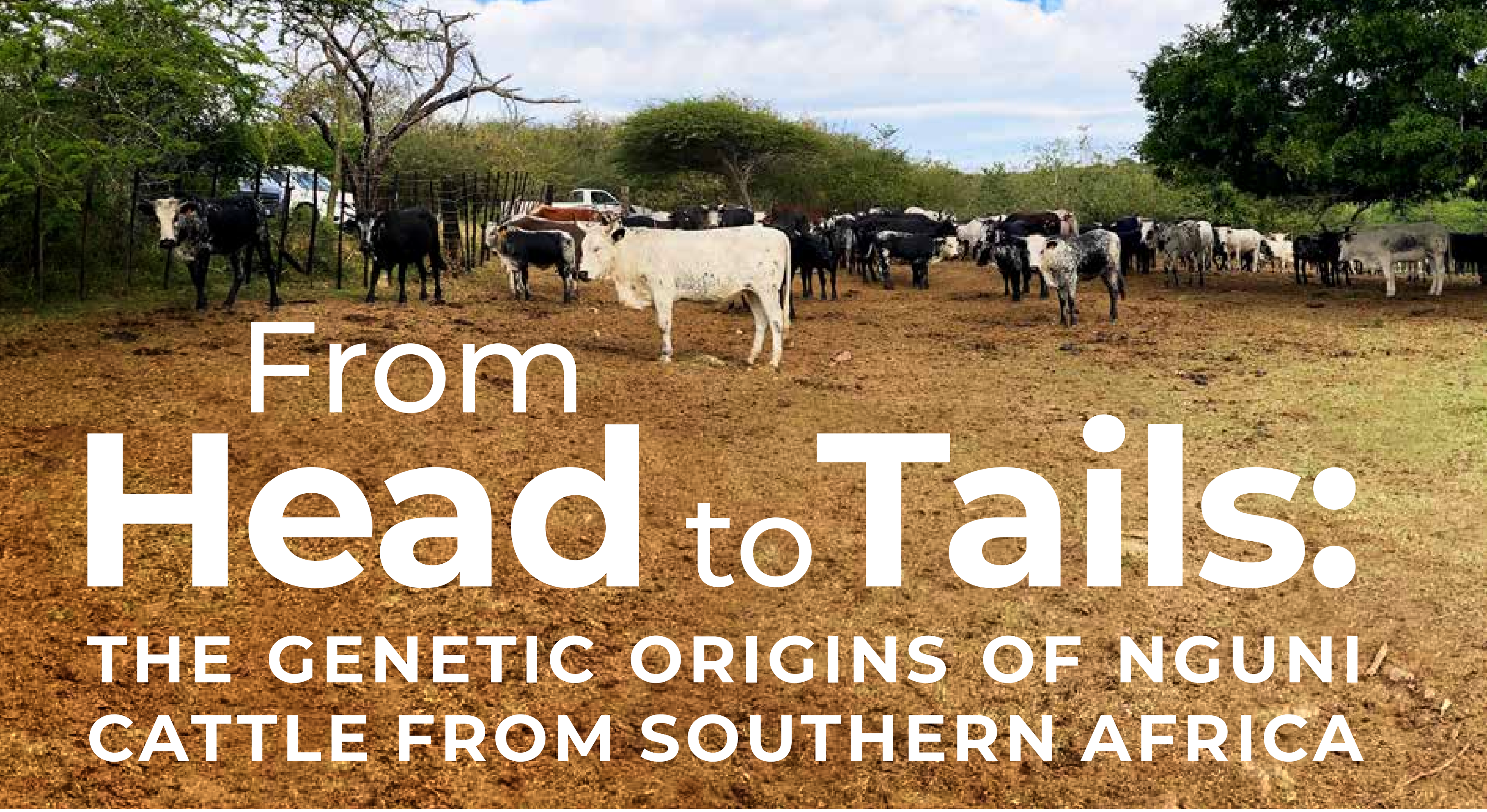

From Head to Tails:

THE GENETIC ORIGINS OF NGUNI CATTLE FROM SOUTHERN AFRICA

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Southern Africa's cattle are an important economic, ecological, cultural and genetic resource. Cattle were domesticated from wild auroch in at least two places – the Near East and the Indian subcontinent – about 8000 years ago. The cattle that originated in the Near East are flat-backed taurine cattle, and those from India are indicine cattle and have large humps on their shoulders. Despite their different origins, the two lineages of cattle can interbreed freely. It has been suggested that cattle were domesticated a third time in northern Africa about 7000 years ago. The evidence for an independent African domestication process is currently difficult to untangle, but the possibility remains.

The earliest cattle in Africa for which we have good evidence, arrived from the Near East, and were managed by pastoralists in northern Africa by about 7400 years ago. They extended across a much wetter and more hospitable Sahara Desert. As the Sahara began to dry, the local pastoralists and their cattle moved south in search of grasslands. Their cattle were the ancestors of southern Africa's modern cattle. But they are not the only ancestors. The humps of southern Africa's living cattle show they also have indicine ancestry. When those Indian cattle arrived in Africa remains unknown. It is likely that once indicine cattle were introduced, they became valuable to local pastoralists and farmers because indicine cattle are drought resistant and disease tolerant. Interbreeding

between local taurine cattle and newly arrived indicine cattle would have contributed to a more robust cattle gene pool.

In past genetic studies of southern African cattle, all the mitochondrial DNA – that is, DNA inherited from the mother, and only the mother – derives from Near Eastern taurine cattle. In contrast, the nuclear DNA – the DNA inherited from both parents – shows signs of origins in both taurine and indicine cattle. There are three possible explanations for this surprising pattern. First, only male indicine cattle were brought to Africa, so maternal lineages of indicine cattle were never introduced to the continent. Second, some features of the maternally inherited mitochondrial DNA of indicine cattle was less well adapted to the African environment and a combination of natural selection and the artificial breeding selection practiced by famers resulted in its rapid removal from the gene pool. Lastly, the 1890s rinderpest panzootic killed so many sub-Saharan cattle that, by chance, maternal lineages from India were removed from African cattle populations.

As part of the Zulu Kingdom Archaeology Project, our research aims to examine these explanations and expand our knowledge of the origins of southern Africa's cattle and their relationships with other cattle. We are sequencing complete mitochondrial genomes of living Nguni cattle and cattle from 18th and 19th century archaeological sites in KwaZulu-Natal. Living cattle can be sampled by pulling hair from the tail. The hair follicle that remains attached to the hair contains enough DNA to analyse. The archaeological cattle come from uMgungundlovu, which was the royal capital of the Zulu king Dingane from 1828 until 1839, and from Nqabeni, a stone-walled site occupied during the 18th century. The archaeological sample uses teeth from cattle at these pre-rinderpest sites.

The team has already collected the archaeological samples for analysis, and over 200 head of modern Nguni cattle have already been sampled. At the end of the current field season in July, the archaeological samples and the hair samples will be transported to the Molecular Anthropology Laboratories at Southern Methodist University, in Dallas, Texas. These labs house both a purpose-built ancient DNA laboratory suite for the analysis of archaeological DNA, and a modern genetics lab in which the cattle hair sample will be analysed. We anticipate that the laboratory analyses on the archaeological specimens will be completed by January 2023, and the on the modern samples by May 2023. When the results are complete, we will report our findings to the society.

This research will vastly expand our present understanding of the genetic heritage of African cattle breeds. We will better be able to model the spread and adaptations of cattle to the diverse environments of sub-Saharan Africa and determine the extent to which the genetic patterns in modern southern Africa cattle are the result of their long migration south or the devastating rinder pest panzootic. Genetic research on modern and ancient African cattle breeds also holds tremendous potential to safeguard good security globally, especially in arid and semiarid environments with lower quality pasturage and high disease loads. Nguni cattle are well adapted to these circumstances and represent a unique genetic resource at a time when there is an urgent need to improve livestock productivity for the benefit of present and future human generations. ■