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Comments on *Chinemys palaeannamitica* and Certain Other Chelonian Taxa Based Upon Material from Archaeological Sites

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ABSTRACT. – *Chinemys palaeannamitica*, based upon a single, incomplete, megacephalic skull from archaeological material from Vietnam, has been considered valid by most authors primarily because of its very large size (hitherto greater than that of any reported modern *Chinemys*). However, the acquisition of a very large female *Chinemys nigricans* from Chan Kiang (= Chan Jiang), Guangdong Prov., China has made possible detailed comparisons between the size, proportions, and morphology of comparably sized skulls of the "extinct" *C. palaeannamitica* and the living *C. nigricans*, and the conclusion is reached that the taxa are synonymous. Comparisons are also made between the holotype of *Testudo anyangensis* Ping, 1930, and osteological material and descriptions of *Mauremys mutica* and *Ocadia sinensis*, and the conclusion is reach that *T. anyangensis* is a synonym of the latter.

History of *Chinemys palaeannamitica*

Bourret (1941a, 1941b) gave a detailed description of a very large freshwater turtle skull, about two-thirds complete, clearly "une Emydidae" (Bataguridae by modern classifications) that had been discovered in 1940 by Monsieur Fromaget, Chef du Service Géologique de l'Indochine, in probable lower Neolithic midden accumulations in the cave of Dong-Giao, locally known as "Thung-gianh". This location was less than 1 km from the Dong-Giao railway station, very close to what was then the border between Annam and Tonkin (now central and northern Vietnam). Associated material included numerous mollusc shells and abundant human remains, including skulls, that by their thickness and heavy brow-ridges appeared to be comparable to those of modern Australian aboriginals or Papuans.

Bourret (1941b) illustrated the specimen (MNHN 1948-42), and declared it the holotype of a new, extinct species, *Geoclemys palaeannamitica* (Fig. 1). He argued that the very large, unridged alveolar surfaces and the posterior position of the internal choanae indicated that the specimen was a representative of Gray's Tribe Malaclemmydina, and was referable to one of the three genera *Damonia*, *Geoclemys*, or *Chinemys*. He ruled out *Chinemys* on the grounds that the two living species of *Chinemys* (actually, three had been described, i.e., *C. reevesii* (Gray, 1831), *C. megalocephala* Fang, 1934, and *C. kwangtungensis* Pope, 1934, but see below) did not have the choanae so posteriorly located; that the living species had an inclined anterior profile (almost vertical in the skull in hand); and the size was much too large (Bourret estimated that the carapace length of the type of *Geoclemys palaeannamitica* was about 350 mm, whereas the largest living *Chinemys* he had seen had a CL of only 220 mm).

Bourret also ruled out *Damonia* (= *Malayemys*) on similar grounds. The single living species of this genus was even smaller than living *Chinemys* (largest of 31 specimens of *Malayemys subtrijuga* in the PCHP collection having CL 198 mm; reaching 210 mm according to Smith, 1931); it had an especially protruding snout with strongly raked anterior profile; and it, too, had the internal choanae in the wrong position. On the other hand, the living *Geoclemys hamiltoni* was known to reach 310 mm (actually 360 mm *fide* Das, 1991), and to have a skull very similar to that of the type of *G. palaeannamitica*, with minor differences (e.g., convex rather than flat area between the orbits; snout not upturned) that indicated to Bourret that the two species were distinct, but congeneric.

Bour (1980) re-examined the holotype of *palaeannamitica*, and was able to improve the visibility of certain bony sutures by means of an acid bath process. He concluded that the missing right side of the skull had been excised with an instrument of some kind, strongly suggesting that its association with human remains was not an artifact. Bour noted that *Geoclemys* was a member of the "*Hardella* complex" of McDowell (1964), characterized *inter alia* by having the Vidian canal lateral to the inferior process of the parietal and bordered by the epipterygoid; having a relatively large nasopalatine foramen; and having ridged alveolar surfaces and cusped jaws. The holotype of *Geoclemys palaeannamitica*, on the other hand, was clearly a member of the "*Batagur* complex", having a very large, almost smooth alveolar surface of which the vomer formed a part (in *Geoclemys* the vomer is deeply recessed below the palatal surface, between the choanae); a very narrow nasopalatine foramen; and strong ectopterygoid processes. The only members of the *Batagur* complex to have these features are *Chinemys* and *Malayemys*, and Bour noted that *G. palaeannamitica* differed from the latter in having narrowed pterygoids; a very wide angle between the maxillary edges; absence of contact between the maxillae and the descending processes of the parietals; and discrete contact between the maxillae and the quadratojugals. Bour thus referred to the subfossil form as *Chinemys palaeannamitica*.

