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Redescription of the Arakan Forest Turtle *Geoemyda depressa* Anderson 1875 (Testudines: Bataguridae)

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ABSTRACT. – A live adult male and female *Geoemyda depressa* were recently purchased in western Yunnan Province, China, 700 km northeast of the only previously known locality for the species in southwestern Burma (Myanmar). Only six specimens of this species have previously been recorded, and these two represent the first specimens collected since 1908. Based on all available museum material, the species is redescribed, although the identity of the type specimen remains equivocal. The Chinese animals are certainly extralimital and were probably imported from Burma for the food market.

KEY WORDS. – Reptilia; Testudines; Bataguridae; *Geoemyda depressa*; turtle; taxonomy; redescription; China; Burma; Myanmar

Geoemyda depressa was first described in 1875 by John Anderson, based on a single mentioned specimen from "Arakan" (in western Burma, now Myanmar), and for which he provided several general shell measurements. In 1878 he repeated (and corrected; see footnote 2, p. 718) his original description, restricted the type locality to "the hilly region in the neighbourhood of Akyab [= Sittwe: 20°09'N, 92°55'E] in Arracan" (p. 722), and provided drawings (Fig. 1; reproduced also in Bourret, 1941, and Wermuth and Mertens, 1961) of a skull, a male in life, and a plastral view of a male shell. Unfortunately, he did not clarify whether these illustrations represented a single individual or whether any or all of them represented the type(s). However, his concluding statement, that he had "obtained examples [plural] of this interesting species [in] Arracan" suggests that he had more than one individual available by 1878 (including those sent to the Berlin Museum and British Museum, see below), although his original (1875) description detailed only one specimen. The location and identity of these specimens has been problematic.

Indraneil Das (*pers. comm.*) reported to us in 1988 that the National Zoological Collection of the Zoological Survey of India (ZSI) in Calcutta apparently had a specimen labelled as the "cotype" of *Geoemyda depressa* Anderson. Because Anderson was the Curator of Zoology at the Indian Museum (the zoological collections of which are now accessioned into the ZSI) from 1865 to 1886 (Leviton and Aldrich, 1984), the type would logically have been deposited in his own collection (particularly since the new museum opened in 1875). At our request I. Das kindly revisited that collection in early September 1995 and located their single specimen (ZSI 751, a disarticulated skull), collected in "Burma" by A. Eden, and registered as the "cotype" of *G. depressa*. This suggests that Anderson (1875) based his original description on two specimens, ZSI 751 (presumably the skull illustrated in Plate LXXV[B] in Anderson, 1878, although this specific comparison has not been made), and one additional specimen. The latter is presumably the male shell illustrated in Plate LVI in Anderson (1878), since Anderson's 1875 and 1878 descriptions as well as ratios of the measurements in those descriptions closely match the animal in the plate. Note, however, that Anderson's first mention of "anals" must be a lapsus for "femorals," since anals are referred to as being differently colored in the next sentence, and that the "depth through skull" measurement in 1878:722 is a lapsus for "depth through centre of shell" from 1875. Unfortunately, this male shell has not been located, and we presume it is lost.

Fritz et al. (1994) recently claimed that an adult female specimen in alcohol in the Museum für Naturkunde in Berlin (ZMB 8869), from "Arakan," was explicitly sent there by Anderson as the holotype of *Geoemyda depressa*. Furthermore, U. Fritz (*pers. comm.*) stated that the specimen was accessioned in the ZMB catalog as the "type" and that the carapace and plastron length were 22.5 and 21.0 cm, respectively, which closely approximate Anderson's (1875) corresponding measurements for the presumed type of 9 inches (ca. 22.9 cm) and 8.1 inches (20.6 cm). Although this specimen was not available to us by loan, R. Günther kindly provided the original photographs reproduced in Fritz et al. (1994) (Fig. 2). When we compared those photographs with Anderson's descriptions, we found several inconsistencies which would seem to deny that they were based on ZMB 8869. First, Anderson (1875, 1878) noted that "the interval between the axillary and inguinal notches [was] deep black." Although the bridge of the male in Anderson's (1878) Plate LVI is solid black, that of ZMB 8869 is not. Second, Anderson stated that "the outer halves of the pectoral and anal [apparently a lapsus for femoral; see above] plates [were] blackish brown, with a partial reticulation extending across the plates; the gulars, postgulars [= humerals], and anals have also a tendency to be coarsely and irregularly reticulated with the same colour." This description applies to the male in Plate LVI, but ZMB 8869 does not have the outer *halves* of any plastral scutes darkly pigmented and it lacks any dark markings on the gulars. Third, Anderson's mea-

