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A New Species of *Pseudocerastes* with Elaborate Tail Ornamentation from Western Iran (Squamata: Viperidae)

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A new species of viper, *Pseudocerastes urarachnoides*, is described from the Zagros Mountains in western Iran. The new species has a short tail, few pairs of subcaudals (15 in the known specimens), the distal pairs forming an oval knob-like structure; lateral dorsal caudal scales projected to form elongate “appendages” along the sides of the terminal knob. Several rows of lateral dorsal scales are weakly keeled and outer rows are only faintly keeled. We speculate that the caudal appendage may serve as a lure for prey in an ambush predator.

KEYWORDS: *Pseudocerastes urarachnoides*, *Pseudocerastes persicus*, *Pseudocerastes fieldi*, new taxon, Iran, caudal lure, caudal ornamentation, Viperidae

The Second Street Expedition to Iran (1968) collected amphibians and reptiles incidental to the mammals that were the primary objectives. These specimens were deposited in the Field Museum of Natural History, where one of us (SCA) examined and identified them in 1970. The first impression of FMNH 170292, seen through the bottle in the preparations room, was that a small solpugid was clinging to its tail. Subsequent examination revealed that the snake was a specimen of *Pseudocerastes* with a peculiar growth at the tail tip. It was identified as *P. persicus*, with which it agreed in most particulars. As there was only the single specimen, it was not possible to say whether the peculiar growth of the tip of the tail had a genetic origin or was, perhaps, some sort of tumor or caused by some parasite. Thus, the specimen languished, but was not forgotten, for nearly four decades. Then, in 2003, one of us (HB) collected a second specimen with identical tail ornamentation and similar scale counts and morphology. It seems likely that there has been genetic continuity in this character over the past 35 years. Were the caudal appendage the result of a characteristic tumor or due to the action of a parasite, we might expect it to have been observed elsewhere and, perhaps, in other species. We believe that these two specimens represent an undescribed species, related closely to *Pseudocerastes fieldi* and *P. persicus*. This appears to be the most elaborate morphological caudal ornamentation yet reported in a snake, with the possible exception of the rattles of *Crotalus* and *Sistrurus*.

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***Pseudocerastes* Boulenger, 1896**

TYPE SPECIES: *Cerastes persicus* Duméril, Bibron, and Duméril, 1854, by monotypy

DEFINITION.—Head distinct from neck, covered with small scales; pupil of eye vertical; nostril directed outwards and upwards, in large undivided nasal shield (pierced between two small scales, a larger crescentic anterior and a smaller scale-like posterior [Gasperetti 1988:350]) (nasal aperture in a large circular or crescentic shield, the upper part of the aperture leading into the supranasal sac [Smith 1943:490, fig. 155A]); supralabials with serrated lower margin and with inner groove to receive lower lip (The structure of the lips, to provide complete closure of the mouth, and the valvular prominence within the nasal aperture, are typical desert modifications against the ingress of blown sand. They are found also in *Eristocophis* [Smith 1943:490]); body scales in 21–25 longitudinal rows, none obliquely disposed; keels on body scales do not reach posterior edge of scale but end in swollen knob before outer edge, keels not serrated; ventrals rounded, without lateral keels; tail short, subcaudals paired (Leviton et al. 1992:114–115).

DISTRIBUTION.—The North Arabian Desert from Sinai and southern Israel, Jordan, Iraq, southwestern Iran east to Afghanistan and Pakistan west of the Indus River, outlying population in northern Oman. (Fig. 13).

We include here brief descriptions of the previously recognized taxa of *Pseudocerastes* for comparison with the new species. Some authors have considered *P. fieldi* a subspecies of *P. persicus*. There appears to be a geographic hiatus in the distribution of the genus, *P. persicus* and *P. fieldi* nowhere known to be parapatric, their ranges separated by the Zagros Mountains. For this reason and the differences in venom properties (see below), we prefer to recognize them at the species level.

***Pseudocerastes persicus* (Duméril, Bibron, and Duméril, 1854)**

Cerastes persicus Duméril, Bibron, and Duméril, 1854:1443, pl. 78b.

