ZOO VIEW

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Aberrant Rattlesnakes—Snake Freak Show

> "From the days of Geoffroy-St.-Hilaire, types of reptilian duplication have been designated by a variety of terms based largely upon the nomenclature used for human monsters"
> —Bert Cunningham (1937)

When one works with living snakes in captivity, some unexpected results may occur. When I was employed at Dallas Zoo during 1966–1995, several startling events surfaced which I am taking the liberty of re-describing and updating here.

In 1959, a dealer obtained a collection of large Western Diamondback Rattlesnakes (*Crotalus atrox*) from an unknown locale in Texas. Several normally colored females gave birth and two neonates were amelanotic. These were given to the Houston Zoo. One lived for 12 years and attained a length of 1.6 m. The Houston female was pale yellow with slight diamond markings; tail was banded with light yellow and brown colors. Pre-frontal, frontal, and intercanthal scales were missing. Three interorbitals were bilateral, kidney-shaped supernumerary scales about one-quarter the size of the supraoculars. This female was called Yellow Female. She was bred to a wild-caught normal male without locality data in 1967 and a brood of 8 stillborn and five wild-type neonates were born on 16 September 1967. Our plan was to follow both pigment and scale anomalies through several generations. The Yellow Female was again mated later several times at the Dallas Zoo in the 1968–1970 interval to an amelanotic male (individual DZM), collected in Walnut Springs, Texas (KU 175575). Although courtship behaviors were not observed between these two snakes, we were confident that Yellow Female and DZM were the parents for two reasons—no infertile egg masses or stillborn young were seen and the two amelanotic snakes were observed *in copulo* several times during the two-year interval. As an aside, we saw many instances of reproductive behaviors in other *Crotalus atrox* (see Gillingham et al. 1983). In our first paper in 1987, Fig. 1 shows the phenotypic manifestations of amelanism and scale anomalies in a pedigree of our snakes. In our second paper in 1994, we showed the pedigree of laboratory breeding of our snakes for six generations.

Some of the newborn snakes crawled strangely but we could not figure out why until one of the staff shouted, "The scales are backwards!" Upon closer examination, we found anomalous ventral scales, head scales, and body scales. We asked Charles Carpenter from University of Oklahoma to film these neonates and analyze their movements using his Vanguard Motion Analyzer. The plan did not work because the reversed ventrals caught on every irregularity, including what appeared to be smooth plywood sheets so our filming was scuttled. Some of the neonates were stillborn and preserved.

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I called Paul F. A. Maderson at Brooklyn College to see if there were any other reports. He is an eminent expert on reptilian integument so I knew that he would certainly be aware of other descriptions. He did not believe me so I offered to send some preserved specimens for examination. A few days later, he called with unbridled excitement, saying that this was just too bizarre and beyond comprehension. I immediately invited him to join us to describe this phenomenon. We published our findings on the possible causes of the inheritance/genetics patterns over six generations (Murphy et al. 1987; McCrady et al. 1994) and the figures in those publications are reproduced here (Figs. 1–10).

I describe here a case of *duplicitas anterias*. A young male Eastern Diamondback Rattlesnake (*Crotalus adamanteus*), measuring ca. 50 cm, was obtained by Dallas Zoo in June 1966. A

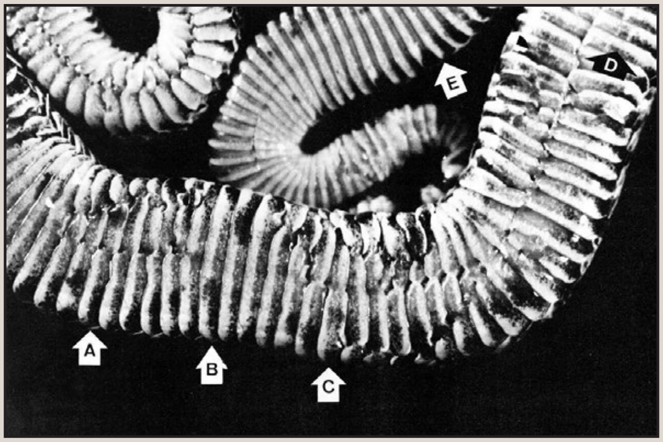

Fig. 1. Ventral view of anomalous gastrosteges of wild-type neonate, (A) half-reversed, (B) reversed, (C) normal-reversed single unit, (D) paired, (E) normal. From Murphy et al. (1987).