Bour also justified his allocation on zoogeographic grounds. He noted that the known range of *Chinemys* came within 600 km of the Dong-Giao cave, whereas *Geoclemys* came no nearer than the Indo-Gangetic Plain, 2000 km to the west. It might also be mentioned that there was no reason why *Chinemys* should not extend further south than southern

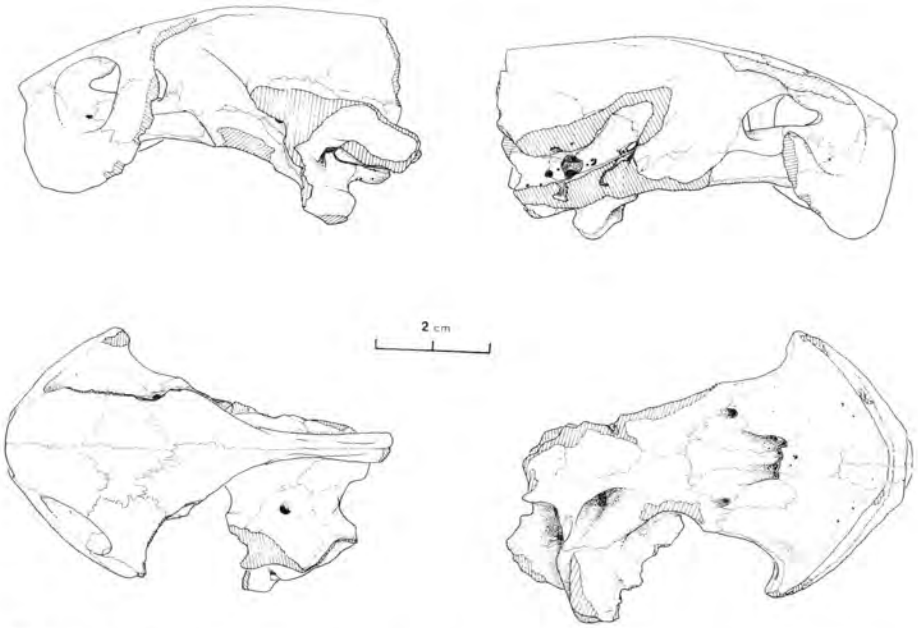

Figure 1. Skull of *Chinemys palaeannamitica* (Bourret, 1941b) (holotype, MNHN 1948-42). Illustrations modified from Bour (1980), reproduced here by kind permission.

China, into northern Vietnam, whereas the Indo-Gangetic area was a completely different zoogeographic realm. Indeed, as Iverson and McCord (1989) have pointed out, both Klingelhöffer (1959) and Felix (1965) had reported *Chinemys kwangtungensis* (Pope, 1934) from northern Vietnam; it apparently also reaches Hainan Island (W. McCord, *pers. comm.* to J.B. Iverson).

Bour compared the holotype of *palaeannamitica* with skulls of the three described living species of *Chinemys*. He reported that *C. palaeannamitica* was certainly larger, and perhaps of more massive build, than any of the living species of *Chinemys*, but noted that McDowell (1964) had found a striking resemblance between the illustration of the skull of *Chinemys kwangtungensis* given by Fang (1934) and Bourret's illustration of the incomplete skull of *C. palaeannamitica*. Nonetheless, Bour was impressed that the living species were markedly smaller than the subfossil form. He considered *C. kwangtungensis* to reach a maximum carapace length of 202 mm and maximum head width of 41 mm, the corresponding figures for *C. megalocephala* being 233 and 59 mm, and for *C. reevesii* 220 and 39.5 mm.