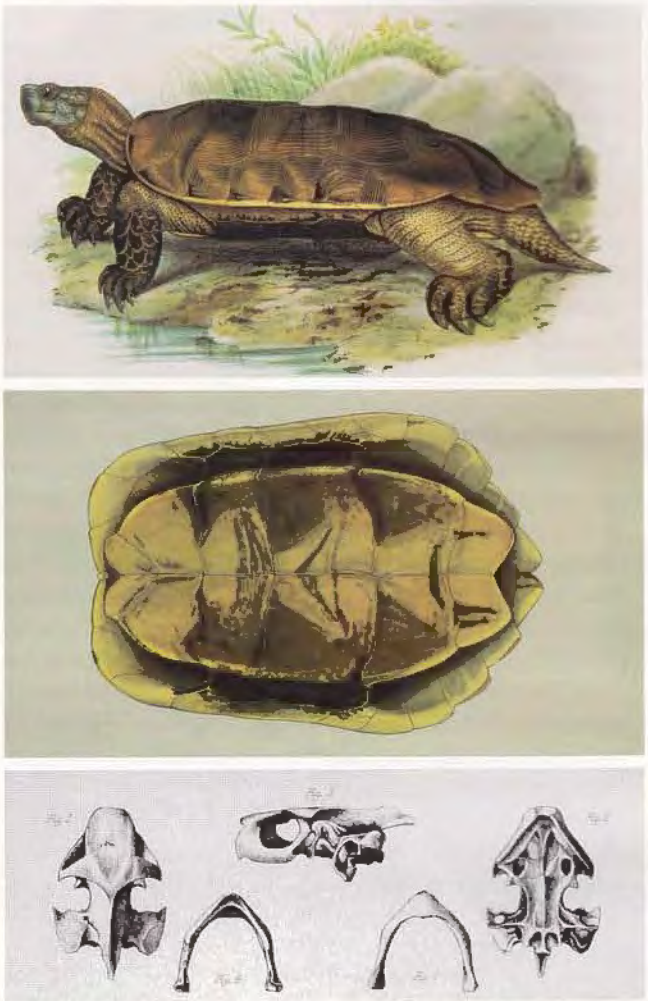

Figure 1. *Geoemyda depressa* as illustrated by Anderson (1878). **Top:** Plate LV, **middle:** Plate LVI, and **bottom:** Plate LXXV[B] (Figs. 1–5).

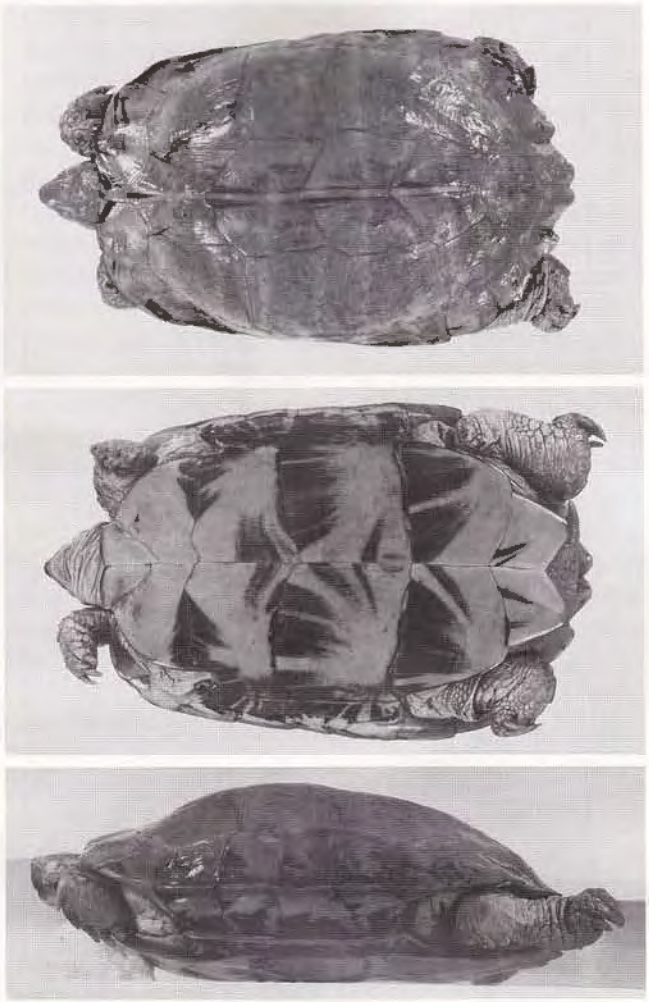

Figure 2. Specimen of *Geoemyda depressa* in the Museum für Naturkunde in Berlin (ZMB 8869) purported by Fritz et al. (1994) to be the holotype.

