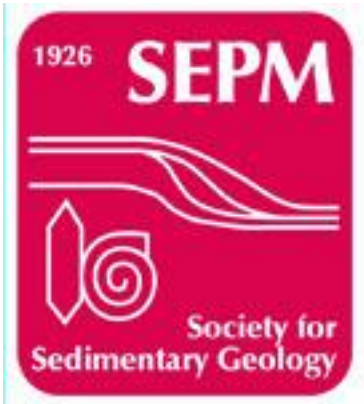

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A FOSSIL BABOON FROM ANGOLA, WITH A NOTE ON *AUSTRALOPITHECUS*

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ABSTRACT—The skull of a juvenile baboon is described from a cave near Leba, Angola, where it occurred in a pink breccia of presumed Pleistocene age. The specimen is assigned to the genus *Parapapio,* but remains indeterminate as to species and sex. Its skull shows a depression fracture which seems to have been inflicted by the blow of a blunt object, most likely a weapon wielded by an australopithecine.

INTRODUCTION

OUR present knowledge of fossil baboons is fairly good in many ways. Baboons are fairly distinctive, and are not easily confused with other fossils. All baboons exhibit a greater or lesser degree of sexual dimorphism as adults, enabling us to distinguish the sexes even among fossils, a possibility which arises all too infrequently in paleontology. A fair number of specimens is known, and from these we are able to recognize several species which have been placed in about five genera. Most of the material consists of partial skulls, of which the facial and tooth-bearing regions are most diagnostic and most often mentioned, described, and illustrated, but complete skulls are not uncommon.

Our knowledge of fossil baboons is nevertheless limited geographically. Freedman (1957) gives the known distribution, which has not changed substantially since he wrote. Four of the six most productive sites in South Africa are no more than two or three miles apart, and contain upwards of 950 specimens, more than three-fourths of the known material. All together, the South African caves have yielded about 1250 known specimens (an estimate based on Freedman's figures), all of these from the Transvaal or the immediately adjacent part of Cape Province. In contrast, only a mere score of known specimens is scattered about the rest of Africa, the majority of these inadequately described or not described at all. Thus, any description of new material from outside South Africa is a welcome occurrence.

The present specimen seems to have been collected by the Rev. Merlin W. Ennis of Lexington, Mass., who was once a missionary in Angola. Rev. Ennis donated the skull to the Peabody Museum of Archeology and Ethnology at Harvard University in 1945, where it remained for over twenty years. It was finally given to Bryan Patterson of the Museum of Comparative Zoology, who gave it to me to describe.

The specimen was accompanied by four labels or notes. The first of these, apparently written by Rev. Ennis, describes the specimen as "Part of a fossil skull from a cave in a marble formation at Leba (cave) near Humpata southern Angola, Africa." One of the other labels identifies the skull as "PAPIO (immature)," while the geologic age is given in one case as definitely Pleistocene and in another as "LATE CENOZOIC ?Tertiary or Pleistocene." Finally, one of the notes gives a bibliographic reference to Dart (1950), where a brief description of the cave site may be found (see also Mouta, 1950).