It may be seen that the maximum head width of

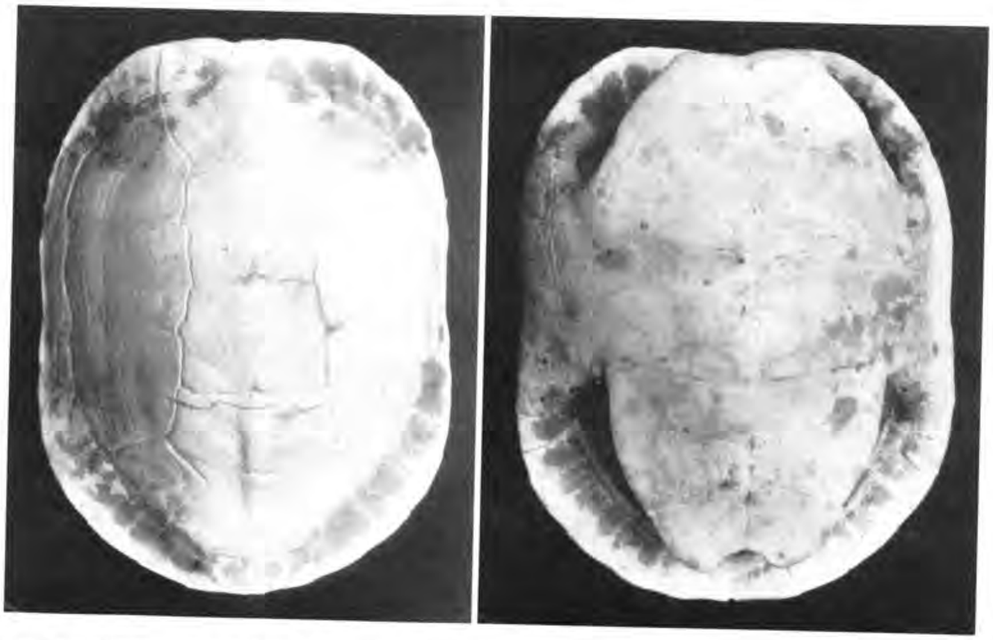

Figure 2. Carapacial and plastral views of bony carapace of *Chinemys nigricans* (PCHP 4073; CL 257 mm).

Figure 3. Lateral, dorsal, and palatal views of skull and mandible of *Chinemys nigricans* (PCHP 4073; skull width 65 mm).

megalocephala was virtually identical to that of *palaeannamitica*, although that of *kwangtungensis*, the species sharing morphological affinity with *palaeannamitica*, was considerably smaller.

Subsequently, Iverson et al. (1989) undertook a morphometric analysis of *C. reevesii* and *C. megalocephala* and declared them to be synonymous. The megacephaly of the latter, originally reported as limited to specimens from the Nanking area, but subsequently reported also from the Huang-Pu River (Yangtze River basin) and from Guangxi (Si River basin; Zong and Ma, 1985) was found not to correspond to any specific geographic area, and discriminant analysis did not reveal any differences, although it did reveal significant geographic variation in plastral scute proportions among *C. reevesii* samples. By contrast, Lovich et al. (1985) found no significant geographic variation over the wide range of *C. reevesii*, a phenomenon that they attributed, in part, to millennia of human disturbance. Zhao and Adler (1993) retained *C. megalocephala* as a valid species, on the grounds that the sample examined by Iverson et al. (1989) was small and mostly from unknown localities.

Iverson and McCord (1989) compared available material of *C. kwangtungensis* with the type specimen (BMNH 1947.3.5.35) of *Emys nigricans* Gray, 1834, and considered the two forms to be synonymous. Having access to 16 live specimens of *C. nigricans* (including seven adult females, largest CL 257 mm) in the private collection of McCord, they noted that old females of this form were extremely megacephalic, and they raised the possibility that *C. palaeannamitica* was synonymous with *C. nigricans*.

