrapene ornata* from post-Wisconsin Pleistocene deposits at Clovis, New Mexico, that is identical with the living species. Simpson (1945) recorded *Terrapene canaliculata* from near Enon, Moniteau County, Missouri. Upon examination of this turtle, however, it was found to be a specimen of *Emys blandingi* (Holbrook).

The present form is different from all those recorded above, and herein is described as new.

Terrapene llanensis, sp. nov.

(Pl. I; Fig. 1)

HOLOTYPE.—No. 26957, Museum of Paleontology, University of Michigan, consists of the posterior four-fifths of the carapace and the posterior lobe of the plastron. There are in addition elements of the appendicular skeleton consisting of two sacral ribs, two ilia and parts of two pubes, a right and left femur, a tibia and fibula, and parts of one scapula.

The specimen was collected by a University of Michigan field party on July 28, 1950. Parts of the same specimen had been collected the previous year in the bed of the stream by Irving Vogt, a local rancher.

HORIZON AND TYPE LOCALITY.—Sangamon, late Pleistocene. The specimen was taken on a tributary of Shorts Creek, as shown on the U. S. Topographic Map of 1892. This creek is known locally as Lone Tree Arroyo. The locality, UM-K2-47, is located on the XI Ranch in T34S, R29W, Sec. 32, Meade County, Kansas. The strata in which the specimen occurred lie unconformably upon the Upper Pliocene Rexroad formation. (Plate II.)

DIAGNOSIS.—A very large species of *Terrapene* with proportionally elongate vertebrae, proportionally broad costals and very high marginals, the latter being approximately one-third of the height of the carapace. The twelfth marginal is almost as large as the preceding ones. The carapace has a very slight carina, flat vertebrae, and no lateral keel. The length of the femoral scute is one-half the length of the abdominal and one-third the length of the anal scute.

DESCRIPTION OF THE HOLOTYPE.—The shell is broad with slight elongation. The lateral costals give the appearance of overhanging the peripherals at the bridge. This is partly but not altogether due to distortion. The contour of the posterior peripherals is almost semicircular. The greatest width of the carapace is 162 mm. At the hinge the inside width is 127 mm. The length of the specimen from the anterior edge of the second vertebral scute to the posterior peripheral is 167 mm. Compared with the proportions of a large adult of *Terrapene carolina*, the total length of the specimen must have been about 232 mm.

The highest point of the carapace is at the anterior end of vertebral scute No. 2, which is

103 mm. high. From this point the carapace slopes gently posteriorly. The carapace is flat on top (Fig. 1A). This flatness is principally the character of the vertebrals and includes the proximal part of the costals. There is a slight carina, which extends throughout the length with the exception of the fifth vertebral. This slight elevation is continuous from vertebral No. 2 to No. 3. It is interrupted and barely visible on vertebral No. 4. Lateral to this carina there is a slight depression or trough.

The surface of the carapace has very fine reticulate ornamentation. The thickness of the

enlarged twelfth marginal is not found in any other recent or fossil form. The eleventh marginal is pointed and projects between the fourth costal and the fifth vertebral (Fig. 1A-B). The ninth marginal does not project between the third and the fourth costal scutes. The other marginals are approximately equal in size.

The fourth costal scute, on both the right and the left sides, presents a concave excavation which is continuous across the posterior part of the fourth vertebral, making a trough. The

TABLE I
MEASUREMENTS OF SCUTES OF HOLOTYPE,
Terrapene llanensis, UMMP 26957

Dimensions in Millimeters

Marginal			Costal			Vertebral		
Number	Length	Width	Number	Length	Width	Number	Length	Width
12	23	29	2	97	61	2	46	54
11	30	29	3	83	50	3	51	60
10	32	30	4	44	48	4	54	58
9	28	30	-	-	-	5	44	51
8	40	30	-	-	-	-	-	-
7	41	30	-	-	-	-	-	-

carapace is variable but averages about 5 mm. The sutures are entirely obliterated.

The vertebral scutes are narrower in proportion to their length than in Recent forms. The costal scutes are shorter in proportion to their width than in Recent forms. The vertebrals are fairly consistent in width with the exception of the fifth which is narrow. The fourth costal is almost square (Table I).