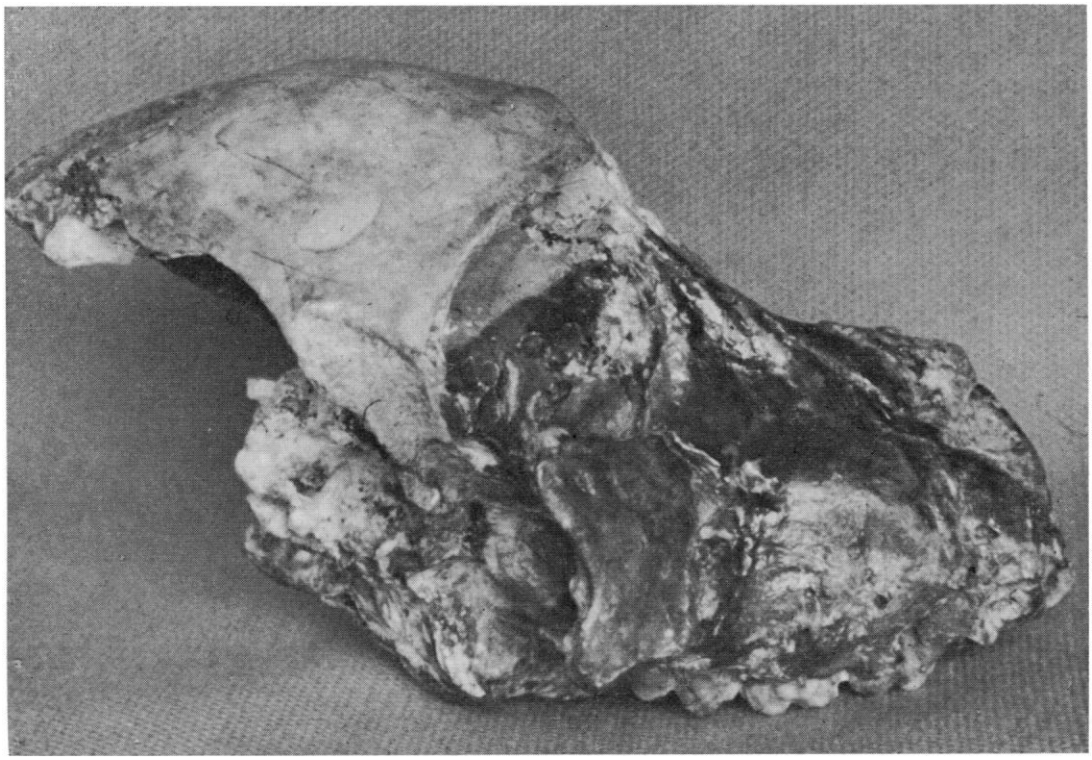
The caves at Leba seem not to have been described in detail, nor has the area been mapped geologically. From what little knowledge is available, we learn that the caves are in a limestone or marble (it is not clear which), and are partially filled with a lime breccia. Most of the fossils known from these caves have apparently been uncovered as the result of mining operations; according to Dart (1950), the lime kilns at Sá da Bandeira obtain much of their raw material from these cave breccias. The caves are not, however, unknown to science: F. Mouta, a geologist at the Polytechnic School in Lisbon, and an entomologist named Machado have both visited the caves. A number of fossils, including a baboon skull mentioned by both Dart (1950) and Mouta (1950), have been sent to Arambourg in Paris, who is quoted as assigning the baboon to *Dinopithecus ingens.* As for the age of the cave deposits, Arambourg (quoted by Mouta) believes them to be "very early Quaternary." Dart is equivocal on this matter, agreeing on the one hand with Arambourg's estimate, and

TEXT-FIG. 1—The Leba skull, anterosuperior view.

claiming on the other hand that neolithic tools are associated with the primate remains. Dart further states that the caves are comparable to the South African baboon-bearing cave deposits of early Pleistocene age, and, like the latter, may be a promising place to look for australopithecine remains. The specimen that I am about to describe can only strengthen this last belief.

DESCRIPTION

The material at hand consists of a skull and two associated fragments, of which the skull will be described first. It is to be understood that the comparisons with modern baboons are based on specimens of comparable biological age to the Leba skull, the age being inferred largely on the basis of tooth eruption and tooth wear.



TEXT-FIG. 2—The Leba skull, left lateral view.

The premaxilla is quite poorly preserved on the right side, and on the left side it is even worse. The nasal process and the premaxillary suture, visible on the right side, are comparable to those of modern baboons. The nature of the incisor teeth is not known.

