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Date of deglacierisation of Mount Elgon

HIGHER East African and Ethiopian mountains are known to have been extensively glaciated during the Quaternary[1,2]. After Mount Meru in Tanzania, Mount Elgon (4,321 m), on the Kenya/Uganda border, is the highest such mountain to be completely free of glaciation today. We present here ^{14}C determinations which indicate that deglacierisation of Mount Elgon occurred shortly before 11,000 BP.

Mount Elgon is a Miocene volcano surmounted by an 8 km diameter caldera. Despite earlier indications to the contrary[1], we have been able to distinguish only one major glacial stage on the mountain. This is marked, *inter alia*, by prominent termino-lateral moraines within valleys radiating out from the caldera rim (altitude ~3,950–4,250 m). The lower-most moraines reach down to altitudes of ~3,350 m. Valleys on the southern slopes of the mountain are headed by ice-scooped rock basins, at least two of which still contain lakes. Basal organic sediment has been collected at two sites within one of these lake basins (4,150 m; 1° 06′ N, 34° 34′ E; grid XS 749215) and submitted for ^{14}C determination. The samples, which are from sediment depths of 385–405 cm and 625–655 cm, respectively, give dates of $11{,}012 \pm 135$ BP (SRR-1118) and $10{,}708 \pm 230$ BP (SRR-1120).

On Kilimanjaro[3], Mount Kenya[4] and Ruwenzori[5,6], several series of major glacial advances have been identified. On the basis of the appearance and altitude of the moraines, the Elgon glaciation is believed to be correlated with the last main glaciations on these mountains (the Mahoma Lake glaciation on Ruwenzori)[1,5]. Only one ^{14}C date has previously been published for a major glacial episode in tropical Africa[7]. This date of $14{,}700 \pm 290$ BP is from basal organic sediment infilling a kettle-hole lying on a terminal moraine of the Mahoma Lake stage.

The origin of the ice-scooped rock basins on the southern Elgon slopes is not well understood. They may be associated with resistant rock strata. Alternatively, or additionally, they may mark either a period of standstill during general ice retreat or a minor glacial re-advance. In either case, the 11,000 BP date for deglacierisation is concordant with that from Mahoma which refers to the date of retreat from maximum ice advance and, therefore, provides evidence to support the theory that glacial episodes are correlated on the different East African mountains. If the ice-scooped rock basins on Elgon originated during a standstill phase or a minor ice advance, then they may correlate with the Omurubaho glaciation on Ruwenzori, marked by moraines at altitudes intermediate between those of the Mahoma Lake glaciation and the present glacier limits[5,6].

ALAN HAMILTON
ALAN PERROTT

*Department of Environmental Science,
New University of Ulster,
Coleraine,
County Londonderry, UK*

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Modification of heat resistance in *Drosophila* by selection

WHAT functional component of an animal is most sensitive to heat? We discuss here two reasonable possibilities which have quite different implications. If heat injury is mediated primarily by enzyme inactivation, then natural selection may well have brought a large number of enzymes to the point where a given duration at a high temperature should cause a comparably critical loss in the activity of each. If this is the case, then selection for increased heat resistance would require simultaneous responses at many enzyme loci, as one sensitive enzyme would make the increased stability of the others worthless. In genetic terms, the sensitive enzyme would be epistatic to the rest. On the other hand, if cell or tissue damage is the first effect of excessive heat, then heat resistance is likely to be a quantitative characteristic, with a considerable additive genetic component. Selection for increased thermostability should be possible. In either case, selection for reduced heat resistance should be relatively rapid, as temperature-sensitive mutants would, as a class, probably be frequent enough to dominate the situation.

Although Waddington[1] pioneered the use of indirect selection for response to heat shock, successful selection for resistance has never, to our knowledge, been reported, although we and others[2] have observed strain differences in heat sensitivity. We have now succeeded in increasing heat resistance within an isofemale line of *Drosophila melanogaster*. Selection for decreased resistance was much more rapid and most of the response seemed to be due to a single allele.

Forty isofemale lines were started from wild inseminated females caught in June and July 1976, in five Iowa locations. These were cultured under standard conditions. Indirect selection was started at once and carried out as follows. From each line or subline, 60 flies were treated. Untreated siblings in the four lines with the greatest (or the four lines with the least) survivorship were allowed to produce 10 sublines each, and the process was repeated. Two transfers were required to produce the necessary numbers, and so selection was carried out about once per month. By the 5th generation, upward selection was proceeding within one isofemale line, and downward within another. Both originated in Chariton, Iowa. Treatment involved the exposure of adults, 10 males and 10 females per vial, to 40 °C for a given period (initially 25 min). The vials contained no food; cotton plugs were moistened and forced into a position well below the surface of a Haake water bath, controlled to within 0.1 °C, into which the vials were immersed. Flies to be treated were etherised and placed in empty vials 1.5–3.5 h before treatment. Figure 1 is a graph of survival, in which 5-min dosage shifts are equated to 0.33 survivorship. The precision of this conversion factor, which is based on actual comparisons, is not critical to the conclusions.

After 10 generations of selection, comparison was made between the upward and downward lines and the unselected lines derived from each of their ancestral isofemale lines: the results are listed in Table 1. The difference in survival between the

Table 1 Survival after 30 min at 40 °C

Stock	Alive	No. dead	Total	Proportion alive
Selected Low	0	2,394	2,394	0
Unselected Low parental	752	1,509	2,261	0.333
Unselected High parental	892	1,478	2,370	0.376
Selected High	1,507	850	2,357	0.639

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