DESCRIPTION (From Smith 1943:490–492, fig. 155).—Head depressed, snout short and broadly rounded; diameter of the eye less than its distance from the mouth; nostril very large, pierced in a large circular or crescentic nasal, bounded above by a supranasal which may be broken up; two scales between the nasal and the rostral; scales on top of the head small, imbricate, smooth on the snout, keeled behind in the young, tuberculate and more strongly keeled in the adult; an erect horn-like scale above the eye surrounded by small scales; 9–12 scales on a line between the horns; 16–20 scales round the eye; 3–4 scales on a line between the eye and the nasal; temporal scales small, keeled; 13–14 supralabials, 4 series of scales between them and the eye, 1st pair of infralabials larger than the others; a pair of large anterior genials, the scales posterior to them being much smaller.

Scales in 23 or 25:23 or 25: 19 rows, striated and strongly keeled, the outermost scales strongly overlapping the ventral scales. V 144–158; C 34–49, paired.

Hemipenis short, extending to the 8th caudal plate, deeply forked; the distal end is calyculate, the remainder spinose, the largest spines being at the proximal end; sulcus lips also spinose.

Snout-vent length 688–690 mm, tail 80–85 mm.

Grayish-brown above, with squarish, dark brown, black-edged spots, which alternate with one another on either side of the vertebral line, or are confluent to form cross-bars; sides of the body with rounded, less distinct spots; top of the head pale grey, upper lip and side of the head darker, the two colors meeting in a sharply defined line which extends from the eye to the angle of the mouth; whitish beneath, spotted with brown. In the adult the markings are much less distinct and may be almost entirely absent. In large adults, tip of tail often dark. An adult from Kacha,

Baluchistan, is heavily marked and mottled with black and cream.

Total length: 890 mm; tail 110 mm.

DISTRIBUTION.—Southeastern Anatolia, Turkey and Iran east of the Zagros Mountains through the Iranian Plateau to central Afghanistan and western Pakistan (Fig. 13). Gasperetti (1988:353, fig. 127) shows four localities in northern Oman and the Musandam Peninsula.

NOTE.—Wall (1913:64) described *Pseudocerastes bicornis* from Khajuri Kach, Waziristan, Pakistan, based on a single specimen now in the Natural History Museum, London. The specimen consists of the head and anterior one-fourth of the body (Smith 1943:492). Subsequent authors (Minton 1966; Mertens 1969; Gasperetti 1988) have placed it in the synonymy of *P. persicus*, although Khan (2002:190) regards it as distinct. It must be noted that were the two specimens here described as a new species missing the tails, they would be identified as *P. persicus*.

Pseudocerastes fieldi Schmidt, 1930

Pseudocerastes fieldi Schmidt, 1930:227, fig. 2 (Type locality: Ayn Bair, Jordan).

DESCRIPTION.—Head depressed, snout is very short and broadly rounded; diameter of the eye less than its distance from the mouth; nostril very large, pierced in a large circular or crescentic nasal, bounded above by a supranasal which may be broken up; two scales between the nasal and the rostral; the upper head scales are small, imbricate, keeled; there is an erect horn-like tubercle above each eye, covered with several imbricate scales; 9–12 scales on a line between the horns; 15 scales around the eyes; one or two series of scales between the nasal and the rostral; scales on top of the head small, imbricate, smooth on the snout, keeled behind; scales on top of the head small, imbricate, smooth on the snout, keeled behind; 13 supralabials, three series of scales between the eye and the labials; four infralabials in contact with the chin shields (genials). 1st pair of infralabials larger than the others; a pair of large anterior genials, the scales posterior to them being much smaller. Dorsal scales are strongly keeled in 21–23 rows; ventrals 134–138; the anal is entire, subcaudals, 35–38, divided (Schmidt's type had 21 dorsal scale rows, 134 ventrals, 35 subcaudals); total length 890 mm, tail 110 mm, TL/T = 6.1–8.6.

