CHAPTER 1

Geology, sedimentation, chronology and the history of the excavations

J. D. CLARK

Introduction

The Kalambo Falls (Plate 1.1) are at the same time impressive and awe-inspiring, whether one is peering down from the lip to the small moist zone of lush vegetation, ferns, 'elephant ear' and wild banana (*Ensete* sp.), supported by the spray at the bottom of the fall, or one is viewing them from the path, west along the top of the gorge, where the full magnitude of the waterfall is manifest against the backdrop of its sheer vertical cliff on the south side, the nesting place for numerous marabou storks. Magnificent and beautiful in their setting, the Kalambo Falls verge also on the sinister, heightened for me by my first visit during the end of the dry season in 1953. We had camped for the night near the lip of the falls on the Zambian side and we had been awakened to a full moon and clear sky by swishing sounds made by the wings of a congregation of marabou storks, swooping down and circling the gorge like so many witches on broomsticks. But we have seen them since, both in the daytime and at night, perhaps in search of carrion. This was indeed a memorable first visit and the next day we literally fell into the prehistoric site itself, the most rewarding and satisfying of any archaeological investigations in which I have been involved in Africa.

Like the much grander Victoria Falls, those of the Kalambo River support relatively the same kind of vegetation communities. This is the phytogeographic region defined by White (1983) as the Zambezian Region and after the Sahara it is the largest main phytogeographic region in Africa. It stretches from 3° to 26° south latitude and from the Atlantic to the Indian Ocean. It has a very rich and diversified flora with the widest range of vegetation types. Woodlands are the most widespread and characteristic vegetation of this region the evolutionary record of which in response to climatic changes is now becoming better known (Vincens 1989). At Kalambo, it is mostly open woodland, primarily the ubiquitous *miombo* woodland with dominant *Brachystegia* and associated tree species. This is country that at first glance might be considered monotonous, but when one lives and works in it, the variability becomes apparent in the many riparian forests along the watercourses, and in the survival of relict evergreen forests, meandering grasslands, small lakes and swamps, evidence of which also stretches back through the prehistoric deposits to the earliest signs of human occupation. Climatic fluctuations, between colder and warmer, and wetter and drier, have produced changes in the vegetation history, but these are changes of degree, not total replacements, as the pollen and macro-plant remains indicate. As now, the *miombo* woodland appears to have been for much of this time the predominant vegetation community. Of particular interest to me was the way in which the present-day Bantu-speaking peoples make use of the woodland resources, both plant and animal, for food and nutrition as well as in their selection, manufacture, and use of their material equipment throughout the year in a rainfall zone of 100–120 cm and a six-month dry season. This is the kind of evidence that can form the basis for trying to understand how prehistoric peoples, in particular the Iron Age and Later Stone Age occupants of the Kalambo Basin, may also have used their environment. These observations are also not inappropriate for attempts to reconstruct the earlier prehistoric record, as will be demonstrated. The present-day yearly and seasonal uses of plants and animals are described in appendix A.

Geography and geology (Figs. 1.1 and 1.2; Plate 1.2)

The Kalambo Falls are situated at 8° 30′ south longitude, 31° 15′ east latitude, on the edge of the Lake Tanganyika rift escarpment near the southeastern corner of the lake and at an altitude of 1150 m. A small township, Mbala (formerly Abercorn), from which the falls could be reached by road, is situated 34 km to the south-south-west.

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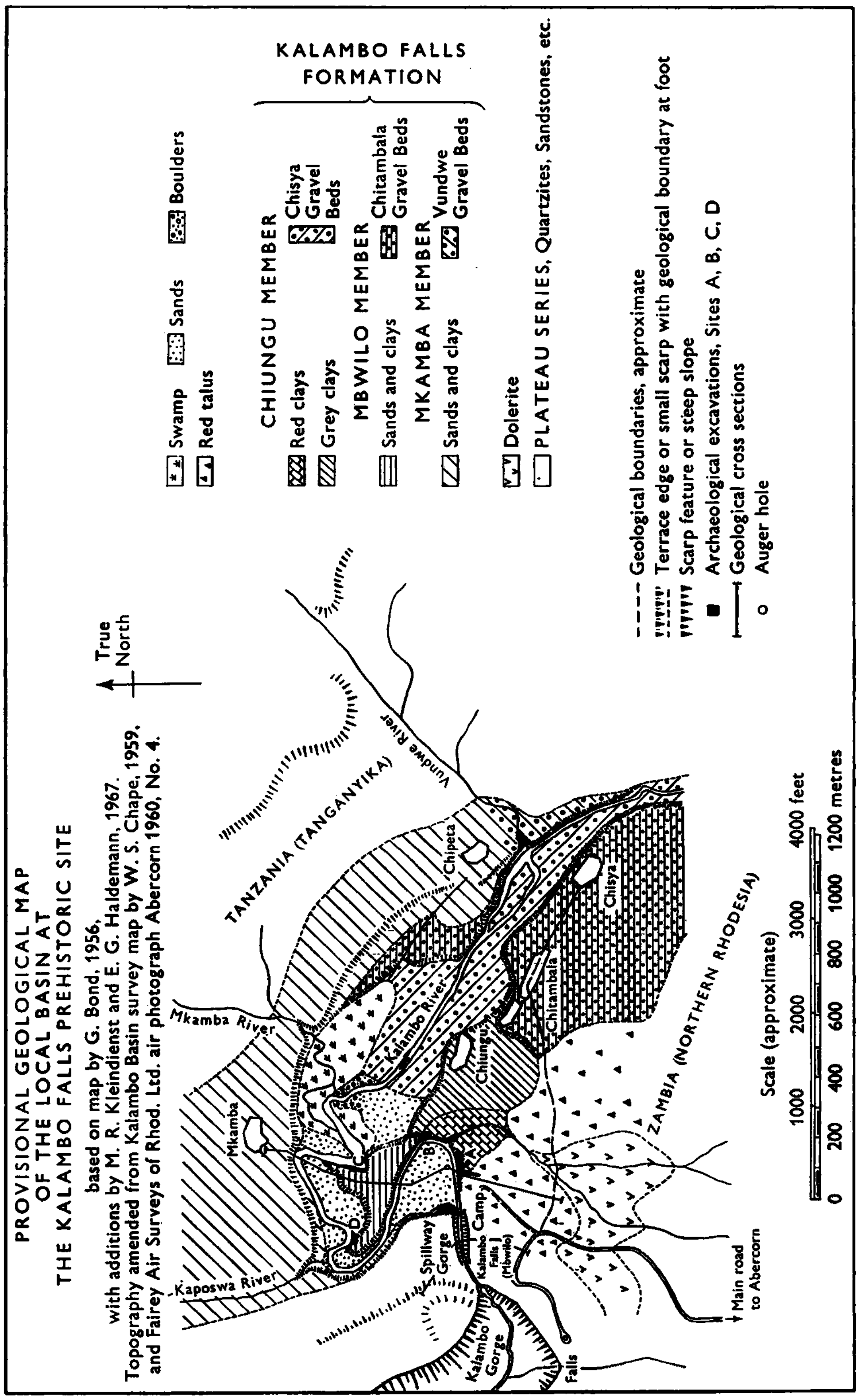

