

SHORT NOTES

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**A REASSESSMENT OF
HARDELLA ISOCLINA DUBOIS,
1908 (TESTUDINES: BATAGURIDAE)
FROM THE TRINIL BEDS OF THE
JAVAN PLEISTOCENE**

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Hardella isoclina was described by Dubois (1908) from the Trinil Beds (Pleistocene) of Kedoeng Panas (= Kedung Panas), Java, Indonesia, also the source of the famous remains of Java man, *Homo* ("*Pithecanthropus*") *erectus*. The holotype and sole example of this fossil turtle species is at the Nationaal Natuurhistorisch Museum (previously Rijksmuseum van Natuurlijke Historie), Leiden and the original description of the new turtle fossil was brief and carried no illustrations. No reason was given for the assignment to the extant north Indian batagurid genus, *Hardella*, which is restricted to the flood plains of the rivers Indus, Ganges and Brahmaputra, in the northern parts of the Indian subcontinent (Smith, 1931; Das, 1995). Williams (1957) subsequently expanded the description, provided photographs and restorations of the fossil, diagnosis, and comparison with recent batagurids from tropical and subtropical Asia. The Trinil fossil was tentatively assigned to the genus *Clemmys*, then primarily a catch-all taxon used for many small, narrow-headed emydids and batagurids with hexagonal neurals with short sides anteriorly. Williams (1957) commented that the knowledge of the skeletal morphology of Asian turtles that existed then did not permit a resolution to the problem of assigning a generic identity to the material from Trinil, but he indicated a close affinity of the fossil with *Clemmys* (now *Mauremys*) *mutica*. In the almost forty years that have elapsed since Williams' redescription, knowledge of the systematics and distributions of Asian turtles has increased to a point that permits us to grapple with the problem once again.

Williams (1957) compared Dubois' new species with a variety of south-east and east Asian turtle genera and species now assigned by some authorities (e.g. Gaffney, 1984; Gaffney & Meylan, 1988) to the family Bataguridae and assigned it (questionably) to the genus *Clemmys*, close to *C. mutica*, which is supported in a comparison with all known batagurid genera from southern and south-eastern Asia (see Table 1). The latter species is now included in the genus *Mauremys*, *Clemmys* having been restricted to certain North

American species (McDowell, 1964). In Hirayama's (1984) scheme of classification, the *Mauremys* group of batagurids fall out from the rest of the members of the family. The Trinil fossil shows one important characteristic that differentiates *Mauremys* from *Clemmys* (sensu McDowell, 1964), the supracaudal scutes extending forward to cross the pygal/suprapygal seam, as well as several additional features that diagnose *Mauremys*, such as the slightly projecting rather than truncate gular region of the plastron, lack of a plastral hinge, and especially, hexagonal neurals (see McDowell, 1964). The ratio of the carapace width to carapace length (0.687), as well as the ratio of the width of the anterior plastral hindlobe at the level of the junction of the abdomino-femoral seam and the plastral margin to carapace length (0.436), are within the ranges reported by Iverson & McCord (1994) for adults and subadults of the east Asian species of *Mauremys* (0.665-0.781 and 0.425-0.517, respectively). The large size (estimated 308 mm carapace length) and the apparent absence of a plastral concavity suggest that the animal may have been a female: in a sample of recent species assigned to the genus *Mauremys*, Iverson & McCord (1994) found that females exceed males in carapace length, except in the Ryukyu (Iverson & McCord, 1994) and Taiwanese populations of *M. mutica* (Mao, 1971).