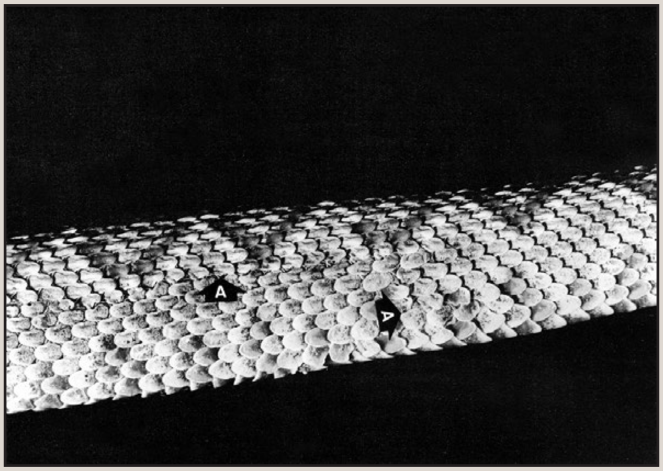

Fig. 2. Lateral view of amelanotic neonate. Note reversal of dorsal scales along body axis (A). From Murphy et al. (1987).

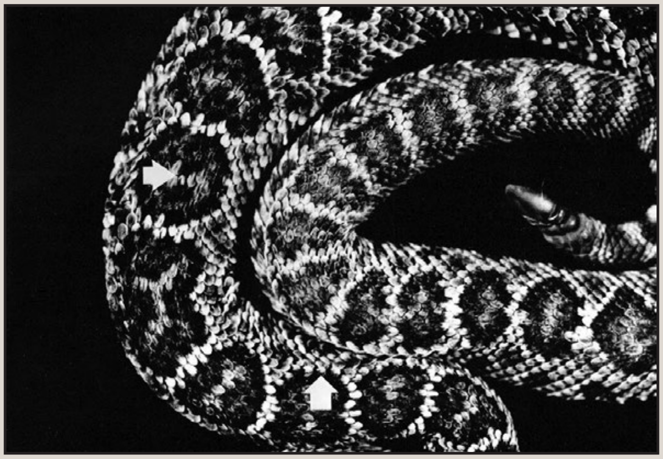

Fig. 3. Dorsal view of wild-type neonate. Note reversal of dorsal scale orientation at various locations along body axis, as denoted by arrows. From Murphy et al. (1987).

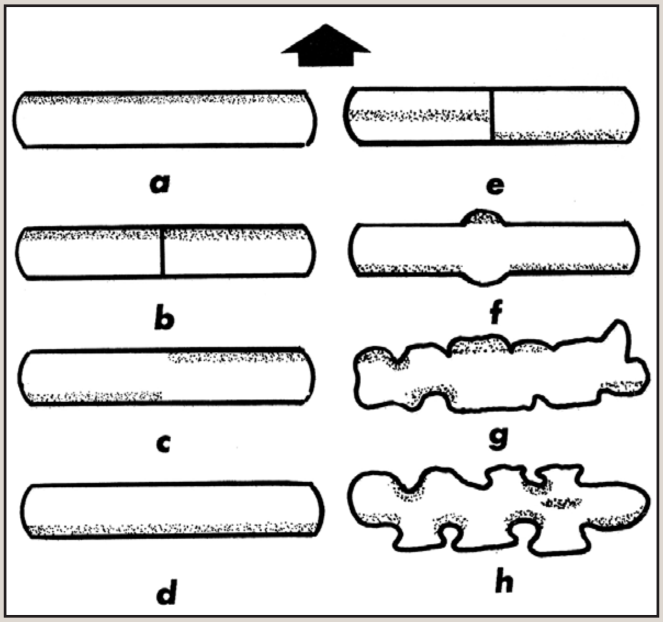

Fig. 4. Diagrammatic representation of anomalous gastrosteges. Darkened area indicates presumed point of attachment. Arrow denotes anterior direction. From Murphy et al. (1987).

