CHAPTER I

The Country

UGANDA is a small country, nearly one-seventh of whose surface is occupied by water, leaving a land area rather less than that of England and Scotland together.

It lies on the Equator and is bounded on the north by the Anglo-Egyptian Sudan, on the south by the Belgian mandate of Ruanda-Urundi and by Lake Victoria, with Tanganyika Territory beyond, on the east by Kenya Colony and on the west by the Belgian Congo.

The central part of the country is a plateau, dissected by many rivers, swamps and lakes, of a general level of 4000 ft. above the sea. East, west and south-west are high mountains, while to the north, beyond Lake Kioga, the land slopes gently down, with scattered hills standing out of the plain, to the Sudan, at a little over 2000 ft. above sea-level.

The mountains and part of the central plateau round the lakes are forested and very wet. Most of the central plateau is savannah country, with a good deal of cultivation, while the south-western uplands are rolling, grassy hills except where they rise to mountains of forest height. The last two areas receive a medium rainfall. The Western Rift Valley, with Lakes George, Edward and Albert, is rather dry, with scrubby bush, while Karamoja, the north-eastern corner of the Protectorate, is very arid indeed, owing to the strongly seasonal nature of the rainfall, which is often violent, but soon wasted by rapid evaporation and surface run-off.

The present topography of Uganda is very largely of recent geological age. It is a three-peneplain[1] topography, of which the second peneplain is widely represented by flat-topped residuals between valleys whose existence is due to uplift movements of post-Miocene age. These movements seem to have been part of the general uplift of eastern Africa, whose more striking results were the rift valleys and associated flexures.

[1] But see Solomon, p. 17, who regards Peneplain I as the westerly prolongation of Peneplain II, or the Buganda Peneplain.

Apart from faulting, the most important effect of these movements was rejuvenation; valleys were carved out and some of them had reached an advanced stage of maturity by Upper Pliocene times.[1]

Several of the major rivers of Uganda occupy deep, mature valleys of the "two-way" type; that is, their headwaters rise in shallow swamp-divides, from which the almost imperceptible flow is in two directions, one towards the Albertine Rift[2] and the other towards either Lake Victoria or Lake Kioga. The Kafu, in the central region, and the Kagera, in the extreme south, are examples. In all cases, these swamp-divides are situated along a south-west, north-east axis, between twenty and thirty miles from the Western Rift and parallel to it, and they coincide with the general position of an uplifted area bordering it. It is clear that this relatively local uplift is more recent than the main, regional uplift of the Miocene peneplain, and is intimately connected with the genesis of the Western Rift Valley, which itself was the result of stresses imposed during the regional uplift.

Wayland was the first to recognise compression as the cause of the Albert Rift, in particular, as opposed to the general tensional theory put forward by Gregory. Bailey Willis[3] also examined the area during a recent visit to Uganda, and is in agreement with Wayland on this point. Proof of the compression is seen in overthrusts, first postulated by Wayland and actually recognised by Bailey Willis, and, in a general way, in the undoubted uplift on either side. Speaking of this compressive action in relation to the geology of the valley, Bailey Willis says:

The escarpment is there (Kibero, where Willis observed the overthrust) *about a thousand feet high...and is the central section of the main, eroded fault scarp. It is...modified by benches that presumably represent successive steps and*

[1] These mature valleys would appear to have been the narrow equivalents of the third Peneplain which is represented by the great plains of Busoga and, in a lesser degree, in Bunyoro.

[2] The term "Western Rift Valley", including Lakes Albert, Edward and George, is rather a loose one, for the Valley is not entirely rifted, but contains areas that have been downwarped and never subsequently faulted. Lakes Edward and George, for instance, occupy a depression which shows only little evidence of faulting on its eastern side, though the Congo side appears to be bounded by a definite fault-scarp. For the sake of convenience, however, both these areas, the Edward-George and the Albert valleys, are here referred to as the Albert or Western Rift Valley.

[3] Bailey Willis, *East African Plateaus and Rift Valleys*, 1936, pp. 47–8.

may be upthrusts or secondary, gravity step faults. The exposure of the ramp or overthrust is an accident of erosion, where a ravine cuts across the scarp and the section reveals the rocks....Their ancient structures were imposed under excessive confining pressure and are characterised by recrystallisation and flowage, rather than by fracture. The thrust on the other hand, is a curved shear, which has resulted in much fracturing and displacement of blocks, as under light load. It could have been produced only in rocks near the surface, that is only when erosion had removed the burden of many thousand feet. Occurring, as it does, in a position where it ramps toward the free face of the steep escarpment it is mechanically connected with that freedom from resistance and presents the action of horizontal pressure from the plateau towards the trough. The ramp thus serves to confirm the inference logically drawn by Wayland from the general relations of the Albert trough to the updoming of Ruwenzori.