Fig. 1.2 Provisional geological map of the local basin at Kalambo Falls, reprinted from Clark 1969, Fig. 5.

The Kalambo River has its source in the Ufipa Highlands in Tanzania and first flows south for some 90 km then makes a nearly right-angle turn to flow westwards for another 50 km to plunge 220 m in a single fall over the escarpment rim to empty into Lake Tanganyika through a short, very deep gorge some 8 km long, cut down in two very distinct stages. The later 30 m vertical inner gorge is a clear indication of tectonic uplift. Kalambo Falls are the second highest falls in Africa and a well-known tourist attraction. For all except the last part of its course, the river flows over the elevated plateau (Central African Shield) at heights of 1225–1525 m. Between Lakes Tanganyika and Malawi, some 600–770 m below the plateau and to the south of Lake Rukwa, another deep rift lake lying between these two major lakes of the Great Rift Valley, is what has come to be called the 'Corridor Country', that provides a tsetse-free route of migration between north and south. At the south-east end of this 'Corridor Country' lies the dormant Rungwe volcano. This is then a country of high relief, with the escarpment mountains and horsts rising to more than 2750 m and with the floor of the rift lying at an altitude of 600 m.

This plateau country is well watered, with rainfall between 100 and 120 cm. Abrupt changes in altitude are reflected in changing vegetational zones, with montane forests and open grasslands at 1800 m above the main plateau with its ubiquitous *miombo* woodlands (*Brachystegia/Julbernardia*) threaded by broad meandering grasslands (*dambos*) in ancient, mature valleys, and with semi-arid *Terminalia* thicket vegetation on the shore of Lake Tanganyika. In parts of somewhat higher elevation, or in the rain shadow of Lake Tanganyika, this *miombo* country contains residual patches of vegetation known as *mushitu*, which preserve both montane and lowland evergreen forest species that are indicators of former climatic and environmental changes. The Kalambo River basin lies within this plateau woodland.

The geography, vegetation and geology of the local basin of the Kalambo River have been described in Volume I (Clark 1969) and should be consulted for more detail. Regrettably, both Volume I and Volume II (Clark 1974) are out of print and not now readily available. It has been necessary, therefore, to provide brief summaries and to reprint some parts of the text relating to the earlier part of the stratigraphic record containing the Lupemban, Sangoan, and Acheulean aggregates. The main stratigraphic sections with their descriptive legends from Volume I have also been reprinted to provide the geological and stratigraphic context for the analysis of the archaeological aggregates that are the subject of the present volume.

Geology, Quaternary sediments and palaeoenvironment

A summary of the geology by Haldemann and Bond is given here to introduce the archaeology of the earlier cultural levels, namely the Middle Stone Age Lupemban, Sangoan and Acheulean Industrial Complexes that occur in the Quaternary deposits of the small local basin, an erosional feature in the valley floor in the 'End-Tertiary' cycle. This local basin is some 4 km long from east to west and 1.5 km wide. The river flows at first swiftly and then, towards its western end, meanders before passing through the narrow Spillway Gorge and over the falls. This basin (Plate 1.3) is contained between two quartzite ridges some 180 m high in a north-west–south-east direction and parallel to the rift escarpment. On entering the valley the stream is running swiftly over coarse gravel/boulder beds deposited during previous cycles, but its course is slowed after 1.5 km or more downstream towards the western boundary hills. It enters a swamp with predominantly *Phragmites* reeds and the regimen is now sluggish; the fine-grained sediments in the bed load have been deposited during four or more cycles of erosion and deposition. They constitute the Quaternary sediments that contain the archaeological aggregates described in this and the previous volume (Clark 1974).