Synonymy of *Chinemys palaeannamitica* and *Chinemys nigricans*

Since Iverson and McCord's (1989) paper was written, their largest female *C. nigricans* (CL 257 mm) died and was deposited in the author's collection. Illustrated in life by Zhao and Adler (1993, Plate 17B), it has been catalogued as PCHP 4073, and skeletonized (Figs. 2-3). According to W.P. McCord (*pers. comm.*) it was obtained from Chan Kiang (= Chan Jiang), Guangdong Prov., China (111°E, 22°30'N). Comparisons were made between the skull (Fig. 3) and Bour's excellent illustrations of the skull of *C. palaeannamitica* (Fig. 1), and the similarity between the specimens was striking. Whereas the holotype skull of *C. palaeannamitica* has a basicranial length of 70 mm and maximum width estimated at 60 mm (Bour) or 58 mm (Bourret), that of PCHP 4073 is 68.5 mm in length and 65 mm in maximum width – i.e., very slightly shorter than the holotype, but slightly wider. Moreover, examination re-

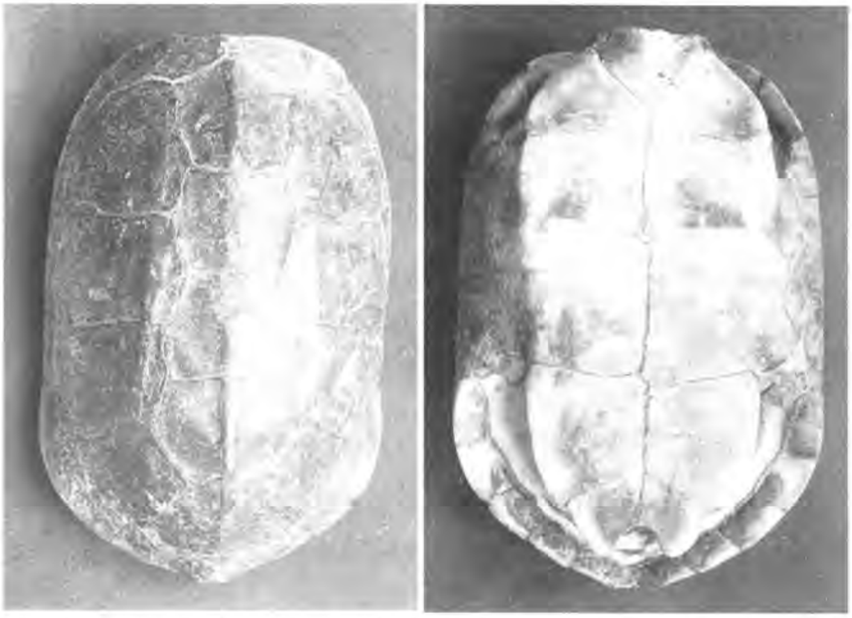

Figure 4. Carapace and plastron of adult female of the *megalocephala* form of *Chinemys reevesii* (PCHP 4067; CL 255 mm). See Fig. 5 for skull.

vealed that the differences between the skulls of the two forms illustrated by Bour (1980) (*C. palaeannamitica* and "*C. kwangtungensis*" [= *C. nigricans*]), were attributable simply to differences in degree of megacephaly between the presumably very old specimen of *C. palaeannamitica* and Bour's largest but still young adult female of "*C. kwangtungensis*" with a carapace length of 202 mm. With the elimination of both size and form as factors separating *C. palaeannamitica* from *C. nigricans*, I therefore conclude that the two taxa are synonymous.

In significantly underestimating the degree of megacephaly achieved by old adult *C. nigricans* (including *C. palaeannamitica*), Bourret thus overestimated the carapace length of the holotype. It was probably very similar to that of PCHP 4073, i.e., about 257 mm, rather than around 350 mm.

As for comparisons between the holotype of *C. palaeannamitica* and the skull of megacephalic *C. reevesii*, which may for convenience be dubbed the *megalocephala* form, it appears that the head-shell proportions of the latter may vary considerably. Bour's largest specimen of *C. reevesii* had a carapace length of 233 mm and head width of 59 mm, whereas my largest specimen (PCHP 4067) has a carapace length of 255 mm but maximum head width of only 51.8 mm, identical to the head width of a much smaller specimen (PCHP 2309) only 202 mm in carapace length. Another (PCHP 3922) had head width of 42.9 mm and CL 195 mm.

