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HOBART M. SMITH

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Kyphotic (hump-backed) soft-shelled turtles have been known for many years in Asia and America. Gressitt (Peking Natural History Bulletin, 2 (pt. 4): 413-415, figs. 1-5, 1937) has reviewed accounts of such turtles, and recorded the anomaly in *Amyda sinensis* (Wiegmann) and *A. steindachneri* (Siebenrock) of Asia and in unidentified species in the United States. Records of kyphosis in American species apparently are few.

Three skeletons in the University of Kansas Museum of Natural History demonstrate occurrence of the condition in at least 3 American species: *Amyda emoryi* (Agassiz), *A. mutica* (Le Sueur) and *A. spinifera* (Le Sueur). The specimen of *A. emoryi* (Catalog No. 2219) was taken at Phoenix, Maricopa Co., Arizona, by Victor H. Householder, on May 1, 1926. The second specimen, called to my attention by C. W. Hibbard, was taken in 1936 from the Kansas River at Lawrence, Douglas Co., Kansas, by Max Wheatley, to whom I am indebted for the accompanying photographs and permission to describe the specimen which he has added to the Museum's collections (No. 23230). The identity of No. 23230 is established as *A. mutica* by the absence of spines (see fig. 3) and by a number of cranial characters. The specimen of *A. spinifera* (No. 23026) is without locality data; its identification is verified by the presence of spines on the front of the carapace.

In the specimen of *A. mutica* (see figures) the hump forms a smooth, high curve, closely resembling the condition in Gressitt's specimens of *A. steindachneri* (*op. cit.*: fig. 1). In the other two the hump is lower and its apex forms a relatively sharp angle; in the specimen of *A. spinifera* the posterior face of the hump is more nearly vertical than the anterior face. In *A. emoryi* the rear edge of the apex is sharply inclined (at an angle of about 45°), whereas the remainder of the surface slants at an angle of about 35°.

In the accompanying table of measurements of specimens in the University of Kansas Museum of Natural History the height is measured from the end of the rib opposite the highest elevation to the crest of the elevation, by projected lines. The length is measured from the anterior border of the nuchal plate to the posterior edge of the last costal plate. The width is measured from tip to

tip of the longest ribs. Catalogue numbers of the specimens, with indication of the localities of capture are as follows: Nos. 2215-9, 2803, 2824, 2837, Phoenix, Maricopa Co., Arizona; Nos. 19459-60, Ozark, Franklin Co., Arkansas; Nos. 2225-9, Lewisville, Lafayette Co., Arkansas; Nos. 1867-70, 1874-6, 1879, 1881, 1930-1, 2666, 2761-2, 2826, 2838-42, Devalls Bluff, Prairie Co., Arkansas; No. 16528, Orange Co., Florida; Nos. 1872, 1878, 1943, 1964, Doniphan Lake, Doniphan Co., Kansas; No. 2220, Douglas Co., Kansas; No. 23230, Kansas River, Douglas Co., Kansas; No. 18159, Harper Co., Kansas; No. 2757, Smoky Hill River, Trego Co., Kansas; No. 23026, no data.

The three abnormal specimens vary in width/height ratio from 1.83 to 3.14. In the 37 normal turtles measured, the corresponding ratio is 4.64 to 7.85. The ratio of 4.64 is possibly subject to correction since the shell tends to warp in some specimens, especially in those retaining the skin about the periphery of the shell. The warping does not produce a marked convexity in transverse section, but does so in longitudinal section. Accordingly the height as here measured is little effected, and the comparison with width rather than length of shell provides for the lesser error from warping. There appears to be no close correlation of proportions with either size or sex.

It is of interest that *Amyda ferox* is the most distinctive in proportions of the carapace. Its carapace is longer in relation to its width than that of any of the other species. The average relative length of the carapace of *A. emoryi* is intermediate between that of *A. ferox* and the averages of *A. spinifera* and *A. mutica*, but the overlap in range with the latter two is complete.

The cause for kyphotic anomalies is unknown. That it is accompanied by a greater degree of growth in the vertebral column than in the periphery of the costal plates is obvious. There seems to be no well-established accommodation for the difference in growth, since the hump produced by it varies considerably in form.

There is no trend from small to large specimens in size of the hump; large and small humps occur in both large and small specimens. Accordingly it seems that the humped condition is developed in the late embryo or early post-embryonic life, and does not later change.

An apparently reasonable hypothesis is that the costal plates ankylose distally with the ribs early enough in embryonic life so that any differential in growth rate between them and the vertebral

column is translated into abnormal contortions of the body. Agassiz and others have shown that the costal plates normally do not fuse with the ribs by the time of hatching; the fusion then does not normally occur in the embryonic stage. Presumably, once fused, the costal plates and vertebral column normally have equal growth rates, since the height/width ratio does not change significantly with increased size. It is well known that fusion takes place in young specimens soon after hatching; in all skeletons examined of this genus, from the smallest (62 mm. in length) to the largest (295 mm.), the fusion has occurred. Therefore, the normal time of fusion must be approximately at the time of hatching.