surements indicate that the ratio of carapace width at the axillary region to the total carapace length was 0.74. Measurements from Plate LVI reveal a ratio of 0.75 to 0.73, depending on whether carapace length is measured medially (i.e., to the "caudal notch" only; Anderson 1875) or as maximum length (i.e., "total length", Anderson 1878), respectively. In contrast, measurements from the photographs of ZMB 8869 reveal respective ratios of 0.69 to 0.68. Similarly, the ratio of carapace width at the axillary region to "sternum" (plastron) length was 0.83 from Anderson's measurements. The ratios from Plate LVI were 0.84 or 0.79, depending on whether the plastron was measured only to the anal notch (i.e, medially), or as maximum anterior to posterior length, respectively; whereas those for ZMB 8869 were 0.77 and 0.72, respectively. However, as Fritz (*pers. comm.*) pointed out, Fig. LVI may have been idealized by the artist and thus not a precise rendition.

Without more explicit information that may have accompanied the deposition of the specimens in the ZMB and ZSI, and without personal access to those specimens or the one figured in Plate LVI, we cannot be certain which specimen(s) represent the type(s). However, the reasons why Anderson might have sent type material to Berlin and not to London (or elsewhere) may not be immediately obvious and warrant clarification. Anderson had visited Peters in Berlin during a trip to European collections in 1874 (Leviton and Aldrich, 1984), and was indebted to Peters for his help with solving the problem of the erroneous type locality for *Morenia ocellata* (see Anderson, 1878), thus enabling him to name his new species, *Batagur* (*Morenia*) *petersi*, after Peters. Clearly, Anderson felt an obligation to Peters. Indeed, he apparently even sent one specimen of the type series of *Morenia petersi* to Berlin (Fritz et al., 1994; see also Anderson 1878). Nevertheless, we cannot understand why Anderson would have felt so obligated to Peters that he would have sent the holotype of *depressa* there instead of depositing it in his own collection. Perhaps information available to future authors will permit a complete resolution of the location and identity of the type or types of *Geoemyda depressa*.

The description of *Geoemyda depressa* Anderson 1875 is even further complicated by the fact that only one year after its publication, Theobald (1876: page vii, Errata et Addenda) described *Geomyda Arakana* [sic] from "Akyab"

in Arakan Province, Myanmar). The description was more vague than Anderson's, but Theobald provided a more explicit type locality, which is no doubt the basis for Anderson's (1878) subsequent type locality restriction (see above). Theobald also recorded that his description was based on an "aged female [measuring] 9.5 inches in a straight line." This specimen was apparently received by the British Museum of Natural History in an exchange with R. Lydekker. The specimen, recorded in the BMNH catalog as the "Type" from "Aracan," includes a dry shell (248 mm maximum carapace length) of an adult female (BMNH 88.6.18.1; now 1947.3.4.28) and a separate skull (BMNH 90.1.28.9; now 1947.3.5.69).

Since Theobald's description seems clearly to be based on a single specimen, and only a single specimen matching that description is known to be labeled as the type, Anderson's (1878) statement that Theobald's description was based on "specimens [plural] in the Indian Museum, Calcutta" is intriguing. Did Anderson simply mean that Theobald's holotype was in two parts (i.e., shell and skull), or was he alluding to another Theobald specimen (e.g., BMNH 87.3.30.1; see below), or was he insinuating that Theobald was inappropriately (from Anderson's perspective) trying to describe a taxon he had no business describing? The latter seems unlikely, since Anderson apparently bore no animosity toward Theobald, for whom he named *Chaibassa theobaldi* (1878) (= *Melanochelys tricarinata* Blyth). Indeed, Anderson (1878) even expressed "much pleasure in connecting Mr. Theobald's name with [that] species." This was done despite Theobald's earlier harsh words (1874) about Anderson's conclusions regarding Indo-Burmese softshell turtles.