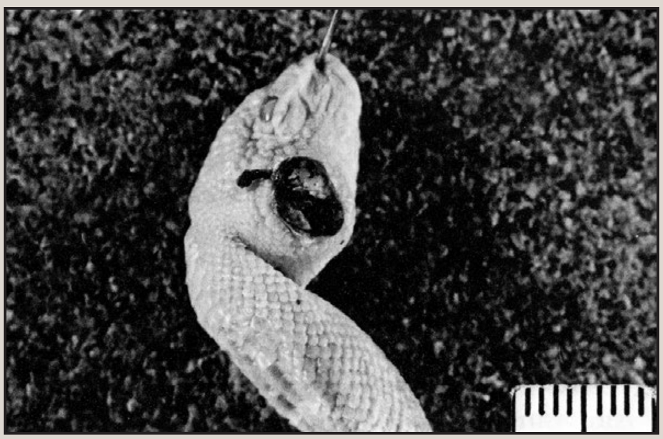

Fig. 5. Cranioschisis in amelanotic neonate. From Murphy et al. (1987).

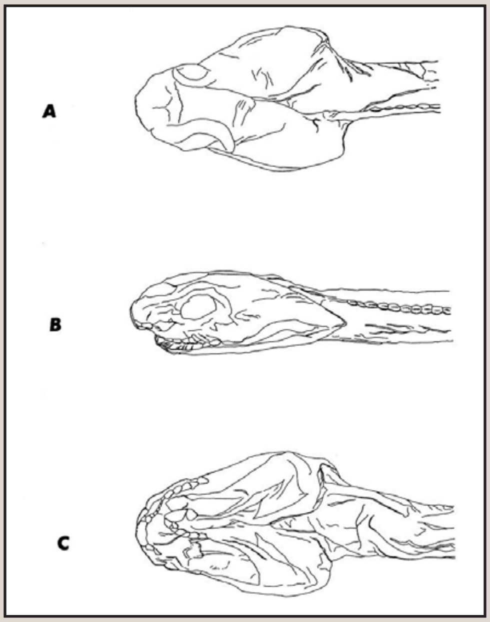

Fig. 6. Specimen represents most abnormal of young produced. A) Dorsal aspect showing absence of head scales. B) Lateral aspect showing absence of eye and rudimentary supralabials. C) Ventral aspect showing rudimentary infralabials and absence of anterior ventrals. From McCrady et al. (1994).

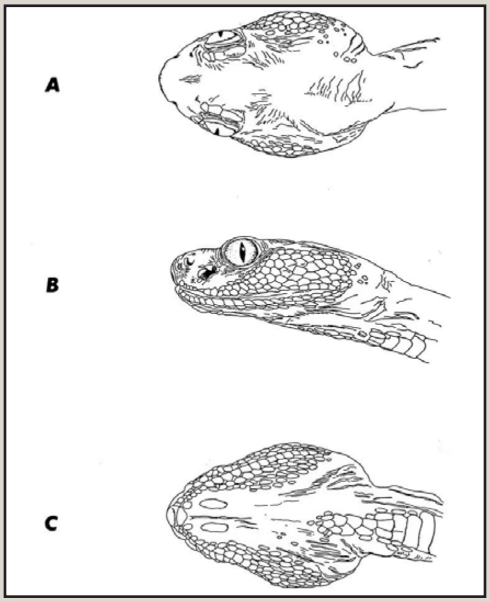

Fig. 7. Partially scaled specimen. A) Dorsal aspect showing remnants of supraoculars. B) Lateral aspect showing reduced labial scales and absence of nasals and oculars. C) Ventral aspect showing reduced genials and bare gular region. From McCrady et al. (1994).