Bedrock in the vicinity of the Kalambo Falls prehistoric site is Precambrian in the Ufipa Highlands where the river has its source. The rocks are migmatites, gneisses and granulites with later intrusions of quartz, porphyry and granite, on which the rocks of the Plateau Series rest unconformably. Earlier rocks of the Plateau Series comprise hard quartzite, feldspathic quartzite and sandstone with beds of grits and conglomerates (having well-rounded coarse pebbles) changing to shales in the lower part. These rocks are overlain unconformably by another thick series. These are the sandstones and shales (Upper Series) with beds of chert and greywacke overlain again by another series of sandstones with veins of chert and quartz. All these rocks are thought to be Proterozoic in age. Within the Plateau Series, which is faulted and folded, occur intrusive dykes and sills of dolerite, and one such dolerite outcrop on the slopes of the quartzite ridge that bounds the local basin to the south is seen in the road sections (see Clark 1969:21–5). Quartzites and cherts that outcrop on the western flank of the basin provided an abundant source of raw material for stone artefact manufacture. Most of the quartzites are very resistant to weathering, but the feldspathic quartzites are softer and weather more easily, so that the sharp edges of the artefacts are more easily damaged. Very fine examples of tools, ranging from Acheulean to Middle Stone Age, were made from these rocks, and in particular from a very fine-grained, cherty rock which is more specifically a silicified mudstone. For ease of reference this rock is referred to as 'chert'. Boulders, cobbles and pebbles, of hard and feldspathic quartzites, are to be found in the Kalambo River upstream where it enters the swamp.

The present pattern of sedimentation, therefore, is one of strongly contrasted coarse and fine facies, a pattern that is seen also in the earlier Quaternary sediments. The Kalambo River discharges much of its sediment within its meandering course at the western end of the local basin and its water over the falls through the short narrow gorge some 150 m long and 9 m high that we have termed the 'Spillway Gorge'. This continues about 90 m upstream from the falls and is cut through hard quartzite, following a strong joint direction. Shoulders of this gorge are about level with the top of the earliest Quaternary sediments referred to as those of the Mkamba Member of the Kalambo Falls Formation, described below.

The level of sedimentation in the basin, which was cyclic not continuous, was controlled by the outlet at the gorge. If this gorge was cut prior to the deposition of the Mkamba Member, as appears probable, then the following two cycles of cutting and filling were the result of blocking and unblocking of the Spillway Gorge in response to climatic change. Following the 1961–2 rainy season, we were able to observe the ways that slumping of oversaturated sediment against the western quartzite boundary ridge had partially blocked the course of the river (Clark 1969: Plate 6). It was not difficult to see how slumping of a pile of tree trunks, such as that in the Acheulean horizons at Site B, and the large boulders exposed in the floor of the gorge could have formed an effective block, allowing sedimentation in the basin itself to rise until the initiation of a new erosion cycle that unblocked it and lowered the level of the river.

We are of the opinion that the Spillway Gorge is likely to have been cut prior to the aggradation of the Mkamba Member, but there still remains a possibility that the original pre-Quaternary outlet from the valley which flowed to the north in a broad valley/trough, running parallel to the rift escarpment named by us the 'Kawa/Kaposwa' divide, might still have been a possible outlet at the time the earliest of the Quaternary sediments were deposited. Today, the flow from this divide is by two small seasonal streams, the Kawa flowing north to enter Lake Tanganyika and the Kaposwa which flows to the south and joins the Kalambo River just west of the 20 m cliff, forming the north bank of the river and named by us the 'Tanganyika Cliff'. This north/south trough is filled with sediments which are nowhere exposed and the depths of which are not known, but they are most likely to have been deposited at a time prior to the aggradation of the earliest Quaternary sediments. So, uplift within this north/south valley or more general warping provided the divide, and the northern outlet was blocked. Unfortunately, the fine-grained sediments in the Tanganyika Cliff contain almost no artefacts, and the base is below water level. In 1966, however, the excavation of the well section (A6/66) at Site A, a short way upstream from the entrance to the Spillway Gorge, reached a depth of 2.7 m below low water level without reaching bedrock. This was hard to interpret but was put down to possible scouring back by strong flow over the lip of the falls.

If, however, the gorge was not cut until after the earliest Quaternary sediments were deposited, and the Kawa/Kaposwa had not formed prior to the tectonics that produced the divide, the Kalambo River might still have been flowing northwards in the ancient, deep pre-Quaternary valley. It seems unlikely, but in the local Kalambo basin where the archaeological sites are situated, there is more than 3 m of fine-grained deposit below the water level in the river and its control by the lip of the falls.

While the lower beds of the Mkamba Member at the foot of the cliffs at Sites A, B and C contained a large amount of wood and other plant material, not a single piece of bone or tooth was preserved. Conditions for the preservation of bone are absent except for the latest Iron Age contexts and very rare finds of bone in an Early Iron Age pit. Bone is soluble in acidic soil and groundwater but may be preserved in alkaline deposits. Bond measured the pH value of a profile at Site A1 and on surface soils in the vicinity (Clark 1969:206–7). The upper levels showed high pH values and, through levels in the fluvially deposited sediments below, the acidity is still high down to water level, which explains the absence of bone and teeth and the preservation of plant materials. Though the absence of faunal remains is to be regretted, the survival of organic plant materials, including pollens, is of great interest. This is on account not only of their antiquity, at the end of the Earlier Stone Age, for which plant materials are very rarely preserved in Africa, but also for what they can contribute to understanding the prevailing vegetation patterns through palaeoecology, and because the preservation of wood and bark shows evidence of opportunistic modification and use by Acheulean groups. Pollens and woods were identified by van Zinderen Bakker (Clark 1969:chapters 1 and 3) and by others (Clark 1969:appendices C–E and I).