There is strong reason for believing that the earliest compressive stresses, which developed along what is now the Albert Rift Valley, resulted first in a simple downwarp or trough. Remnants of the down-tilted peneplain can be seen at a number of places, particularly along the south-east edge. It is clear that the first actual fault of rift valley magnitude truncated the sides of what Wayland has called the "hanging topography" of the down-tilted Miocene peneplain.

While the chief result of the lateral compression was the formation of a long trough, which subsequently developed into the Albert Rift Valley, some of the stresses were also from below, and caused the uplift of a long tract of country bordering the depressed trough. To this uplift may be ascribed the first reversal of the long, westerly flowing rivers. Those parts of their valleys which lay on the trough side of the uplifted zone were either rejuvenated or else became insignificant streams of little erosive power, according as to whether their headwaters drained a wide area within the uplifted zone or not. An instance of the latter is the Nkussi, and of the former, the Muzizi. This river, with a comparatively short course, appears always to have drained an enormous area north-east of Ruwenzori, and its whole catchment area was rejuvenated at the time of the uplift movements. Erosion seems to have kept pace with uplift, so that the valley was always more or less graded to the floor of the trough, for, to-day, remnants of the earliest lacustrine sediments, the Kisegi Beds, are to be seen in the floor of the valley, more than 800 ft. below the level of the peneplain, but above the falls by which the river now enters the Rift Valley, and which were caused by the major faulting of post-Kisegi times. Kisegi Beds are also to be seen down in the Albert Rift, more than a thousand feet below the Muzizi valley.

In the case of another river, the Kagera, it is also true that the western end, which to-day flows into Lake Edward (at the southern extremity of the Western Rift), runs through very high country, mostly old remnants of Peneplain I, and possesses a very large catchment area, like the Muzizi. Consequently, when the uplift of the edge of the Albert trough took place, that part of the uplifted area containing the catchment zone was tremendously rejuvenated westwards towards the depression, though there may have been, and very likely was, reversal on the eastern side. To-day, this western end of the river enters the Edward depression through a very deep and obviously ancient valley which has never been truncated by rifting, as in the case of the Muzizi, because faulting has not played so great a part in the formation of the Edward depression as in the Albert basin, particularly along its eastern side.

Lake Victoria and Lake Kioga both owe their origin to this secondary uplift along the edge of the Albertine trough, first, because the movement caused the creation of shallow basins, and, secondly, because these depressions were filled by the waters of such rivers as were reversed by the movement.

The events so far described took place in pre-Pleistocene days, probably during the Pliocene, and have little connection with the Pleistocene succession except in so far as they modified the Miocene levels and created new base-levels, thus directing the course of the early Pleistocene rivers.

There is, however, much evidence of later movements also, which affected these rivers, and one such movement, at least, appears to have been a tilt from north-east to south-west which reversed the easterly flowing rivers back to the Albertine Rift in human times. This may have been due to faulting within the Rift, though this seems unlikely, as the main fault, which produced the Albert Escarpment as we know it to-day, is demonstrably older than any of the Pleistocene deposits in the

Rift. It may be that this tilt was the result of slipping at depth along the plane of the older faults, or overthrusts.

Wayland ascribes this river reversal to the rise of the lakes and their flooding up the rivers due to pluvial conditions, and not to tilting, but, apart from lack of evidence of pluviation at this period, there is the evidence of tilted beaches in support of a north-east to south-west movement at this time.

The final tilt was back towards the north-east, reversing the direction of flow once more and leaving the rivers and valleys much as we know them to-day.

CHAPTER II

Research in Uganda prior to 1935

IN this chapter, I shall do no more than summarise, as briefly and clearly as possible, the results achieved by Mr E. J. Wayland in the course of his 15 years' work up to the end of 1934. I shall present only his own views and data, as published from time to time, leaving all discussion until the appropriate chapter. Solomon will, of course, reconsider the evidence of pluviation in East Africa when dealing with his own results in Chapter III.