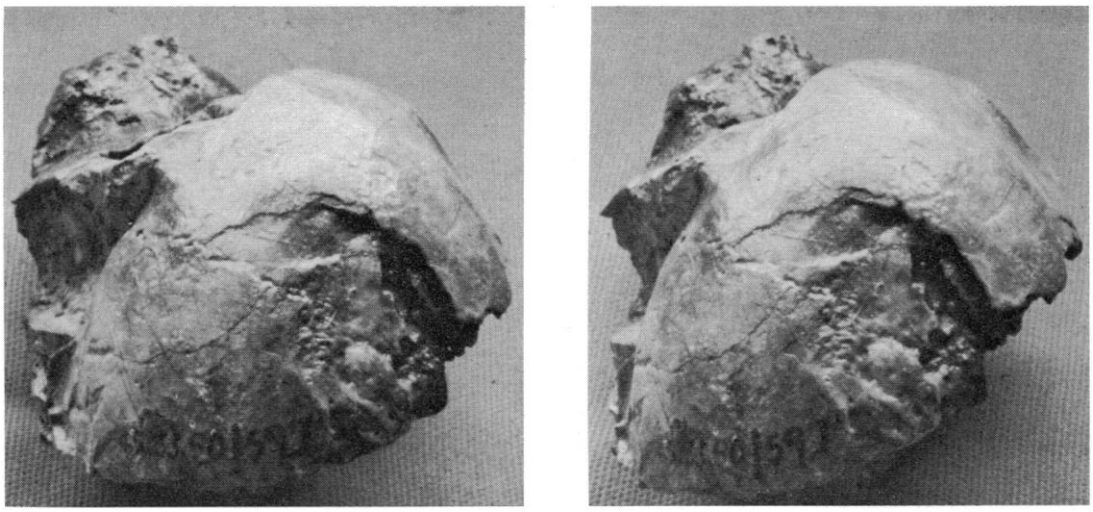
The fused nasals are preserved, and seem to correspond quite closely to those of modern baboons, except that the bone seems to be distinctly broader at the level of the external nares. A slender, median, anterior extension of the nasals over the nares also seems to exist.

The maxilla is well-preserved on the right side, and is broadly comparable to that of modern baboons, except for the lack of a maxillary fossa. In modern baboons, this is a depressed area on the external surface of the maxilla in a position over dP^4 and the anterior half of M^1, just anterior to the base of the zygomatic arch. It is comparable in position with the canine fossa of man, which serves for the attachment of the caninus muscle (= m. levator anguli oris). The absence of this fossa in the Leba skull causes the jugo-maxillary suture to run more vertically, while in modern baboons it is deflected laterally around the maxillary fossa, so that the zygomatic process of the maxilla extends more laterally on its ventral margin.

The maxillary teeth have been eroded from the left side, but are preserved to advantage on the right side. The crown of dC^1 has been broken off, but the root shows it to have been comparable in size with the same tooth in modern baboons, which do not, incidentally, exhibit any noticeable sexual dimorphism at this age. The well-worn dP^3 is quadrate and four-cusped, similar in all respects to the same tooth in modern baboons, although perhaps the posterior moiety is slightly larger in the fossil form. The last milk molar, dP^4, is worn, and has suffered some chipping of the enamel subsequent to death, but it gives all indications of similarity to dP^4 of modern baboons. M^1, the only permanent tooth already in use, is somewhat more robust than the corresponding tooth of modern baboons, especially in width, but is otherwise comparable. M^2 is visible within its crypt, from which it has not yet begun to erupt.

The palate is not preserved.

The jugal, except for the complete extent of its frontal and zygomatic processes, is preserved intact on the right side, less so on the



TEXT-FIG. 3—Stereo pair showing the damage to the skull roof of the Leba baboon; oblique posterosuperior view.

left. Since the maxillary fossa is absent, the corpus of the jugal extends farther anteromedially on its ventral (masseteric) margin. In modern baboons, there seems to be a noticeable increase in the robustness of the corpus of the jugal at this age, but there is also a good deal of variation not attributable to age. Still, it is suggested that the Leba skull had a jugal corpus that was slightly stouter than that of modern baboons its own age, and was instead comparable to slightly older baboons.

