A Tertiary Volcanic Landscape in East Africa

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Introduction

In parts of East Africa there are large gaps in the geological column between Precambrian and Tertiary. This is especially true in the Karamoja district of Uganda where dissected Tertiary volcanoes rest directly on Precambrian basement rocks. Two volcanic centres, Napak and Moroto (Fig. 1), were visited by the writer and Dr. W.W. Bishop in 1961 as part of an expedition from the Department of Geology, University of Glasgow (Bishop and Whyte 1962). The objectives of this expedition were to prepare maps of and collect rocks and fossils from various Tertiary volcanic centres in Uganda and Kenya.

General Geology

The deeply dissected Napak volcano is represented diagrammatically in Fig. 2. The geology of this centre has been described in detail by King (1949). It consists of isolated remnants of the original cone, each remnant being composed of several thousand feet of bedded tuffs and agglomerates interspersed with a few nephelinite and phonolite lava flows. The remains of the central pipe is infilled with carbonatite and surrounded by a wide zone of ijolites. The tuffs and agglomerates forming the isolated outliers of the volcano all dip radially outwards from the central plug approximately in the same attitude as when first laid down.

The pyroclastic layers vary from coarse agglomerates through medium to fine grained tuffs. All are composed of volcanic rock fragments and separate crystals with cements of volcanic dust or calcite. The fine tuffs (often micaceous) are rich in calcite and form the principal fossil-bearing layers.

Fossiliferous Sediments

On the basis of their lithology, the fossiliferous sediments can be divided into two groups :—

1. Sands, grits, and gravels (with a few tuff layers) at the base of the volcano and resting directly on the basement rocks.

These deposits form thin layers on the sub-volcanic surface sometimes infilling valleys cut into that surface. They are mainly fluviatile in origin.

2. True pyroclastic deposits form the largest part of the volcano. Within these alternating agglomerates and tuffs, there are layers of fine to medium grained calcareous tuffs containing mammalian fossils. At certain levels, the presence of fossil wood and layers of concretionary calcareous nodules suggest time-gaps in the sequence. These deposits mainly represent sub-aerial accumulations of volcanic ash with local water-sorting due to surface run-off.

Fossils

Most of the mammalian fossils consist of broken unidentifiable bones with a smaller proportion of skulls, teeth, jaws, and bones of rodents, primates, carnivores, and ruminants. Crocodile, rhino, and turtle fragments are also found.

1. The basal sands and grits contain worn fragments of rodents, carnivores, mastodon, rhinos, and primates with fossils more characteristic of riverine deposits namely crocodiles and turtles.

2. In contrast, the sub-aerial tuffs, although much richer in mammalian fossils, do not contain any of the characteristic fluviatile fossils and in addition they include fossil wood, seeds, fruits, and land gastropods.

At each locality every fossil fragment seen was collected whether identifiable or not, and an attempt was made statistically to assess the abundance of the different mammalian groups at different sites around this Tertiary volcano. For this purpose it was assumed that each find represented an individual. The results for the Napak volcano as a whole compare well with similar statistical results from other Tertiary fossil sites in East Africa (Bishop and Whyte 1962) such as Songhor and Koru in Kenya (Kent 1944, Shackleton 1951) and Moroto in Uganda (Bishop and Whyte 1962).

More sites were studied on Napak than anywhere else, and the statistics suggest that different environments existed around the volcano, as reflected by the proportion of different mammals at each site. Similar changes in environment are found at different levels around present-day volcanoes.

