

THE  
GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE V. VOL. III

No. VI.—JUNE, 1906.

ORIGINAL ARTICLES.

I.—THE PIGMY HIPPOPOTAMUS OF CYPRUS.

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(PLATE XV.)

THE accompanying Plate represents a restoration of the skeleton of *Hippopotamus minutus*, Blain., which has lately been completed in the Geological Department of the British Museum (Nat. Hist.). The vertebral column and limbs are almost entirely composed of the actual bones, while the model of the skull has been built up according to the various parts obtained separately. No ribs were preserved in their entirety, neither were perfect specimens of the scapulæ or innominate bones procured. A large amount of material, including that from which the reconstruction of this skeleton has been made, was brought from Cyprus as the result of excavations carried on there by me at different times in 1901–2. The specimen was mounted and the skull modelled with great skill by Mr. F. O. Barlow, Formatore in the British Museum (Nat. Hist.).

As already recorded,<sup>1</sup> a number of Pleistocene deposits containing remains of this pigmy hippopotamus were discovered, five of which were situated in caves in the sea cliffs of Cape Pyla, which has a coastline of about five miles. In one of these, which is known as that of Haghiōs Sarōnda, the ossiferous breccia attains a thickness of seven feet, while indications are not wanting to suggest the belief that originally it was of even greater dimensions. In the other caves in the vicinity remains were present in much smaller quantities, this being in most cases evidently partially the result of incursions of the sea subsequent to their deposition. Seven other deposits occur on the south side of the Kerynia Mountains, all within a distance of a few miles, and are situated in low and insignificant cliffs which lie parallel with the axis of the range. Owing to the Upper Eocene formation overlapping the limestone to a greater

<sup>1</sup> Trans. Royal Soc. B., vol. 197 (1904), pp. 347–8.

extent on the northern slopes, this secondary cliff-line is absent on that side, which may account for the fact that no osseous remains were found or heard of on the seaward aspect of these hills.

It has been previously noted<sup>1</sup> that several of the deposits found in the north of the island are now no longer enclosed in caves, the walls and roofs of which have partially or entirely disappeared, probably on account of the very rapid atmospheric erosion which takes place in barren limestone districts in this climate.<sup>2</sup> In each of these, with one exception, there is at least one cave-wall still remaining. The exception is found in that of Haghios Chrysostomos, below the peak of Buffa Vento, which is more isolated from the main mountain mass than any of the others, and is situated in an irregular line of limestone rocks which crest a spur projecting into the overlying formation, which is locally known as the "Hummocks." Herr Alfred Bergeat, who studied the geology of Cyprus, mentions, in a paper published in 1891,<sup>3</sup> the mammalian remains near the monastery of Haghios Chrysostomos, which he considers occur, not in a cave-deposit, but in a breccia<sup>4</sup> of large extent. This opinion was probably due to the almost entire disappearance of the limestone cliff-line which formerly rose above the Kythraean formation, but both the presence of very similar examples in the vicinity, and also the stalagmitic nature of the deposit, which was demonstrated during the excavations made here, appear to leave no doubt as to its original deposition in a cavern.

The finding of the remains of this the smallest of the Hippopotami proved, as Dr. Forsyth Major has already pointed out,<sup>5</sup> to be the re-discovery of an almost forgotten species, first noticed by Cuvier<sup>6</sup> as long ago as the early part of last century, though the locality from which it came was not previously known. Although adding to the number of the pigmy Hippopotami of the Mediterranean islands, *H. minutus* rather unexpectedly proves to have apparently little affinity with these, but to be instead more closely allied to the still surviving Liberian species, which has been considered by several authorities, notably the late Sir William Flower,<sup>7</sup> to be sufficiently distinct to form a separate genus (*Chæropsis*), in which the Cypriote form would now probably have to be included, for, as Dr. Forsyth Major anticipated,<sup>8</sup> the further material obtained since the publication of his paper has shown it to be likewise tetraprotodont.

<sup>1</sup> Op. cit., p. 348.

<sup>2</sup> The same phenomenon has been found to occur among the Pleistocene cave deposits of Crete. See GEOL. MAG., Dec. V, Vol. II, May, 1905, pp. 193-202.

<sup>3</sup> "Zur Geologie der Massigen Gesteine der Insel Cypem": Tschermak mineralogische und Petrographische Mittheilungen, Band xii (1891), pp. 278-9.