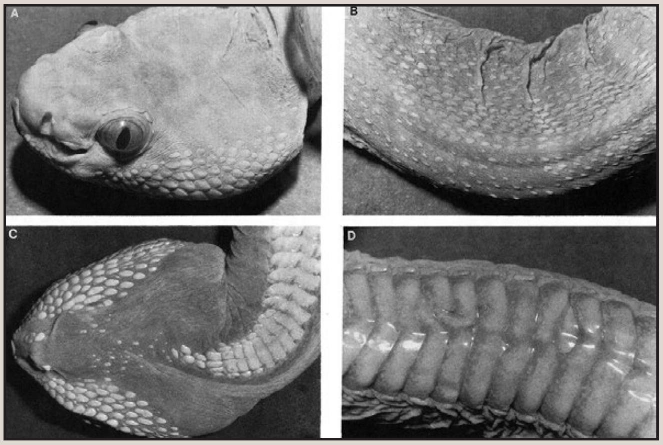

Fig. 8. Partially scaled specimen. A) Dorsolateral aspect of head showing reduced scalation and bare temporal region. B) Dorsal aspect of body showing reduced dorsal scales. C) Ventral aspect of head showing bare gular region. D) Ventral scales showing midline cleft. From McCrady et al. (1994).

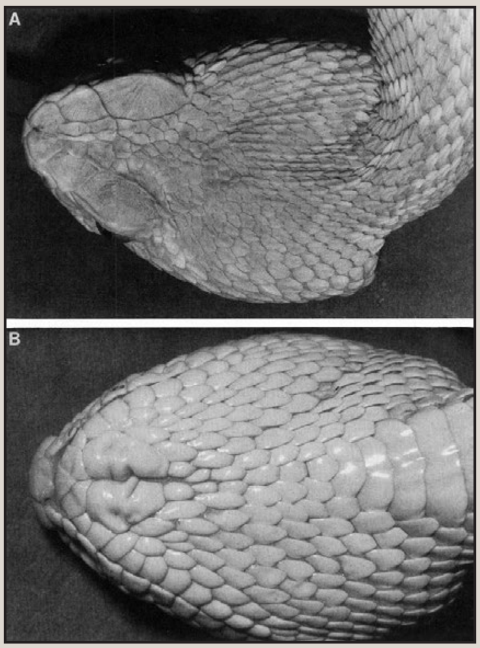

Fig. 9. Scaled specimen. A) Dorsal aspect of head showing abnormal scalation (internasals, canthals, and intercanthals). B) Ventral aspect of head showing abnormal genials. From McCrady et al. (1994).

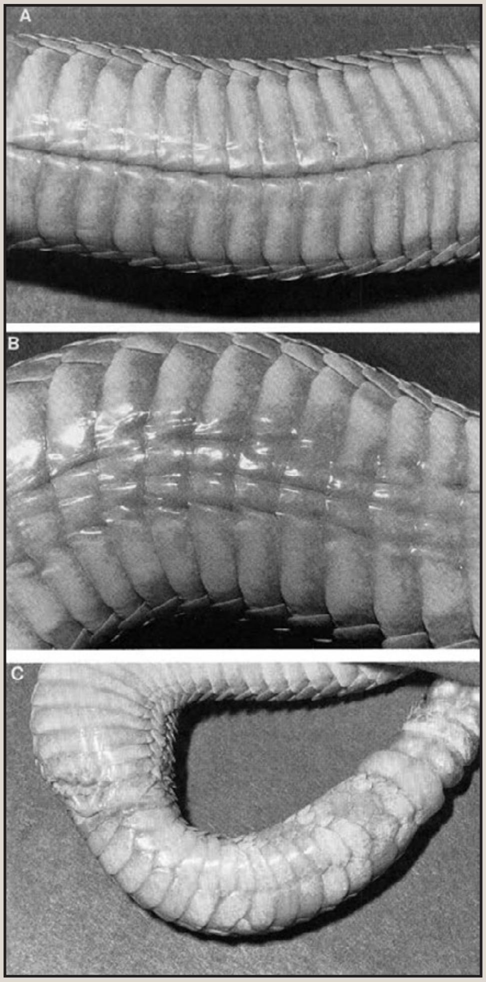

Fig. 10. Scaled specimens. A) Ventral scales showing single midline cleft. B) Ventral scales showing triple midline cleft. C) Ventral aspect of posterior trunk showing anal plate and subcaudal abnormalities. From McCrady et al. (1994).

