and the remaining 63 male and 16 female paratypes are in my collection.

In preparing this description of *evansi* the new species was compared with 134 males and 30 females of *neumoegeni* from various localities in Arizona and northern Mexico.

**Osteology of the Skull of Phrynosoma cornutum (Harlan)**

Arthur J. Detrie

The horned lizard, *Phrynosoma cornutum*, was first described by Harlan as *Agama cornuta*; in 1831, J. E. Gray transferred the species to the genus *Phrynosoma*. Much work has been done on the species. Many of the references to *Phrynosoma cornutum* are of a taxonomic nature, while references to its morphology are few and the material in the papers is scant. Description of the osteology of the skull are lacking.

Potter uses *Phrynosoma cornutum* as one of his examples of the Reptilia, and his accurate descriptions in his text book and laboratory manual are widely quoted. This is practically the only ready reference of any value on the anatomy of *Phrynosoma*.

Standard methods were used in the preparation of the materials for this study. Disarticulated skulls were prepared by the maceration of fresh materials. Preserved specimens were used for determination of gross relationships. Sagittal, parasagittal, and various oblique sections were made. Dissection of decalcified specimens, as well as dissection of frozen specimens, made it possible to trace many soft parts.

**Description of Phrynosoma cornutum**

The horned lizard ranges from eastern Kansas (and perhaps western central Arkansas) southward through most of Texas to northern Mexico, and westward through Colorado Springs, Colo. One individual from Fort Benton, Missouri

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(Suckley), and four from California (George Stevens) have been recorded.

The horned lizard belongs to the family Iguanidae, members of which are characterized by possessing wide, flat bodies covered with horny scales and spines. A row of spines lies just lateral to the median ridge on each side; and at least one row of spines lies at the lateral edges of the belly, at their most ventral extension. There is also a crest of spines that conjoin to make a continuous proximal row on the fore limbs. The body shows four well defined regions: a spine-covered head, a short, heavy neck, and a broad, flat trunk with two pairs of limbs, tapering into a short tail.

The head is roughly triangular in shape, high in profile, and covered dorsally with numerous spines. The large terminal mouth is bounded by thin lips. Ear-openings covered by very thin tympanic membranes lie in a slight recess behind the mouth. The snout is bounded laterally by a pair of small, rounded openings, the external nares. Dorsolaterad from the nostrils are the eyes, which are protected dorsally by a supraorbital process. This process ends posteriorly in a prominent supraciliary spine. Just behind each eye is a tympanic area. Three temporal horns separate tympanic area and ear-opening. Median to the posterior temporal horns are paired occipital horns, the most prominent horns of the skull. The posterior temporal horns, with the occipital horns, mark the posterior boundary of the head. The mandibular jaws are bounded laterally by a row of eight spines that decrease in size anteriorly. A row of very small spines lies just median to each mandibular ramus; otherwise the ventral surface of the lower jaw is covered with small scales.

Findings

At the extreme anterior end of the snout is the premaxilla bearing four or five teeth (Fig. 1, pm). This small bone extends upward between the nares to join the nasal bones. Two unnamed foramina lie in the premaxilla for passage of trigeminal nerve branches and blood vessels. Potter makes reference to paired premaxillaries in the horned lizards, but my specimens did not indicate the presence of any suture line.

\footnote{All measurements are given in Table I and were taken from the skull of an average specimen.}

\footnote{Potter, op. cit., 1938, p. 188, fig. 298.}
Postdorsal to the premaxilla is a pair of diamond-shaped nasal bones (Fig. 1, n). They border the posterior rim of the nares and extend anteriorly along the median line to join the premaxilla.

Prefrontal bones (Fig. 1, pf) extend laterally from the posterior portion of the nasals to the anterior edge of the supraorbital fossa (Fig. 1, sf). Usually they are fused with the supraorbitals to form the single Y-shaped bone that borders the anterior half of the supraorbital fossa. The shape of the prefrontal bones is that of a slightly-curved wedge.

A rather large, T-shaped bone extends anteriorly between the prefrontals to meet the nasal bones. The frontal bone (Fig. 1, fr) forms the median and posterior borders of the supraorbital fossa. At each posterolateral point is a postorbital (superciliary) horn (Fig. 1, pto).

Anterior to the postorbital horn, and forming the lateral border of the orbital fossa, is a slender, slightly curved supraorbital bone. This supraorbital bone (Fig. 2, so) forms a protective arch over the eye. The supraorbital is usually fused with the prefrontal. At its anterior end it meets the lateral margin of the prefrontal and a process from the maxilla.