The marginal scutes flare slightly and are unusually high. They are approximately one-third of the height of the carapace. Peripherals Nos. 5, 6, and 7 are perpendicular and thus do not form a right angle as in *T. canaliculata*. The twelfth marginal is very wide and very high (Fig. 1A) and its width is equal to that of the other marginals. Its height is just slightly less than that of the other marginals. This

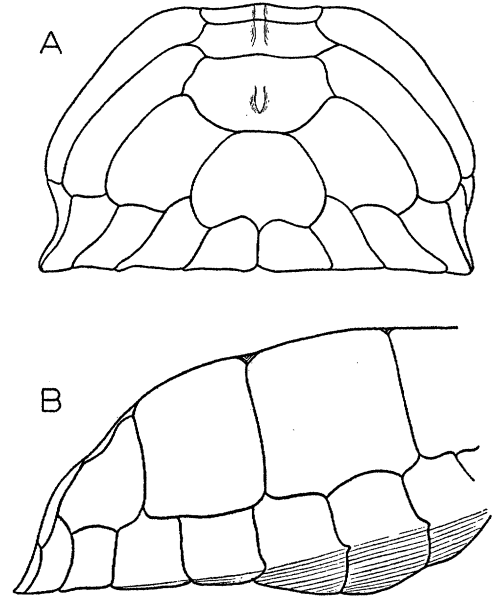


Fig. 1. *Terrapene llanensis* Oelrich, sp. nov. A—Posterior view of carapace. Holotype No. 26957, Museum of Paleontology, University of Michigan. B—Lateral view of carapace of same specimen.

fifth vertebral is dome-shaped, due to the attachment of the pelvic girdle within the carapace. This doming is found in all Recent forms, but is not so pronounced.

The internal part of the carapace does not differ from that of other members of the *Terrapene carolina* group. The flatness of the dorsal surface is reflected internally along the vertebral line. The marginals are very thick and heavy. Their ventral border extends horizontally. The impressions which receive the heads of the ilia are not as deeply excavated as in Recent forms.

The plastron is very slightly pointed posteriorly. There is a slight excavation of the

periphery at the junction of the femoral and anal scutes. The femoral scute flares slightly outward, although it is not appreciably wider than the abdominal.

The plastron is 150 mm. long at the mid-line and 142 mm. wide at the hinge. The abdominal scute is 48 mm. long, the femoral 23, and the anal 68. The femoral is approximately one-half the length of the abdominal and one-third the length of the anal scute. The lateral hinges are 46 mm. long or approximately one-third of the total length. The average thickness of the plastron is 10 mm. The hinge line is divided into two parts. The dorsal is horizontal and presents a rough suture line; the ventral, lobate on each half, is a smooth rounded shelf-like projection. The ventral surface is convex.

Of the appendicular skeleton the left femur is nearly complete. Its total length is 57 mm. Its distal end is 12 mm. wide. The general proportions are the same as those in Recent species of boxturtle. The femur is not as greatly curved anteroposteriorly as in Recent specimens.

The right tibia is 38 mm. long and greatly curved toward the mid line. The pelvis is fragmentary, but is not unlike that of Recent forms with a well-developed, low, depressed carapace.

DISCUSSION.—This boxturtle is closely related to the living *Terrapene carolina* group. Its relationships to the existing *Terrapene ornata* of the midwestern High Plains area are very remote.

Measurements show that the vertebral scutes of *Terrapene llanensis* are proportionately longer as compared to their width than in any of the Recent forms. The width-length ratio of the costals indicates that they are shorter in this form than in any of the Recent species.

No individual turtle can be assigned without question to a previously described species on the basis of its proportions. This is especially true of the boxturtle. In the specimen described here, however, the sutures are obliterated and the only distinguishing characters are the proportional measurements of the scutes. It is significant that the width-length ratios of both the vertebral and the costal scutes lie outside the observed ratios of Recent species.

The narrowness of the vertebral series as a whole is most similar to that of *Terrapene major*, and the proportions of the costals also resemble those of that form. Although these

measurements closely approximate those of *T. major*, they do not overlap them.