Although costal plates and the vertebral column grow in direct proportion to each other throughout life from a period shortly after hatching, the vertebral column apparently grows more rapidly than the costals shortly before and possibly also shortly after hatching, at least in kyphotic and probably also in normal specimens. An exceptionally early date of fusion of costal plates and ribs would thus result in a kyphotic condition, and it may well be assumed that the earlier the fusion, the greater the hypertrophy would be. Whether or not this hypothesis correctly accounts for kyphosis in turtles can be ascertained only by further study.

Stejneger (Bull. Mus. Comp. Zoöl., 94: 12, 1944) regards the presence of 8 neurals as opposed to 7 as an important peculiarity of *A. mutica*. The 42 specimens for which the number of neurals is recorded reveals, however, that there is greater variation than previously supposed: in 16 *A. mutica* more than half (9) have 7 neurals and the remainder (7) have 8. Eight neurals were recorded also in 2 of 18 *spinifera*, and in 1 of 7 *A. emoryi*. Seven neurals are present in the single specimen of *A. ferox* examined.

It is of interest also that the number of costals, which has been reported to be consistently 7 in New World species and 8 in Old World species, varies markedly. In New World specimens, one *A. mutica* has 7 on one side, 8 on the other, and 8 occur on both sides of one other (of a total of 16 examined). One of twenty *A. spinifera*, and one of eight *A. emoryi* have 8; the single *A. ferox* (Schneider) has 7. Accordingly the suggestion by H. M. Smith (Field Mus. Nat. Hist., Zoöl. Ser., 23:19, 1939) that *Platypeltis* Baur be resurrected for the American soft-shelled turtles on the basis of the occurrence of only 7 costals, is untenable.

The generic allocation of American soft-shelled turtles has varied considerably in recent years: Smith (*loc. cit.*) uses *Platypeltis;*

Pope (Turtles of the United States and Canada, p. 343, 1939) uses *Trionyx* Geoffroy; and Stejneger (*op. cit.*, p. 8) uses *Amyda* Geoffroy. As stated above, use of *Platypeltis* at the present time is unwarranted, since no constant difference has been discovered that would support generic separation of Asiatic and American members of this group. New World turtles should be placed either in *Trionyx* or in *Amyda*, depending upon the interpretation of type designation for the latter name. Malcolm Smith (Bull. Raffles Mus. 3:2, 1930) and others have considered that, as a part of the original description, Geoffroy (Ann. Mus. Hist. Nat. Paris, 14:20, 1809) designated the type species of his new generic name *Trionyx* as *aegyptiacus* E. Geoffroy (= *triunguis* Forskål a well-recognized species). Stejneger argues that Geoffroy did not adequately designate a type from among the many species he treated in his genus *Trionyx*, and that it remained for Fitzinger (Syst. Rept., p. 30, 1843) to select one of these as a type; he chose *coromandelicus* Geoffroy, which is a synonym of *granosa* Schöppff, a species belonging to a different genus (as now recognized) from that to which *triunguis* belongs, although Geoffroy had made the mistake of considering both groups as members of his genus *Trionyx*. Now if Fitzinger's type designation is accepted, the name *Trionyx* is to be applied to that group containing *granosa* (only one other form is known in the genus, and both forms occur only in India and Burma), whereas the name *Amyda* of Geoffroy (*op. cit.*, p. 1) is applied to the genus (as now recognized) which includes *triunguis* and some 20 other species of Asia and North America. The type of *Amyda* is a typical member from Asia (*cartilagineus* Boddaert). On the other hand, if Geoffroy's type designation is accepted, the American forms (and the others of that genus) would take the generic name *Trionyx*, of which *Amyda* would be a synonym, and the genus to which *granosa* belongs would take the name *Lissemys* Malcolm Smith (Fauna Brit. India, Rept. Amph., 1:154, 1931).

Stejneger discussed the various aspects of this problem (*op. cit.*, pp. 6, 7), and I can add nothing to his discussion. His arguments for the acceptance of Fitzinger's type designation rather than that of Geoffroy are well founded upon the statement of the International Rules of Zoölogical Nomenclature, while those of Smith are not. In weighing these two alternatives, the practical value of maintenance of the "status quo" is not here important, for the whole system of nomenclature in this field is completely upset; *any* conclusive decision would be of great practical value and one al-