Cantor (1842) described *Emys muticus* (amended to *Emys mutica* by Gray, 1844) from Chusan (= Zhoushan Island), Zhejiang Province, China, and the species is now known to exhibit considerable geographic variation, resulting in a rich synonymy (see Iverson & McCord, 1989). McDowell (1964) allocated this taxon to the genus *Mauremys* (after a protracted life in *Clemmys*). Although juveniles of *Mauremys mutica* have been characterised in the literature as showing a tricarinate carapace (e.g. Pritchard, 1979; Ernst & Barbour, 1989), adult shells can be nearly smooth, with only a vestige of a vertebral keel. The illustrations of an adult *Mauremys mutica* (as *Clemmys mutica*) in Siebenrock (1909: Pl. XVII-XVIII) are virtually identical to those in Williams (1957: Pl. VII-VIII), except that in the former, vertebral I is widened anteriorly, vertebrae II-IV are more wide than long, the gular scales projecting more prominently, and the inguinal scales are relatively larger. The fossil turtle differs from *Mauremys japonica* (Temminck & Schlegel, 1835), in showing smooth marginals at the posterior of the carapace (serrated in the east Asian species) and the presence (vs absence) of a vertebral keel. It differs from the recently described *Mauremys iversoni* Pritchard & McCord, 1991, in showing an angular gular region (vs gular region rounded); absence (vs presence) of lateral keels; and the failure of the humero-pectoral seam to cross the entoplastron (vs humero-pectoral seam crosses entoplastron: see Fig. 2A in Pritchard & McCord, 1991). Given these minor differences, allocation of the Trinil fossil to the genus *Mauremys* seems appropriate.

TABLE 1. Comparison of south and south-eastern batagurid genera with "*Hardella isoclina*" Dubois, 1908. + indicates a presence; - an absence. Measurements (in mm) of the carapace are the largest recorded for a species within the respective genus.

Genus	Vertebral keels	Pleural keels	Humero-pectoral seam crosses entoplastron	Posterior margin of carapace strongly serrated	Plastral hinge	Plastral buttress strong or moderate	Neurals II & III short-sided anteriorly	Maximum carapace length
<i>Batagur</i>	+/-	-	-	-	-	+	+	600
<i>Callagur</i>	+	+/-	-	-	-	+	+	760
<i>Chinemys</i>	+	+	+	-	-	+	+	120
<i>Cuora</i>	+/-	-	+	-	+	+	+	216
<i>Cyclemys</i>	+	-	+	+	+	-	-	260
<i>Geoclemys</i>	+	+	-	+/-	-	+	+	390
<i>Geomyda</i>	+	+	+	+	-	-	-	131
<i>Hardella</i>	+	+/-	-	-	-	+	+	610
<i>Heosemys</i>	+	+	+	+	-	-	-	242
<i>Hieremys</i>	-	-	+	-	-	-	-	450
<i>Kachuga</i>	+	-	-	+/-	-	+	+	580
<i>Malayemys</i>	+	+	-	-	-	+	-	210
<i>Mauremys</i>	+/-	+/-	+/-	-	-	+	+/-	195
<i>Melanochelys</i>	+	+	+/-	+/-	+/-	+/-	-	383
<i>Morenia</i>	-	-	-	-	-	-	+	210
<i>Notochelys</i>	+	-	+	-	+	+	+	320
<i>Ocadia</i>	-	-	+	-	-	-	+	271
<i>Orlitia</i>	+	-	-	+/-	-	-	+	760
<i>Pyxidea</i>	+	+	+	+	+	+	-	180
<i>Siebenrockiella</i>	+	+	+	+	-	-	+	170
<i>Sacalia</i>	+	-	+	-	-	-	+	176
" <i>Hardella isoclina</i> "	-	-	-	-	-	-	+	308

A subfossil pond turtle shell called *Testudo anyangensis* by Ping, 1930 has been reported from the ruins of Anyang Hsein in northern Honan, eastern China, which has been assigned to *M. mutica* by McDowell (1964), although Pritchard (1994) argued that it was conspecific with *Ocadia sinensis*. Living *M. mutica* are distributed over eastern China, including Taiwan and Hainan, the Ryukyu islands in southern Japan, and the Annam region of northern Vietnam, and have been introduced into Japan; *M. japonica* is restricted to the islands of Honshu, Shikoku and Kyushu; and *M. iversoni* is known only from Fujian and possibly Guizhou Provinces of China (Iverson, 1992; Pritchard, 1979; Pritchard & McCord, 1991). In summary, no members of the genus have been recorded from the Sundaic region, including Java (see also Whitten & McCarthy, 1993). With a carapace length of 308 mm, the specimen from the Trinil bed is substantially larger than the largest *Mauremys mutica* on record (ca. "9 1/2 in" in Pritchard, 1979; and [as *Annamemys annamensis*] 19.5 cm in Ernst & Barbour, 1989). A larger size may not by itself conclusively demonstrate a specific status, as Pleistocene fossils of *Geoclemys hamiltonii* from Pakistan and northern India (Das, 1991), and *Melanochelys tricarinata* from northern India (Lydekker, 1889) are also known to be significantly larger than the maximum size reached by living representatives of the respective species.