<sup>4</sup> Included in the Kythraean Series of Messrs. Bellamy & Jukes-Browne. See "The Geology of Cyprus," W. Brendon, Plymouth, 1905.

<sup>5</sup> GEOL. MAG., Dec. IV, Vol. IX, May, 1902, pp. 198-9, and Proc. Zool. Soc., 3rd June, 1902, pp. 107-111.

<sup>6</sup> "Ossements Fossiles," 2nd ed., i, pp. 322-331 (1821).

<sup>7</sup> Proc. Zool. Soc., 1887, p. 612.

<sup>8</sup> Proc. Zool. Soc., 3rd June, 1902, pp. 107-111.

On comparing the mounted skeleton of *H. minutus* with that of *H. liberiensis*,<sup>1</sup> it was found that in height and antero-posterior length they agree very closely: the height at the withers in each case being about 2 feet 2 $\frac{3}{4}$  inches, and the length of the vertebral column (along the ventral curve) about 4 ft. 6 $\frac{1}{2}$  ins. These measurements are, however, if taken by themselves, decidedly misleading, for, in spite of this apparent similarity in size, the Cypriote species has a much smaller skull, must have been longer in the leg, and altogether the slighter animal of the two. This is especially remarkable in the bones of the limbs and feet, which, when compared, are found to be all noticeably very much more slender in *H. minutus* than in the Liberian species. The same diminutiveness also obtains in the dentition: the antero-posterior length of the upper cheek teeth of one side, taken from specimens in a similar stage of wear, is in *H. liberiensis* 142 mm. and in *H. minutus* 132 mm. Three considerably worn molars in a right mandibular ramus of the latter measure antero-posteriorly 77 mm., while the space occupied by the corresponding, though less abraded, teeth of *H. liberiensis* is 85 mm. In the molars from Cyprus there is even less approach than in those of *H. liberiensis* to the trefoil pattern so characteristic of the worn teeth of the larger Hippopotami, and it may also be mentioned that the upper canines of the West African species are so deeply grooved that the surfaces of wear become practically bilobed in outline, whereas in those of the Cypriote race they are as indicated in Fig. 1, p. 244. The width of the palate is, relatively speaking, similar in the two species.

Dr. Forsyth Major has pointed out<sup>2</sup> one or two peculiarities in the skull of *H. minutus*, and we may add that the outline of its anterior half, when viewed from above, is more regular and uniform than is the case in that of *H. liberiensis*, owing to the maxillæ being less constricted and the premaxillæ further extended and more closely connected with the anterior portion of the maxillæ as shown in Figs. 2 & 3, p. 244, this being especially noticeable when the two skulls are seen side by side. The comparative length of those borders of the maxillæ which adjoin the nasals is considerably greater in *H. minutus* than in the recent pigmy species. Another striking difference is that in the former the upper surface of the skull between the orbits is slightly concave, this hollowed appearance being intensified by the projection of the post-orbital processes of the frontals, which in a slight degree assume the tubular form so conspicuous in *H. amphibius*, but which seems to be altogether absent in *H. liberiensis*.

Darwin has declared<sup>3</sup> that a luxuriant vegetation is not necessary for the maintenance of large species of mammals, but in that case undoubtedly an extensive tract of country must be available to contribute to their support. It is pretty generally supposed that many of the small forms found in islands are the direct result of

<sup>1</sup> Presented to the National Collection by Dr. Büttikofer in 1887.

<sup>2</sup> Proc. Zool. Soc., 1902, pp. 107-111.

<sup>3</sup> "Voyage of the Beagle," 12th ed., Ward, Lock, & Co. (1897), p. 98, etc.