Maximum Size of *Chinemys reevesii*

The maximum size reached by *C. reevesii* (including the *megalocephala* form) remains unclear. Adults of this species are often very small. Boulenger (1889) and Stejneger (1907) gave the maximum length as 125 and 122 mm, respectively. Schmidt (1927) found that 13 Ningkwo (Anwei, China) males averaged only 75 mm, and 15 females 103 mm, but Pope (1935) noted that larger sizes were sometimes reached, an individual from Futsing Hsien measuring 220 mm, and he had seen other specimens "fully as large". Mertens (1936) considered that 96 mm was the normal adult length for *C. reevesii*, and that two females with carapace lengths of 220 and 214 mm and two males with lengths of 150 and 180 mm could be interpreted as showing gigantism. Mao (1971) indicated that 12 males from Taipei Hsien (northern Taiwan) averaged 123 mm (range 99-143 mm), and 19 females averaged 146 mm (range 109-182 mm).

I do not have access to dimensions of adequate series of Japanese *C. reevesii*, but I have seen numerous live specimens in temples and ornamental pools in Japan, and would estimate that the typical carapace length of the adult females seen was approximately 200 mm – considerably greater than is normal for Chinese specimens.

Figure 5. Skull and mandible of adult female of *megalocephala* form of *Chinemys reevesii* (PCHP 4067; CL 255 mm; skull width 51.8 mm). See Fig. 4 for shell.

Figure 6. Skull and mandible of adult female of *megalocephala* form of *Chinemys reevesii* (PCHP 2309; CL 202 mm; skull width 51.8 mm).

It is unfortunate that Lovich et al. (1985), who availed themselves of a very large series of 256 museum specimens of *C. reevesii* from all parts of the range, did not give any carapace dimensions, although they reported the methodology by which no fewer than 27 straight-line measurements were taken of the shell of each specimen. Odd too that Iverson et al. (1989), in their sophisticated cluster and discriminant analysis, using large samples of all taxa of extant *Chinemys* that included access to the unpublished numerical data analyzed by Lovich et al. (1985), also gave no basic information on the carapaces lengths (typical or maximal) of the species in question.

The apparent record-size specimen of megacephalic *C. reevesii* is thus PCHP 4067 at 255 mm CL. (Fig. 4). That specimen is only 156 mm wide compared to the maximum reported width of *C. nigricans* of 195 mm (PCHP 4073). Thus, it remains probable that *C. reevesii* does not reach the overall size of either the holotype of *C. palaeannamitica* or of PCHP 4073, nor have skulls been forthcoming that indicate close morphological similarity between *C. reevesii* and *C. palaeannamitica*. Nonetheless, the similarity between large skulls of *C. reevesii* (*megalocephala* form) (e.g., PCHP 4067, CL 255 mm and PCHP 2309, CL 202 mm) and of medium-sized adult females of *C. nigricans* (e.g., PCHP 3942, CL 199 mm) is striking (Figs. 5-7).

Geographic considerations also favor the interpretation that *C. palaeannamitica* is a synonym of *C. nigricans* rather than of *C. reevesii*, in that *nigricans* is the adjacent, southern form whose distribution separates *C. reevesii* from the type locality of *C. palaeannamitica* (Bour, 1980; Iverson, 1992). The other alternative that we need to consider is that *C. palaeannamitica* survives today as a distinct species, and is represented by PCHP 4073. This is contraindicated by the plastral pattern of the latter, which is typical of that of large *C. nigricans*. The collecting localities of the two are also very far apart.

Other Archaeological Chelonian Species

On at least two other occasions, turtle remains from archaeological sites in eastern Asia have been generically misassigned and incorrectly identified as undescribed species. Yeh (1961) described a box turtle shell from a Ying Dynasty site at Dawenkou, Taian, Shantung, China, that he named *Terrapene culturalia*. The generic attribution was challenged by Milstead (1965), who reallocated the specimen, strangely, to another Nearctic genus, *Emydoidea*, arguing that the feature of the medial border of the pectoral scute being much longer than the lateral border precluded assignment to *Terrapene*, but was typical of *Emydoidea*. I have been unable to corroborate this; examination of four shells of adult *Emydoidea blandingii* (PCHP 307, 1179, 1180, 2704) indicates almost parallel anterior and posterior borders for the pectoral scutes, as illustrated by Ckhikvadze (1983).