Modified wooden artefacts from Site B are described and illustrated in chapter 7 in this volume. The pollens and macro-plant remains show the extent to which changes in

Table 1.1 *The Kalambo Falls prehistoric site: rock stratigraphic units*

Formation	Member		alluvial facies	colluvial facies
Kalambo Falls Formation	Chiungu Member	?	predominantly red sandy clays and clays	Red sandy clay
		Chisya Gravel Beds	predominantly grey sandy clays and clays	
		?		
	Mbwilo Member	?	Sandy clay	Red Rubble Bed
		Chitambala Gravel Beds	Sands or sands and clays interstratified with rubbles	
			Rubble Bed[a]	
		?		
	Mkamba Member	?	Pits Channel Fill sands	
		Vundwe Gravel Beds	Rubble Bed[b]	
			Ochreous Sands and Grey Clay Beds	
			White Sands and Dark Clay Beds	
		?	?	?

Notes:
[a] Rubble I or its subdivision in the archaeological nomenclature.
[b] Rubble II or its subdivision in the archaeological nomenclature.

the lithic components of the artefact aggregates are or are not correlated with changes of climate (temperature, rainfall) and of the vegetational communities occupying the Kalambo basin. The more recent palaeontological coring at the south end of Lake Tanganyika has added important understanding of the Holocene and Late Pleistocene vegetation and climate in the interior plateau of south central Africa. This has made it possible to understand better the record from Kalambo Falls reviewed in this volume by Taylor *et al.* Much of the above has been summarised from chapter 1, part 1 of chapter 2 by Haldemann, and appendix A by Bond in Volume I (Clark 1969).

The Quaternary deposits and the rock stratigraphic units that form the Kalambo Falls prehistoric site have been described and defined by M. R. Kleindienst in part 2 of chapter 2 (Clark 1969) and are reprinted here. These sediments were initially described as lacustrine by Howell and Clark (1963), Mortelmans (1956) and Bond, following his geological survey in 1956 (Clark 1969:197, appendix A). Survey by Haldemann in 1959 and 1961 resulted in these deposits being recognised as mostly of fluvial origin, an interpretation with which Bond subsequently agreed (Clark 1969:203 fn). Table 1.1 gives the full terminology used to define the Quaternary sediments in the local Kalambo basin that comprise the Kalambo Falls Formation.

The sediments are exposed in all the excavations at Sites A, B, C and D, the most complete and type section being that in the A4 Trench and other excavations at Site A. The locations of these sites, as shown in the map of the western end of the local basin, reproduced here as Fig. 1.2, are in the bends in the meandering river, the furthest upstream being Site C and the others, D, B and A, correspondingly further downstream, with Site A being only about 90 m above the Spillway Gorge. Plans of the excavated areas at Sites A and B are given in connection with the detailed description of the sedimentary sequence of these sites in Volume I (Clark 1969), and the plans are reproduced here (Figs. 1.3 and 1.4 for Site A; Figs. 1.5 and 1.6 for Site B) together with the section drawings and legends for Sites A, B and D to be found in fold-outs in the back pocket of this volume. These are necessary in order to follow M. R. Kleindienst's definitive description of the Kalambo Falls Formation with its three Members that are the context for the archaeology (Clark 1969:48–55). This is reproduced below, but omitting reference to dating, which is discussed later in this chapter and incorporates new dating evidence.

The geology section drawings and legends that are reproduced here from Volume I are as follows and are renumbered for this volume.

Site A

A1/56

New Fig. No. 1.7	Fig. 20 Site A: east wall section of A1 excavation, 1956
New Fig. No. 1.8	Fig. 21 Site A: section at south wall of A1 excavation, 1956.
New Fig. No. 1.9	Fig. 22 Site A: sections at west wall of A1 excavation, 1956.
New Fig. No. 1.10	Fig. 23 Site A: north wall section of A1 excavation, 1956
New Fig. No. 1.11	Fig. 27 Site A: section of A6 excavation, 1966