Colors are grayish or brownish above with four series of large dark spots, the two median rows sometimes confluent and forming cross bars; a dark streak on each side of the head from the eyes to behind the gape; the under parts are whitish, dotted with dark and a lateral series of dark spots. (Schmidt 1930:227–229; Gasperetti 1988:352–354, Table 15).

DISTRIBUTION.—Sinai, Israel, Jordan, Syria, Iraq, southwestern Iran (Fig. 13). The specimen cited by Anderson (1963:472) from Binak, Iran, upon reexamination, is identified here as *P. fieldi* (table 1).

NOTE.—Probably the main external morphological difference between *P. persicus* and *P. fieldi* is that the scale rows of *P. persicus* are all strongly keeled, whereas in *P. fieldi* several lateral rows are nearly smooth and the outer rows are entirely without keels. *Pseudocerastes fieldi* also has a significantly shorter tail. Sexual dimorphism has not been studied adequately in either taxon.

Bdolah (1986) demonstrated that the composition and properties of the venoms of *P. fieldi* and *persicus* differ greatly. The venom of *P. persicus* showed the typical complexities of most viperid snake venoms with potent hemorrhagic activity whereas that of *P. fieldi* demonstrated none. The venom of *P. persicus* has a yellow pigment typical of most snake venoms and that of *P. fieldi* is completely lacking in yellow flavin pigment and its isoelectric focusing profile is a simple one with very few protein bands. *Pseudocerastes persicus*, on the other hand, had close to 30 protein bands spanning a wide pH range. It was concluded that these differences indicate a long genetic separation of the two forms (Bdolah 1986:726) (Gasperetti 1988:352–353).

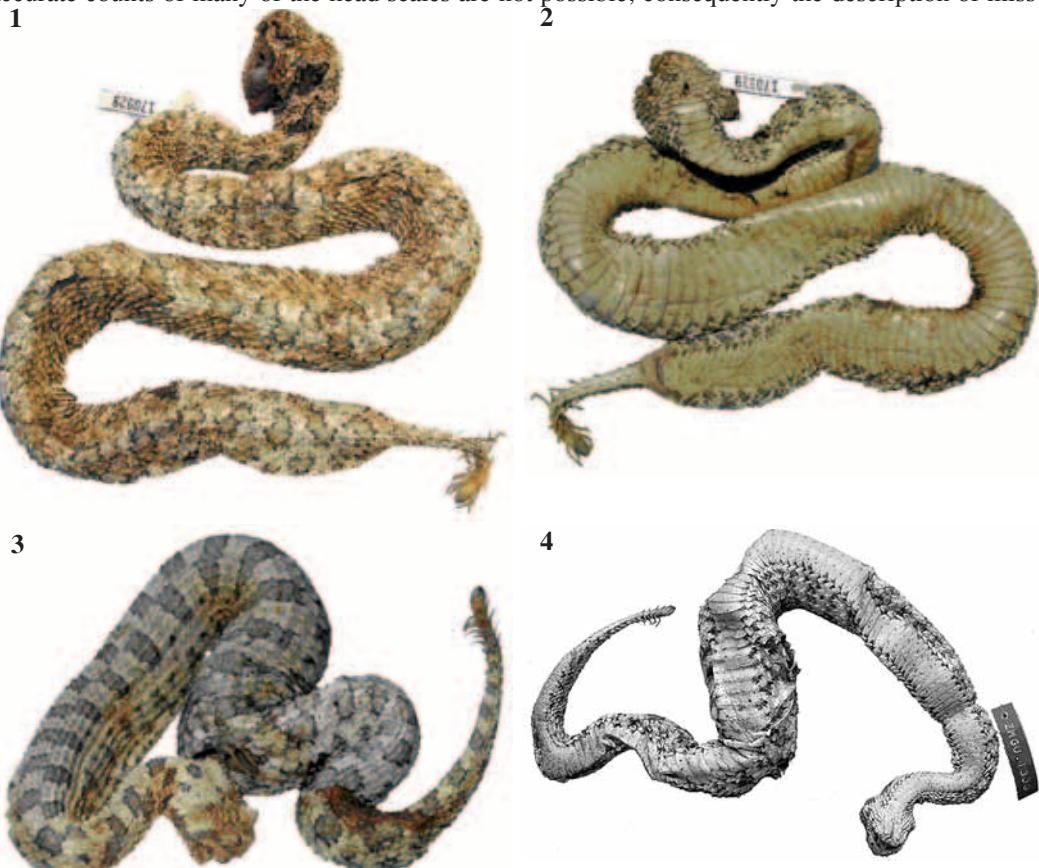
The tail tip is often dark in adults of both taxa, suggesting the possibility of caudal luring. (Gasperetti 1988:354, Table 15).