female, roughly the same size, was received 5 months later. This male achieved a total length of about 135 cm and weighed about 3.5 kg and the female measured about 110 cm and weighed 1.1 kg on 15 January 1971. Exact measurements were not taken in order to avoid stressing these snakes. Coitus occurred during 30 January 1973 and the snakes remained *in copulo* for over nine hours. On 1 August 1973, the female gave birth to nine normal young and one bicephalous neonate (gestation period of 213 days) (Fig. 11). The latter snake survived for 12 h and heads moved independently. When the snake tried to crawl, the right head was the initiator but movement was limited due to the severe contortions of its body. Both heads tried to breathe but the effort was labored—gaping, protruding the glottides, and shuddering of the body. Both tongues moved but the left one stopped moving after 9 h. A radiograph taken after death revealed that the snake was fused at the midline (Fig. 12). The anterior right hand portion measured 6 cm (40 total vertebrae) and the left was 5 cm (36 total vertebrae). There was a bifid digestive tract that was fused in the posterior portion, 3 cm anterior to the cloaca. The overall length of the right was approximately 20 cm and the left was ca. 17 cm. The right side had a relatively normal cardiovascular and respiratory system. Vestigial heart and lung were identified on the left side. The tracheae were normal. Kidneys, liver, spleen, and pancreas could not be located. The fangs, jaws, and mouths appeared to be normal. Head scalation (right) supralabials 14 + 15; infralabials 18 + 18; canthals 2 + 2; scales between anterior canthals 2 and posterior canthals 4; total scales in prefrontal region 11; width 15 mm; length 24 mm. The left side was supralabials 14 + 15; infralabials 18 + 17; canthals 2 + 2; scales between anterior canthals 2; scales between posterior canthals 4; total scales in prefrontal region 13; width 14 mm; length 24 mm. This snake is deposited in the vertebrate collection of the University of Texas at Arlington (UTA R-5545).

In 1937, Bert Cunningham published a monumental treatment of birth anomalies in his book *Axial Bifurcation in Serpents.* In it, he included eleven plates showing an array of the most dramatic