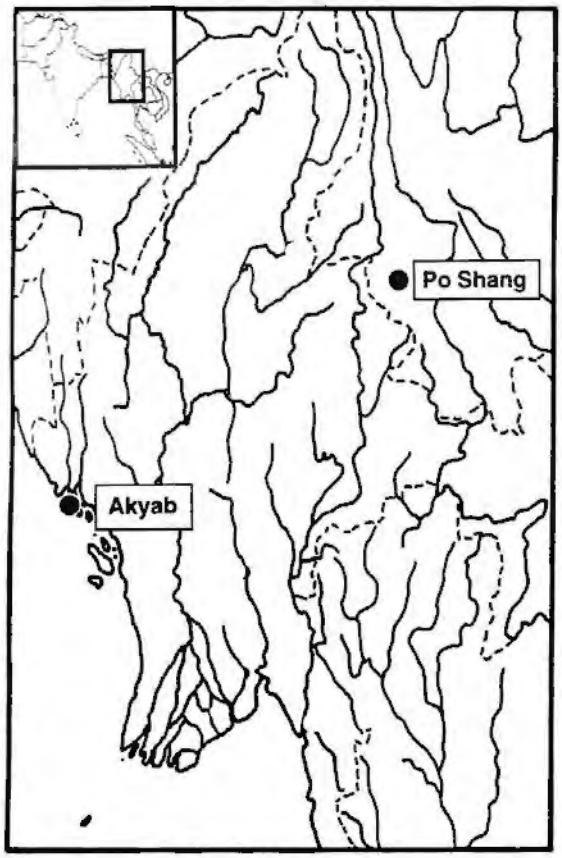

Figure 3. Localities for *Geoemyda depressa* in Burma (Myanmar) and western Yunnan, China.

On the other hand, during the 1870s Theobald may well have developed a resentment of Anderson for describing taxa from Burma (i.e., Theobald's "territory;" I. Das, *pers. comm.*) and for confusing the taxonomy of turtles that Anderson knew only in the lab, but that Theobald knew in the field (e.g., see Theobald, 1874). As support for this scenario, in his Asiatic Society Catalogue, Theobald (1868) was very cordial in his references to Anderson, and he even named *Trimeresurus andersoni* (= *T. purpureomaculatus*) "for the hardworking and zealous officiating Curator." However, Anderson is not even acknowledged in Theobald's 1876 catalogue of British India. Although we will likely never know the full politics surrounding the interaction between Anderson and Theobald, Anderson's was the earlier description of the Arakan forest turtle, and it was he who appropriately synonymized Theobald's *G. arakana* with his own *G. depressa* in 1878. In any case, by 1888 Theobald's type had been sent to the BMNH, perhaps as part of Anderson's desire to transfer the type collection to the British Museum (initiated in 1877, but never completed; see Leviton and Aldrich, 1984). By then Theobald himself had already sent the BMNH another female specimen (a severely deformed, dried shell of an adult female; BMNH 87.3.30.1) from "Aracan."

To add one last bit of confusion, in 1881 Hubrecht reported a specimen (National Natuurhistorisch Museum in Leiden, RMNH 6209) of "*Geoemyda depressa*" from Padang, Sumatra. However, that specimen is actually *Heosemys spinosa* (identity confirmed by Iverson, Peter Paul van Dijk, and Marinus S. Hoogmoed).

Until 1994 only one additional specimen of *G. depressa* materialized. BMNH 1908.12.28.11, a subadult female in alcohol, from "Aracan," was donated in 1908 by Dr. Dobson of the Army Medical College. We assume that neither Theobald nor Anderson had seen this specimen prior to their descriptions. That brought the total number of specimens of *Geoemyda depressa* known prior to 1994 to five (excluding the lost male cotype).

No new information about *Geoemyda depressa* (except its relegation to the genus *Heosemys* by McDowell, 1964, and its return to the genus *Geoemyda* by McCord et al., 1995) was forthcoming until Fritz et al. (1994) reported on the specimen in the ZMB collection and briefly compared it with *Heosemys grandis* and *H. spinosa*.

Finally, in May of 1994, colleagues of Oscar Shiu purchased a live adult male and female *Geoemyda depressa* from a local person in a small village near Po Shang (23°42'N, 100°01'E) in western Yunnan Province, China. Although this locality is near the border with Burma (Myanmar), it lies over 700 km northeast of the type locality in southwestern Burma (Fig. 3). These specimens were forwarded alive to WPM, in whose collection the male remains alive at this

writing. Because these were the first living specimens of this taxon seen in over 100 years, we attempted to borrow all available museum material and provide a complete redescription of the species (including the first live color photographs).