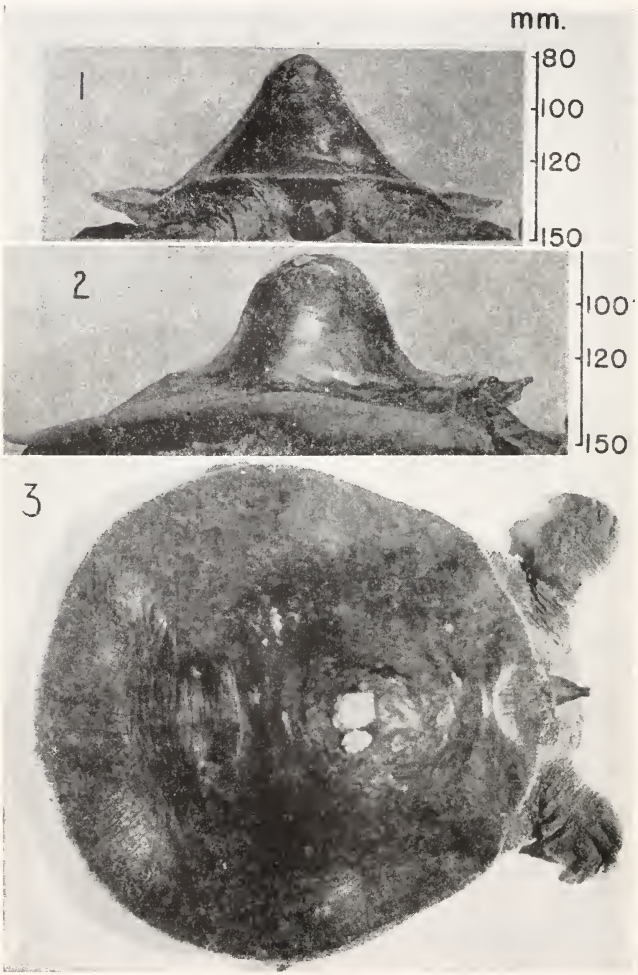
ternative holds no special, practical advantage over the other. Accordingly, it seems reasonable to consider the matter closed with Stejneger's analysis, retaining *Amyda* for the American and related species of soft-shelled turtles. That this assemblage contains natural subgroups that may warrant subdivision into other genera is obvious, but to none of these will the name *Trionyx* be applicable.

Table of Data on *Amyda*

SPECIES	Number	Sex	Width (mm.)	Length (mm.)	Ratio, width-length	Height (mm.)	Ratio, width-height	Neurals	Costals
emoryi	2219*	.....	81	62	1.30	34	2.38	.....	7
"	2215	♂	.....	.....	.....	.....	.....	7	7
"	2216	.....	104	88	1.18	18	5.77	8	7
"	2217	.....	.....	.....	.....	.....	.....	7	8
"	2218	.....	106	93	1.14	21	5.04	7	7
"	2803	♀	150	132	1.13	28	5.35	7	7
"	2824	♀	204	198	1.03	32	6.37	7	7
"	2837	♀	.....	.....	.....	.....	.....	7	7
"	19460	.....	97	77	1.26	14	6.93	8	7
ferox	16528	♀	282	295	0.99	53	5.32	7	7
mutica	2841	♀	99	75	1.32	16	6.18	7	7
"	23230*	.....	101	78	1.29	55	1.83	7	7
"	2838	♀	106	79	1.34	17	6.23	7	7
"	1964	♂	110	95	1.15	18	6.11	7	7
"	2839	♀	115	77	1.49	18	6.39	7	7
"	2840	♀	115	85	1.35	17	6.76	8	7–8
"	19459	.....	131	106	1.23	20	6.55	7	7
"	2220	♀	144	116	1.24	22	6.54	7	7
"	1874	.....	162	137	1.18	32	5.06	7	7
"	1930	♀	180	138	1.30	33	5.45	8	7
"	1875	.....	181	164	1.10	39	4.64	8	8
"	1881	♀	.....	.....	.....	.....	.....	8	7
"	1868	♂	185	167	1.10	39	4.74	7	7
"	1876	♀	190	177	1.07	33	5.75	8	7
"	1870	♀	194	166	1.27	35	5.54	8	7
"	1943	.....	98	76	1.29	18	5.44	?	7
spinifera	1872	.....	129	101	1.27	17	7.59	7	7
"	1931	♂	148	102	1.45	26	5.69	7	7
"	18159	♀	151	129	1.17	26	5.80	?	7
"	1878	♀	163	132	1.23	25	6.52	8	7
"	2225	♀	165	131	1.17	21	7.85	7	7
"	23026*	♀	170	133	1.27	54	3.14	7	7
"	2227	♀	191	175	1.09	39	4.89	7	7
"	2228	♀	196	167	1.17	.....	.....	7	7
"	1867	♂	207	164	1.26	26	7.58	7	7
"	2757	.....	213	196	1.08	30	7.10	7	8
"	2229	.....	215	178	1.20	28	6.78	7	7
"	2762	♀	219	184	1.19	40	5.47	7	7
"	1879	.....	223	187	1.19	38	5.87	7	7
"	2761	♀	233	182	1.28	43	5.41	7	7
"	2666	.....	234	208	1.12	42	5.57	8	7
"	2226	♀	239	215	1.11	38	6.29	7	7
"	1869	.....	245	211	1.16	44	5.55	7	7
"	2842	.....	245	219	1.12	45	5.44	7	7
"	2826	♀	245	237	1.03	45	5.44	7	7

* Kyphotic

University of Kansas, Museum of Natural History, Lawrence, Kansas.



FIGS. 1-3. *Amyda mutica*, Univ. Kans., Mus. Nat. Hist., No. 23230, Lawrence, Kansas. All views approximately half natural size. 1, Frontal view. 2, Lateral view. 3, Dorsal view.

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