the attracted *E. coli* cells and the proteolysis of their cellular contents would then produce additional attractants for more *E. coli* cells to move towards the *M. xanthus* colony. This primitive form of ensnarement must be of significant survival value for this very slow-moving microorganism.

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Dating hominid remains

SIR — McDermott *et al.*[1] are to be congratulated for obtaining mass spectrometer uranium-series dates that corroborate previously published early-uptake electron spin resonance (ESR) readings from hominid-bearing Middle Palaeolithic sites in Israel. But the authors do not mention the difficulties arising from dating isolated animal teeth derived from Garrod's excavations in the 1930s in Tabun and Skhul.

Exact recording of provenance was not practised then and understanding of site-formation processes was minimal. Unfortunately, the Skhul cave was emptied, so further dating of stratified samples cannot now be undertaken[2]. As at Qafzeh[3], all hominid burials from Skhul were uncovered from a 1-m-thick deposit (layer B2; plate I of ref. 2) covered by an additional 1 m of Middle Palaeolithic sediment (layer B1). Although McDermott *et al.* suggest that burials 1, 4 and 5 might have been later in age than the rest of the hominids, we cannot directly relate dates derived from animal teeth to those of human skeletons.

One way to resolve this problem would be direct dating of the hominid skeletal remains. Thus the younger dates 41,400 ± 400 and 45,500 ± 700 years ago may indicate the presence of a Late Middle Palaeolithic assemblage in the upper part of layer B or reflect intrusions from layer A (Upper Palaeolithic). Note that these dates fall within the range of the Early Upper Palaeolithic in the Levant[4].

At Tabun, Garrod was also not certain about the attribution to layer C of the woman's burial (marked as Neanderthal remains in Fig. 1 of ref. 1). Even she suspected that it could have been interred by the producers of the Tabun B industry (page 64 of ref. 2). Interestingly, both in Amud and Kebara caves similarly robust skeletons were uncovered with the same industry as Tabun B (ref. 5). The main portion of the lithic assemblages from Skhul B and the hominid bearing layers in Qafzeh are similar to each other and to Tabun C, where the isolated jaw (TII) resembles the Skhul and Qafzeh fossils referred to as early *Homo sapiens*. Thus dates in the range of 47,000/45,000 to 75,000/80,000 years ago are appropriate to the so-called 'Tabun B-type' industry and to the Levantine Neanderthals. By contrast, the early modern *H. sapiens* in Skhul, Qafzeh and Tabun C, all with similar 'Tabun C-type' artefacts, are dated to 80,000–120,000 years ago. Thermoluminescence dates on burnt flints from Skhul support the electron spin resonance readings[6] and indicate an average age of 119,000 ± 18,000 years.

We agree with the conclusions[1] that early modern *H. sapiens* in the Levant were coeval with European Neanderthals, but believe that the former preceded the arrival of the latter in the near East, which can perhaps be attributed to the development of glacial conditions (Emiliani stages 5c or 4)[7].

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1. McDermott, F., Grün, R., Stringer, C. B. & Hawkesworth, C. J. *Nature* **363**, 252–255 (1993).
2. Garrod, D. A. E. & Bate, D. M. *The Stone Age of Mount Carmel* Vol. I (Clarendon, Oxford, 1937).
3. Vandermeersch, B. *Les Hommes Fossiles de Qafzeh, Israel* (CNRS, Paris, 1981).
4. Bar-Yosef, O. *Phil. Trans. R. Soc.* B**337**, 193–200 (1992).
5. Bar-Yosef, O. & Meignen, L. in *The Middle Paleolithic: Adaptation, Behavior and Variability* (eds Dibble, H. & Mellars, P.) 163–182 (Univ. Pennsylvania Press, Philadelphia, 1992).
6. Mercier, N. *et al. J. Archaeol. Sci.* **20**, 169–174 (1993).
7. Bar-Yosef, O. in *L'Homme de Néandertal* Vol. 3 (ed Otte, M.) 31–38 (Université de Liège, 1988).

MCDERMOTT *ET AL.* REPLY — All of us, including Bar-Yosef[1], who work in material from old archaeological excavations, must make the best of the samples at our disposal. The long-standing debate about whether the Tabun Neanderthal should be ascribed to layer B, C or even D is impossible to resolve at this stage. We[2] have preferred to stick with the stratigraphical assignment of Garrod[3]. Even if the skeleton came from a different horizon (layer B or D in modern stratigraphies), so would the bulk of the associated faunal remains in Garrod's collection, and for this reason our uranium–thorium age results for the skeleton are robust.

As for Skhul, the three youngest uranium-series ages (40,000–45,000 years) almost certainly underestimate the true age because of a complex uranium-uptake history (they are younger than even the early-uptake ESR ages), and as we stated in our paper[2], further research is required to investigate whether or not two age populations are present.

We agree with Bar-Yosef and Pilbeam that direct dating might be a solution, but it is unclear how they propose to do this. We are now tackling the problem indirectly by uranium-series and ESR dating of elements of the fauna actually associated with Skhul 5 and 9, and in the future we shall attempt direct γ-ray dating[4] on the hominid remains.

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1. Bar-Yosef, O. in *L'Homme de Néandertal* vol. 3 (ed. Otte, M.) 31–38 (Université de Liège, 1988).
2. McDermott, F., Grün, R., Stringer, C. B. & Hawkesworth, C. J. *Nature* **363**, 252–255 (1993).
3. Garrod, D. A. E. & Bate, D. M. *The Stone Age of Mount Carmel* vol. 1 (Clarendon, Oxford, 1937).
4. Yokoyama, Y., Falguères, C. & Bibron, R. in *L'Homme de Néandertal* vol. 1 (ed. Otte, M.) 135–141 (Université de Liège, 1988).

Chemocline of the Black Sea

SIR — Sinninghe Damsté *et al.*[1] have investigated the question of anthropogenic impacts on chemocline depth fluctuations in the Black Sea by examining the molecular record of photosynthetic bacterial pigment degradation products in Black Sea sediments. They interpret the historical presence of anoxygenic photosynthesis to mean that "the penetration of the photic zone by anaerobic waters is not a recent phenomenon", and suggest that "natural causes for shoaling of the chemocline are more likely than anthropogenic ones". The issue of an anthropogenic influence on the chemocline affects the coastal zones of countries surrounding the Black Sea. But in my view Sinninghe Damsté *et al.* misstate several earlier arguments and, more important, rely on a small and irrelevant dataset.

Murray *et al.*[2] reported the rapid, unexpected rise of the chemocline by comparing hydrographic data collected in 1969 and 1988. They concluded that "Natural, interannual or decadal variations in climate and river runoff" drive vertical fluctuations in the chemocline, and argued that any effects caused by anthropogenic influences on freshwater inputs could be "superimposed on these natural variations". Water mass balance