Geoemyda depressa Anderson 1875
Arakan Forest Turtle

Diagnosis. — A medium-sized batagurid turtle, distinguished from all other batagurids by the combination of large size; brown, often black-streaked, depressed carapace; non-descript head markings; unhinged plastron with black radiations; well-developed bony bridge; huge anterior antebrachial scales; massive antebrachia; medial gular length nearly as short or shorter than interhumeral seam length or interanal seam length; interfemoral seam usually nearly twice as long as its interanal seam; choanae marked with ridges (type C of Parsons, 1968); and lack of a quadratojugal.

External Morphology. — Description based on 3 BMNH specimens, 2 live specimens, photographs of ZMB 8869, and the 3 figures (possibly of the same specimen) in Anderson (1878); because the anterior carapace of BMNH 87.3.30.1 bulges anomalously, it is excluded from appropriate parts of the following description.

Maximum carapace length (CL) to at least 263 mm in males and at least 258 mm in females, elongate, relatively low (maximum carapace height/CL = 0.35 to 0.38; mean = 0.36; $n = 4$), with an obvious medial keel and a very weakly developed pair of lateral keels, widest at the level of marginal (M) 7 or 8 (maximum carapace width/CL= 0.69 to 0.73; mean = 0.70; $n = 4$), with a moderately serrated posterior margin in males and a weakly to moderately serrated one in females, and with obvious growth annuli except in the oldest female specimen. M1 longest, M8 and 9 nearly as long, M5 (rarely), 11, or 12 shortest; M9 or 11 tallest, M8–12 flared. Lateral margins of at least M4 and 8 upturned, forming a shallow trough on the dorsum of at least those two scales. Cervical scute small, rectangular to triangular, longer than wide; posterior margin broader than anterior margin. Vertebrals (V) 1–5 wider than long; V1 extending laterally only to middle of M1 (not near contacting M2); V5 contacting middle half of M11. Medial keel well-developed, but least obvious on V1 and V5. Lateral pair of keels very weak to nonexistent, evident at least on costal areolae. Carapace brown, often (but not always) with random, small, narrow, black radiating markings that widen laterally on each scute; subadult female with weak radiations only on M5–7. Triangular black carapacial markings most consistently present on the anteriolateral corners of M2–12.

Figure 4. Carapacial and plastral views of *Geoemyda depressa*. **Left:** female, WPM 2 (UF 102893), 258 mm CL; **right:** male, WPM 1, 263 mm CL. See the journal cover for an additional color photo of the male.

Maximum plastron length shorter than carapace length (PL/CL = 0.92–0.96 in three females; 0.84 in one male). Plastron distinctly upturned anteromedially, with no hinges, and with a solid, bony bridge. Plastral forelobe width (PW1) at level of junction of humeropectoral seam and lateral plastral margin 42.5 to 46% (mean = 44.5%) of plastron length. Anterior width of plastral hindlobe (PW3) 53 to 55% (mean = 54%) of plastron length. Plastral hindlobe with distinct anal notch (medial depth of notch 51 to 58% of interanal seam length in four females, mean 55%; 65% in one male). Bridge moderately long (bridge length/PL = 0.40 to 0.44, mean = 0.42; BL/PW3 = 0.72 to 0.83, mean = 0.78); a single, small, crescent to trapezoidal shaped axillary scute and a small, triangular or rectangular inguinal scute present on each bridge. Average plastral formula: interabdominal seam (IAB: mean percent of PL, 25.6%) >> interpectoral seam (IP: mean percent of PL, 20.1%) > interfemoral seam (IF: mean percent of PL, 18.0%) >> interanal seam (IAN: mean percent of PL, 10.6%) = interhumeral seam (IH: mean percent of PL, 10.5%) ≥ intergular seam (IG: mean percent of PL, 9.3%). Plastron yellow-brown and black in adults, with black markings covering the bridge areas, the posterolateral area of the humeral scutes, the posterior half and anterolateral area of the pectoral scutes, most of the abdominal scutes, the anterior half and posterior fourth of the femoral scutes, and the anterior part of the anal scutes (Fig. 4). In subadult radiating lines not so extensive, confined to area of bridge and seams between pectorals, abdominals, and femorals.

Head moderately broad; upper jaw slightly hooked, with a small tooth-like projection on either side of the medial notch in the upper tomium (worn in older specimens); triturating surfaces narrow, without ridges. Area of medium-sized scales between orbit and tympanum. Head non-descript; dorsum of head and tomia very dark brown, rest of head gray-brown; small ventromedial area of lower tomium cream-colored. Choanae marked with ridges (type C of Parsons, 1968).

