

season, but perhaps inevitably suggest some oddly shaped climatic divisions, and occasionally an unexpected sequence as on the 100 mm map, where in the Congo twelve 'wet' months are followed *south* from the Equator by a strip with January dry.

Maps showing average daily screen temperature (maximum, minimum and range), without correction for altitude, and average daily relative humidity near sunrise and near midday are included for four representative months: January, April July and October. In his commentary the author clearly indicates the dependence of relative humidity on temperature, but it is perhaps a pity that maps of saturation deficit were not also included, since it is easy to fall into the trap of making imprecise and somewhat misleading correlations between relative humidity and other phenomena.

Three further series of maps, representing Africa and the western half of the Indian Ocean at a scale of 1:30 M, show pressure and winds at mean sea level, upper-level contours and wind frequencies, (at 850, 700, 500, 300 and 200 mbs.), upper temperature (at the above levels) and upper dew points (at 850, 700 and 500 mbs. only).

A detailed commentary on each series of maps is included in the introduction with cautionary comments on the reliability of the basic observations. Most useful of all are the sections on analytical technique in the tropics, primary tropical synoptic features, and a study of the mean synoptic situation in each of the four months illustrated. The author is careful to emphasise that a climate can be properly explained only when the meteorological processes causing each day's weather are understood. These sections, complete with a list of references, make valuable reading for any student of tropical meteorology and of climate in Africa, and for any teacher anxious to avoid the over-simplified assertions perpetuated in many textbooks. The analytical techniques practised in East Africa are described in non-technical terms together with a summary of the models recognized in upper-level contour analysis. Many statements should stimulate the clarification of any hazy thinking by meteorologists in Africa. The inter-tropical front, for example, is firmly kept in place "north of the Equator and west of the Kenya-Ethiopian plateau."

The atlas cannot claim to be a full analysis of climate in Africa. No rainfall probability maps are included, no assessments of evaporation rates or irrigation needs, but as the author emphasizes it is not yet possible to give a detailed climatological description of all elements for the whole of Africa. These maps are not in fact analytical but descriptive. The value of the atlas lies in the presentation of data not readily available that, in association with the text, contribute towards an explanation of African climates. It is intended by the author to be a contribution towards the development of Africa, to help in the training of the new generation of African meteorological personnel, and to describe and explain the climate of Africa for the benefit of scientists, teachers, students and others whose interests or studies are influenced by climatic factors. The author expresses the hope that in due course African meteorologists will find 'the opportunity to amplify and refine much of the data and many of the ideas which are here presented in a broad fashion'. Mr. Thompson has prepared a valuable aid for his successors. — J. M. KENWORTHY.

OLDUVAI GORGE, TANZANIA: RE-ASSESSING ITS GEOLOGICAL AND CLIMATIC SIGNIFICANCE

OLDUVAI GORGE 1951-61. Vol. 1: A preliminary report on the geology and fauna. L.S.B. LEAKEY. xiv, 118 pp. Cambridge University Press. 1965. U.K. price 75s.

As its title indicates, this volume covers a ten-year period of research at Olduvai into the geological sequence and fossil fauna of the gorge. It does not cover the now-famous hominoid remains and the palaeolithic cultures. The faunal sequence, much of which is described by six of the other contributors listed on the title page, ranges from Early Pleistocene to Recent and though fascinating as a study in evolution will not attract the geographer's attention as much as the sections dealing with geological and climatic interpretations (Chapters 1, 7, 8 and Appendix 1).

These sections may for convenience of discussion be divided into three parts, Chapters 1 and 7 comprise Dr. Leakey's own special contributions. Chapter 8 is made up of five reprinted notes from *Nature*, concerning the controversial discussions of the age of the lowest members of the stratigraphic sequence. The last word here, according to G.H. Curtis and J.F. Evernden, is "that there is no alternative to accepting an age for *Zinjanthropus* and for the Lower Pleistocene of approximately two million years". This remains to be seen in the light of the increasing sophistication of the potassium-argon dating technique upon which it is based. The third part of the volume related to geological and climatic interpretations is the appendix by Dr. R. Hay. This paper, a reprint from *Science*, contains a straightforward and realistic account of the Olduvai deposits as having accumulated in a small 'playa' basin which was frequently saline and dominated in the east by the volcanic centres of Lemagrut and Ngorongoro. Hay's interpretations have already been somewhat modified on the basis of later fieldwork, but his climatic deductions remain essentially unchanged. These are that the overall Pleistocene climatic regime of Olduvai gorge was relatively dry and not unlike the present.

Dr. Leakey's contributions mentioned above are open to criticism on a number of grounds. Chapter 1 dealing with the general geology represents little advance from the previous book, gives no indication of the relevant work of the Tanzania Geological Survey (e.g. Pickering, 1958; Sheets 37, 38 and 39 covering Serengeti and its regional setting), and in factual detail, emphasis and interpretation contradicts Hay's appendix.

In Chapter 7, Leakey proceeds to elaborate his views concerning the inferences to be drawn from the deposits. Here again the contrast with Hay's cautious deductions already quoted will not be lost on the reader. A statement to the effect that "the Olduvai sequence suggests most strongly that there were prolonged periods when the climate was wetter than it is today" (p. 79) precedes a reiteration of the now largely-discredited terminology and climatic inferences that were current fifteen years ago. The suggestion that "a series of deposits existed in the area (East Africa) associated with good evidence of climatic changes" (p. 80) takes no account of the authoritative though critical regional re-appraisals of Cooke (1958) and Flint (1959); indeed there is no reference to these major works anywhere in the whole text! These authors effectively

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demonstrated that sound evidence for climatic change is in fact lacking even at the type localities of the Kageran, Kamasian and Kanjeran pluvials. Furthermore Leakey's statement that "the evidence of Olduvai gorge.....confirms that major climatic fluctuations took place during the Pleistocene" is impossible to reconcile with Hay's conclusion that "the climate was relatively dry at least seasonally throughout most or all of the lengthy period of hominid occupation recorded by Beds I to IV" (p. 99).

