Reply to Schmidt et al.: Interpretation of Paleolithic adhesive production: Combining experimental and paleoenvironmental information

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We agree with Schmidt et al. (1) that simple tar manufacturing processes exist. Tar could have been (re)discovered accidentally (2), and we do not exclude the use of condensation (3) by Neandertals. However, we think it is not the most parsimonious interpretation of all tar finds. Based on (regional) archeological and paleoenvironmental data, we suggest more efficient methods of tar production were used in the Zandmotor case (4). We will further address our reasoning.

Efficiency

Schmidt et al. (1) suggest that simultaneously repeating the condensation process reduces the production time, yet this can also be done with distillation methods. Having more people work simultaneously requires the same number of man-hours and may add a degree of social sophistication. This also does not change the amount of birch bark required. Birch forests provide plenty of bark (1); however, the Zandmotor environment was primarily steppe-tundra and largely treeless (5, 6). Therefore, raw material constraints and efficiency cannot be disregarded.

Composition

Koller et al. (7) analyzed the Königsaue piece and stated tar was produced at temperatures below 400 °C. This was generally accepted until Kozowyk et al. (2) produced tar at higher temperatures. The presence of certain fatty acids and diacids indicate a production method similar to a raised structure (8). These are visible in the Zandmotor tar, shown in the long-chain diacids plot of m/z 98 (ref. 4, figure S4). High ratios of botulin and lupeol to degradation markers with the condensation method (ref. 3, figure 2D) are remarkable, with temperatures in the flames being much higher than Koller et al. (7) initially stated. More compositional analysis (cf. ref. 6) will no doubt be a tremendous aid to future research. The importance of uniform methods of analysis to establish diagnostic criteria for different production methods is also clear. Birch tar is well suited for reuse (9). However, curation similar to Neolithic finds (6) cannot be posited on current evidence and intuits a large amount of logistical complexity on the part of Neandertals. Furthermore, the thermoplastic properties making birch tar ideal for reuse also mean that it does not need to become liquid, as this hampers the application. Ethnographic examples show adhesives were only warmed until soft and then pushed onto flakes (10). Complete homogenization of contaminants, found in the Zandmotor tar, is unlikely to result from reuse.

Prehistoric Analogies

Schmidt et al. (1) state that birch tar was kept and transported long distances in the Neolithic and that harvesting significant quantities of bark was not an issue. However, at that time, people used highly

efficient and complex methods of tar production and still may have needed to consider the seasonality of bark harvesting and the qualities of different ages and types of bark (8). If these considerations were necessary when birch was plentiful, they become more significant for the Zandmotor tar produced by highly mobile societies in a largely treeless landscape.

Conclusion

We agree that intuition cannot solve debates about Paleolithic tar production. Only through rigorous experimentation (3), uniform methods of analysis (8), and consideration of contextual information (4) can we get a better handle on the past.

1 P. Schmidt, M. Rageot, M. Blessing, C. Tennie, The Zandmotor data do not resolve the question whether Middle Paleolithic birch tar making was complex or not. *Proc. Natl. Acad. Sci. U.S.A*., 10.1073/pnas.1919564117 (2020).

2 P. R. B. Kozowyk, M. Soressi, D. Pomstra, G. H. J. Langejans, Experimental methods for the Palaeolithic dry distillation of birch bark: Implications for the origin and development of Neandertal adhesive technology. *Sci. Rep*. 7, 8033 (2017).

3 P. Schmidt et al., Birch tar production does not prove Neanderthal behavioral complexity. *Proc. Natl. Acad. Sci. U.S.A*. 116, 17707–17711 (2019).

4 M. J. L. T. Niekus et al., Middle Paleolithic complex technology and a Neandertal tar-backed tool from the Dutch North Sea. *Proc. Natl. Acad. Sci. U.S.A*. 116, 22081–22087 (2019).

5 K. F. Helmens, The Last Interglacial–Glacial cycle (MIS 5–2) re-examined based on long proxy records from central and northern Europe. *Quat. Sci. Rev*. 86, 115–143 (2014).

6 D. Mol et al., The Eurogeul—first report of the palaeontological, palynological and archaeological investigations of this part of the North Sea. *Quat. Int*. 142-143, 178–185 (2006).

7 J. Koller, U. Baumer, D. Mania, High-tech in the Middle Palaeolithic: Neandertal-manufactured pitch identified. *Eur. J. Archaeol*. 4, 385–397 (2001).

8 M. Rageot et al., Birch bark tar production: Experimental and biomolecular approaches to the study of a common and widely used prehistoric adhesive. *J. Archaeol. Method Theory* 26, 276–312 (2019).

9 P. R. B. Kozowyk, J. A. Poulis, A new experimental methodology for assessing adhesive properties shows that Neandertals used the most suitable material available. *J. Hum. Evol*. 137, 102664 (2019).

10 L. R. Binford, An Alyawara day: Making men's knives and beyond. *Am. Antiq*. 51, 547–562 (1986).