Posterior to the frontal is the parietal, the largest bone in the skull.

Between the parietal and the frontal bones (in the median line) is the parietal foramen (Fig. 1, pfr). It represents the point at which vestiges of the parietal eye are found. Some authors locate this foramen with the boundaries of the parietal bone, but in all of my specimens, the foramen was found directly in the line of suture. Posterolateral processes (Fig. 1, ppr) of the parietal bound the median sides of the lateral temporal fossae (Fig. 1, ltf). Closely associated with the posterolateral processes are the occipital horns (Fig. 1, och).

The temporal bone (Fig. 1, t) makes up the lateral and most of the posterior boundaries of the lateral temporal fossa. On the lateral side are three prominent horns called the temporal horns.

The small C-shaped postorbital bone (Fig. 1, porb) separates the lateral temporal fossa and the infraorbital fossa.

8Idem.
It joins the temporal and jugal laterally and the frontal and parietal medially.

The slender jugal (Fig. 3, j) lies just anterior to the postorbital bone and forms the lateral boundary of the orbit. The jugal foramen (Fig. 3, jf) serves in the jugal bone for the passage of the maxillary branch of the trigeminal nerve. The jugal forms a union with the maxilla (Fig. 2, m) by an oblique suture. Toward its anterior end is the infraorbital canal which serves as a passageway for blood vessels and the maxillary branch of the trigeminal nerve.

The maxilla (Fig. 2, m) extends from the jugal anteriorly to the premaxilla. Each maxilla bears thirteen or fourteen teeth. Five or six unnamed foramina on the ventrolateral surface allow maxillary branches of the trigeminal nerve to reach the skin, lips and teeth (Fig. 2, df). A frontal process of the maxilla extends dorsally to form the lateral border of the nares. At its dorsal end the frontal process meets the nasal, prefrontal, and supraorbital bones. At the anterior end of the maxilla, just anterior to the dorsal process bounding the nasal openings, is the foramen of the nasal branch of the facial.
Ventral Surface of the Skull

Premaxillae and maxillae form the antero-ventral border of the skull. Extending posteriorly from the premaxillae are two small bones called vomers (Fig. 4, v). They are somewhat triangle-shaped, and lie between the internal nares. Anteriorly to each vomer and covered by mucous epithelium is a small foramen opening into Jacobson's organ. Anterior to the openings of the Jacobson's organ and in the anterior end of the maxilla are two smaller foramina for branches of the trigeminal nerve, and blood vessels that extend to the nares.

The palatine bones (Fig. 4, p) lie directly behind the vomers. They are much larger than the vomers and extend laterally at an angle. They fuse with the vomers anteriorly but do not meet in the mid-line, being separated by the ventral foramen (Fig. 4, vf). Lateral to each palatine is the anterior palatine foramen (Fig. 4, apf) which carries a small artery. Slightly posterior to the ventral opening of Jacob-
son's organ is a common recessed space where are the openings of the internal nares.

Behind each palatine is a triangular pterygoid bone (Fig. 4, pty) with large unnamed lateral foramen, and several smaller, unnamed foramina for blood vessels, scattered over the surface. The pterygoids are separated in the mid-line by the ventral foramen.

The transverse bone (Fig. 4, trn) is a small thick bone connecting pterygoid and maxilla.

The basisphenoid (Fig. 4, bsp) is posterior and median to the pterygoids and connected with them by short lateral arms. It has been reported previously that the basisphenoids are paired bones⁹, but no sutures were found in my specimens.

The parasphenoid (Fig. 4, psph) extends anteriorly from the basisphenoid into the ventral foramen. It is a thin, slender cartilaginous bone, grooved on its ventral surface, is approximately 10 mm. long, and makes contact anteriorly with the vomers.

The occipital (Fig. 5, oc) is just posterior to the basisphenoid. This bone, although without definite suture lines, has its several parts named. The basioccipital portion lies ventral to the foramen magnum. Paired exoccipitals bearing occipital condyles are lateral to the foramen magnum, and a supraoccipital portion lies dorsal to the foramen magnum (Fig. 5, supoc).

Posterior to the basisphenoid and the occipital are numerous foramina. In Fig. 6 (a sagittal section) the foramina in the occipital are shown in center location. The same relative positions are maintained on the outside of the occipital from where the following descriptions are made.

