

avoid freezing, but is still within the area of the pool or puddle which thaws and warms first in spring, thus facilitating the occasional winter activity and early spring emergence of members of this species. One advantage of activity in late winter and early spring might be that it permits maximum utilization of the food resources of temporary puddles before evaporation and high temperatures of summer make the puddles uninhabitable.

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A NEW HORNED LIZARD (*PHRYNOSOMA ADINOGNATHUS*) FROM THE EARLY PLEISTOCENE OF MEADE COUNTY, KANSAS, WITH COMMENTS ON THE HERPETOFAUNA OF THE BORCHERS LOCALITY

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ABSTRACT: An analysis of the herpetofauna contained in material from the Borchers locality (early Pleistocene, Meade County, Kansas, USA) yielded the following faunal additions: *Ambystoma tigrinum*, *Cnemidophorus* cf. *C. sexlineatus*, and a new horned lizard (*Phrynosoma adinognathus*). The new species is similar to *P. douglassi* in many respects, but is larger and much more robust structurally.

THE fossils described in this paper were recovered from material at the University of Kansas Museum of Natural History collected by the late Claude W. Hibbard in 1939 and 1940 on the Borchers ranch in

Meade County, Kansas. The remains were taken from a silt layer immediately above the type B Pearlette ash. The Borchers fauna had originally been assigned to the Yarmouth Interglacial, but the type B ash

has been dated at 1.9 ± 0.1 million years B.P. (Naeser et al., 1973) making this late placement unlikely. It is probable that the Borchers fauna occurred during an earlier interglacial (perhaps Aftonian), but the Kansas Pleistocene stratigraphy is currently in a state of flux and specific assignment should await further clarification. Re-examination of other local faunas in the area, and further work on their absolute dates are necessary before precise correlation with glacial periods is possible.

Hibbard previously studied the mammalian faunal component of the Borchers (Hibbard, 1941, 1949, 1960) and described several new species. He also recovered the remains of the large, thick-shelled land turtle *Geochelone*. Brattstrom (1967) described ten snakes from the location, from a collection at the University of Michigan. The Borchers material at this museum, however, has been neglected since Hibbard's original study.

RESULTS

Salamanders

Ambystoma tigrinum

Twenty-eight vertebrae (KUMVP no. 25251) have been referred to this species on the basis of characters utilized by Tihen (1958). Many are nearly perfect, but some are partially broken and show some evidence of possible transport to the deposition site. Seven additional vertebrae (KUMVP no. 25252) are too incomplete for specific reference.

Snakes

Brattstrom (1967) reported the following species from the Borchers fauna: *Agkistrodon contortrix*, *Coluber constrictor*, *Crotalus viridis*, *Elaphe* cf. *E. obsoleta*, *Heterodon nasicus*, *Lampropeltis getulus*, *L. doliata*, *Pituophis catenifer*, ?*Rhinocheilus lecontei* and *Sistrurus catenatus*. The present collection contains several poorly preserved snake vertebrae, most of which cannot be identified beyond the generic

level. The taxa represented are: *Crotalus* sp., *Elaphe* sp., *Coluber constrictor* and *Heterodon (nasicus?)*.

Brattstrom found that the Borchers *Heterodon* vertebrae he examined ". . . were typical of the species [*nasicus*] except that the anterior dorsal edge of the zygosphene is flat as in *H. plionasicus* rather than slightly upturned at the sides." The vertebrae in this collection agree in this regard, and some also exhibit a *H. plionasicus* type of ventral keel with a rounded, less angular posterior end. It is possible that the *H. plionasicus*-*H. nasicus* transition occurred later in the Pleistocene than previously thought.

Lizards

Cnemidophorus cf. *C. sexlineatus*

A distal fragment of a right dentary with four bicuspid teeth (KUMVP no. 25257) is referred to this species. The teeth compare favorably with those of recent specimens, but the bone is too fragmentary for positive identification.

Phrynosoma adinognathus sp. nov.

(Fig. 1)

Holotype.—KUMVP no. 25258, the proximal two-thirds of a right dentary bearing five teeth with spaces for two more. Length 8.9 mm.

Paratypes.—No. 25259, the proximal half of a left dentary bearing six teeth with spaces for two more. Length 5.3 mm. No. 25260, the distal half of a right dentary bearing five teeth with spaces for five more. Length 6.5 mm.

Horizon and Type Locality.—Pleistocene (Aftonian?). University of Kansas Meade County Locality no. 9; east of State Lake on east side of Crooked Creek, Meade County, Kansas. T. 33S., R. 28W. NW $\frac{1}{4}$ of NE $\frac{1}{4}$ of S. 21 (37° 10' N, 100° 22' W). Borchers local fauna.