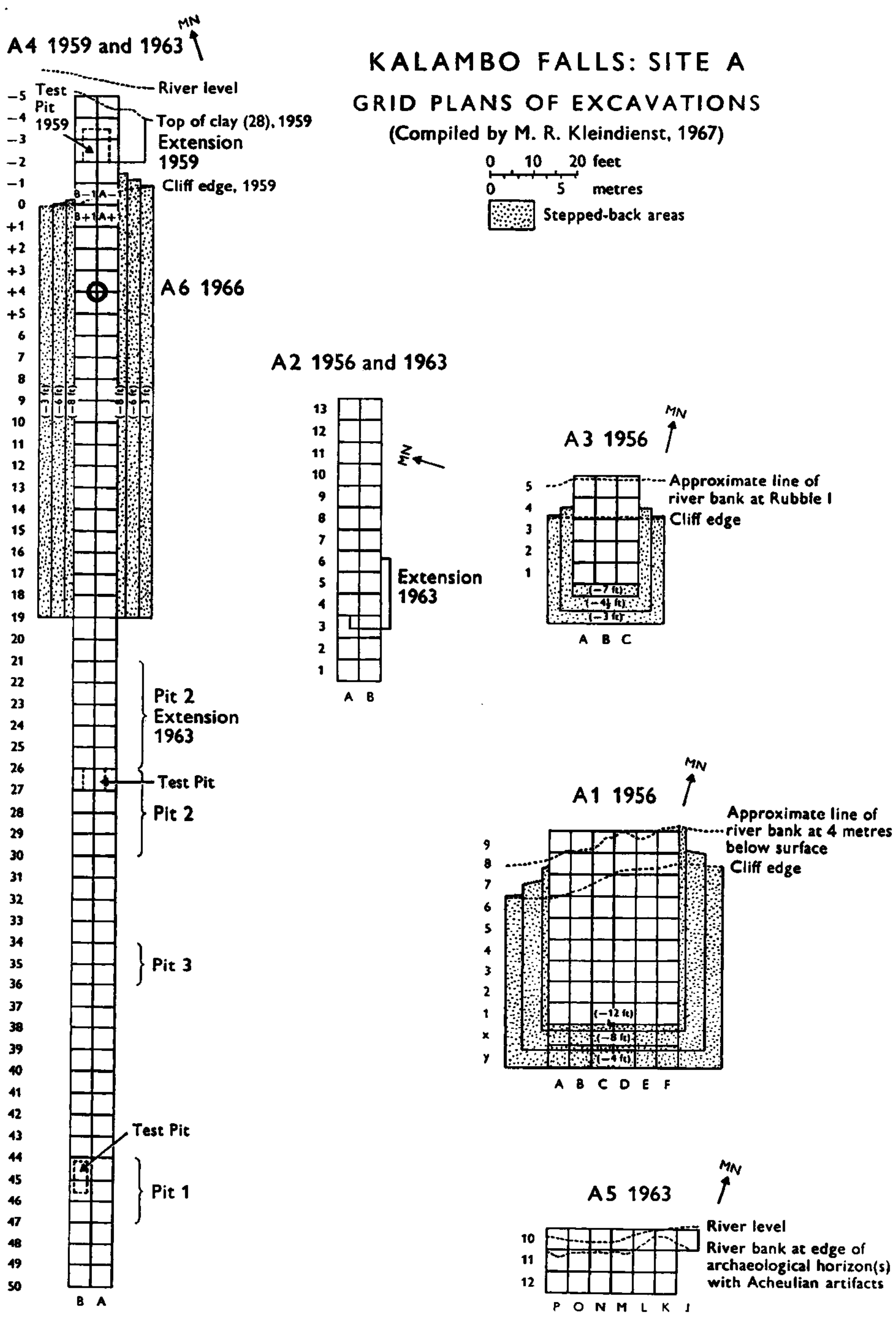

Fig. 1.3 Outlines of Site A excavations, showing grids, reprinted from Clark 1969, Fig. 18.

