SOME SUGGESTED PROCEDURES IN THE ANALYSIS OF BONE ACCUMULATIONS FROM SOUTHERN AFRICAN QUATERNARY SITES.

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The description of complete bone accumulations, or representative samples of these, from Quaternary sites in Southern Africa has seldom been undertaken. More usually the palaeontological tendency has been to select certain identifiable specimens from a bone assemblage and to describe these; in this way the South African fossil record has been documented.

Objectives in the study of a complete bone accumulation include an attempt to establish what animals have contributed bones to the assemblage and by what skeletal parts these individuals are represented. The subsequent interpretation of the accumulation generally has three aims: (a) to establish what agents were responsible for collecting the bones; (b) to reconstruct aspects of the behaviour of the animals or men which contributed to the assemblage and (c) to provide reconstructions of the environment which existed when the accumulation was being formed.

In view of an increasing interest in bone accumulations, it seems desirable that data collected by different investigators should be directly comparable. For this reason, some suggestions are made here as to how analyses may be undertaken. These may serve as a basis of discussion.

The kind of analysis which is possible will depend on the nature of the bone assemblage. If the bones are reasonably complete and undamaged, it may be possible to allocate almost all to their correct skeletal categories and taxa. Bones which have been highly fragmented however, as is generally the case with primitive human food remains, will yield far less definitive information.

The species list.

The first step in the analysis consists of removal of all bone pieces can be specifically identified with certainty. These form the basis of the species list and generally consist of skull pieces or other skeletal parts with diagnostic characteristics. For this stage of the work, a

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complete and well-organised osteological reference collection is indispensable, for it is on the availability of this, as well as on the competence of the investigator, that the reliability of identifications will depend. Where specialists on particular groups of animals are available, it is always advantageous to refer problematical specimens to them.

Broader taxonomic groupings.

After removal of specifically identifiable specimens, a second sorting is aimed at removal of bone pieces referable to broader taxonomic categories, such as "suid", "small", "medium" or "large carnivore" or "bovid". Special mention will be made here of the bovid or antelope groupings as Southern African bone accumulations from Quaternary sites are often dominated by antelope remains. Where these are fragmentary, or where many species are involved, it is generally not possible to do more than to group the antelope from which they came in size classes. For this purpose, four Antelope Size Classes are proposed and have been used by the writer in various analyses. They are based on the live-weights of the animals whose remains may be present in the bone accumulations.

34 Extant species of antelope are currently recognised in the Southern African region, the classification of which is shown in Table 1. An attempt has been made to define the live-weight ranges for adult specimens of each species and the various literature references used for the purpose are given in the appendix.

Table 2 shows the antelope species arranged in order of increasing weight, from dik dik to eland. The list has been divided into four arbitary categories as follows:

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	Live-weight range	Upper limit
ANTELOPE I	0 - 23 kg. 0 - 50 lbs.	Large ♂ common duiker.
ANTELOPE II	23 - 84 kg. 50 - 185 lbs.	Large ♂ blesbok
ANTELOPE III	84 - 296 kg. 185 - 660 lbs.	Large wildebeest or roan antelope.
ANTELOPE IV	more than 296 kg. " " 660 lbs.	Antelope larger than wildebeest or roan.

In practice, complete but disarticulated skeletons of a large ♂ duiker, large ♂ blesbok and large wildebeest are kept for ready reference. Any bovid bone fragment which is to be placed in a size class may then be compared for size with the relevant part of the reference skeletons and placed in the appropriate category.

The residue.

Upon completion of the sorting procedures referred to above, the sample will have been reduced to a residue of fragments which cannot be placed with confidence into any taxonomic category. It is often found that a large part of this residue consists of pieces from the shafts of long bones, particularly of bovid origin. In the case of primitive human food remains, the long bones will generally have been smashed up for the extraction of marrow and the process will have resulted in the production of characteristic bone fragments. These are referred to as bone flakes if they conform to the following requirements: (a) that they come from the shafts of long-bones, i.e. limb bones such as femur, radius or metapodial; (b) that they lack complete articular ends and (c) that they do not preserve more than half the circumference of the long-bone shaft. Typical bone flakes are shown in Fig. 1 (c). In cases where more than half the circumference of the long-bone shaft has been preserved (Fig. 1(b)), the specimens are called shaft pieces. Fragments showing recognisable articular ends (Fig. 1(a)) are

classified ..../ 4.

classified according to anatomical parts and would therefore not generally form part of the residue. The two pieces shown in Fig. 1(a) would be listed as a distal humerus and a proximal femur in their appropriate Antelope Size Classes.

