species, indicating a habitat that could support grazing mammals¹⁰.

The GRIP core seemed to corroborate a difference between Holocene climate and that of previous interglacials by showing major fluctuations within the 'last interglacial' around 120 kyr. The veracity of this part of the core has been questioned, however: the 'fluctuations' may be due to folding; moreover, they are not seen in some other ice-core and oceanic sequences¹¹. On the other hand, independent lines of evidence corroborate Eemian inconstancy, including data from the crucial terrestrial realm. Data from a lake core in France² indicate two rapid cooling events within the last interglacial, including a period of reversion from forest to open subalpine vegetation. Analysis of detailed pollen records from Germany³ suggests greater climatic instability in the last interglacial than in the Holocene. Finally, evidence of mid-Eemian cooling has come from studies in the Norwegian Sea and North Atlantic Ocean⁴.

The spatial structure of the terrestrial interglacial environment requires further investigation, as does the mammoths' response to it, which clearly varied across their vast range. A crucial role may have been played by unglaciated Arctic regions in providing interglacial refuges for the tundra-steppe grazers. This pattern was again followed at the start of the Pleistocene/Holocene transition, which seems to have begun as a 'normal' interglacial. However, subsequent changes, culminating in the onset of stable climate documented by the ice cores, resulted in an irreversible turnover of the Pleistocene biota.

Adrian M. Lister

*Department of Biology,
University College London,
London WC1E 6BT, UK*

Andrei V. Sher

*Severtsov Institute of Ecology
and Evolution,
Russian Academy of Sciences,
Moscow 117071, Russia*

original excavation, found at the museum.

We used mass spectrometric U-series analysis of the enamel and dentine to evaluate U-uptake history, which affects the calculated ESR age⁵. Early uptake yields the minimum age for a given data set, while linear-uptake ages commonly agree with other age estimates. Equivalent early-uptake ages and U-series ages in teeth from layers 5–6 indicated early U-uptake, whereas early-uptake ages of teeth from layers 7–8 were larger than associated U-series dates, implying continuous U uptake. The respective linear-uptake or early-uptake ages of teeth from layers 1–8 were indistinguishable, with a mean of 130 ± 10 kyr, showing that the entire fluvial sequence was formed in the last interglacial (stage 5e), consistent with its faunal character.

Whereas hominids from beds 3–7 are all Neanderthals, layer 8 (also dated to 130 kyr) contained cranial elements of a 6–8-yr-old juvenile (Krapina 1). Some metric and morphological aspects group it with other juvenile Neanderthals, but its more pentagonal shape in rear view, higher frontal squama and some other characteristics approach the condition of early modern humans (N. Minugh-Purvis, unpublished thesis, Univ. Pennsylvania). A partial occipital bone from layer 8 (Krapina 11) lacks a suprainiac fossa, a characteristic of Neanderthals observed in occipitals from layers 3–4. These data suggest that the layer 8 hominids are possibly transitional to anatomically modern hominids, raising the question of when this taxon first appeared in Europe.

W. J. Rink

H. P. Schwarcz

*Department of Geology,
McMaster University, Hamilton,
Ontario L8S 4M1, Canada*

F. H. Smith

*Department of Anthropology,
Northern Illinois University,
DeKalb, Illinois 60115, USA*

J. Radović

*Croatian Natural History Museum,
Demetrova 1, 1000 Zagreb, Croatia*

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Scientific Correspondence

Scientific Correspondence is intended to provide a forum in which readers may raise points of a scientific character. Priority will be given to letters of fewer than 500 words and five references.

ESR ages for Krapina hominids

SIR — At the site of Krapina, 40 km NNW of Zagreb, more than 850 skeletal remains from several Neanderthal individuals were found, principally in layers 3 and 4 (refs 1, 2), associated with a Middle Palaeolithic industry³. We have obtained electron spin resonance (ESR)⁴ and U-series dates on tooth enamel from

the site (see table). Teeth from the 1899–1905 archaeological excavations of K. Gorjanović-Kramberger, stored at the Croatian Natural History Museum, were analysed as in ref. 4. External γ - and β -dose rates were estimated from U, Th and K analyses of blocks of weakly indurated sand preserved from the

ESR AND U-SERIES DATES FOR KRAPINA

Layer	Sample	ESR age (kyr)			U-series age (kyr)		
		Early uptake	Average	Linear uptake	Average	Enamel	Dentine
9	91187A	87 $\pm$ 7	87 $\pm$ 7	113 $\pm$ 10	113 $\pm$ 10		
8	91182A	109 $\pm$ 9		147 $\pm$ 14			
	91182B	90 $\pm$ 8		120 $\pm$ 12			
	91182C	88 $\pm$ 7		122 $\pm$ 11			
	91182D	90 $\pm$ 6		126 $\pm$ 11			
	91182E	94 $\pm$ 6		128 $\pm$ 11			
	91182G	88 $\pm$ 8		120 $\pm$ 11			
	91182H	93 $\pm$ 9		130 $\pm$ 12			
	91182I	90 $\pm$ 10		123 $\pm$ 13			
	91183A	108 $\pm$ 9	99 $\pm$ 5	139 $\pm$ 14	132 $\pm$ 5	69.7 $\pm$ 0.5	89.8 $\pm$ 1.4
7–8	91183B	96 $\pm$ 8		128 $\pm$ 12			
	91183C	94 $\pm$ 7		127 $\pm$ 12			
	91183D	94 $\pm$ 7		128 $\pm$ 12			
	91183E	95 $\pm$ 8		126 $\pm$ 12			
	91183F	103 $\pm$ 9		135 $\pm$ 13			
	91183G	100 $\pm$ 8		132 $\pm$ 13			
	91183H	102 $\pm$ 8		135 $\pm$ 13			
	91184	131 $\pm$ 13		152 $\pm$ 17			
5–6	91186A	126 $\pm$ 11	130 $\pm$ 3	178 $\pm$ 17	167 $\pm$ 10	131 $\pm$ 1	223 $\pm$ 4 ⁺⁵⁵
	93042A	132 $\pm$ 13		160 $\pm$ 18			415 $\pm$ 38
	93042B	132 $\pm$ 14		162 $\pm$ 19			
1	91185A	142 $\pm$ 12	133 $\pm$ 15	185 $\pm$ 19	180 $\pm$ 15		
	91188A	142 $\pm$ 11		192 $\pm$ 18			
	91189A	116 $\pm$ 9		163 $\pm$ 16			

ESR dates are computed assuming 10 $\pm$ 10% water in sediment. γ - And β -doses from sediment were determined from neutron activation analyses of sediment samples for U, Th and K. β -doses were corrected for attenuation. U-series ages were determined by thermal ionization mass spectrometry⁵.