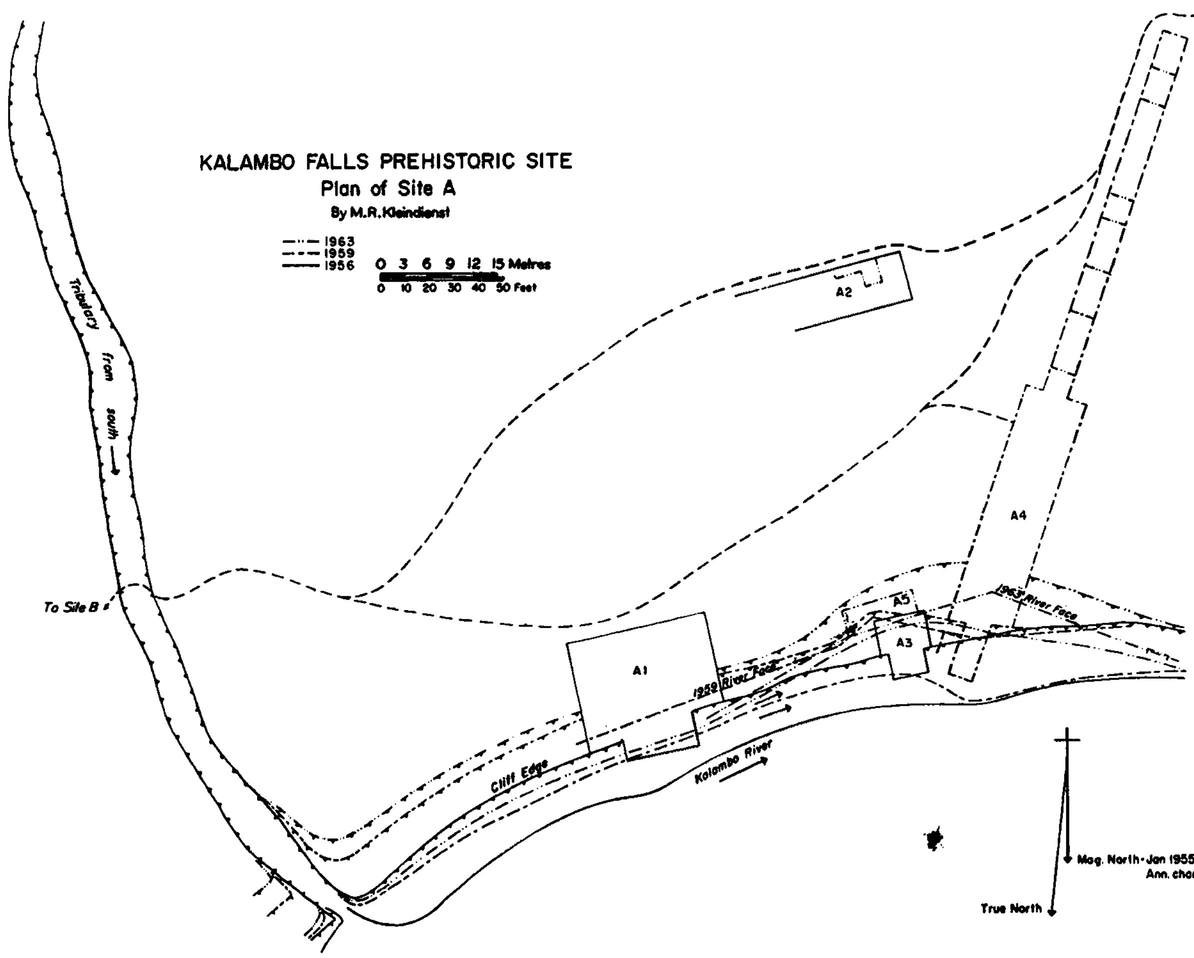

Fig. 1.4 Plan of Site A, 1963, reprinted from Clark 1969, Fig. 19.

A4/59 and 63

New Fig. No. 1.12 Fig. 28 Site A: west wall section of A4 excavations, 1959 and 1963

New Fig. No. 1.13 Fig. 29 Site A: east wall section of A4 excavations, 1959 and 1963

River Face Cliff

New Fig. No. 1.14 Fig. 32 Site A: composite section of River Face Cliff based on excavations, 1956 and 1963

A5/63

New Fig. No. 1.15 Fig. 31 Site A: east, west and south wall sections, A5 excavation, 1963

Site B

B1/56

New Fig. No. 1.16 Fig. 35 Site B: north and east wall sections of B1 excavation, 1956

B2/59

New Fig. No. 1.17 Fig. 36 Site B: north wall sections of B2 excavation, 1959

New Fig. No. 1.18 Fig. 37 Site B: south wall section of B2 excavation, 1959

New Fig. No. 1.19 Fig. 38 Site B: west wall section of B2 excavation, 1959

New Fig. No. 1.20 Fig. 39 Site B: east wall section of B2 excavation, 1959 and sections in pits B3 and B4, 1959

Site D

D2/56

New Fig. No. 1.21 Fig. 41 Site D: east and south wall sections

Photographs of the excavations in 1956, 1959 and 1963 were published in Volume I Plates 11–32 and show the main depositional features and units and the progress of the work. These are not reproduced here but should be

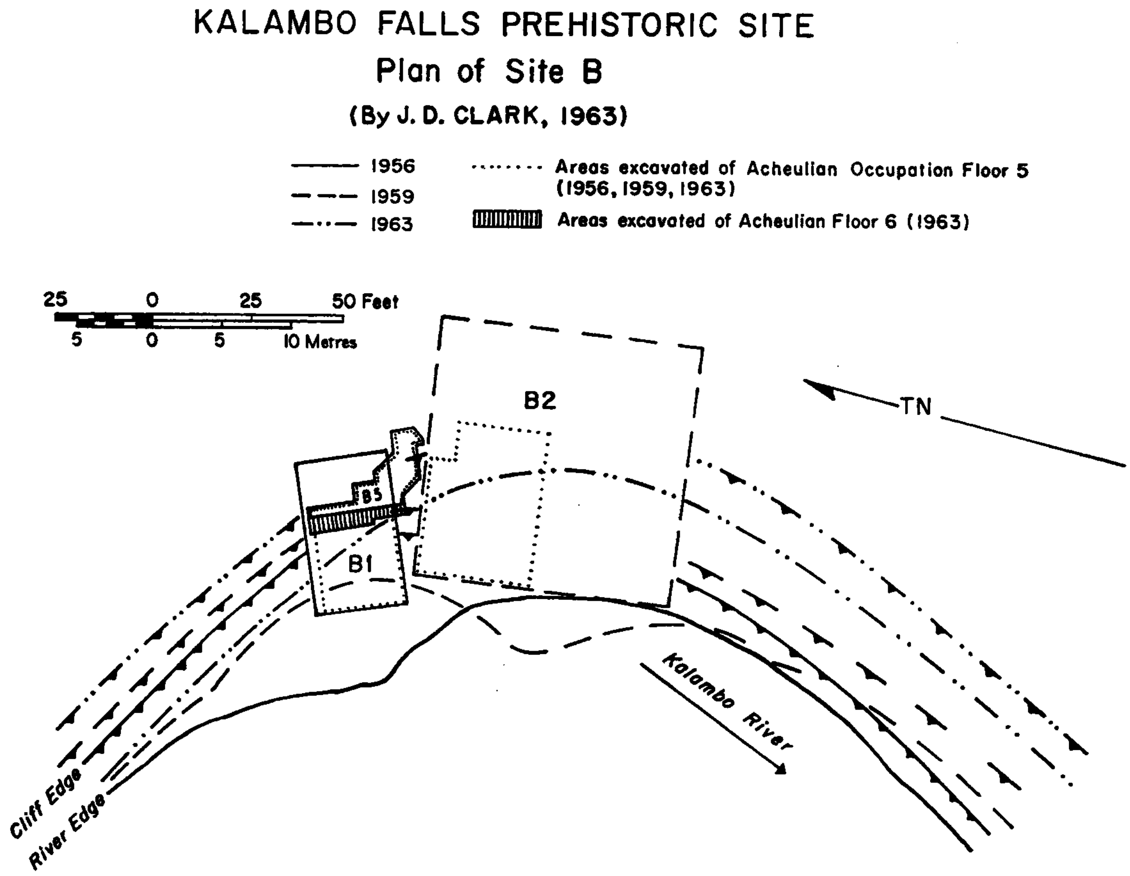

Fig. 1.5 Plan of Site B, 1963, reprinted from Clark 1969, Fig. 33.

consulted for understanding of the different excavated areas. Two of the main 1959 excavations are illustrated here, however (Plates 1.4 (A4 Trench) and 1.5 (B2/59)) to show some of the sedimentary units referred to in the text and the general nature and setting of the excavations. Other plates showing features of archaeological horizons and beds relate to the textual descriptions of archaeological aggregates in chapters 4, 5 and 6.