McCoy and Richmond (1966) took the obvious step of comparing the holotype of *Terrapene culturalia* to various Chinese box turtles (an abundant and diverse group, long known from China, despite the title of Yeh's paper), and found it identical to the widespread form *Cuora flavomarginata*. They proposed that both *Terrapene* and *Emydoidea* be reinstated as North American endemic gen-

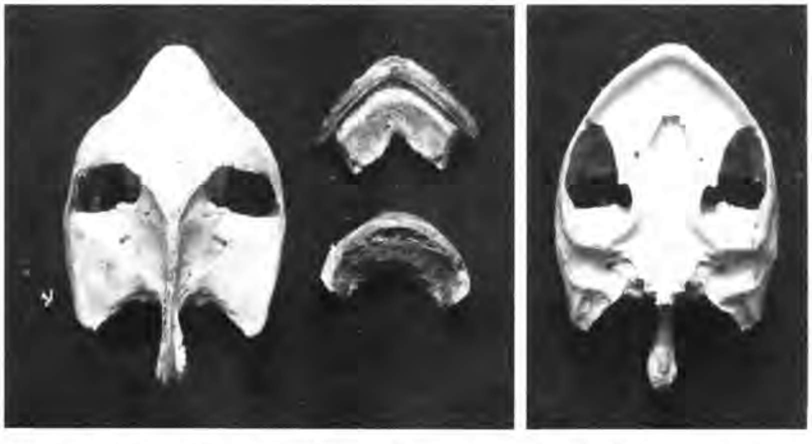

Figure 7. Skull and rhamphothecae of young adult female *Chinemys nigricans* (PCHP 3942; CL 199 mm; skull width 42.0 mm).

era, although it is noteworthy that rather fragmentary Palaearctic fossils (nuchal bones and incomplete plastra) had already been described as *Emydoidea antiqua* by Khosatzky (1956), and another fossil Palaearctic species, *Emydoidea tarashchuki*, was later proposed by Ckhikvadze (1980).

The other archaeological species, also from China, was described as *Testudo anyangensis* by Ping (1930), based on an almost complete bony shell, 247 mm in length, from the ancient ruins of Anyang Hsien, Honan (= Henan), China. Lindholm (1932) noted that this specimen was an emydid (batagurid by current nomenclature), not a testudinid, and he placed it in a new genus, *Pseudocadia*, on the basis of the "unique" configuration of the sulci on the entoplastron (i.e., gulohumeral sulci not encroaching upon entoplastron), and also the great width of the entoplastron relative to its length, a point of distinction from *Ocadia*. Pope (1935) agreed with Lindholm's conclusion, and added that *Pseudocadia* was also unusual in having the entoplastron crossed at its widest point by the humeropectoral suture.

On the other hand, McDowell (1964) observed that Lindholm's impression that the humeropectoral sulcus always passed behind the entoplastron in *Mauremys mutica* was in error; this, he said, was only true of specimens from the northern part of the range, as had been pointed out by Nakamura (1934). This being the case, McDowell found no significant difference between *Pseudocadia* and northern *Mauremys mutica*, and concluded that referral of *Pseudocadia* to the synonymy of *M. mutica* was "plausible". He rejected the comparison with *Ocadia* on the grounds that the Anyang turtle showed great forward extent of the inguinal aperture, and a slightly projecting, rather than truncate, gular region.

Iverson and McCord (1989) agreed with McDowell, opining that *M. mutica* "exhibits considerable geographic variation that potentially includes...*Testudo anyangensis* Ping (1930)". Nonetheless, I am not so sure. The Anyang turtle, at 247 mm in straight carapace length, is considerably larger than is normal for *M. mutica*, males of which average 142 mm (max. 195 mm) and females 130 mm (max. 170 mm) (Mao, 1971). *Ocadia sinensis*, on the other hand, reaches at least 271 mm, and the newly described *O. philippeni* is reported to exceed 360 mm (O. Shiu, *pers. comm.* in McCord and Iverson, 1992).

