

Supplemental material A.

Notes on some Lothagam Bovidae from the Apak and Kaiyumung Members

According to Harris (2003), *Kobus presigmoidalis*, *Damalacra* sp. A, and *Aepyceros premelampus* range from the Lower Nawata to Kaiyumung Members. Of the Apak and Kaiyumung specimens, I could not find those assigned to the first of these taxa; none of those assigned to *Damalacra* are of this genus; some are certainly of *Aepyceros*, but they are doubtfully of the same species as those from the Nawata Formation. Thus, there is no evidence that any species ranges throughout the whole Lothagam sequence. Below are some additional notes on bovids from its upper part.

Tragelaphus cf. *rastafari* Bibi, 2011b

Harris (2003) assigned to *Tragelaphus nakuae* the cranial and horn-core fragments KNM-LT-26576; he did not include this species in the list of Lothagam bovids because of their unknown stratigraphic provenance, but they are almost certainly from the same individual as a proximal horn-core KNM-LT-26204, not mentioned by Harris (2003), but accessioned as coming from the Apak Member. However, its basal horn-core dimensions (53.2×72.2) are definitely greater than those of *T. saraitu* from the Woranso-Mille area (Geraads *et al.* 2009a), dated to c. 3.5 – 3.7 Ma; they fit instead *T. nakuae*, or its ancestor *T. rastafari* from Hadar, and the slight increase of divergence upwards is in better agreement with this latter species. Thanks to the abundance of the relevant *Tragelaphus* comparative sample, this specimen can confidently be dated at less than 3.5 Ma, and I regard the recorded stratigraphic origin as erroneous.

Ugandax sp.

Some bovine horn-core pieces were found in sediments above the Nawata Formation. The best one is KNM-LT-23597 from the Apak Member. As noted by Harris (2003), it is tragelaphin-like in its distinctly triangular cross-section; although the orientation is uncertain, it is likely that the sharpest keel was anterior, but there is also a strong posterior one, and a more rounded lateral (ventral) one. The horns were certainly very divergent, with only slight posterior and ventral curvatures. Harris (2003) assigned this fossil to *Simatherium kohllarseni*, but the horn-cores of this species, present at Laetoli, Tanzania (Gentry 2011), and perhaps in the Turkana basin, are devoid of keels, in contrast to KNM-LT-23597, which is more reminiscent of members of the *Ugandax* group, especially the Middle Awash specimens

(Haile-Selassie *et al.* 2009, fig.9.6), but is too incomplete for formal identification. The horn cores KNM-LT-23674 and KNM-LT-23724 from the Kaiyumung Member were also assigned to *S. kohllarseni* by Harris (2003) but are much smaller than those of this species; they differ from KNM-LT-23597 in their rounded cross-section, and the frontal of KNM-LT-23724 is not pneumatized, with a supra-foramen located in a large triangular depression, and the pedicle is at an angle with the horn-core. This latter specimen at least is almost certainly *reduncin*, and *S. kohllarseni* can be deleted from the Lothagam fauna list.

Genus *Oryx* Blainville, 1816

Harris (2003) included in *Praedamalis?* sp. six specimens; four of them are from the Kaiyumung Member, and indeed resemble what was previously known under this name, which Gentry (2010) synonymized with *Oryx*. The horn-cores are transversely compressed, in contrast to modern *Oryx* but as in early forms of this genus, and almost straight, as in other East African oryxes.

Origins of the Lothagam bovid fauna

Late Miocene levels of the Ngorora Formation (Member E) yielded rare bovids, assigned by Thomas (1981) to *Boselaphini* gen. et sp. indet. and *Pseudotragus ? gentryi* (later made the type-species of *Gentrytragus* Azanza & Morales, 1994), but not described by him. From the roughly contemporaneous Nakali Formation, no bovid has been published, except that Thomas (1981: 349) tentatively assigned a maxilla to *Kipsigicerus labidotus*, a species defined by Gentry (1970) at Fort Ternan, but Gentry (2010: 749) doubted the identification of this species at Ngorora; indeed, another maxilla figured by Thomas (1981, pl.2, fig.2) does not look boselaphin. Kanimatsu *et al.* (2007) listed only *Gazella* sp. and an unidentified boselaphin. All these taxa are too poorly represented to be linked to the Nawata bovids.