Definition: the Kalambo Falls Formation

BY M. R. KLEINDIENST

The type section for the Kalambo Falls Formation is designated as that exposed by Trenches A4/A6, the excavations along the River Face Cliff, and Trench A1 at Site A. Detailed descriptions of lithology, sections (Clark 1969:Figs. 20–3, 27–9, 31–2, Plates 11–23), and a summary of the geological evidence are given in chapter 4 of Volume I, and will not be repeated here (see also Clark 1969:chapter 2 part 1, chapter 5 and appendix A). In the Site A area, located just upstream of the outlet from the local basin, a more complete geological record is preserved than in other sections of the basin.

The Kalambo Falls Formation is subdivided into the Mkamba Member, the Mbwilo Member, and the Chiungu Member, all of which occur in the type section and at Site B.[1] At Site A, the sections exposed in the steep south bank of the Kalambo River, and in the excavations, show a complex succession of cutting and filling in fluviatile deposits. In such a geological environment, the sediments cannot be expected to be reproduced in detail at the other archaeological sites. However, although the sequence cannot be traced directly, the deposits at Sites B, C and D can be correlated on the bases of lithology, organic remains, ^{14}C dating, elevation and artefact content (Clark 1969:chapter 5).

In general, the deposits are interbedded sands, silts and clays with more clayey sediments at the top. The sands frequently show current bedding, and there are numerous minor discordances representing either breaks in deposi-

[1] Because of the paucity of suitable local geographical names, it has been necessary to depart from the International Code (Hedberg 1961) in that most beds are named only from their lithology.