After removal of the bone flakes and shaft pieces, the remainder of the residue is listed as consisting of miscellaneous fragments.

Size distribution of bone pieces in the sample.

To allow comparisons between bone assemblages from different levels or different sites it would be useful to collect data on the sizes of bone fragments in each assemblage. Such information is not always meaningful however as the initial sizes of the unbroken bones will depend on the sizes of the animals from which they came. An accumulation dominated by the remains of large ungulates will naturally be very different in the size distribution of its pieces from one dominated by the remains of mammalian microfauna. However it does seem meaningful to compare the sizes of selected elements in bone accumulations. Length measurements have, for instance, been made by the writer on bone flakes and the results give an indication of the degree to which bovid long-bones have been fragmented. Bone flakes may be placed in length categories most conveniently with the aid of a sorting box, which has subdivisions in it below perforations of known length cut in its lid. The bone flakes are simply dropped through those perforations which most closely match their lengths - a graded series of slots varying in length from 1 - 15 cms. at 1 cm. intervals will accommodate most flakes.

Fragmentation of a bone sample may also be expressed as number of fragments per kilogram, though comparisons between assemblages will be meaningless unless the bones come from animals of comparable size.

Estimation of minimum numbers of individuals.

The minimum number of individual animals which must have contributed bones to an assemblage may be calculated for any desired taxonomic grouping. Once the skeletal parts referable to the particular taxon have

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been listed, it will be possible to see which parts are most frequently represented in the sample. If one finds, for instance, that left distal humeri are the most numerous skeletal elements in the remains of antelope from Size Class II and that 75 occur, one may conclude that at least 75 individual antelope in this size bracket have contributed to the sample.

On the basis of such criteria as tooth-eruption, tooth-wear and suture-fusion, individual animals may also be placed in classes reflecting age at death.

Special features of bone fragments.

In the course of the sorting procedures, the bone pieces should be examined for the presence of special features. These include evidence for use of bones as tools, surface abrasion, cut marks, carnivore damage, pathology and porcupine gnawing. The incidence of any such features in an assemblage will greatly influence the interpretation which may be attempted.

It is remarkable how much information may be obtained from the study of bone accumulations - often from those parts of the assemblage which, in the past, have been ignored or discarded by palaeontologists. Scientists undertaking excavations are urged to retain all bone fragments, within reason, which they may unearth. It is possible that the seemingly uninteresting fragments may contain clues vital to the interpretation.

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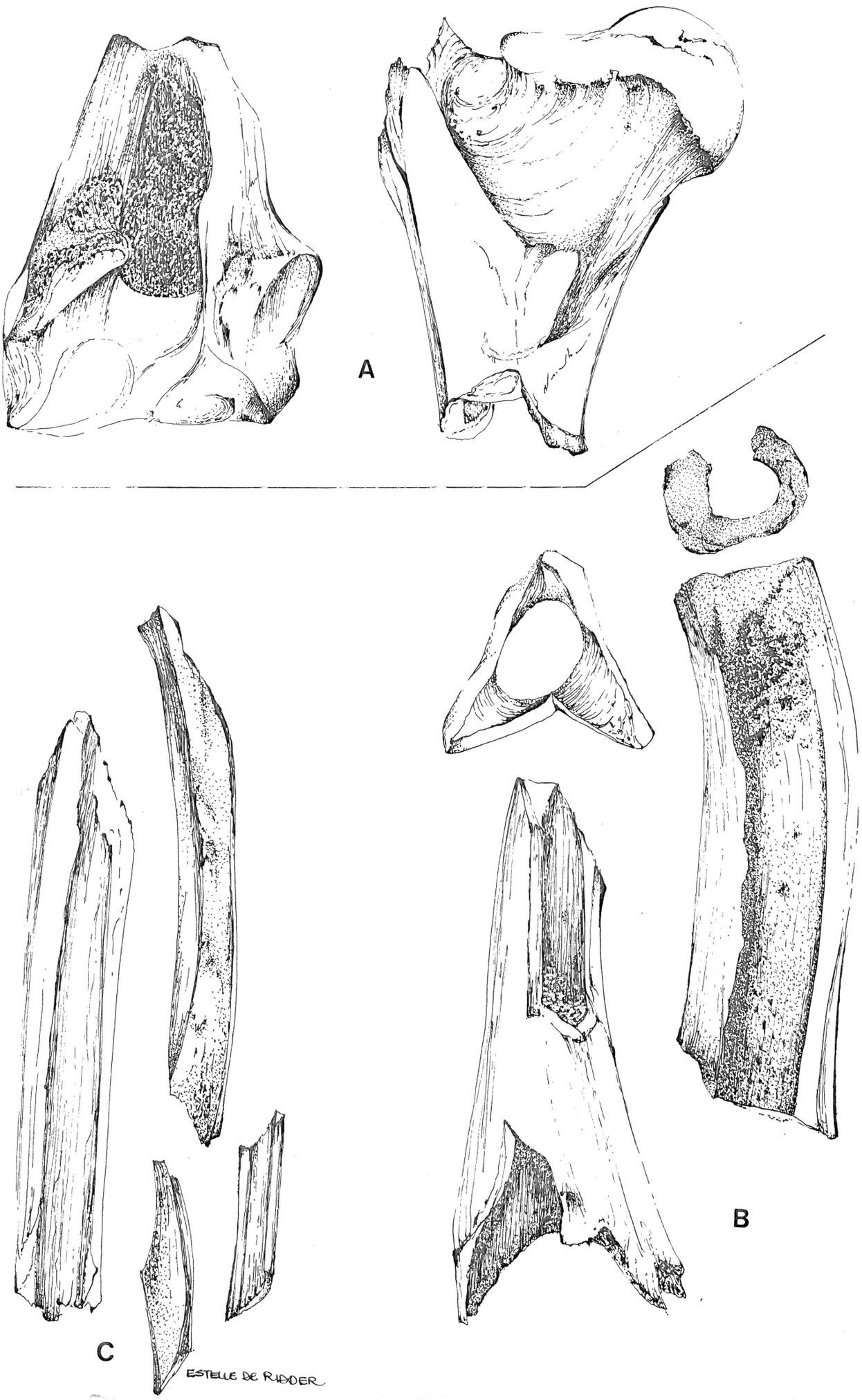
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TABLE 1.