The interior of the orbit is preserved on the right side; the lateral wall, broken on this side, is fortunately preserved on the left. The ventral and lateral margins, and the medial half of the dorsal margin of the orbital rim, are preserved on the right side, and the lateral margin is preserved on the left side, so that only the lateral portion of the dorsal rim is not preserved on either side. The details of the floor of the orbit and of the optic and anterior lacerate foramina are not well-preserved. The jugal contribution to the orbital wall is comparable to that of modern baboons, as far as can be determined. The lacrimal portion of the orbital wall extends more posteriorly in the Leba skull, especially towards the floor of the orbit. The position of the lacrimal foramen is comparable. The palatine contribution to the orbital wall begins somewhat more posteriorly in the Leba skull, but is otherwise comparable to modern baboons. The contribution of the frontal to the interior of the orbit is the same as in modern baboons. Medially on the supraorbital rim, there is not even an incipient thickening that might suggest the development of tori, but such indications are lacking as well in modern baboons of similar age. More laterally on the same rim, where indications of an incipient supraorbital torus may usually be found in modern baboons of this biological age, the broken margin suggests that such an indication might have been present, but this is not at all conclusive. There is a suggestion of minute, hamular-like processes on the supraorbital rim, such as are variably present on about half of the Recent baboon skulls examined, but this is where the breakage of the orbital rim begins on the right side, and the suggestion may thus be a false one.

The frontal is fairly intact, except for some circum-orbital damage, discussed above, and some damage in the vicinity of the bregma, to be discussed more fully below. The left fronto-parietal suture is distinct; on the right side, the specimen is broken along this suture. The frontal breadth, measured just posterior to the postorbital process, is somewhat less than the average, but well within the range of variation of modern baboons of comparable age. The height and exact configuration of the median profile across the frontal seem too variable in modern baboons for any comparisons to be valid.

The temporal region is preserved on the left side only. Much of the braincase is intact, especially on the left side, but the greater part of it is still filled with matrix. (The removal of this matrix would require a delicate and

TABLE 1—Comparison of measurements (in mm) of the Leba skull with those of Recent baboons of similar biological age.

MCZ number	Assigned to	Notes	Sex	Relative age (estimated)	Tooth eruption		Approximate relative size	Approximate height of frontal behind orbits
					M^1	M^2		
——	*Parapapio* sp.	Leba skull	?	Used as standard	somewhat worn	not yet exposed	Used as standard	Used as standard
8466	*Papio doguera doguera*		?	much younger	partially exposed	not yet exposed	much smaller	slightly higher
29790	*Papio doguera neumanni*		?	younger	nearly all exposed	not yet exposed	smaller	slightly lower
10570	*Papio cynocephalus*	arena specimen	male	younger	just erupting	damaged	larger	slightly lower
11395	*Papio doguera*	zoo specimen	female	younger	all exposed	not yet exposed	about the same	same
29791	*Papio doguera neumanni*		male	about equivalent	erupted but unworn	crypt just opening	about the same	slightly higher
29792	*Papio doguera neumanni*		male	about equivalent	somewhat worn	crypt just opening	about the same	higher
26472	*Papio doguera neumanni*		male	older	moderately worn	nearly all exposed	larger	same
29789	*Papio doguera neumanni*		male	older	moderately worn	half exposed	larger	higher
22752	*Papio cynocephalus*		female	older	moderately worn	half exposed	larger	? slightly higher

experienced hand; damage to the braincase might well result from any such attempt.)

The anterior half of the left parietal is preserved, and shows no differences from the same bone in modern baboons.

The damage to the skull in the vicinity of the bregma may prove to be of more than passing interest. The damage may best be described as a shallow depression fracture, and seems to have resulted from the rather localized impact of a blunt object, which impact may or may not have caused the animal's death, but was certainly capable of doing so. As the animal was found in a cave breccia, the possibility that this damage was caused by falling debris from the roof of the cave cannot be dismissed lightly. The damage is of a type unlikely to have been inflicted by a non-human predator or scavenger, but the damage may have been inflicted by an australopithecine, wielding such a weapon as a bone or a wooden club. Although no australopithecine remains have yet been found anywhere in the vicinity of Leba, and although no possible weapons have been found associated with the Leba skull, I am fairly confident that the damage to the Leba baboon was inflicted by an australopithecine, a possibility to be discussed at greater length below.

Associated with the skull are two further fragments. The first includes what appear to be three ribs and at least one vertebra, embedded in matrix. A second piece contains at least one fragment of a rather flat bone, and also the cast, about one-half inch in diameter, of some round or round-ended object such as a femur or perhaps a pebble.

