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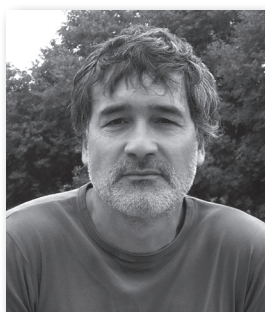
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A Cover Story for a *Nature* cover: milking in the prehistoric 'Green Sahara'

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Central Sahara is one of the African hotspots for the study of the emergence and development of pastoralism during the Early Holocene. Recent research carried out in the Tadrart Acacus (SW Libya) added significant information on the first appearance of domestic livestock in the area, the building of a pastoral identity and the development of a full pastoral economy, based on the exploitation of secondary products, including dairying. The chemical analyses of pottery residues excavated at Takarkori rock shelter together with rock art evidence of the region led us to date the earliest evidence of milking in Africa at the beginning of the Middle Pastoral, around 6100 uncalibrated years BP, shedding new light to the lifeways of these early Saharan herders.

The first western travellers who explored the Central Sahara in the 19th century were astonished by the rock engravings on the banks of fossil rivers portraying hippos, crocodiles as well as domestic animals – particularly cattle – in fact, they strongly contrasted with the surrounding environment (Barth, 1857-1858; Duveyrier, 1864).

Since then, the idea of a “Green Sahara”, that could host large faunas and human communities, became quite common and several generations of researchers – especially from Europe – spent money and energies in the field (e.g. Barich, 1987; Hassan, 1997; Kuper, 1995).

Italian research focussed on Libya: unsurprisingly, given the colonial experience of the 1930s (Pace *et al.*, 1951), but this continued also after World War II, with the expeditions led by Fabrizio Mori and his associates, in particular Angelo Pasa, in the area of the Tadrart Acacus and surroundings (e.g., Mori, 1965). Even if Mori concentrated his research on prehistoric rock art, his approach was since the very beginning truly inter-disciplinary, inserting the artworks in their archaeological context, based on stratigraphic excavations and integrated laboratory approach. Mori and Pasa excavated important archaeological sites, such as Uan Muhuggiag, which yielded the remains of domestic cattle radiocarbon dated to 7400 BP¹. Given the early

¹ Throughout the text, the quotation ‘BP’ refers to uncalibrated years before present, according to Libby’s half-life. For the calibration, we used OxCal online version 4.1 (Bronk Ramsey, 2009).

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age, he advanced the provocative idea of an early and independent centre of domestication in the very core of central Sahara (Mori, 1961), attracting the attention of the scientific community.

The study of the emergence, development and cultural aspects of pastoral societies has been one of the most prolific fields of research, not only in the Sahara but in Africa in general (e.g., di Lernia, 2002; Gifford-Gonzalez, 2005; Marshall & Hildebrand, 2002; Wendorf & Schild, 2001; MacDonald & MacDonald, 2000). The debate on the existence of an autonomous centre of domestication in Africa remains a hot topic, mostly in the light of the evidence from Nabta Playa and other sites in Egypt (Stock & Gifford-Gonzalez, 2013; di Lernia, 2013).

Personally, I never considered Africa as an independent centre of cattle domestication, but mostly I feel that this debate largely distracted the attention of archaeologists and other scientists from other crucial topics related to herding societies in Africa. In particular, I would recall the cultural practices undertaken by Saharan pastoral groups to cope with environmental changes due to abrupt climate variations; the full exploitation – including secondary products – of domestic livestock; and the building of a pastoral identity (di Lernia, 2013).