FAMILY: BOVIDAE		Weight Range	
Subfamily: Bovinae		Lbs.	Kg.
Syncerys caffer	Buffalo	808 - 1841	367 - 837
Subfamily: Alcelaphinae			
Connochaetes gnou	Black wildebeest	350 - 400	158 - 182
" taurinus	Blue "	450 - 602	205 - 274
Alcelaphus buselaphus	Red hartebeest	300 - 350	136 - 158
" lichtensteine	Lichtenstein's hartebeest	322 - 450	146 - 205
Damaliscus albifrons	Blesbok and bontebok	70 - 180	32 - 81
" lunatus	Tsessebe	300 - 350	136 - 159
Subfamily: Reduncinae			
Kobus ellipsiprymnus	Waterbuck	350 - 600	158 - 272
" defassa	Defassa waterbuck	350 - 450	158 - 205
" vardoni	Puku	124 - 184	56 - 84
" leche	Lechwe	170 - 230	77 - 105
Redunca arundinum	Reedbuck	98 - 171	45 - 78
" fulvorufula	Mountain reedbuck	50 - 60	23 - 27
Subfamily: Peleinae			
Pelea capreolus	Grey rhebuck	50 - 60	23 - 27
Subfamily: Hippotraginae			
Oryx gazella	Gemsbuck	400 - 500	182 - 227
Hippotragus equinus	Roan	491 - 658	223 - 299
" niger	Sable	450 - 580	205 - 264
Subfamily: Tragelaphinae			
Taurotragus oryx	Eland	870 - 2078	396 - 945
Strepsiceros strepsiceros	Kudu	330 - 651	150 - 296
Tragelaphus scriptus	Bushbuck	50 - 182	23 - 83
" angasi	Nyala	200 - 250	91 - 114
" spekei	Sitatunga	200 - 250	91 - 114
Subfamily: Antilopinae			
Antidorcas marsupialis	Springbuck	40 - 115	18 - 52
Aepyceros melampus	Impala	80 - 132	36 - 60
Subfamily: Cephalophinae			
Cephalophus monticola	Blue duiker	12 - 16	6 - 7
" natalensis	Red "	20 - 30	9 - 14
Sylvicapra grimmia	Common duiker	24 - 45	11 - 21

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		Weight Range	
		Lbs.	Kg.
Subfamily: Oreotraginae			
Oerotragus oreotragus	Klipspringer	21 - 36	10 - 16
Subfamily: Madoquinae			
Madoqua kirki	Dikdik	10 - 11	4,5 - 5
Subfamily: Neotraginae			
Nesotragus moschatus	Suni	10 - 15	5 - 7
Ourebia ourebi	Oribi	30 - 42	14 - 19
Raphicerus campestris	Steenbuck	24 - 33	11 - 15
" melanotus	Cape grysbuck	15 - 20	7 - 9
" sharpei	Sharpe's grysbok	15 - 20	7 - 9

TABLE 2.

