the ten questions about it. The next level of flicker was introduced, as soon as time was up, and was held for 2 min while the earlier passages and answers were being collected, and while instructions were given for the next part of the experiment. This procedure was repeated for all four levels of flicker. A complete sequence of exposure took about 30 min to administer.

The fluctuating proportion of the voltage was found not to affect the measured rate of comprehension ($P > 0{\cdot}05$ on analysis of variance). The control condition without flicker produced an average comprehension score of 58 per cent, and the flicker conditions all produced scores lying between 56 and 60 per cent. The only reliable ($P < 0{\cdot}05$) terms in the analysis of variance were differences of difficulty of the different passages, a marked practice effect, and differences between individuals. Yet the experimental method has been shown to be sensitive to relatively small differences in the design of printed letters[6,7].

For tests of short duration, flickering light thus gives results rather similar to those produced by noise[8]. People begin to complain long before the disturbance is great enough to produce measurable changes of performance. Several volunteers who had acted as observers in the earlier experiments spontaneously remarked that they had not noticed the flicker while they carried out the tests. Probably their attention was restricted to a small area in central vision, whereas flicker is more noticeable in peripheral vision[9].

We thank P. R. Freeman and C. H. Brock for help with the statistical analysis, and the volunteers for their co-operation.

E. C. POULTON

Medical Research Council,
Applied Psychology Research Unit,
Cambridge.

P. G. KENDALL

Electrical Research Association,
Leatherhead.

R. J. THOMAS

W. S. Atkins and Partners, Epsom.

[1] Thomas, R. J., and Kendall, P. G., *Inst. Elec. Eng. Conf. Rep. No. 8*, 125 (1963).
[2] Kendall, P. G., and Thomas, R. J., *E.R.A. Report No. 5121* (Electrical Research Association, Leatherhead, 1965).
[3] Fry, E., *Reading Faster: A Drill Book* (Cambridge University Press, Cambridge, 1963).
[4] Thorndike, E. L., and Lorge, I., *The Teachers' Word Book of 30,000 Words* (Teachers College, Columbia University, New York, 1944).
[5] Edwards, A. L., *Amer. J. Psychol.*, **64**, 598 (1951).
[6] Poulton, E. C., *Nature*, **184**, 1824 (1959).
[7] Poulton, E. C., *J. App. Psychol.*, **49**, 358 (1965).
[8] Broadbent, D. E., *Handbook of Noise Control*, edit. by Harris, C. M., chap. 10 (McGraw-Hill, New York, 1957).
[9] Lloyd, V. V., *Amer. J. Psychol.*, **65**, 346 (1952).

ANTHROPOLOGY

Relative Antiquity of the Ubeidiya Hominid

IN 1959 Dr. G. Haas, of the Department of Zoology of the Hebrew University of Jerusalem, was sent some fossil animal bones which had been turned up by a bulldozer levelling a field near Tell Ubeidiya in the Jordan Valley near Lake Tiberias. In this material, Dr. Haas identified bones of extinct mammalia and "a human incisor and two small fragments of a hominid calvarium of very great thickness"[1].

Investigations of the mammalia showed that they represented a fauna of early Pleistocene type at first regarded as Villafranchian, but eventually identified as Cromerian. The question of whether the hominid specimens were contemporaneous or not with the fauna was obviously of crucial importance. Possibly it could be decided by application of relative dating techniques[2].

Dr. Haas sent a series of the animal bones to us at the Anthropology Sub-Department of the British Museum (Natural History) for analytical investigation. Later, Prof. M. Stekelis, of the Department of Prehistoric Archaeology of the Hebrew University, arranged for Prof. P. V. Tobias to let us sample the hominid specimens for analysis.

Table 1. ANALYTICAL COMPARISONS BETWEEN FOSSIL ANIMAL BONES AND HOMINID FRAGMENTS FROM UBEIDIYA, ISRAEL

	Fluorine by X-ray diffraction (cm)	Fluorine (per cent)	100 F/P_2O_5	N (per cent)	eU_3O_8 (p.p.m.)
Mammal bone *A*5/layer 23	0·274	2·4	7·9	0·1	335
Mammal bone *A*6/layer 23	0·270	2·8	10·1	0·1	101
Fish bone *A*6/layer 24	0·264	2·3	7·7	0·4	220
Hominid parietal *a*	0·323	0·5	1·2	Nil	4
Hominid parietal *b*	0·333	0·5	1·6	Nil	4
Hominid temporal	0·300	0·7	1·8	0·6	11
Hominid molar	—	0·8	2·2	Nil	*
Hominid incisor	—	0·6	1·7	0·5	*

* The teeth proved to be too small to provide adequate samples of dentine for radiometric assay.

The collagen content was assessed by nitrogen analysis and this showed no significant difference between the animal and hominid material—ranging from 0 to 0·4 per cent in the animal bones, and from 0 to 0·6 per cent in the hominid. Under Mediterranean climatic conditions, however, the disappearance of collagen is comparatively rapid (compare Neolithic bone from Jericho which contained 0·3 per cent nitrogen—a reduction from 4 per cent in modern bone). A preliminary report giving the nitrogen results was sent to Dr. G. Haas and Prof. P. Tobias while we examined the bones for their 'uranium' and fluorine content.

Where there is free percolation of moisture, collagenous residues in buried bones are leached, so that there is a gradual reduction of nitrogen content; but *pari passu*, fluorine and elements of the uranium family present in the percolating solutions are absorbed by the bones so that the fluorine and 'uranium' content increases with the passage of time. Thus if the two groups of bones, hominid and animal, were of different stratigraphical ages they should be differentiated by analysis for these elements. (It has already been established that there is no difference in the geochemical properties of hominid and other bones.)

Dr. G. F. Claringbull, Keeper of Minerals at the British Museum (Natural History), undertook a preliminary assessment of the level of fluorination in the animal and hominid bones by X-ray diffraction analysis using the method introduced by van der Vlerk[3]. The precision of the measurements allows only a semi-quantitative estimate of fluorine content, but the results (Table 1, first column) show a clear differentiation between the two groups. Meanwhile, in the Sub-Department of Anthropology, we were carrying out radiometric assays of the specimens, and these (Table 1) also showed a marked disparity between the two groups. We then asked the Laboratory of the Government Chemist to carry out chemical tests. The fluorine results obtained by G. F. Phillips, together with the other results tabulated here, removed all doubt about the relative antiquity of the hominid and animal bones.

The hominid bones are clearly very much younger than Cromerian, but whether they are later Pleistocene or post-Pleistocene cannot be determined on the available data. One of the human parietal fragments from the bulldozed assemblage fitted a fragment excavated from Layer 23, but as there was no detectable difference in the composition of the two pieces, that found '*in situ*' was like all the other fragments evidently part of an intrusive group.

THEYA I. MOLLESON
KENNETH P. OAKLEY

Sub-Department of Anthropology,
British Museum (Natural History),
London, S.W.7.

[1] Stekelis, M., Picard, L., Schulman, N., and Haas, G., *Bull. Research Council Israel*, 9G 175 (1960).
[2] Oakley, K. P., in Pyddoke (1963), *The Scientist and Archaeology*, 111 (Phoenix Press, London).
[3] Niggli, E., Overweel, C. J., and van der Vlerk, I. M., *Proc. K. Akad. Weten. Amst.*, B, **56**, 538 (1953).