POSITION AND RELATIONSHIPS

The baboons of Africa fall into the several genera *Simopithecus, Dinopithecus, Gorgopithecus, Parapapio,* and *Papio,* of which the last alone is living. In all of these genera, the adult baboons are strongly dimorphic, largely as the result of certain specializations, some of them directly and functionally related to size, acquired by male baboons when they reach adulthood. These include the enlarged canines, the

TABLE 1—*Continued*

MCZ number	Assigned to	Curvature of profile glabella to nares	Supraorbital tori	Supra-orbital "hamu-lars"	Max-illary fossa	Mini-mum inter-frontal breadth[a]	Corpus of jugal		
							breadth[b]	depth[c]	thickness[d]
——	*Parapapio* sp.	gentle, with two slight increases	? incipient laterally	?	none	48.9	13.4	20.7	5.6
8466	*Papio doguera doguera*	one marked increase	incipient laterally	none	none	48.9	7.4	11.0	2.0
29790	*Papio doguera neumanni*	much more concave	incipient laterally	minute	strong	57.8	7.8	16.7	4.0
10570	*Papio cynocephalus*	gentle but steep	none, even laterally	none	weak	56.1	7.8	16.5	3.4
11395	*Papio doguera*	one marked increase	incipient laterally	none	weak	54.6	9.5	16.7	3.4
29791	*Papio doguera neumanni*	gentle, with two slight increases	incipient laterally	minute	strong	56.0	7.0	18.1	3.5
29792	*Papio doguera neumanni*	one marked increase	incipient laterally	minute	strong	56.2	7.7	19.2	5.2
26472	*Papio doguera neumanni*	gentle, with almost no increase	discernible, esp. laterally	minute	strong	—	9.4	21.2	4.8
29789	*Papio doguera neumanni*	more concave	discernible, even medially	none	strong	56.5	8.3	21.5	4.4
22752	*Papio cynocephalus*	much more concave	discernible, even medially	minute	strong	53.2	11.0	23.9	5.6

[a] Measured on the constricted portion of the frontals, just posterior to the postorbital processes.
[b] Measured somewhat crudely, from the anteriormost point between the bases of the zygomatic and ascending processes of the jugal, anteromedially to the approximate midpoint of the jugo-maxillary suture.
[c] Measured as the least distance from the orbit to the ventral (masseteric) margin of the zygomatic arch, which may sometimes be to the maxilla rather than to the jugal itself.
[d] Measured near the ventral (masseteric) border on the base of the zygomatic arch, across or just distal to the jugo-maxillary suture.

enlarged, blade-like P_3, the pronounced supraorbital tori, and the greatly elongated and strengthened muzzle. These specializations are lacking in young specimens comparable in biological age with the Leba skull, and, in fact, in animals of that age, I can find no consistent difference between male and female skulls. Thus, the Leba skull is of indeterminate sex.

As far as its affinities are concerned, the Leba skull can best be assigned to the genus *Parapapio*. The Leba skull lacks the *adult* specializations of *Simopithecus, Dinopithecus,* or *Gorgopithecus,* but this may be indicative of its youth only, since M^1 is the only reliably adult structure already present. The teeth compare amazingly well with those of modern baboons (*Papio*), with which *Parapapio* is "dentally identical" according to Freedman (1957). The upper molars of *Simopithecus* are quite distinct, with high cusps, separated by deep pits, clefts, and indentations, and with a high ridge of enamel connecting the protocone and hypocone; none of these features is found in the Leba skull. The molars of *Dinopithecus* differ from the Leba M^1 in that they "often show many subsidiary cuspules which may be quite large," and in that there is a deep central pit or fossa bounded by two anteroposterior ridges of enamel, of which the one connecting the protocone and hypocone is much the stronger. The milk molars of the one known juvenile specimen of *D. ingens* are expanded posteriorly (see Table 3), and thus differ from the Leba skull. In *Gorgopithecus,* Freedman (1957) states that "there are rather well-developed subsidiary mesio-buccal [antero-external] cuspules on almost all of the upper molars known, and even those which do not have

TABLE 2—Comparison of measurements (in mm) of the first upper molar of the Leba skull with the observed ranges of variation in other fossil species using data from Freedman, 1957.