Diagnosis.—Horned lizard somewhat larger than *Phrynosoma douglassi*; general dimensions of dentary and juncture of rami

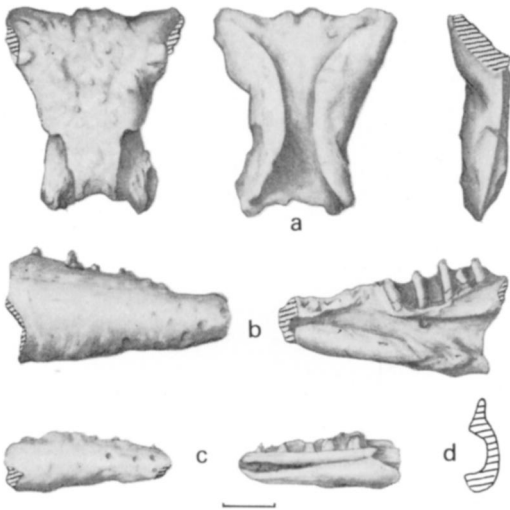


FIG. 1.—*Phrynosoma adinognathus* sp. nov. (a) dorsal, ventral and lateral views of referred frontal KUMVP no. 25261 (b) labial and lingual views of holotype dentary no. 25258 (c) labial and lingual views of paratype dentary no. 25260 (d) diagrammatic cross-section through proximal end of dentary. Scale line = 2 mm.

on lingual surface similar, but much more robust on fossil. Dorsal surface of frontal more uniformly convex.

Description of Types.—Length of holotype 8.9 mm, depth at last tooth 4.5 mm, maximum thickness 2.2 mm. More than the distal third of the dentary is lost and the extreme posterior end is broken. Only about the posterior third of the tooth row is intact. The peg-shaped teeth are typical for the genus. The labial surface is smooth as in *Phrynosoma douglassi*, however in cross-section it is more convex than in that species. The most striking character is the extreme thickness of the bony material; several times as thick in some regions than is seen in *P. douglassi*.

The paratypes agree with the holotype in every respect. No. 25260, the distal half of a dentary, is somewhat thicker and more blunt anteriorly than in *P. douglassi* of similar size. The mental foramina are also less distinct.

Comparisons.—The holotype was compared to a collection of several hundred sub-Recent *Phrynosoma douglassi* dentaries from Burnett Cave, Eddy County, New Mexico. Measurements on the thickness of the lower lingual ramus just posterior to the juncture of the rami in 35 of the largest specimens from this locality yielded an average of 0.62 mm. The fossil measures 1.20 mm

at this point. A Student's *t*-test showed the difference significant at the 0.1% probability level. The following Recent specimens were also compared: three *P. douglassi ornatisimum* from New Mexico (\bar{x} = 0.65 mm), a large *P. douglassi brevirostre* from Colorado (0.60 mm), and a single *P. douglassi brachycercum* from Chihuahua (0.50 mm).

The thickness of the bone did not seem to increase allometrically with linear dimension in the material I examined from Burnett Cave. Some of the smaller individuals were heavier boned than others of greater length. Even though the holotype is slightly larger in linear dimension than the largest *Phrynosoma douglassi* examined it is very unlikely that the observed discrepancy in thickness could be explained through allometry.

Referred Material.—No. 25261, a nearly complete frontal lacking only the posterolateral arms. Greatest length 7.7 mm, interorbital width 3.2 mm, maximum thickness 2.0 mm. Nos. 25262 and 25263, somewhat less complete frontals of smaller size. These specimens were compared to a large series of *Phrynosoma douglassi* frontals from Burnett Cave. The thickness and width relative to length appear to be much greater in the fossils. The dorsal surface is only lightly sculptured, and is more smoothly convex in the sagittal plane. Nos. 25262 and 25263 are somewhat smaller but agree in all other respects and may represent younger individuals. These elements are referred to the new species because of their strikingly robust structure.

Additional horned lizard material, including four small dentary fragments (no. 25264), a fragment of a right maxilla (no. 26905), a distal fragment of a right humerus (no. 25265), and two vertebrae (no. 25266) are inadequate for assignment to species.

Remarks.—*Phrynosoma adinognathus* is uniquely different from other known species. The material available suggests a form similar to *P. douglassi*, but larger and more heavily built. The skull also appears to have been more arched than in living species. The specific name is from the Greek *adinos*, meaning "thick," and *gnathos* or "jaw," referring to the extreme thickness of the bone of the dentary.

DISCUSSION

The only horned lizard presently occurring in southwestern Kansas is *Phrynosoma cornutum*. It is also present in the upper Pliocene Saw Rock Canyon fauna of Meade

County (Etheridge, 1960), and the late upper Pliocene Rexroad fauna of Seward County (Oelrich, 1954). Etheridge (1958) reports both this species and *P. modestum* from the Meade County Cragin Quarry fauna (Pleistocene, Sangamon).

Hibbard (1960) stated that the remains of *Geochelone* in the Borchers fauna indicate a subtropical climate with winter temperatures not lower than freezing at the time of occupation. Of the recent mammalian genera recovered, he considered *Sigmodon* and *Onychomys* indicators of a warm climate. Although the former genus is basically tropical, *S. hispidus* and *O. leucogastor* presently occur in southwestern Kansas and thus, in themselves, the occurrence of these genera in the Borchers is not evidence of a warmer climate at that time.

Although the Borchers fauna is more diversified, it is similar to that presently found in the Meade County area indicating some similarity in climatic conditions. Based on the records of *Geochelone*, it is evident that in the past southwestern Kansas has experienced periods of greater equability with less seasonal variation in temperature than at present. Such conditions seem to have prevailed during the existence of the Borchers fauna.

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