PLEISTOCENE CLIMATES IN UGANDA

Wayland's attitude and approach to the problems of Pleistocene climates in East Africa is best summed up in his own words:[1]

The very wide distribution of perched gravels in Uganda, and their not unusual occurrence at exceptionally high levels above present day streams or valley bottoms, attracts the attention of a geologist at once; so too does the ubiquity of stone age artifacts...and often enough it is in gravels that these have been preserved.... Similar...occurrences and associations in Ceylon were, before the war, partly responsible for the writer adopting Brooks' view with regard to the major climatic events of the Pleistocene. Brooks points out that large ice sheets promote permanent anticyclones above them, and that precipitation within such anticyclonic areas is slight, the deficit being made up in non-glaciated regions. Applying this to the conditions of the Glacial Period, Brooks contends that the existence of vast ice sheets in the higher latitudes and heavy rainfall elsewhere is at once in accordance with the demands of meteorological theory and the facts of geological evidence. Accepting this, the present writer saw in the widespread Pleistocene gravels of Ceylon additional support of Brooks' view, and it required no effort of imagination similarly to account in part at least, for many of the Uganda gravels.

As Wayland goes on to record, he came to the conclusion, in 1919, that Lake Victoria had been higher in level, "*probably in consequence of the meteorological conditions of the Ice Age*". By 1922, he had evidence of

[1] *Summary of Progress of the Geol. Survey of Uganda*, 1919–29, pp. 37 *et seqq.*

three pluvial periods, "*but could discover no evidence of a fourth which Brooks' hypothesis, combined with the generally accepted fourfold division of the Ice Age...seemed to demand*". Later, the evidence seemed to be partly interpretable in another way[1] but, by 1926, Wayland "*was still strongly inclined towards a three-glacio-pluvial hypothesis*".

Leakey's and Nilsson's independent results in 1927 appeared to confirm Wayland's threefold pluvial scheme, but, later in the same year, further work in Uganda caused him to effect a rearrangement, as he no longer felt that the Uganda pluvials each coincided with one main ice advance (Günz-Mindel, Riss and Würm) but, if really contemporary ice advances, "*then rather with Günz-Mindel, Riss-Würm and a post-glacial event, possibly the Buhl stadium*".[2]

Until 1929, Leakey still followed Wayland's older correlation between the three main European glaciations and the three East African pluvials (*sic*), but, in that year, as the result of Solomon's collaboration, the third "pluvial" was considered, as really a post-pluvial wet phase, possibly corresponding, as Wayland thought, with Buhl.

In 1929 also, Nilsson published his preliminary paper on his own detailed work on the Kenya lake beds and East African mountains, where he obtained, apparently, the most convincing evidence of three major pluvials of glacial age and two more of post-glacial age. However, Wayland's, Leakey's and Solomon's agreement on two major pluvials, each corresponding to two European glacials, tended to overshadow Nilsson's results and received further support from Brooks' independent opinion that

> *the most we can do is to separate the glacial period into three subdivisions, a first glacial period corresponding with the Günz and Mindel glaciations in the Alps, a long "Interglacial period" which was the Mindel-Riss, and a second glacial period including the Riss and Würm stages.*[3]

Still further support for the Wayland-Leakey-Solomon glacio-pluvial theory was forthcoming when Dr (now Sir George) Simpson, Director of the Meteorological Office, London, gave his lecture on Past Climates.[4] In this, Simpson demonstrated that

[1] *Man*, 124, 1924.
[2] *Sum. Prog. Geol. Surv. Ug.* 1919–29, p. 38.
[3] Brooks, *Climate through the Ages*.
[4] *Alexander Pedler Lecture*, British Science Guild.

from the point of view of past climates two meteorological elements are outstanding, temperature and precipitation.

Stated broadly, two cycles of increased solar radiation and, thereby, of temperature, over the whole world, must have led to increased evaporation and, consequently, precipitation. This, necessarily, led to the feeding and growth of existing ice-sheets round the poles and to pluvials in equatorial and subtropical zones. Continued increase of solar radiation in each rising cycle led to excessive temperatures and, eventually, to the melting of the ice-sheets and to the existing glacial climate giving place to a warm, wet interglacial. In the tropical zones, however, precipitation would be continuous. The second glaciation of each radiation cycle would gradually come on during the decline of the radiation cycle, only to give place to a cold, dry interglacial stage when precipitation slackened off all over the world. This interglacial would thus coincide with the interpluvial in unglaciated regions.

Simpson's theory seemed to remove the difficulty, fully realised by Wayland, that there only seemed to be evidence of two main pluvials in East Africa, to equate with four European glacials, and Simpson's main conclusion, that

each pair of glacial periods, with the intervening warm wet interglacial period coincides with a pluvial period in unglaciated regions,

from henceforth received Wayland's unqualified support. From 1929 onwards, with one exception, there was no significant change in Wayland's views on this subject. This single exception was the emphasis laid, in 1932, on the existence of *intrapluvial* oscillations within the pluvials. Until that date, there is, so far as I know, no mention of these phenomena in Wayland's published views, but, in 1932, their existence, both in Uganda and at Oldoway, is almost categorically stated. Dealing first with Uganda, Wayland writes:[1]

It was discovered in Uganda, and subsequently in Kenya, that Pluvial I had two rainfall peaks. It is now found that in the Kagera valley there is evidence of a similar climatic oscillation in the latter part of Pluvial II.