	N	Length	Anterior width	Posterior width
Leba skull	1	12.3	10.6	10.0
Parapapio broomi	21	8.4–10.5	8.9–10.4	8.2– 9.9
P. jonesi	10	7.3– 9.3	8.3– 9.0	7.4– 8.9
P. whitei	7	9.7–11.0	10.0–10.9	9.2–10.4
P. antiquus	5	9.2–10.8	10.0–10.8	8.8–10.0
Papio izodi	1	9.7	9.5	9.1
P. robinsoni	22	8.7–12.5[a]	9.0–12.1	8.4–10.3
P. angusticeps	10	9.0–10.8	8.7–10.5	8.0– 9.3
Simopithecus oswaldi	3	12.0–14.0		10.0–12.5[b]
S. darti	2[c]	12.0	9.9	9.4– 9.5
S. danieli	7	11.7–15.1	10.9–12.2	9.9–10.9
Dinopithecus ingens	15	12.5–14.8[d]	11.7–13.5	11.3–12.9
Gorgopithecus major	4	12.2–13.8	11.0–12.7	10.6–11.4

[a] A length of 12.9 mm is also estimated for one specimen.
[b] The anterior and posterior width were not recorded separately.
[c] Freedman claims that these two specimens probably are of the same individual.
[d] A length of 10.9 is estimated for one specimen.

actual cuspules show some extra development in this region"; the Leba M^1 lacks such cuspules. The tooth morphology of the Leba skull thus suggests a relationship to either *Papio* or *Parapapio* rather than to the three more specialized extinct genera just mentioned.

The distinctions between *Papio* and *Parapapio* are few, and their dentitions are especially similar. Of the several distinguishing features listed by Freedman (1957), only three have any possible pertinence to the Leba skull: (1) The frontals and nasals of both sexes of *Parapapio,* viewed in profile, show "a straight line, or smooth, only slightly concave curve, between the glabella and the posterior margin of the nasal aperture," whereas, in the profile of *Papio,* "the dorsal surface of the muzzle shows a sharp, distinct drop in the inter-orbital region, and then a much more gradual slope down to the alveolar point." (2) "A maxillary fossa is usually present" in *Papio,* while in *Parapapio* "there are no deep maxillary fossae." (3) In *Parapapio,* "the supraorbital tori are very weakly developed, and do not project forward in either sex," while, in at least the males of *Papio,* the tori are well-developed. A comparison of the Leba skull with several modern baboons of comparable biological age shows the presence or absence of a maxillary fossa to be the most reliable diagnostic character in animals of this age. The fossa is not present in younger *Papio,* but develops as M^1 comes into use, becoming stronger with age. The Leba skull agrees with *Parapapio* in lacking such a maxillary fossa. The shape of the profile is somewhat variable in *Papio* of this age, but the majority show at least a tendency towards increased steepness in the interorbital region, and decreased slope more anteriorly. In this character, again, the Leba skull agrees rather with *Parapapio.* The supraorbital tori seem not to be very useful characters in animals of this age, and their exact nature in the Leba skull cannot be determined anyway. There is no indication that the Leba skull differs markedly, if at all, from Recent *Papio* in this regard.

The Leba skull can best be assigned to the genus *Parapapio.* In those features which distinguish *Papio* and *Parapapio,* the Leba skull agrees more closely with the latter. In all other respects, the two genera are similar, and the Leba skull agrees quite closely with both, at least as far as can be determined from direct comparisons with Recent *Papio* and from Freedman's descriptions of *Parapapio.* For want of any indication that the known species of *Parapapio* can be distinguished among juvenile material, the Leba skull cannot be assigned without question to any known species. The Leba specimen does differ from known *Parapapio* in the greater length of M^1; it may therefore prove to represent a new species or subspecies. Only further explorations of the caves at Leba will reveal whether any taxonomic distinction for the Leba baboon is warranted.