Antebrachia proportionately massive in adults, with long, thick claws. Digits long and only very weakly webbed. Anterior surface of anterior antebrachium covered with at least four rows of huge, imbricate scales (not sickle-shaped), the largest one in adults much larger than the orbit in diameter; largest scales on hindlimb at heel, the largest one approximately the same diameter as the orbit. Upper parts of limbs finely scaled. Tail covered with scales of medium size. Exposed parts of limbs very dark brown to black. Recessed areas of skin creamy brown, with very small, dark brown scales (appearing finely spotted). Tail of moderate length, very dark brown, much longer in male than female, anus at or within level of carapacial margin in females, well beyond it in males. Plastron concave in males, flat in females.

Osteology. — The single BMNH skull has the maxillae separated anteriorly by the premaxillae; pterygoid broadly contacting the jugal, but processus inferior parietalis not contacting the jugal; foramen palatinum posterius large, slightly larger than foramen orbito-nasale; fissura ethmoidalis narrow, basically key-hole shaped; processus trochlearis oticum consisting mainly of a greatly exposed prootic; cranial cavity ventrally narrowed very little by the processi inferiores parietales; latter contacting palatines; and no quadratojugal (postorbital bar).

Radiographs of the Yunnan specimens were not definitive regarding neural configurations; however, the anterior neurals appeared to be hexagonal, with the shortest sides directed posteriorly. The free margins of the first two and last three peripheral bones are serrated. The humeropectoral seam crosses the entoplastron.

Systematics. — Comparisons among the members of the genera *Cyclemys*, *Heosemys*, *Pyxidea*, and *Geoemyda* were made by McCord et al. (1995). The cladistic relationships among the species in those genera presented by them were not changed when the unknown character states for *G. depressa* in their Table 1 were identified in this study and the analysis rerun.

Comments. — Given that all previous specimens of *G. depressa* were recorded as being collected in Arakan in Burma (Myanmar), there is no reason to doubt the validity of that general distribution. However, it should be noted that Akyab (Anderson's restricted type locality) is over 60 km from the Arakan hills (Annandale, 1906). On the other hand, since the Yunnan specimens were purchased from a local person who had maintained them as pets (O. Shiu, *pers. comm.* to WPM) in a village over 700 km from the only known, and very remote, locality in Burma, the likelihood that they were collected locally in Yunnan is doubtful. It remains an enigma as to how an adult pair of this very rare species could come into the possession of an individual in such an isolated part of Yunnan Province, China. However, Kuchling (1995) has reported the extensive traffic (for food) of non-native turtles into markets in Ruili (24°00'N, 97°53'E), also in western Yunnan. This may be the means by which our specimens made their way to China.

Captive Observations. — Our two individuals were omnivorous, feeding readily on bananas, strawberries, romaine lettuce, earthworms, and pinkie mice, but refused to eat peaches. Their habits in captivity suggested a preference for a wet, terrestrial existence. They were not good swimmers and were stressed in deep water; they seemed most at home in a large tank at 25°C with only 2–3 cm of water. They had to be maintained in a tank with high walls because they were excellent climbers. They were quite bold (the male more than the female), rarely retreating into their shells, but rather attempting to run away if approached. They were not at all aggressive toward humans or to one another or to smaller turtles (e.g., *Cuora*), even when feeding.

Acknowledgments

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National Natuurhistorisch Museum in Leiden (RMNH) facilitated specimen loans. Rainer Günther of the Museum für Naturkunde der Humboldt-Universität zu Berlin (ZMB) provided photographs. Information about the specimen in the collection of the Zoological Survey of India was provided by Indraneil Das. Kraig Adler provided valuable copies of old literature (including the original plates from Anderson, 1878) as well as historical information about early authors and collectors. Comments on early drafts of the manuscript were provided by Kraig Adler, Aaron Bauer, Roger Bour, Jonathan Campbell, Indraneil Das, Colin McCarthy, Peter Paul van Dijk, and Robert G. Webb. Support for JBI was provided by Earlham College, the Joseph Moore Museum of Natural History, and his family.

SPECIMENS EXAMINED

BMNH 87.3.30.1, 88.6.18.1 (now 1947.3.4.28; with skull 90.1.28.9 [now 1947.3.5.69]), 1908.12.28.11; UF 102893 (female, formerly WPM 2); WPM 1 (male alive in the collection of WPM; to be deposited on death in the UF collection); ZMB 8869 (photographs only).

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