Bovidae are not common in the Namurungule Formation of the Samburu Hills, and have only been briefly described. Tsujikawa (2005) lists a large *Tragoportax*, a *Gazella*, a single tooth of *Reduncini* (a questionable identification), but the most interesting species, regarded as close to the Middle Miocene Ngorora '*Sivoreas eremita*' (previously listed as *Palaeoreas* by Nakaya *et al.* 1987, and as *Ouzocerus ?* sp. by Nakaya 1994) has horn-cores that are twisted on their axis (like modern *Taurotragus*). I agree with Gentry (2010) that these forms are doubtfully identical with *Sivoreas eremita* Pilgrim, 1939 from the Chinji Formation of the Siwaliks; their boselaphin affinities are questionable but in any case they are unlike all Lothagam bovids.

Chorora in the Middle Awash Valley of Ethiopia, dated to c. 8.5 – 8 Ma (Suwa *et al.* 2015) yielded a few bovid teeth. The most common form was regarded as similar to tragelaphins by Geraads *et al.* (2002), but as a Boselaphini by Suwa *et al.* (2015), who also illustrated two upper molars as of a Reduncini. On the basis of the published material, there is no compelling reason for not regarding all these forms as identical; the broad upper molars, the reliefs of the buccal side, and the tendency to form a central enamel island would fit Tragelaphini or Boselaphini, but the small size, weakness of entostyle, and expanded metaconid on p4 better agree with the Tragelaphini. In any case, the lack of horn-core prevents unambiguous tribal assignment and connections with Lothagam.

Turning to earlier sites in North Africa, Bou Hanifia in Algeria has only a gazelle and *Damalavus boroccoi*, thought by Arambourg (1959) to be an alcelaphin because of its large pedicle sinus. However, this sinus is also found in *Palaeoryx* and in the *Protoryx* group, of which *D. boroccoi* was probably an early representative, still primitive in its low cranial flexure, and is certainly not closely related to any Lothagam bovid.

The Bovidae from the Beglia Formation at Bled Douarah in Tunisia have only partly been published (see below for the age of this formation). Gentry (2010) regarded very hypsodont teeth published by Robinson (1986) as close to the poorly defined genus *Hypsodontus*, but identification is ambiguous. '*Pachytragus solignaci* Robinson, 1972, seems to be a close relative of Aegean forms; the course of its horn-cores resembles that of some alcelaphins, but the broad occipital is unlike this group, and no alcelaphin-like tooth has been reported, so it is probably unconnected to the Lothagam ? *Damalacra*.

The limited bovid collection from Jebel Krechem, also in Tunisia (Geraads 1989), mostly includes spiraled horn-cores and a partial frontlet. The frontal is distinctly pneumatized, with relatively small supra-orbital foramina; the horns were certainly short, strongly twisted, and most of them have an incipient keel. These are all differences with *Afrotragus*, and close relationships are unlikely.

From Morocco, *Benicerus theobaldi* Heintz, 1973, from the late Middle Miocene, and *Skouraiia helicoides* Geraads et al., 2012b, from the Late Miocene, have horn-cores with homonymous torsion, unlike all Lothagam bovids.

In summary, there is little evidence that these early Late Miocene African Bovidae include ancestors of the Lothagam forms. This is partly due to the scarcity of African faunas of Vallesian-equivalent age, but also supports the hypothesis of their Eurasian origin.

Age of the Beglia Formation of Tunisia: Phylogenetic interpretations of mammals from the Beglia Formation have been biased by the belief that it straddles the Middle / Late Miocene boundary. However, as I had observed earlier (Geraads 1989) the reported absence of hipparions in the lower part of the sequence, commonly regarded as attesting a Middle Miocene age, might as well be due to incomplete sampling (the late L. Ginsburg had informed me long ago that he had found hipparion in it) or to ecological differences with the upper part, as acknowledged by Robinson (1972:89). For instance, despite their purportedly similar age, the upper part of the Beglia Formation strikingly differs from Bou Hanifia in Algeria in the abundance of anthracotheres and rarity of equids, implying a major ecological difference. It is likely that the whole Beglia Formation is of Late Miocene age, and none of its mammalian taxa indicate that it belongs to the earliest part of the Late Miocene.

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