***Pseudocerastes urarachnoides* Bostanchi, Anderson, Kami, and Papenfuss, sp. nov.**
Figures 1–12.

MATERIAL EXAMINED.—HOLOTYPE: FMNH 170929 [♀], Iran: Ilam Province: 70 km SW Ilam [probably on road to Amirabad and Mehran], collected by Daniel R. Womochel and Anthony F. DeBlase, Second Street Expedition to Iran, 27 August 1968 (see map, Fig. 13). PARATYPE: ZMGU [♂], 1300, Iran: Kermanshah Province: 25 km south of Qasr-e-Shirin on road to Gilan-e Gharb, open level area in agricultural region, ca. 200 meters elevation, collected by Hamid Bostanchi, May 15, 2001 at about 0800 hrs (see map, Fig. 13).

DIAGNOSIS.—A *Pseudocerastes* with a short tail ($TL/T = 9.65$), few pairs of subcaudals (15 in the known specimens), the distal pairs forming an oval knob-like structure; lateral dorsal caudal scales projected to form elongate "appendages" alongside terminal knob. Several rows of lateral dorsal scales are weakly keeled.

DESCRIPTION OF HOLOTYPE (FMNH 170929 ♀, [Figs. 1–2, 8, 10]; head scales based on paratype, ZMGU 1300 ♂[?] [Figs. 5–7, 9]).—The head of the holotype is severely damaged and accurate counts of many of the head scales are not possible; consequently the description of miss-



FIGURES 1–4. (1) Holotype, FMNH 170929, dorsal view (SCA photo). (2) Holotype, FMNH 170929, ventral view (SCA photo). (3) Paratype, ZMGU 1300, dorsal view (James Parham photo). (4) Paratype, ZMGU 1300, ventral view (HGK photo).

ing head characters is based on the paratype. Head depressed, snout short and broadly rounded; the upper head scales small, imbricate, keeled; there is an erect horn-like scale above the eye surrounded by small imbricate scales; 16 scales on a line between the horns; (Fig. 6); 17 scales around the eyes; three series of scales between the eye and the labials; two series of scales between the nasal and the rostral; 11/12 upper labials; 13/12 lower labials, 3–5 in contact with the chin shields; anteriormost lower labials enlarged, in contact behind mental and in contact with one pair of genials (fig. 7). Dorsal scales strongly keeled, in 21 rows at level of 6th ventral, 23 rows at level of 73rd ventral, 17 rows at level of 145th ventral; several lateral rows are weakly keeled but the outer row is faintly, but distinctly keeled at midbody (Fig. 10); ventrals 145; the anal is entire, subcaudals 15 pairs; total length 531 mm, tail 55 mm, TL/T = 9.65.