Posteriorly is a small foramen for the hypoglossal nerve (Fig. 6, h). Slightly anterior-ventral is another small foramen through which the spinal accessory passes (Fig. 6, s). Two lateral condylar canals, (Fig. 6, cc) one on each side of the foramen magnum and anterior to the spinal accessory foramen, allow veins to leave the brain-case. Ventral to the condylar canal is a larger foramen called the posterior lac- erum (Fig. 6, pl) which provides a passage for the auditory, trigeminal, and facial nerves. Anterior to the foramen al-

⁹Idem.
ready mentioned are two small openings for the vagus and glossopharyngeal nerves (Fig. 6, v, g). On the ventral surface of the skull on each side lateral to the basisphenoid will be found the opening of the Eustachian tube.

The quadrate bone (Fig. 3, q) forms the posterior ventral angle of the skull. It is a small bone resembling the vestibular section of a sea-shell. The quadrate is attached to the posterior lateral process of the temporal bone, and extends anteriorly and ventrally to join a lateral process of the pterygoid. The ventral end of the quadrate provides a condyle for articulation with the articulare bone of the lower jaw. The quadrate is grooved posteriorly. Over this hollow area and

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<td><strong>Length</strong></td>
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the lateral end of the Eustachian tube is fitted the tympanic membrane.

The delicate, cartilaginous hyoid apparatus is imbedded in the gular muscles between the mandibular rami (Fig. 7). A long, thin, spear-like entoglossal portion extends anteriorly into the free part of the tongue. The main body is called the basihyal. The three horns extending lateroposteriorly from the body on each side are called anterior cornu, middle cornu, and posterior cornu (Fig. 7, ac, mc, pc). The middle cornu has on its extreme end a flat process that is involved with the muscles in the vicinity of the quadrate bone. No direct connection between the hyoid and any other bony process was noted.

The anterior part of the lower jaw is composed of two large, slightly curved dentary bones which are fused at their anterior tip (Fig. 8, d). Each bone carries 17 or 18 teeth which are homodont and pleurodont.10 Posterior to the dent-
ary, as viewed from the ventral surface, lies the angulare (Fig. 8, a), which is slightly curved with a serrated lateral edge. Medial to the juncture of the dentary and the angulare is a small conical bone, the coronary (Fig. 8, c). Extending dorsally from this bone is the coronoid process; it serves for the attachment of several muscles.

Posterior to the coronary, and extending to the posterior end of the jaw, are the closely-joined supra-angulare and the articulare bones. It is difficult to find the latter except in fresh specimens. The articulare has a small diamond-shaped projection that appears to be a separate bone. This projection is visible on the median edge when viewed from the ventral side. It resembles a wedge driven into the juncture of the articulare, supra-angulare and angulare bones. Walter\textsuperscript{11} refers to a similar bone as a “gonial” bone.

In the mandible, on the median side at the point where the coronoid, supra-angulare and articulare join, is the internal mandibular foramen; on the lateral side in the angulare bone is the external foramen. The dentary has numerous mental foramina through which the mandibular branch of the trigeminal reaches the teeth and lips. At the most posterior dorsal point is the articular process, which makes contact with the quadrate bone of the upper jaw. On the median side of the mandible is the thin splenial bone which acts as the median cover of the mandibular canal. In this canal is Meckel’s cartilage and the mandibular branch of the trigeminal nerve and the blood vessels. The mandibular foramen lies just posterior to the coronoid process; and the mental foramina are on the anterior lateral side, serving as a passage for nerves and blood vessels to teeth and lips.

Internal Bone Structure

The nasal chambers are bounded on the ventral side by the vomers. These in turn, are covered by an expansion of what is probably the palatines, so that the vomers are actually within the nasal cavity. These cavities are separated by a median ethmoid or mesethmoid bone (Fig. 6, me), modified at its anterior end to encompass the well developed Jacobson’s organ. This organ is located on the floor of the extreme anterior end of the nasal cavity, and is protected by

\textsuperscript{11}Ibid., 1949, p. 580.
its own vomero-nasal cartilage. Two branches of the olfactory nerve are found in the ethmoid bone near the point of fusion with the vomers. Within the median ethmoid (separating the two nasal cavities) are two tubular longitudinal canals, through which anterior branches of the olfactory nerve reach the organ of smell. The posterior wall of the nasal cavity is made up of two ectethmoids. It is probable that the turbinal bones arise from these. These turbinal bones are cone-shaped and connect internal and external nares. The point at which the internal nares enter the roof of the mouth is protected by a palatine shelf. Posterior to the ectethmoids is an interorbital septum\(^{12}\) which separates the orbits of the eyes. The posterior walls of the orbit are made up of the orbitosphenoid and the alisphenoid; the floor, of the parasphenoid; and the roof is formed by the frontals. The brain cavity is bounded ventrally by the basisphenoid, dorsally by the parietal and posteriorly by the occipital bones.