As remarked by Williams (1957), the record introduces an apparently Chinese element into the Trinil fauna. *Mauremys isoclina* or its ancestors may have

entered the Sundas during the low waters of the Late Pleistocene glacials, when sea-levels dropped by as much as 120 m below present levels (Gascoyne *et al.*, 1979), thereby connecting most of the Sundaic islands to what at present is continental Asia, permitting faunal exchange between the regions. Other remarkable Indo-Chinese and/or Asian mainland elements in the Sundaic fauna showing remarkable distributional disjunctions are on record. These include the sucker-mouthed loaches from hill stream environments that are currently assigned to Gyriinocheilidae, whose members are distributed in Indo-China, and while apparently absent in the Indo-Malayan region, reappear on north-western Borneo (see map in Berra, 1989: 67); the disjunct distribution shown by the discoglossid toads and ranid frogs of the genus *Meristogenys*, both of which have representatives on the Sundas, and further north, in south-eastern China (Inger, 1996); the batagurid turtle genus *Geoemyda* (*vide* McCord *et al.*, 1995); anguinid lizard genus *Ophisaurus* (*vide* Inger, 1958), the colubrid snake genus *Stoliczkaia* (*vide* Smith, 1943), various species of mammals, including the tree shrew *Dendrogale*, the rodent *Dremomys* and the mustelid *Melogale* (Lord Medway, 1972); fossil representatives of hyaenids (Brongersma, 1937), and perhaps the distribution of Java Man himself (*vide* Hooijer, 1951). The widespread distribution of the aforementioned biota was doubtless facilitated by lowered sea levels that coincided with the Pleistocene glaciation. Some of the extant taxa among the present day Sundaic fauna are therefore of allochthonous origin, which have contrib-

uted to the overall high biological diversity of the Sundas.