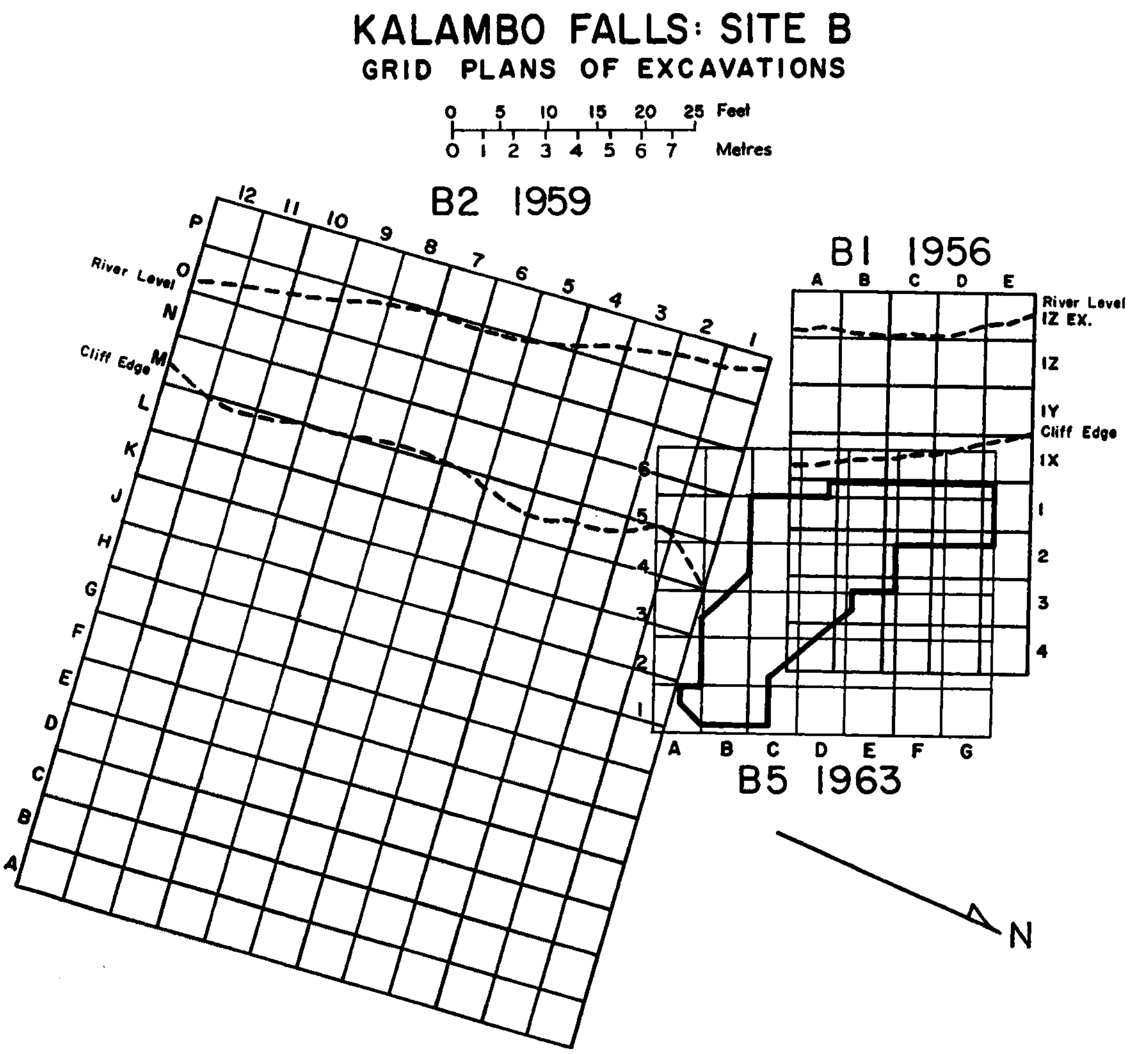

Fig. 1.6 Site B excavations, showing grids, reprinted from Clark 1969, Fig. 34.

tion or local erosion, marked by abrupt changes in lithology, and/or the presence of pebbles, angular rubble, larger cobbles or boulders, organic remains and, in places, artefacts. These nonconformities are more noticeable near the base of the exposed sequence, in the Mkamba Member, and in the Mbwilo Member where its basal Rubble Bed is low in elevation. Other discordances are eroded surfaces representing breaks of greater magnitude, some of which can be identified in several of the excavations. Some fillings of relatively small channels have also been sectioned in the trenches, the fillings usually being made up of coarser sediments at base, overlain by sands or clayey sediments. Channel fills at the base of the Ochreous Sands and Grey Clay Beds of the Mkamba Member, the Pits Channel Fill containing the uppermost identified deposits of the Mkamba Member in Trench A4, and the 'Older' and 'Younger Channel Fills' in the Chiungu Member at Site A are examples. The degree of sorting, current bedding, channelling and rapid lithological change both vertically and horizontally are all characteristic of river deposition.

Rubble layers interstratified with fine bedded sediments are well exposed in Trench A4 (Clark 1969:Figs. 28 and 29, beds 15 and 18) and in the Site A River Face Cliff (Clark 1969:Fig. 32). Although much or most of the coarse material in these rubbles was undoubtedly contributed by such processes as slopewash and creep, some also came from the eroded older sediments as these were cut through and the fines removed. In the excavations rubbles are, in places, demonstrably lag deposits, and most have also been affected by river action (Clark 1969:127–8, chapter 4). These rubble layers occur in the upper part of the

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Table 1.2 *The cultural sequence at Kalambo Falls: summary of aggregate composition, stratigraphy and dating of the main archaeological units*

Developmental chrono-stratigraphic terms	Industrial complex	Industry	Phase	Component	Main artefact classes	Sites and stratigraphy: archaeological occurrences	Radiocarbon dates
Iron age	(Late)				Not positively identified before Lungu settlements. Vol. II, Plates 1 and 2.	Surface and subsurface hillslope soils.	? < 350 BP (< AD 1580 ± 50)
	(Early)	Kalambo Falls			Open settlements, permanent occupation but few permanent structural features. Storage pits, ?grave shafts and furniture. Iron working tools and personal ornaments. Copper (rare). Grindstones, pigment, pots and bowls with bevelled rim, hatching, stamping, parallel channelling, grooving and false relief chevron decoration. ?Cattle and wild fauna. Vol. II, Plates 3–32.	Site C *Settlement* (1963). Hillslope soil, Site A7 (1966). Chiungu Member channel clays, Sites A and B, 1956 and 1963.	930 ± 40 BP (AD 1020 ± 50) 1905 ± 40 BP (AD 345 ± 40)
'Later Stone Age'		Kaposwa			*Flakes:* long and short quadrilateral, irregular. Mostly parallel, convergent and irregular dorsal scar patterns. Plain or point striking platforms. Micro-burin variant spalls. *Cores:* single (especially pyramidal) and two platforms; formless; bipolar. *Utilised/modified:* small flakes, bladelets, fragments, etc. *Outils esquillés*. Anvils (dimple scarred). Rubbers, grindstones, pestles, hammerstones, pigment. *Shaped tools: large cutting* – none. *Heavy duty:* percussion flaked and ground and polished stone axes, bored stones. *Light duty:* mostly microlithic – backed bladelets and flakes; lunates, trapezes, triangles; shouldered and truncated forms; small scrapers (mostly short end and side), pieces with burin blow. Vol. II, Plates 33–42.	Occupation floor. Top of sands (Mbwilo Member) of ± 30 foot (9 m) terrace, Site C, 1959, 1963. Surface, Chitambala Gravel Beds.	3850 ± 40 BP (1900 ± 40 BC) 3920 ± 40 BP (1970 ± 40 BC)
'Second Intermediate'		Polungu		Hillslope component	*Flakes:* all forms, especially blades and short triangular. Parallel, convergent and radial dorsal scar patterns. Plain, faceted and point striking platforms. *Cores:* single and two platforms; bipolar; formless; Levallois and discoid. *Utilised/modified:* block anvils, rubbers, pestles, hammerstones, pigment, *outils esquillés*; flakes, blades, etc. *Shaped tools: large cutting* – none. *Heavy duty:* irregular core-axes and convergent picks (rare); core-scrapers; choppers (rare); retouched cores (?adzes). *Light duty:* backed and truncated bladelets; backed flakes; unifacial (short triangular) points; small convex scrapers; burins (rare); proto-burins. Vol. II, Plates 43–47.	Hillslope deposits A4 Excavation, 1959 and 1963.	