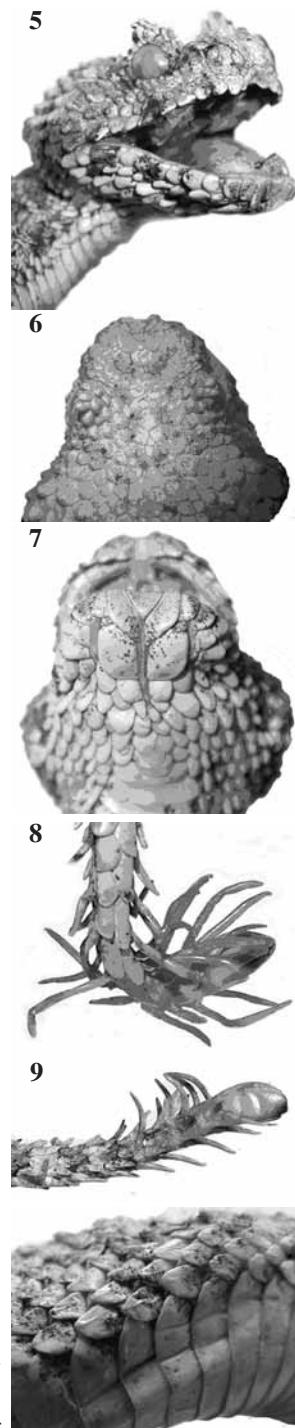
Tail short, with only 15 pairs of subcaudals; dorsolateral caudal scales adjoining subcaudals have elongated keels, progressively longer from proximal to distal end of tail, keels of distal-most becoming entire scale, the longest measuring 11.2 mm; tail terminates in an elongate, oval, bulb-like structure, measuring 10.4 mm, apparently formed of last pair of subcaudals, much enlarged, and a single enlarged dorsal scale; lateral scales elongated to the extent that they give the impression of arthropod legs (Figs. 8–9). The caudal vertebrae extend well into this structure and are not deformed or modified (Fig. 12).

Colors are grayish and brownish above with four series of large dark spots, the two median rows sometimes confluent and forming cross bars; a dark streak on each side of the head from the eyes to behind the gape; the under parts are cream, with a lateral series of dark spots (Figs. 1–4).

REMARKS ON PARATYPE.—ZMGU 1300 is a juvenile, apparently male (see Table 1 for counts and measurements). The caudal ornamentation is less well developed (Fig. 9), possibly a factor of age.

The new species most closely resembles *Pseudocerastes persicus* in the dorsal scale characters which distinguish that taxon from *P. fiedleri*, apart from the greatly shortened tail and the elaborate caudal appendage, which set it apart from both. To the human observer this caudal appendage greatly resembles an arthropod clinging to the tail tip.

Unfortunately, neither specimen is in ideal condition, the head of FMNH 170929 having been severely damaged and ZMGU 1300 having partially rotted prior to proper preservation.



FIGURES 5–10. (5) Lateral view of head of Paratype, ZMGU 1300 (James Parham photo). (6) Dorsal view of head of paratype, ZMGU 1300 (HGK photo). (7) Ventral view of head of paratype, ZMGU 1300 (James Parham photo). (8) Tail ornamentation of Holotype, FMNH 170929 (SCA photo). (9) Tail ornamentation of paratype, ZMGU 1300 (HGK photo). (10) Ventrolateral scale rows keeled (holotype, FMNH 170929) (SCA photo).

DERIVATION OF NAME.—From the Greek: *ura* = tail; *arachno* = spider; *ides* = similar to.

DISCUSSION AND SPECULATION.—This unusual snake occupies a region that lies between the recorded ranges of *P. persicus* and *P. fieldii*. Its discovery raises a number of interesting questions and speculations. Only one of us (HB) has seen this species alive, and while we speculate that the caudal appendage functions as a caudal lure, this remains to be verified. While anthropomorphic interpretation should be avoided where documentation is lacking, caudal luring is known for several species of snakes, e.g., *Bitis caudalis*, *Crotalus cerastes*, *Sistrurus catenatus*, *Agiistrodon contortrix*, *Acanthophis antarcticus*, *Acanthophis praelongus*, *Morelia viridis*, and others, and will probably be verified in many species with differentially colored tails. Gasperetti (1988:354) suggested that this might be the case for the previously known species of *Pseudocerastes*. Neill (1980) reviewed the literature on caudal luring in juvenile snakes, especially crotalids and boids, and suggested that the loss of contrasting tail color with age marked the transition from ectothermic prey (e.g., amphibians, lizards, scorpions, centipedes) to mammals. Greene (1992:111–112) added additional species to the list of snakes exhibiting caudal luring and suggested that contrasting tail coloring and luring behavior might be a synapomorphy in the Crotalinae, Viperidae, or larger clade. This raises the question of the elaborate and sophisticated appearance of the caudal appendage in our new species, as the waving or wriggling motion of a distinctively colored tail tip seems perfectly adequate to attract lizard and anuran prey. We can only speculate that in the case of the present species, the caudal lure serves to deceive a more specific kind of prey, such as shrews or birds. Indeed, ZMGU 1300 contains an undigested, unidentified passerine bird in the stomach (the feet protruding through the body wall). When sufficient specimens become available, additional stomach contents should be examined and observations made of the behavior of captive individ-



