

Arrow poisons in the Palaeolithic?

In a previous issue of PNAS, d'Errico et al. (1) reported interesting findings from Border Cave in South Africa, including the presentation of a "poison applicator," directly dated to ~24,000 y ago. The fragmented wooden stick with perpendicular incisions appears, although smaller in diameter, not too indistinct from some poison applicators recovered in the Kalahari. Residues found on the item were studied using gas chromatography, and the authors interpreted the results as evidence for the toxin ricin. This was used to substantiate the claim that this "applicator" is direct evidence of the use of poisons in hunting.

Evidence of poison use in bow-and-arrow hunting would add to the concept of it as a highly cognitive multistage process involving the exploitation of natural substances for future gain. Discovering the use of poisons as part of prehistoric hunting technology is generally anticipated; Ellis' review of ethnographic data (2) highlights a clear link between the use of lithic tipped arrows and the use of toxins, and I contend, as does Ambrose (3), that the use of poisons likely started at the inception of arrow technology, and intimate knowledge of poisons enabled the production and use of otherwise inefficient but light hunting gear.

Nevertheless, there are weaknesses in d'Errico et al.'s evidence (1) which one hopes can be rebutted. It should be noted that if this is good evidence of ricin, it is a leap to imply that this is direct evidence of the use of poisons specifically in hunting. Ethnographic database review (4) finds castor plant products (source of ricin) are reported as medicines several times but are not mentioned in the context of arrow poison. In addition, ricinoleic acid and ricinelaic acid (the acids cited as evidence of poison) are not poisonous but are the main components of castor oil, which, incidentally, has been cited as a substance used in hide preparation methods local to Border Cave in KwaZulu-

Natal (5). Given the other uses of castor plant derivatives, and the authors' own contention that the item is likely not a projectile implement, alternative hypotheses could be that this was a tool for food preparation, medicinal purposes, or the preparation of hides. Little consideration appears to have been given to alternative castor plant extract use or to the other compounds discovered in the sample (viewed as contaminants?). Discussion of how these might fit into the interpretive framework would help clarify the argument of d'Errico et al. (1), and it is not clear why these alternative possibilities are omitted from discussion. A lack of spectra for the two residues analyzed from the wooden item makes it impossible to evaluate relative concentrations of the compounds, and this further limits the ability to review this evidence independently. Finally, it is worthy of note that ricin itself is a protein (yet no protein analysis was conducted) and is not effective after heating; d'Errico et al. (1) claimed the substance had been heated, which appears to contradict their argument regarding its use.

Given the questions surrounding these results, I am not sure that this can be considered the "oldest known secure evidence of the use of poison for hunting purposes" (1).

Adrian Anthony Evans¹

Archaeological, Geographical, and Environmental Sciences, University of Bradford, Bradford BD7 1DP, United Kingdom

1. d'Errico F, et al. (2012) Early evidence of San material culture represented by organic artifacts from Border Cave, South Africa. *Proc Natl Acad Sci USA* 109(33): 13214–13219.
2. Ellis CJ (1997) Factors influencing the use of stone projectile tips: An ethnographic perspective. *Projectile Technology*, ed Knecht H (Plenum, New York), pp 37–74.
3. Ambrose SH (2002) Small things remembered: Origins of early microlithic industries in sub-Saharan Africa. *Archeological Papers of the American Anthropological Association* 12(1):9–29.
4. eHRAF (2012) Human Relations Area Files: World cultures. Available at www.yale.edu/hrf. Accessed August 10, 2012.
5. Krige EJ (1965) *The Social System of the Zulus* (Shuter & Shooter, Pietermaritzburg, South Africa).

Author contributions: A.A.E. performed research, analyzed data, and wrote the paper. The author declares no conflict of interest.

¹To whom correspondence should be addressed. E-mail: a.a.evans@bradford.ac.uk.