MATTERS ARISING

Zenith atmospheric attenuation measurements

ZAMMIT and Ade[1] have made a valuable contribution to observations of millimetre wave attenuation and rightly argue its importance in locating telescopes. In finding a linear relationship between attenuation and measured total water, they question the results of Llewellyn-Jones *et al.*[2] who reported from laboratory measurements a quadratic dependence of absorption on the amount of water. We believe that the two results may not be in conflict when the difference in degree of saturation of the vapour in the two experiments is recognized. In the laboratory the vapour sample was homogeneous in temperature and was measured over a wide range of relative humidity including values close to saturation. In the zenith sky experiment, the measurements represented integrated absorption from layers at different temperatures and of unknown relative humidity, the only other quantity known being the total amount of water. It was therefore possible for all layers to be sufficiently far from saturation so that the millimetre wave absorption was in the range of linear dependence on water amount. That this is realistic has been verified by modelling millimetre wave absorption for various atmospheric columns specified by radiosonde data taken as a function of height. These show that integrated absorption in real atmospheric columns can be an insensitive measurement from which to deduce molecular behaviour. We believe, therefore, that a monomeric water model is not proven to be adequate for the prediction of millimetre wave attenuation.

Zammit and Ade find that their measured absorption values exceed the predictions of accepted standard models and while the validity of these must always be questioned, the procedure of simply reassigning parameters to fit a given set of experiments may obscure new effects. Any observed absorption in excess of a physically acceptable molecular model may mean that some additional mechanism has been overlooked. From the aspect of choosing telescope sites it then becomes important to see if meteorological conditions can be found when the additional mechanism is inoperative and the excess becomes zero.

Specifically, from what is known about excess absorption, there is a strong case for investigating continental sites surrounded by deserts such as Kitt Peak, Arizona or Sacramento Peak, New Mexico for comparison with maritime sites like Izana, Tenerife and Mauna Kea, Hawaii. It is possible that in dry regions the relative humidity values at all levels of the atmosphere would be lower and that telescope sites located in them would be free from the effects of local high humidity sources which were found at Mauna Kea[3]. Such a benefit would not be revealed by simply measuring the total amount of water above the site.

H. A. GEBBIE
Department of Electrical Engineering
Imperial College of Science and Technology,
London SW7 2BT, UK

D. T. LLEWELLYN-JONES
R. J. KNIGHT
Rutherford-Appleton Laboratory,
Chilton, Didcot,
Oxon OX11 0QX, UK

1. Zammit, C. C. & Ade, P. A. R. *Nature* **293**, 550–552 (1981).
2. Llewellyn-Jones, D. T., Knight, R. J. & Gebbie, H. A. *Nature* **274**, 876–878 (1978).
3. Moffat, P. H., Bohlander, R. A., Macrae, W. R. & Gebbie, H. A. *Nature* **269**, 676–677 (1977).

Petralona Cave dating controversy

IN their investigation of the fossil hominid cranium from Petralona Cave, Greece, Henning *et al.*[1] have neglected some of the relevant literature data. They state that the skull was lying on the cave floor. However, I[2] and all six men who found the skull[3] report that the skull "was adhering to a rock"[4] through a stalagmitic column, while the skeleton of the same individual was buried under a stalagmitic cover ~5 cm thick. The skeleton had apparently been separated from the skull during a dry period; the soil, having shrunk, moved the skeleton, while the skull remained attached by stalagmites about 20–24 cm above the skeleton. The skull belonged to a human who died there before the formation of the travertine layer. Samples from the stalagmitic cover of the rock to which the skull adhered and from the travertine layer covering the skeleton, have been ESR-dated by Ikeya[5] who obtained an age of 670 kyr BP (where the archaeological dose was 0.1 rad yr^{-1}) and 340 kyr BP (where the dose was 0.2 rad yr^{-1}). The same stalagmite tested by U/Th (sample 75 GR4-2) by Schwarcz *et al.*[6] "actually yields a finite age of 440 kyr".

Hennig *et al.* state that the skull was covered only with a brown calcite layer. However, I maintain that the skull was covered with pale whitish stalagmite, similar to that which is still found on the rock of the 'Mausoleum' and which was adhering to the skull. The brown calcite was overlying the whitish encrustation of the skull[7], which protruded by 7–10 cm.

The stratigraphy of the cave indicates an age for the skull and the skeleton of the Petralonian man older than 700 kyr. This is supported also by faunal evidence, macro and micro, preserved in the cave[8–10] and by the lithic technique[11,12] proving that man did live in the cave as early as the Lower Pleistocene.

ARIS N. POULIANOS
Anthropoligike Hetaireia Hellados,
Daphnomele 5
Athens 706, Greece

1. Hennig, G. J., Herr, W., Weber, E. & Xirotiris, H. L. *Nature* **292**, 533–536 (1981).
2. Poulianos, A. *Anthropos* **4**, 37–46 (1977).
3. Malkotsis, Y. *et al. Makedonia* 19 Sept., p. 1 (1960).
4. Malkotsis, Y. *et al. Cur. Anthropol.* **22**, 287 (1981).
5. Ikeya, M. *Anthropos* **7**, 144 (1980).
6. Schwarcz, H. P., Liritzis, Y. & Dixon, A. *Anthropos* **7**, 152–173 (1980).
7. Malkotsis, Y. *Anthropos* **7** (front cover January, 1980).
8. Kurtén, B. & Poulianos, A. N. *Anthropos* **4**, 47–130 (1977).
9. Kretzoi, M. *Anthropos* **4**, 131–142 (1977).
10. Fortelius, M. & Poulianos, N. *Anthropos* **6**, 15–43 (1979).
11. Poulianos, A. *Anthropos* **5**, 74–80 (1978).
12. Poulianos, A. & Ganapayya, B. P. *Anthropos* **7**, 260–273 (1980).

IN their recent investigation of the age of the Petralona skull using electron spin resonance (ESR), Hennig *et al.*[1] compared the results of $^{234}U/^{230}Th$ dating[2], of the top travertine floor in the area where the skull rested. It is hoped that the contribution of the $^{234}U/^{230}Th$ dates (corrected for its detrital residues) to ESR results will clarify matters and be a step forward in resolving this controversy.

Their statement that practically all previous age determinations were done on samples from deeper strata, but not from the thin brown top layers of the travertine floor, was inaccurate. I have studied the top, brownish layer of the Mausoleum by the $^{234}U/^{230}Th$ dating method. Three samples in this investigation contribute to the ESR dates[2,3]: P-12, P-13 and P-6 (Table 1).

P-12 had an obvious multi-layered appearance (consisting of an upper series of lime-reddish grey layers), ~0.6 cm thick which presumably implies different times of deposition. (A similar description applies to a further five samples throughout the cave.)

The age of P-12 drops from 250 kyr to 154^{+19}_{-16} kyr using a mode of correction which calculates the different U and Th leachable radioisotopes, by analysing the detritus insoluble residues after total carbonic dissolution[2,4]. This corrected age, due to the interstratified nature of the sample, indicating as it does a very slow deposition of calcite, (thin section analysis has confirmed this), represents the average of the intermittent stages of this 0.6 cm layer. That is, the upper surface layer could be as young as 80 kyr and the deeper part as old as 259 kyr, which would

0028-0836/82/370280-02$01.00