Leakey's remarks on the evolution of Lake Victoria call for comment. To quote the excellent review of these suggestions by Bishop (1965)..... "the proven uplift of the western margin of the lake during the later Pleistocene (last 50,000 years) is ignored. A 300-foot lake level in the Kanam area is not feasible without the aid of local earth movement or ponding as Lake Victoria would not hold water at this level in Villafranchian times. Greater precipitation than the present day is not proven on the basis of the Kanam evidence, or by mid-Pleistocene deposits 100 feet above the present lake at Kanjera. The reference to Kaiso as supporting the Kanam evidence is invalid..." (p. 255). It follows also that many of the deductions based on these incorrect assumptions are likewise invalid.

Much of this problem resolves itself into whether, putting aside the local problems of interpretation, what happened in the Kavirondo gulf was characteristic of the rest of the lake basin. Many of the pioneer geologists believed that Lake Victoria originated in the Miocene because of presence of Lower Miocene lacustrine sediments within the basin in Kavirondo. A similar confusion may also explain Leakey's belief in an Early Pleistocene Lake Victoria. There is no other evidence apart from Kanam of a lake at this period, rather the reverse, for the Uganda evidence points to an age for the reversal of the main plateau drainage to form the main lake more or less as it is at present no earlier than late Middle Pleistocene (Bishop and Posnansky, 1960). It is perhaps not without significance that this very time is the period of major faulting and warping at Olduvai (p. 83). The argument for climatic change after Bed IV is not clear (p. 83). The faulting which followed disrupted the basin at Olduvai; the fact that the disrupted basin does not now hold water even in wet years hardly justifies the statement that when it did the climate must have been wetter!

In fact there are no undeformed lake beds in the whole basin above 60-65 feet above the present average lake level. At heights above this the lake would overflow its watershed in the south (Temple, 1964b). It would appear that higher lake beds must either have suffered deformation or have no genetic relation to the development of the present lake. Several further points deserve mention. There is no 30-foot beach around Lake Victoria; its validity even in the Kavirondo area seems disputable (Kent, 1942). Hence the deductions which follow are also doubtful. No mention is made of the undeformed raised beaches at 60-65, 40-45 and 10-12 feet around the western, northern and southern shorelines of the lake which reflect almost certainly phased downcutting by the Nile (Bishop, 1958, Temple, 1964 a). The downcutting of an overflow course such as the Nile, although it must have been fairly rapid, cannot have been completed overnight! There have been no recent attempts to raise the level of the lake as Leakey erroneously suggests. This happened incidentally during the construction stage of the dam, but the rise in water level was dissipated within eighteen months. The discussion of the present water balance of the lake is misleading as is the explanation of the recent rise in lake level.

The fact that this is preliminary report is hardly a justification for the internal inconsistencies and the uneven presentation. It is difficult to reconcile a preliminary presentation with the sumptuous format, the voluminous illustrations (some of doubtful quality) and the high price. This is certainly not a book to recommend to any other than perhaps the palaeontologist, though Dr. Leakey is to be commended upon stimulating controversy and discussion and in keeping East African field-studies before the public eye. — P. H. TEMPLE.

References.

- Bishop, W.W., 1958. 'A review of the Pleistocene stratigraphy of the Uganda Protectorate.' Joint meeting, *East-central, west-central and southern regional committees for Geol. Leopoldville*, 91-105.
- Bishop, W.W., 1965. 'Hominidac and controversy; a review' *Geogr. J.*, 131, 254-256.
- Bishop, W.W., and Posnansky, M., 1960. 'Pleistocene environments and early man in Uganda.' *Uganda J.*, 24, 44-61.
- Cooke, H.B.S., 1958. 'Observations relating to Quaternary environments in East and Southern Africa' *Bull. geol. Soc. S. Africa*, 20, annexure 74.
- Flint, R.F., 1959. 'Pleistocene climates in Eastern and Southern Africa.' *Bull. geol. Soc. Amer.*, 70, 343-374.
- Hay, R.L., 1963. 'Stratigraphy of Beds I through IV, Olduvai gorge, Tanganyika., *Science*, 139, 829-833.
- Kent, P.E., 1942. 'The country round the Kavirondo gulf of Victoria Nyanza.' *Geogr. J.*, 100, 22-31.
- Pickering, R., 1958. 'A preliminary note on the Quaternary geology of Tanganyika.' Joint meeting, *East-central, west-central and southern regional committees for Geol. Leopoldville*, 77-89.
- Tanganyika Geological Survey, Map sheets, 1:125,000: Oldoinyo Ogot (Serengeti plain-east), 1958, (Quarter degree sheet No. 38); Moru (Serengeti plain-west), 1960, (No. 37); Angata salei, 1961, (Nos. 39).
- Temple, P.H., 1964a. 'Evidence of lake-level changes from the northern shoreline of Lake Victoria, Uganda.' *Geographers and the Tropics: Liverpool Essays*, ed. Steel, R. W. and Prothero, R.M., 31-56.
- Temple, P.H. 1964b. 'Raised features along the southern shoreline of Lake Victoria.' *Proc. E. Afr. Acad.*, 1, 13-22.

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