As has been previously noted, there is a group of large fossil boxturtles that has been considered ancestral to *T. major* and that was placed in synonymy with *T. canaliculata* by Barbour and Stetson (1931). *Terrapene llanensis* resembles closely the type of *T. canaliculata* (Hay). Three nearly complete specimens of *T. canaliculata* (USNM 11834, 11428, and 12000) were used for comparison as well as the type specimen (USNM 5500) and many other fragmentary specimens. *T. llanensis* differs from *T. canaliculata* in the absence of both a well defined dorsal carina and a well developed lateral keel. The fourth vertebral scute in *T. llanensis* is much shorter than in *T. canaliculata* with the result that the twelfth marginal is very large. In some specimens of *T. canaliculata* the twelfth marginal reaches half the height of the other marginals, but in none is it as large as in *T. llanensis*.

In *T. llanensis* only the eleventh marginal projects between the distal ends of the costal scutes, however, whereas in *T. canaliculata* the marginals No. 5, 7, 9, and 11 project high between the costal scutes. The peripheral bones No. 5, 6, and 7 of *T. llanensis* are perpendicular, while the corresponding bones of *T. canaliculata* are rolled beneath the carapace and in cross section form a right angle.

The vertebrae of *T. canaliculata* are flat on top. This flatness does not include part of the proximal end of the costals as in *T. llanensis*. The width-length ratios of the vertebrae are less in *T. canaliculata*; or in other words, the vertebral series of *T. llanensis* is broader. Correspondingly, the width-length ratios of the costals are less and the costals shorter in *T. llanensis*. The external measurements of the plastron are the same, although in *T. canaliculata* the length of the abdominal scute is more than twice the length of the femoral scute.

In describing *T. llanensis* an attempt has been made to show its affinities to both the Recent and fossil forms. It has been noted above that *T. llanensis* resembles the Recent *T. major* and that *T. canaliculata* is considered to be the ancestor of *T. major*. Of the known fossil forms *T. canaliculata* is the closest relative. Both *T. canaliculata* and the Recent *T. major* are more highly specialized in their structure

than the High Plains form. They both possess a well developed dorsal carina, a well developed lateral keel, elongate vertebrae, and a generally elongate streamlined body. The position of *T. canaliculata* as ancestor of *T. major* would, therefore, seem reasonable. The resemblances of *T. llanensis* and *T. canaliculata* indicate a relationship between them comparable to that of the living forms of boxturtles throughout the eastern United States and México.

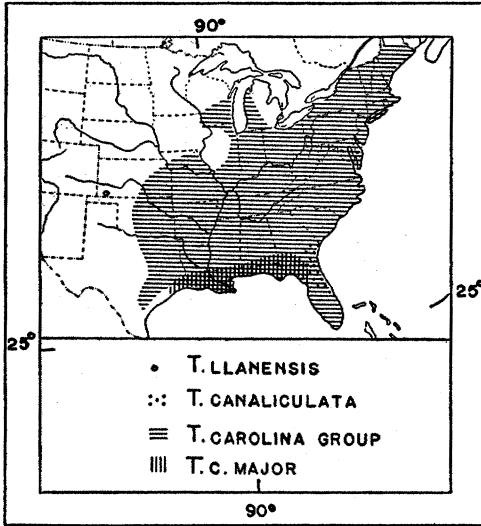


Fig. 2. Localities of Pleistocene specimens and approximate distribution of extant forms of the *Terrapene carolina* group.

The Recent forms of the *Terrapene carolina* group (Fig. 2) occupy a temperate woodland habitat which may vary as to humidity. This habitat is significant of the climate indicated by the presence of *T. llanensis* in southwestern Kansas during the middle or late Pleistocene. The *Terrapene carolina* group in the United States includes the living *T. c. major*, *T. c. carolina*, *T. c. triunguis*, and *T. c. bairi*.

Terrapene canaliculata has been found only in the southern part of Georgia and Florida. The presence of *T. llanensis* in southwestern Kansas extends the distribution of the middle Pleistocene boxturtles to the northwest. This distribution is greater than that of its closest living relative, *T. major*, which is restricted to the Gulf coastal plain (Florida and Texas), and greater than the present distribution of the *Terrapene carolina* group (Fig. 2). This northwestern extension of the *Terrapene carolina* group indicates an interglacial climate in Kansas during the middle or late Pleistocene.

ASSOCIATED FORMS.—*Tremarctotherium simum* (Cope), short-faced bear; *Mammuthus columbi* (Falconer), Columbian elephant; *Paramylodon*, a large sloth; and various invertebrates occurred with the turtle and were reported by Rinker (1949).

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