Furthermore, comparison of Ping's figures of the Anyang turtle with bony plastra of three *Ocadia sinensis* (PCHP 1086, 2703, 3186) does not reveal trenchant differences in either the form of the gular area or the position of the inguinal notch. In addition, although it is true that the position of the humeropectoral sulcus upon the entoplastron is variable in *M. mutica*, as discussed by Mao (1971), it is generally rather near the posterior border (i.e., coincident with it, or narrowly anterior or posterior to it). I have not seen specimens of *M. mutica* in which it comes even close to the widest point of the entoplastron, a configuration, on the other hand, that is closely approached in a specimen of *O. sinensis* (PCHP 3186).

Three additional, suggestive rather than conclusive, characters point in a similar direction. First, *Mauremys mutica* is usually a rather smooth-shelled form, without evidence of scute annuli impressed upon the surface of the bony carapace, whereas in *Ocadia sinensis*, such sculpturing is often present, as is evident on the shell of the Anyang turtle. Second, the neural bone configuration is highly variable in *M. mutica*, as described by McDowell (1964), who found an octagonal element at position 2, 3, or 4 in the majority of specimens examined. *Ocadia sinensis*, on the other hand, has a rather conservative configuration of hexagonal neurals with short sides anteriorly throughout positions 2 to 7, as is also the case with *anyangensis*. And third, the nuchal scute, while variable in both forms, is usually relatively long and with posteriorly diverging sides in *M. mutica*, whereas at least some specimens of *O. sinensis* (e.g., PCHP 1086) have a diminutive, square nuchal scute similar to that of the Anyang specimen.

Thus, I am inclined to view *Pseudocadia anyangensis* as a synonym of *Ocadia sinensis*, as Zhao and Adler (1993) did, without comment. McDowell (1964) was uneasy about such a conclusion on geographic grounds, Anyang being in northern Honan (Henan), about 800 miles north of the northernmost then-known localities for *Ocadia* in Fukien (Fujian) Province. However, Zhao and Adler (1993) list *O. sinensis* from Zhejiang, and Iverson (1992) has shown that this species reaches at least as far north as Shanghai, near the Zhejiang/Jiangsu border, over 300 miles north of the Fujian record. In any case, a turtle shell from an archaeological site may have been subject to extensive transportation by human agency, as McCoy and Richmond (1966) speculated may have happened with the holotype of *Terrapene culturalia*.

Other cases exist in which new species of Asiatic turtles have been based upon archaeological or palaeontological material that was not critically compared with adequate series of extant taxa. For example, Prasad and Satsangi (1963) described the Plio-Pleistocene species *Geoemyda pilgrimi* from the Indian Siwaliks, based upon a single 200 mm shell that Das (in press) has determined is referable to an extant taxon of a different genus altogether. More recently, Tao (1985) described *Chinemys pani* from probable Pleistocene material from Taiwan, but this taxon may be synonymous with *C. reevesii* according to Zhao and Adler (1993). Also, Tao (1988) described *Ocadia sinensis changwui* from submarine, probably late Pleistocene material from Taiwan Strait, but Zhao and Adler (1993) noted no significant differences from typical *O. sinensis*. On the other hand, authorities such as Wilson and Zug (1966) or Jackson (1975), who had access to Recent comparative material, were appropriately conservative in their evaluation of fossil North American *Graptemys* material.

In conclusion, Bourret, the describer of *Geoclemys palaeannamitica*, was a dedicated, prolific, and competent cheloniologist, and his allocation of the Annam turtle skull to *Geoclemys* was understandable in that *Chinemys* had only been separated from this genus a few years earlier (by Smith, 1931), and two of the three generic characters used by Smith (the tail length and the position of the humeropectoral sulcus) were not applicable in that the Annam turtle was represented only by a broken skull. Furthermore, the damaged sides of the Annam skull would make it difficult to apply Smith's third generic character, which applied to bone contacts in the temporal arches. And finally, the megacephaly of the specimen was so extreme that no comparable modern specimen of *Chinemys* had at that time been forthcoming.

Acknowledgments

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