During the field activity in SW Libya of “The Archaeological Mission in the Sahara” (Department of Archaeology, Tripoli – Sapienza University of Rome), I addressed some of these issues, through different research projects in our study area – a large region in south-western Libya encompassing the mountains of the Messak and Tadrart Acacus, together with large dune fields and dried fluvial valleys (locally called *wadi*). In particular, the analysis of the transition towards a full productive economy was investigated at Takarkori rock shelter in the Acacus Mountains. The investigation was particularly fortunate, given the richness of the archaeological deposit and its excellent state of preservation (Biagetti & di Lernia, 2007, 2013; di Lernia & Tafuri, 2013). The site – a large shelter open to the west – lies around hundreds of meters above the floor of Wadi Takarkori, which marks the present border between Libya and Algeria. The area around the site, today a desert dotted by a few shrubs and Acacia trees, hosted in the past different ecological niches, including a large watered area a few kilometres westwards. The excavations started in 2003 and lasted to the end of 2006, revealing the presence of Early Holocene ‘complex’ hunter-gatherers, whose first occupation dates to 8900 BP: a series of fixtures, including stone huts and fireplaces, characterize the site during the so-called Late Acacus occupation, which ended around 7400 BP. The first herders, dated to around 7300-6400 BP, used the shelter as a burial ground keeping this tradition for millennia, throughout the whole pastoral culture (up 4300 BP): interestingly, only women and children were buried in the shelter, revealing a specific cultural habitus (di Lernia & Tafuri, 2013).

The richness, diversity and peculiarity of the archaeological record at Takarkori are not an uncommon situation in central Saharan sites, and in the Tadrart Acacus in particular: many other sites feature spectacular findings, including extraordinarily preserved ecofacts, but not faunas, and Takarkori is no exception. The remains of animals – both wild and domestic – are barely preserved, mostly for taphonomic reasons. The investigation on the nature and organization of pastoral economy, from the initial phases through its development, had therefore to rely on other proxies: among these, we selected the analysis of residues preserved in the potsherds to understand food practices among early herders.

Takarkori rock shelter yielded a rich record of pottery fragments, around 3000: some of them also showed visible coatings and residues on both inner and external surfaces. A significant number of potsherds was sampled on the basis of their stratigraphic position, cultural attribution, manufacture

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features, vessel part and decoration. The study was initially undertaken by Silvia Bruni, University of Milan, and later involved Richard Evershed, Julie Dunne and other colleagues from the University of Bristol (UK). Most of the potsherds sampled (56 out of 81) belonged to the Middle Pastoral period (ca. 6100-5000 BP), the remainder referring to other phases.

The chronology of the pottery finds was secured by more than 50 radiocarbon dates run on samples from the different layers of the stratigraphic sequence: this allowed to finely match the indications based on decoration patterns against radiocarbon information. The statistical analysis of the radiocarbon determinations also confirmed the time frame of the different cultures who lived in the area during the early and middle Holocene (Cherkinsky & di Lernia, in press).

The pottery samples were analysed by GC-C-IRMS to determine the $\delta^{13}\text{C}$ values for the individual C16:0 and C18:0 carboxylic acids, with the aim of classifying fatty acids. Methods and hard data are fully reported in the *Nature* paper (Dunne *et al.*, 2012): the analyses led to the identification for ca. 30% of the Middle Pastoral samples of pure animal fat origin. These data represent the earliest hard evidence of the 'secondary' exploitation of domestic cattle through milking and milk processing in Africa. Even if the state of preservation of organic matter in arid environment was one of the keys for the successful identification of pottery residues as fatty acids, the 'smoking gun' for the existence of exploitation of milk and its processing within Middle Pastoral society was already visible in the extraordinary rock art paintings of the Acacus and surrounding, where cows with full udders are often depicted. In a few cases, prehistoric painters portrayed the actual milking of a cow, such as at Wadi Teshuinat II (Gallinaro *et al.*, 2008) in the Acacus or Wadi Tiksatin in the Messak (Lutz & Lutz, 1995). Unfortunately, rock art is difficult to be dated, and chronological attributions are rare (di Lernia & Gallinaro, 2010; di Lernia, 2012).

The implications of this research are of particular magnitude, not only for the understanding of pastoral practices in the early Saharan prehistory, but also for the understanding of human migrations across North Africa, and beyond. However, it was the magnificent beauty of the prehistoric cattle painted on the walls of the Tadrart Acacus rock shelters (and the beautiful photograph by Roberto Ceccacci) that got us the cover of *Nature* – a great satisfaction indeed.

Acknowledgments

The research would not have been possible without the contribution of Stefano Biagetti, Silvia Bruni, Julie Dunne and Richard Evershed. The Tuaregs of the Acacus helped for the sampling of butter and other reference collections material. The Mission is funded by Sapienza University of Rome (Grandi Scavi di Ateneo) and the Minister of Foreign Affairs (DGSP).

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