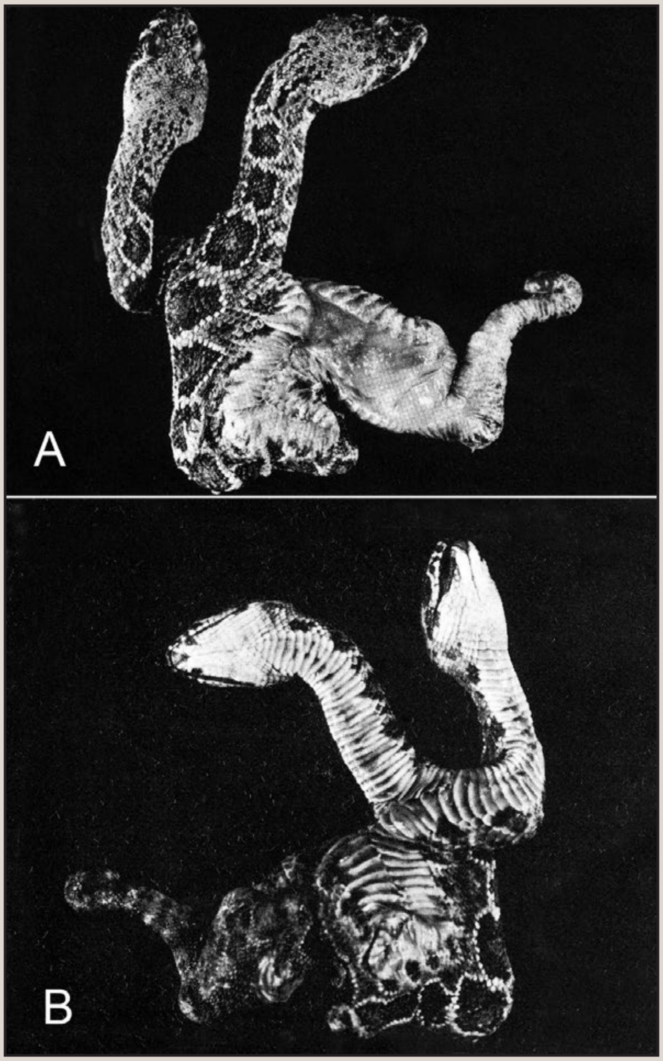

Fig. 11. Dorsal (A) and ventral (B) views of bicephalic *Crotalus adamanteus.*

birth defects imaginable, detailing 225 cases of 44 species in 29 genera. Seventy-five years later, Van Wallach compiled a comprehensive treatment of axial bifurcation and duplication in snakes. His investigation was quite interesting and thorough—a review of scientific and popular literature and a checklist of 169 species in 93 genera with an analysis of data by geographic area as well as anatomy and behavior.

Wallach published several papers on this topic (2004, 2007, 2012). In most cases, two-headed monsters are stillborn and the majority of living snakes die shortly after birth. The San Diego Zoo has had several two-headed California Kingsnakes (*Lampropeltis californiae*) between 1955 and 1974 named "Dudley-Duplex" and "Nip and Tuck." When feeding, both heads tried to swallow the same mouse. To prevent injury, Boyer and Baldwin (1997) devised a simple way to solve this problem (Fig. 13). For zoo workers who might receive a two-headed snake in the future, remember this simple solution.

Fig. 12. Ventral-dorsal radiograph of bicephalic *Crotalus adamanteus.*

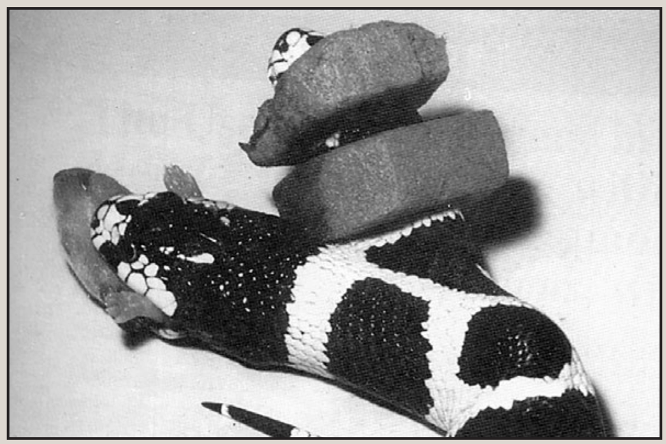

PHOTO BY DONAL BOYER

Fig. 13. Two-headed California Kingsnake (*Lampropeltis californiae*) at San Diego Zoo wearing a foam rubber collar to prevent injury when food was offered. The collar was alternated between the heads during feeding.

Acknowledgments.—For various courtesies and support of these studies, I gratefully thank the herpetological staff at Dallas Zoo who maintained this large colony of rattlesnakes for many years. Without their dedication and expertise, these studies could not have been accomplished. All of these snakes were very difficult to handle with snake hooks but rarely did they strike defensively; we began to wonder if these behavioral traits may have been inherited. More importantly, no one was bitten. Co-authors J. E. Rehg, P. F. A. Maderson, J. A. Shadduck, C. M. Garrett, D. T. Roberts and W. B. McCrady were instrumental in preparing these papers. An early draft of this article was reviewed by Judith Block, Jonathan A. Campbell, and William W. Lamar. Lamar helped prepare the figures. Most photographs were taken by David T. Roberts, Dallas Zoo. I am pleased to recognize Smithsonian's Museum of Natural History librarian Polly Lasker, British Herpetological Society, The Herpetologists' League, and *Zoo Biology*.

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