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REPLY TO MAROM ET AL.:

# Mitochondrial panmixia in dromedaries predates ancient caravan trading

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In their note, Marom et al. (1) correctly point out that the phylogeographic pattern emerging from the (mito)genetic signatures in modern dromedary breeds and ancient wild and domestic dromedaries may help illuminate the organization of caravan trade. With the latter not being the focus of our paper, however, we did not address this aspect in full detail but concluded that transcontinental and crosscontinental transportation of bulk goods using dromedaries would offer the most plausible explanation for the lack of patterning in our data (2). As far as we understand, the authors do not challenge our conclusions but support our argument that camel caravans played a role in dispersal and genetic admixture. Few historical sources detail trade and pilgrim routes and the organization of caravans through the desert landscapes of the Arabian Peninsula, but obviously several north–south routes existed (3).

According to Marom et al. (1), camel caravans were already used from ~15th century BCE. They cite the study of the camel remains from Tell Jemmeh (4) and correlate caravan trade with the rise of city-states in the oases of Arabia. Apart from a small Chalcolithic deposit with no camel bones at all, the mound of Tell Jemmeh was continuously inhabited from the Middle Bronze Age to the Hellenistic period. The earliest camel finds come from strata dating to the 14th or 13th centuries BCE, but apart from stratigraphic considerations, further data are not provided to support this early date. Moreover, diachronic skeletal distribution (4) shows that, at Tell Jemmeh, 98.5% of the camel remains postdate 700 BCE and that the few Late Bronze Age finds reported include small skeletal elements (carpal, fibula, phalanx 2) or fragments, which we believe could easily represent intrusive specimens. Here, we recall the studies by

Grigson (5), which addressed the problems with early dates for camel finds from the Near East, and by Magee (6), which noted a compelling lack of archaeological and archaeozoological evidence for camel-borne trade before 1000 BCE.

Marom et al. (1) also suggest applying stable isotope analysis to ancient camel specimens from different locations along caravan routes, because strontium signatures in tooth enamel (juvenile signature) and bones (lifetime signature) could help tracing mobility in camels and distinguish local breeding stock from imported animals. It remains to be seen, however, whether sufficient large-scale geologic variability between the different residence areas under study exist, such that variations in bioavailable strontium values can be detected and interpreted in terms of animal transfer and mobility (7–9).

Finally, from our data, it is difficult to estimate how much of the genetic diversity present in modern one-humped camels results from extensive exchange and breeding in stations along ancient caravan routes. In the maternal (mitochondrial) haplotypes, for one, we see a panmixia in modern dromedaries, which certainly predates crossbreeding at central oases along the routes. At the time that large-scale human-mediated dispersal of dromedaries started, most of today's observed mitochondrial genome diversity was already present, secured and augmented from the ancestral diversity of the wild (now extinct) dromedaries (2).

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