[1] *Annual Report of the Geological Survey of Uganda*, 1932, p. 16.

Then, speaking of Oldoway, which he had just visited, he writes:[1]

I contend that a stratigraphical break exists between Beds III and IV, that this is associated with a climatic oscillation, and that it is the only stratigraphical break of any consequence....

At that time he felt the break to be that between Pluvials I and II, but, later,[2] he stated that

my own work in Uganda shortly revealed this same climatic episode as an oscillation within a pluvial; not in Pluvial I, however, but in Pluvial II.

As far as one can judge, the evidence in support of the intrapluvial in Pluvial I was provided by local, though not intense, soil reddening, selenite beds within Pluvial I deposits and by talus accumulations of this date, separating water-laid deposits.

The evidence for the intrapluvial in Pluvial II was much more marked, according to Wayland, as it led to much greater soil reddening, etc., though it was in no sense as marked as in the great Interpluvial.

The intensity of the latter was such, in Wayland's opinion, that it caused the almost complete drying up of Lake Albert and the extinction of some animal forms by the time that Pluvial II began. It was responsible for the important Kaiso Bone Beds, remains from which were described, in 1926, by British Museum authorities.[3]

It is evident that, by 1933, probably as a result of his visit to Oldoway, Wayland realised that it was impossible to effect a close correlation between his two major pluvials and Leakey's Kamasian and Gamblian periods, and he had already shown[4] how there seemed to be some disparity between the cultures, claimed to be of the same periods, on each side of Lake Victoria. In his opinion, Leakey and his colleagues had placed the Interpluvial too far up in the scale, and much that they included in their first Pluvial actually belonged to the second. The stratigraphical break that Wayland observed at Oldoway (marked by the reddened Bed III) was, at first, thought by him to mark the Interpluvial, but, as already recorded above, he very soon found that it was,

[1] *Loc. cit.* p. 14.
[2] *Rifts, Rivers, Rains and Early Man in Uganda*, p. 343. *J.R.A.I.* vol. LXIV, July–December, 1934.
[3] *Occ. Paper, No.* 2, Geol. Surv. Uganda, 1926.
[4] *Antiquity*, 1932.

apparently, the same as that displayed in the Kagera valley, Uganda, where it was clear that it occurred in Pluvial II. As he remarks,[1]

it follows that much of the Kamasian belongs, not as the East African Archaeological Expedition claims, to the first Pluvial, but to the second.

In point of fact, as perusal of Wayland's 1934 paper shows, the *whole* of Leakey's Kamasian, as displayed at Oldoway, beginning with the pre-Chellean implementiferous Bed I, belongs to Wayland's Pluvial II, though it is obvious that some of the earlier Kenya deposits, not implementiferous and mainly volcanic tuffs, occurring round the Rift Valley, were most probably formed at the same period as Wayland's Pluvial I. At the same time, the implications of Simpson's theory of essential contemporaneity between the pairs of glacials and the major pluvials, led to still greater discrepancies between the Kenya and Uganda dating. While Leakey, on the one hand, made his two pluvials—Kamasian and Gamblian—correspond (probably) with Günz-and-Mindel and Riss-and-Würm respectively, thereby bringing the archaeological sequence more into line with the European dating, Wayland's interpretation led him to correlate as follows:[2]

assuming that the African pluvials are to be equated with the glacials of higher latitudes, and having recourse for the moment to Alpine nomenclature, the Chelleo-Acheulean culture of Kenya and Uganda belongs not to the close of Mindel times, but to the end of the Riss and the beginning of Würm days,

an assumption widely at variance with the known facts in Europe.

With regard to the intensity of the pluvials, Wayland has stated[3] quite clearly that, in his opinion, there was nothing "*catastrophic in the climatic phases of the Pleistocene in Central Africa*", nor did he see reason

to suppose that precipitation, even during the first pluvial, was excessive for the tropics as we know them in some parts today; nor do I think that desiccation was sustained or intense during the intrapluvials.

Archaeology

Wayland's own account of his archaeological investigations, which was published in 1934,[4] makes it unnecessary to do more here than indicate

[1] *R.R.R.E.M.U.* p. 343.
[2] *Loc. cit.*
[3] *Loc. cit.* p. 348.
[4] *Op. cit.*