FIGURES 11–12. Radiographs of holotype showing undeformed caudal vertebrae extending into bulbous area of tail indicating that the tail tip was neither damaged nor regenerated. (Radiographs by Mark Zimmerman, FMNH.)

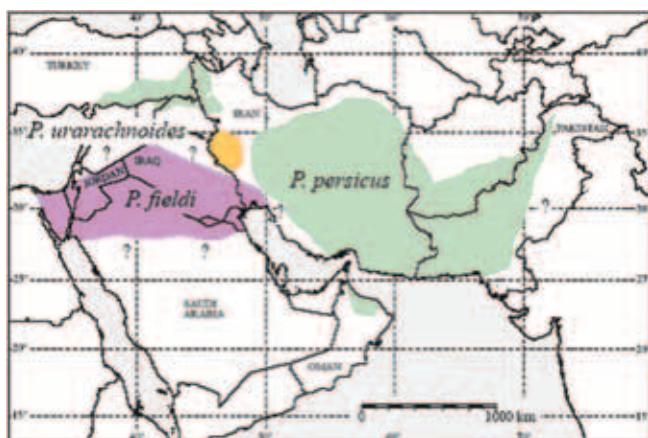


FIGURE 13. Map showing distribution of the genus *Pseudocerastes* (limits of distribution uncertain). (Map prepared by Karen Klitz.)

TABLE 1. Counts and measurements for specimens examined.⁷

	<i>P. urarachnoides</i>		<i>P. persicus</i>	<i>P. fieldi</i>		
	FMNH 170929	ZMGU 1300	Latifi (2000)	Latifi (2000)	CAS 86633	CAS 159051
Sex	♀	♂ [?]		♀	♀	♀
<i>Scale counts</i>						
Ventrals	145	146	144–163	142	153	158
Subcaudals (pairs)	15	15	38–50	46	41	38
Anal plate	single	single	single	single	single	single
Dorsal scales at midbody	21	23	23–25	21	23	23
Scales around eye	— ⁸	18/17	15–20	16	20	18
Interorbital scales	~9–10	16	10–15	10	15	12
Scales between eyes and upper labials	3	3	2–4	3	4	4
Upper labials	~8	11/12	11–14	—	14/13	11/13
Lower labials	13/12	15/14	13–17	—	18/17	13/13
<i>Measurements</i>						
Snout-vent (mm)	531	386	1160	750	515	279
Tail (mm)	55	46	130	80	75	39

⁷ Additional counts and measurements for *P. persicus* and *P. fieldi* are given by Gasperetti (1988:354, table 15).

⁸ Head damaged

uals. Latifi (1991:131) states that the diet of *P. persicus* consists of lizards and mice; Khan (2002) gives deserticolous lizards and arthropods as prey items.

As both available specimens were initially preserved in formalin, no tissue samples suitable for molecular analysis are available. Should such become available in the future, by comparing DNA from the three known species of *Pseudocerastes*, it may be possible to obtain a molecular clock estimate of the time required to evolve such a structure.

The venom of *Pseudocerastes persicus* and *P. fieldi* differ in their chemical composition and in their physiological action (Bdolah 1986:726), and it will be interesting to compare these with the venom properties of the new species, if and when the opportunity arises.

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