	Weight Range	
	Lbs.	Kg.
ANTELOPE CLASS I.		
Dikdik	10 - 11	4,5 - 5
Suni	10 - 15	5 - 7
Blue duiker	12 - 16	6 - 7
Cape grysbok	15 - 20	7 - 9
Sharpe's grysbok	15 - 20	7 - 9
Red duiker	20 - 30	9 - 14
Klipspringer	21 - 36	10 - 16
Steenbok	24 - 33	11 - 15
Common duiker	24 - 45	11 - 21
Oribi	30 - 42	14 - 19
ANTELOPE CLASS II.		
Springbuck	40 - 115	18 - 52
Mountain reedbuck	50 - 60	23 - 27
Grey rhebuck	50 - 60	23 - 27
Bushbuck	50 - 182	23 - 83
Blesbok	70 - 180	32 - 81
Impala	80 - 132	36 - 60
Reedbuck	98 - 171	45 - 78
Puku	124 - 184	56 - 84
ANTELOPE CLASS III.		
Lechwe	170 - 230	77 - 105
Nyala	200 - 250	91 - 114
Sitatunga	200 - 250	91 - 114
Tsessebe	300 - 350	136 - 158
Red hartebeest	300 - 350	136 - 158
Lichtenstein's hartebeest	322 - 450	146 - 205
Kudu	330 - 651	150 - 296
Black wildebeest	350 - 400	158 - 182
Defassa waterbuck	350 - 450	158 - 205
Waterbuck	350 - 600	158 - 272
Gemsbok	400 - 500	182 - 227
Sable	450 - 580	205 - 264
Blue wildebeest	450 - 602	205 - 274
Roan	491 - 658	223 - 299
ANTELOPE CLASS IV.		
Buffalo	808 - 1841	367 - 837
Eland	870 - 2078	396 - 945

APPENDIX.

LITERATURE REFERENCES ON THE LIVE-WEIGHTS OF SOUTHERN AFRICAN BOVIDS.

Astley Maberley, C.T., 1963. The Game Animals of Southern Africa. Van Schaiks, Pretoria.

Best, G.A. and Edmond-Blanc, F., 1969. Rowland Ward's Record of Big Game. 13th Edition (Africa). Rowland Ward (Publications) Ltd., London.

Bigalke, R.C., 1965. Experiments in immobilising ungulate mammals. Zoologica Africana 1 (1): 239 - 247. (Weights of springbuck).

Dorst, J. and Dandelot, P., 1970. A Field Guide to the Larger Mammals of Africa. Collins, London.

Hirst, S.M., Kettlitz, W.K. and Visagie, G.P., 1965. The use of Ro-2807 (Roche) as a tranquilliser in wild animals. Zoologica Africana 1(1), 231-238 (weights of oribi).

Labuschagne, R.J. and v.d. Merwe, N.J. (no date). Mammals of the Kruger and other National Parks. Nat. Parks Board publication.

Meinertzhagen, R., 1938. Some weights and measurements of large mammals. Proc. Zool. Soc. Lond., Series A, 433 - 439.

Mitchell, B.L., 1965. Breeding growth and ageing criteria of Lichtenstein's Hartebeest. The Puku. Occ. Pap. Dept. Game and Fisheries, Zambia, no. 3, 97 - 104.

Robinette, W.L., 1963. Weights of some of the larger mammals of N. Rhodesia. The Puku. Occ. Pap. Dept. Game and Fisheries, Zambia, no. 1, 207 - 215 (weights of Sharpe's Grysbok).

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Smithers, R.H.N., 1966. The Mammals of Rhodesia, Zambia and Malawi. Collins, London.

_____, 1971. The Mammals of Botswana. Nat. Mus. Rhodesia Memoir no. 4.

Tinley, K.L., 1969. Dikdik Madoqua kirki in South West Africa: notes on distribution, ecology and behaviour. Madoqua, 1, 7 - 33.

Walker, E.P., 1964. Mammals of the World. Vol. II. John Hopkins Press, Baltimore.

Wilson, V.J. and Child, G., 1964. Notes on bushbuck, Tragelaphus scriptus, from a tsetse fly control area in N. Rhodesia. The Puku, Occ. Pap. Dept. Game and Fisheries, Zambia, no. 2, 118 - 128.

_____, 1965. Notes on klipspringer from tsetse fly control areas in E. Zambia. Arnoldia, 1 (33), 1 - 19.

Wilson, V.J., 1968. Weights of some mammals from Eastern Zambia. Arnoldia, 3, no. 32, 1 - 20.