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REFERENCES

- Berra, T. M. (1989). *An atlas of distribution of the freshwater fish families of the world*. University of Nebraska Press, Lincoln and London.
- Brongersma, L. D. (1937). On fossil remains of a hyaenid from Java. *Zool. Med.* **20**, 186-202, Pl. XIII.
- Cantor, T. (1842). General features of Chusan, with remarks on the flora and fauna of that island. *Ann. & Mag. Nat. Hist.* **11**, 481-493.
- Das, I. (1991). The taxonomic status of the Pleistocene turtle *Geoclemys sivalensis*. *J. Herpetol.* **25**, 104-107.
- Das, I. (1995). *Turtles and tortoises of India*. Oxford University Press, Bombay, Delhi, Calcutta and Madras.
- Dubois, E. (1908). Das geologische Alter der Kendeng- oder Trinil Fauna. *Tijdschr. Kon. Ned. Aardr. Gen., ser. 2* **25**, 1235-1270.
- Ernst, C. H. & Barbour, R. W. (1989). *Turtles of the world*. Smithsonian Institution Press, Washington, D.C.
- Gaffney, E. S. (1984). Historical analysis of theories of chelonian relationships. *Syst. Zool.* **33**, 283-301.
- Gaffney, E. & Meylan, P. A. (1988). A phylogeny of turtles. In *The phylogeny and classification of the tetrapods. Vol. 1*, 157-219. Benton, M. J. (ed.) Clarendon Press, Oxford.
- Gascoyne, M., Benjamin, G. J. & Schwartz, H. P. (1979). Sea-level lowering during the Illinoian glaciation from a Bahama "blue hole". *Science* **205**, 806-808.
- Gray, J. E. (1844). *Catalogue of the tortoises, crocodiles, and amphisbaenians in the collection of the British Museum*. British Museum, London.
- Hirayama, R. (1984). Cladistic analysis of batagurine turtles (Batagurinae: Emydidae: Testudinoidea); a preliminary result. *Studia Geologica Salamanticensia. Vol. Especial I (Studia Palaeocheloniologica 1)*. F. de Broin & E. Jiménez-Fuentes (eds): 141-157.
- Hooijer, D. A. (1951). Pygmy elephant and giant tortoise. *Scientific Monthly* **72**(1), 3-8.
- Inger, R. F. (1958). Notes on the Bornean glass snake. *Sarawak Mus. J.* **8**, 479-481.
- Inger, R. F. (1996). Distribution of amphibians of southern Asia and adjacent islands. *Misc. Publ. Mus. Nat. Hist. Univ. Kansas*. (In press).
- Iverson, J. B. (1992). *A revised checklist with distribution maps of the turtles of the world*. Privately published, Richmond, Indiana.
- Iverson, J. B. & McCord, W. P. (1989). The proper taxonomic allocation of *Emys nigricans* Gray, *Emys muticus* Cantor, and *Geoclemys kwangtungensis* Pope. *Amphibia-Reptilia* **10**, 23-33.
- Iverson, J. B. & McCord, W. P. (1994). Variation in east Asian turtles of the genus *Mauremys* (Bataguridae; Testudines). *J. Herpetol.* **28**, 178-187.
- Lord Medway. (1972). The Quaternary mammals of Malaysia: A review. In *The Quaternary era in Malasia*. Ashton, P. & Ashton, M. (Eds). Trans. Second Aberdeen-Hull Symp. Malesian Ecol. Aberdeen 1971, 63-83. Department of Geography, University of Hull and Institute of South-East Asian Biology, University of Aberdeen, Aberdeen.
- Lydekker, R. (1889). The tortoises described as *Chaibassia*. *J. Asiatic Soc. Bengal* **58**, 327-333.
- McCord, W. P., Iverson, J. B. & Boeadi. (1995). A new batagurid turtle from northern Sulawesi, Indonesia. *Chelonian Conserv. & Biol.* **1**, 311-416.
- McDowell, S. B. (1964). Partition of the genus *Clemmys* and related problems in the taxonomy of the aquatic Testudinidae. *Proc. Zool. Soc. London* **143**, 239-279.
- Mao, S.-S. (1971). *Turtles of Taiwan*. Commercial Press, Taipei.
- Ping, C. (1930). Notes on the shell of a land tortoise from the ancient ruins of Anyang. *Bull. Fan. Inst. Biol., Peking* **1**, 217-226.
- Pritchard, P. C. H. (1979). *Encyclopedia of turtles*. T. F. H. Publications, Neptune, New Jersey.
- Pritchard, P. C. H. (1994). Comments on *Chinemys palaeannamitica* and certain other chelonian taxa based upon material from archaeological sites. *Chelonian Conserv. & Biol.* **1**, 131-137.
- Pritchard, P. C. H. & McCord, W. P. (1991). A new emydid turtle from China. *Herpetologica* **47**, 139-147.
- Siebenrock, F. (1909). *Clemmys mutica* Cant. von der Insel Formosa. *Ann. K. K. Naturhist. Hofmus, Wien* **23**, 312-317, Pl. XII-XIII.
- Smith, M. A. (1931). *The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. Vol. 1.- Loricata, Testudines*. Taylor and Francis, London.
- Smith, M. A. (1943). *Fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese region. Vol. III. Serpentes*. Taylor and Francis, London.
- Whitten, A. J. & McCarthy, C. (1993). List of the amphibians and reptiles of Java and Bali. *Tropical Biodiversity* **1**, 169-177.
- Williams, E. (1957). *Hardella isooclina* Dubois redescribed. *Zool. Med.* **35**, 235-240.

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