Through the anterior walls of the brain case near the median line (Fig. 6) are four foramina through which the II, III, IV, and VI nerves pass. Of these foramina, the optic is the largest, and is usually the most dorsal of the group. Ventral to the optic foramen are the trochlear and abducens foramina, and posteriorly is the oculomotor foramen.

The quadrate bone forms the cavity over which the tympanic membrane is fitted. In conjunction with this cavity is the lateral opening of the Eustachian tube. A small extra-stapedial cartilage is imbedded in the dorsal half of the tympanic membrane and provides an outer attachment for the fused outer and inner columellae. A short intercalary bone was noted just median to attachment at the extra-stapedial.

The medial end of the columella has a membranous attachment to the occipital in which are located the semicircular canals. A detailed diagram may be found in Goodrich's *Studies on the Structure and Development of the Vertebrates.*

\(^{12}\)Ibid., 1949, p. 587.

**BIBLIOGRAPHY**


A NEW VIOLET ENDEMIC TO SOUTHEASTERN TEXAS—On April 4, 1949, Mrs. Bruce Reid of Silsbee, Texas, sent me a fragmentary specimen of a native violet (3 flowers and 2 leaves). The leaves were markedly different from those of our other native violets. The material sent was, however, insufficient to permit proper study of the plant. In April, 1950, one of the objects of a trip to the Big Thicket area of Texas was to become familiar with this violet in its native habitat, and to get satisfactory herbarium specimens of it. This was done on April 19, when I was a guest of the East Texas Baptist Encampment, located about 4 airline miles W-SW of Newton. The back entrance to the encampment from State Highway 87 is about 3 miles long; the violet is found along nearly the whole length of this road, and is much more abundant than Viola pedata L. Unlike that species, the new violet, so far as seen, is uniform in foliage and bloom.

Viola Reidiae Cory, sp.nov. V. pedatae habitu corolla pistilloque similis, differt praecipue foliorum laminis rhomboideis trinervatis crescentibus dentatis neque lobatis compositis. Plants with the habit, corolla, and pistil of Viola pedata, but with none of the leaves pedately divided. Petioles of inner leaves up to 10 cm. long, and of the outer leaves ½ to ¾ as long; blades of inner leaves diamond-shaped, 3.0-3.5 cm. long and 1 cm. broad, both ends entire, the middle third with 3 (2-4) pairs of relatively long and slender obtusish teeth; blades of outer leaves shorter and broader, about 1.5 cm. long and broad, and with about 4 pairs of shallowly crenate teeth; all leaf-blades are prominently 3-nerved at the base, with each lateral nerve branched not far above the base, and above the middle, branched once or twice more. TYPE: No. 57217, April 19, 1950 (S.M.U. Herbarium.) The collection locality is estimated to be about 5 airline miles SW of Newton and ½ mile off State Highway 87, where the species is of frequent occurrence in open pine woods.

This violet was discovered by Mrs. Bruce Reid of Silsbee and Mrs. J. L. Hooks of Beaumont, both of whom (as occasion offered) have given valuable help to visiting botanical parties with which I have been connected. Since Mrs. Reid first called my attention to this violet, and recently has taken me to its locality, I dedicate it to her. The Latin diagnosis is by Dr. Lloyd H. Shinners.—V. L. Cory, Field Botanist, Southern Methodist University Herbarium.

Kallstroemia perennans Turner, nom. nov.—Kallstroemia hirsuta L. Williams, Ann. Mo. Bot. Gard. 22: 49. 1935. Not Kallstroemia hirsuta (Benth.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 19a: 177. 1931. Previously known only from the type (TEXAS, VAL VERDE Co., Langtry, C. R. Orcutt 6126, May, 1913). Recent collections have been made in BREWSTER Co.: 7 miles west of Terlingua, Parks, Warnock & Turner 1188, June 19, 1949 (S.M.U., Gray, & Sul Ross College Herbaria); and 15 miles west of Terlingua, Amarilla Mts., "calcareous hills with gypsum crystals," Parks & Turner 1350, Aug. 18, 1949 (Sul Ross). Williams describes the plant as annual. The type specimen [photograph] lacks the root. Inspection in the field shows the plant to be a definite perennial with a thick, almost woody root. It is the only perennial Kallstroemia found in N. America. The flowers are orange (not white or yellowish as suspected by Williams).—B. L. Turner, former Graduate Student, Southern Methodist University; now of Washington State College, Pullman.