The Leba skull extends the known geographical range of the genus *Parapapio* into Angola. The genus is best represented in South African deposits of Pleistocene age, but *Parapapio*

TABLE 3—Comparison of measurements (in mm) of upper teeth of certain fossil and Recent baboon skulls.

	dP^3			dP^4			M^1		
	Length	AW	PW	Length	AW	PW	Length	AW	PW
Parapapio sp. (Leba skull)	9.0	7.9	7.0	10.7	8.7[a]	8.6	12.5	10.5	9.8
Recent *Papio*									
MCZ 8466	8.3	6.4	6.0	9.8	7.5	7.2[a]	—	—	—
MCZ 29790	8.5	6.7	6.5	9.0	7.9	7.3	—	—	—
MCZ 10570	8.6	6.9	6.8	9.6	8.3	7.4	11.3[a]	8.5	7.8
MCZ 11395	7.8	6.6	6.3	8.5	8.1	7.6	—	—	—
MCZ 29791	8.1	6.3	6.3	8.9	7.9	7.0	11.0	9.3	8.3
MCZ 29792	8.1	5.8	5.8	9.1	7.4	6.7	10.9	9.1	8.2
MCZ 26472	7.2	6.0	6.2	8.2	7.4	7.0	10.1	9.4	8.7
MCZ 29789	8.2	6.5	6.2	9.1	7.8	7.2	11.0	9.4	8.5
MCZ 22752	8.8	6.6	6.8	9.1	8.3	7.2	10.6	10.0	8.9
Papio robinsoni[b]									
CO. 106 B-C	8.2	7.0	6.8	9.5	8.3	7.6	12.0	10.2	9.1
SK. II 27	7.8	5.8	5.7	8.0	7.4	6.2	—	—	—
Dinopithecus ingens[b]									
SK. 554	9.5	7.8	7.6	11.0	9.0	9.1	13.3	11.9	11.7

[a] Estimated

[b] Data from Freedman (1957); specimens in the Department of Paleontology and Physical Anthropology, Transvaal Museum, Pretoria, South Africa.

jonesi has also been found as distantly as northwestern Kenya (Patterson, 1968).

A NOTE ON *AUSTRALOPITHECUS*

The genus *Australopithecus* represents an important stage in human evolution. The australopithecines are the oldest known members of the family Hominidae, unless the genus *Ramapithecus* (from the upper Miocene) be included, which it probably should. It is in the genus *Australopithecus* that we first have good evidence of tool use, and of the spreading of hominids across the continents of Africa and Asia. Except for the questionable "pebble-tools" of the so-called Oldowan type, the most important types of tools used by australopithecines seem to have been "osteodontokeratic" (Dart, 1957), that is, made of bones, teeth, and horns, and possibly also of wood, rather than of stone. The diet of the australopithecines seems to have included at least some meat; the prey was in all likelihood subdued by the blows of crude clubs. Such clubs may have been wooden, but it is more likely that they consisted of the unaltered limb bones of antelopes and other ungulates. In the South African cave deposits, *Australopithecus* is often found associated with the baboons which may have been its victims. According to Dart (1949), 80% of the baboons found in these caves show evidence of injuries inflicted by *Australopithecus,* usually from blows upon the head. The resulting type of damage is usually a shallow depression fracture in the baboon cranium, similar to that described above for the Leba skull. Yet, despite the abundance of australopithecine material in these South African caves, the genus *Australopithecus* has never been described from Angola.

The caves at Leba are of roughly the same age, the same limestone cave facies, and the same broad climatic region as the South African caves, which abound in australopithecine remains. Dart (1950), who is thoroughly familiar with the South African caves, insists on their similarity to the caves at Leba, where he states that one might well expect to find *Australopithecus* in the future.

The damage to the Leba skull is certainly a shallow depression fracture of the type illustrated by Dart (1949). Such injuries may readily be inflicted by the blow of an antelope femur or similar weapon, and *Australopithecus* is known to have used such weapons, especially on baboons. I believe that this constitutes good evidence for the former existence of *Australopithecus* at the Leba site, and I therefore suggest that the known range of this genus be tentatively extended to the Leba site in Angola. The Leba caves are thus a promising place to look for fossil baboons, and also for fossil hominids.

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