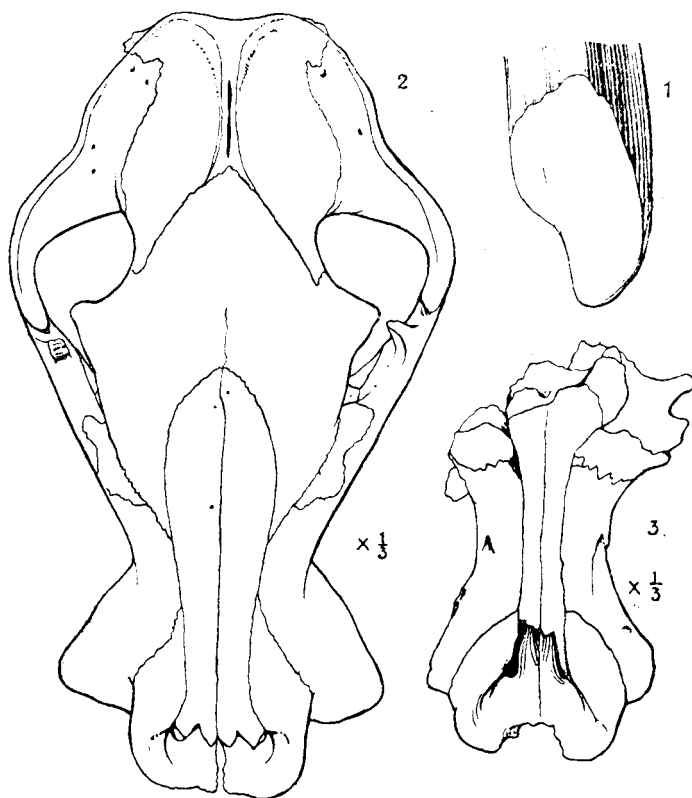


FIG. 1.—Worn surface of left upper canine of *Hippopotamus minutus*, Blainv. Nat. size.

FIG. 2.—Skull of *H. liberiensis*, after Leidy.<sup>1</sup> One-third nat. size.

FIG. 3.—Imperfect skull of *H. minutus*, after Dr. C. I. Forsyth Major.<sup>2</sup> Reduced to one-third nat. size.

<sup>1</sup> Journ. Acad. Nat. Sci. Philadelphia, 1853, ser. II, vol. II, pl. XXI, fig. 2.

<sup>2</sup> Proc. Zool. Soc., June, 1902, pl. X, fig. 5.

isolation in a limited area by the sea and the consequent shortage of suitable food. On the other hand, pigmy species are not necessarily found in a restricted island habitat, as proved at the present day by the existence of *H. liberiensis*, and perhaps Prjevalsky's Horse might also be cited as an example of this. However, in both these it seems most probable that their diminutive size is rather a primitive than a highly specialised characteristic, and it also seems likely that the same may be true to a great extent in the case of the Cypriote Hippopotamus; the isolation of this last in an island may rather have been chiefly the means of preserving a survivor of an earlier age. As already mentioned, some of the primitive characters, both in the pattern of the teeth and in the structure of the skull of this species, have been noted by Dr. Forsyth Major.<sup>1</sup>

To satisfactorily account for the extinction of the pigmy Hippopotamus and Elephant of Cyprus is a task of extreme difficulty, as there seems to be no evidence that either still existed contemporaneously with man, and, on the other hand, in earlier historical times the island was famed and coveted by different nations, chiefly on account of its great fertility and the extent of its forests. This extinction appears all the more inexplicable when we consider that it must have taken place, comparatively speaking, not so very long after the specialisation in size had been accomplished, for, according to Messrs. Bellamy and Jukes-Browne,<sup>2</sup> Cyprus was still connected with the mainland in early Pleistocene times, since which period *Elephas cypriotes*, at all events, would apparently have attained its later minute proportions. Torrential inundations and other destructive agencies have been suggested as the ultimate reason for the extermination of some of the species peculiar to the Mediterranean islands, and this may be true in some instances, possibly in Malta, but in Cyprus there seems to be no indications of the occurrence of such violent phenomena during the Pleistocene period. It is more likely that some climatic change, and its consequent alteration of the vegetation, was the indirect cause of the disappearance of this pigmy Hippopotamus, which, belonging to an ancient and effete race, was unable in a new direction to "undergo sufficiently rapid variation to enable it to avoid getting so far out of harmony with its surroundings that further existence became impossible."<sup>3</sup>

<sup>1</sup> Op. cit.

<sup>2</sup> See Key to Geological Map of Cyprus, p. 15 (by the former), London, Stanford, 1905; and these two authors on the Geology of Cyprus, Brendon & Son, Plymouth, 1905, pp. 55-6, and fig. 9. With reference to this last, it is interesting to find that Bishop Graziani, writing early in the seventeenth century, says of Cyprus: " 'Tis thought she was heretofore a peninsula joining that side of Asia, being separated by the violence of a flood " ("The Sieges of Nicosia and Famagusta," edited by Claude Delaval Cobham, London, 1899).

<sup>3</sup> Dr. C. W. Andrews, "Some Suggestions on Extinction": GEOL. MAG., Dec. IV, Vol. X, January, 1903, p. 2.