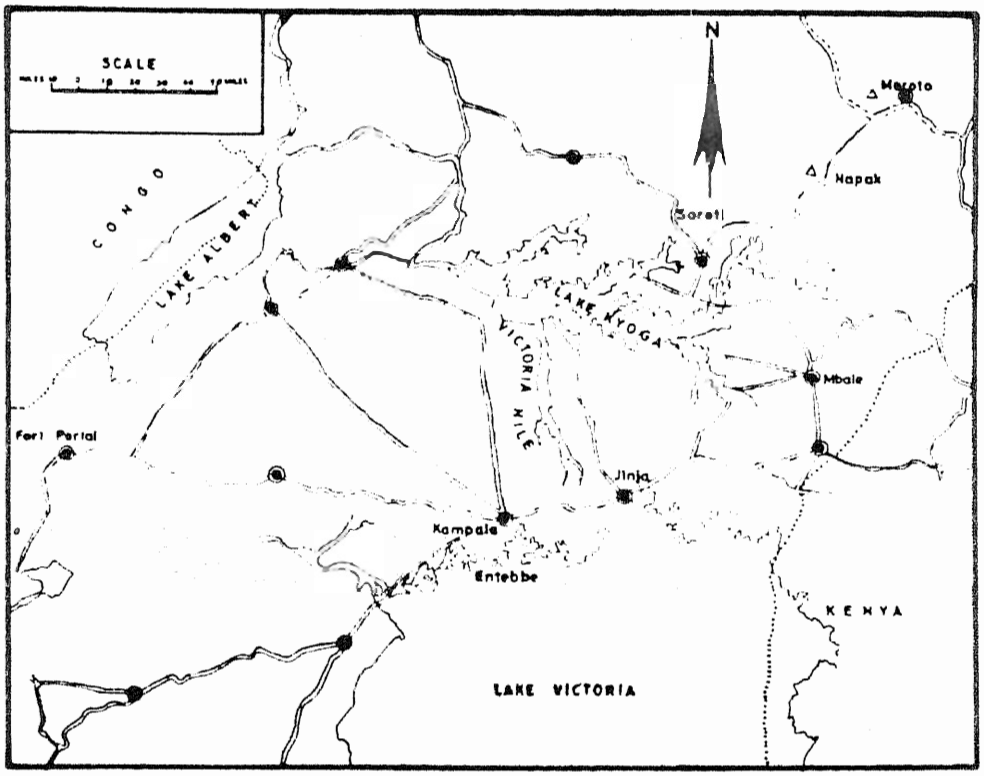

FIG.1 SKETCH MAP OF PART OF UGANDA.

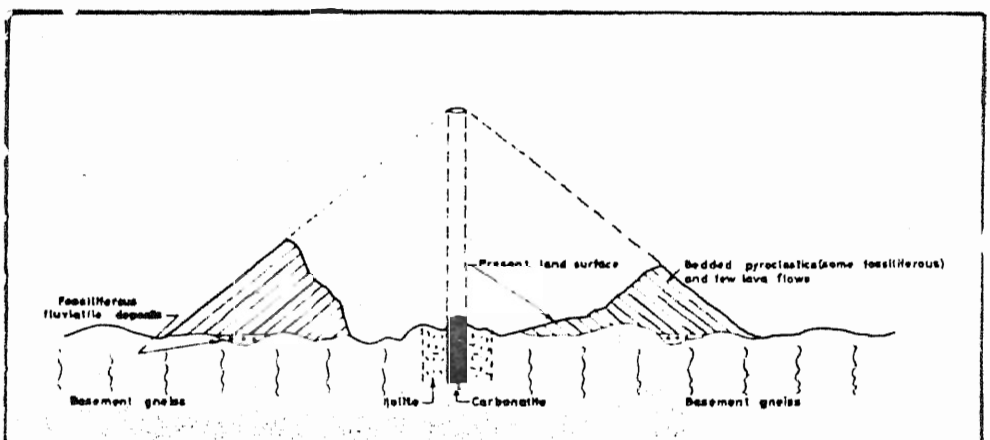

FIG. 2 DIAGRAMMATIC SECTION THROUGH NAPAK VOLCANO IN UGANDA.
(Not to scale)

At all the fossil sites the number of skulls, teeth, and jaws collected was high in proportion to the number of bones. This must be due to the scavenging activities of carnivores and rodents that removed the more edible bones. This is supported by the fact that many of the bone fragments collected have signs of gnawing and chewing. At the present-day, when an animal dies or is killed in the African plains, the flesh and most edible bones are quickly removed, and only the relatively inedible skull, teeth, and jaw are left. A similar fate was suffered by animals dying on the Tertiary land surfaces. Successive ash layers were deposited on temporary land surfaces on the slopes of the volcano and around it. Animals and plants lived and died on these slopes, and their remains were covered up and preserved by the next ash fall. There is no evidence that the animals were killed by the ash falls; if they had been, complete skeletons would have been preserved, and these are never found.

Proconsul

In recent years, owing largely to investigations of Tertiary deposits in East Africa, finds of large mid-Tertiary hominoid fossils have increased considerably. The Glasgow expedition discovered the left maxilla of a large Proconsul at one of the Moroto sites in 1961, and later that year additional fragments from the same individual were found by another party (Allbrook and Bishop 1963). This specimen has since been tentatively assigned to the species *Proconsul major*. There are still not enough specimens available of all three Proconsul species, but at the moment *P. major* is more abundant at the two Uganda sites (Napak and Moroto) whereas *P. africanus* and *P. nyanzae* are dominant over *P. major* at other mid-Tertiary sites in Kenya (Allbrook and Bishop 1963).

Preservation of Fossils

The abundance of fossils found at certain horizons in the pyroclastic deposits to some extent reflects the abundance of mammalian life in mid-Tertiary times. They are most abundant in the calcareous layers, because bone preserves best in a highly calcareous environment. Most of the calcite cement in these tuffs was probably secondarily introduced after deposition, but it is possible that at least some of it was deposited with the sub-aerial ash, perhaps at times when carbonatite magma filled the volcanic pipe.

In addition to Napak and Moroto, several other sites were examined in 1961, namely Songhor, Koru, Ombo, Mariwa, and Fort Ternan in western Kenya.

Potassium-40/argon-40 age dating is being carried out on biotite from the tuffs. It is hoped to establish a series of reliable Tertiary dates with faunal associations.

Undoubtedly these Tertiary volcanic sites will continue to yield increasing numbers of fossils in the years to come, and especially important will be the hominoid fossils, a complete knowledge of which is necessary if we are to unravel man's exact link with the apes.

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