AN ATTEMPT TO RECONSTRUCT THE BEHAVIOUR OF AUSTRALOPITHECINES : THE EVIDENCE FOR INTERPERSONAL VIOLENCE.

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ABSTRACT

The evidence for inter-personal violence in australopithecines has been reviewed critically. In most instances invalid conclusions have been drawn because ante-mortem damage to specimens has not been isolated conclusively from post-fossilisation effects. It is concluded that the question of the incidence of inter-personal violence in this group must remain an open one.

During the recent years, a great deal of interest has developed concerning the origin and roots of human aggression. Throughout the span of recorded history, inter-group conflict or warfare has been a recurrent feature of human society. It has resulted in widespread disruption and loss of life but never, until recently, has it endangered the survival of the entire human species. It appears that people have always made use of their ingenuity and technology when devising their weapons of war, so it was perhaps inevitable that newly harnessed atomic power should immediately have been employed in an aggressive context. Since the second world war, nuclear technology has developed so rapidly that a third world war could, we are told, result in the extinction of the human species together with many other forms of life.

For this reason, the desire to understand the fundamental causes of recurrent aggression, so characteristic of international relations, is more widespread than at any time in the past. The desirability of avoiding a nuclear conflict is obvious and the question of the motivation of human aggression is receiving attention from anthropologists, ethologists and others.

The repetitive pattern of intergroup warfare, traceable over several thousand years, suggests that this kind of behaviour is species-typical for *Homo sapiens*. If so, it is likely to have a genetically-controlled, innate component inherent in it. Not all writers on the subject agree however.

The anthropologist Bernard Campbell, discussing the "Roots of human behaviour" (1970) wrote:

> "Anthropology teaches us clearly that Man lived at one with Nature until, with the beginnings of agriculture, he began to tamper with the ecosystem: an expansion of his population followed. It was not until the development of the temple towns (around 5 000 BC) that we find evidence of inflicted death and warfare. This is too recent an event to have had any influence on the evolution of human nature . . . Man is not programmed to kill and make war, nor even to hunt: his ability and desire to do so are learned from his elders and his peers when his society demands it."

Other authorities, such as Konrad Lorenz (1963) are of the opinion that the innate component in intergroup aggression is a powerful one. Clearly, in deciding on this matter, it would be useful to know whether pre-agricultural man did in fact live in peace and harmony as Campbell has surmised, or whether, ever since our emergence, the archives of human history have been "blood bespattered and slaughter-gutted" as Professor Raymond Dart has claimed. Since the early 1930's

Dart has repeatedly argued that the pre-human australopithecines were killers. In 1953 he wrote:

> "On this thesis man's predecessors differed from living apes in being confirmed killers: carnivorous creatures that seized living quarries by violence, battered them to death, tore apart their broken bodies, dismembered them limb from limb, slaking their ravenous thirst with the hot blood of victims and greedily devouring livid writhing flesh."

He concluded that, in addition to being carnivorous, the australopithecines were also cannibalistic.

A recent paper in Current Anthropology by Marilyn K. Roper (1969) reviewed the evidence for intrahuman killing during the Pleistocene. In compiling this valuable survey she was handicapped by not having had personal access to the original specimens. The purpose of the present paper therefore is to re-examine the published evidence for interpersonal violence among South African australopithecines and to draw some conclusions from it.

THE MATERIAL AND ITS LIMITATIONS

The fossils to be considered here come from the five australopithecine sites of Kromdraai, Swartkrans, Taung, Sterkfontein and Makapansgat Limeworks. All the specimens have been preserved in cave breccias – sediments which originally filled the caverns and which were gradually calcified to form solid rocks.

There is no question that the bones involved have suffered damage. The decision to be made is whether the damage was inflicted before or after the death of the australopithecine and by whom or what. Dart, who has described the majority of the observed injuries is fully aware of the difficulties involved. Concerning them he wrote (1949b):

> "The customary, and often uncritical attitude expressed towards damaged bones recovered from cavern deposits is to attribute the damage to (a) carnivora or (b) falls of rock or earth. Relative to carnivora, it is well-known that most South African carnivora, such as the lion, jackal and spotted hyaena, actually avoid caverns and live out on the veld, killing their prey and consuming it in open country. Two South African types, namely the leopard and the brown hyaena, are attracted by the protection of rock shelters or fissures, and the leopard customarily preys on baboons.
>
> But it has never been shown, as far as I am aware, that either the leopard or the brown hyaena could accumulate in a fissure or in cavern deposits of the dimensions laid bare at Makapansgat, where they extend to hundreds or even thousands of cubic feet. This year alone (1949) we have taken away from the Makapansgat dump more than 10 tons of bone breccia sorted out of approximately 600 tons of dumped material; and at least another 1 000 tons remain to be sorted. Even if these two carnivora had made such extensive localised accumulations, it would still remain to be demonstrated that the brown hyaena (or the leopard) was a systematic slayer of other carnivora and would collect the bones of other leopards as well as those of the jackal and lion, that have been found there; or would drag into the deposit remains of the largest ungulates such as the kudu, giraffe, hippopotamus and rhinoceros; and could also kill the elephant.
>
> With regard to the second facile assumption, that falls of rock or subsidences of earth might be responsible, Professor Mackintosh (who has frequently conducted meticulous post

mortems in Johannesburg upon human bodies fatally overwhelmed in collapses of earth or rock), has borne out Schepers' remark by informing me that such crushing is quite distinctive. Being unselective in their application and general in their effects, earth collapses or rock falls crush the whole pelvis, thorax or head, or distort the entire body. These skulls on the contrary consistently display damage that is sharply localised. In many instances the depressed areas are so specific that the direction from which the blow was delivered can be reasonably inferred and the type of weapon responsible for the fracture diagnosed, as is so frequently done for recent human injuries by medico-legal experts. Such implemental injuries, needless to say, are also incapable of being inflicted by the teeth or paws of carnivora but present features characteristic or distinctive of the implement employed."

In his study, Dart made use not only of his own wide medical experience but also that of Prof. Mackintosh who, at that time, was head of the Department of Forensic Medicine at the University in Johannesburg. Since 1949 we have learnt a great deal about cave deposits and the bone accumulations which may occur within them. It has become apparent that, in the case of a cave deposit which has taken perhaps 20 000 years to accumulate, bones are likely to have been introduced by a great variety of agencies. Moreover, once buried within the deposit, they may suffer the most remarkable distortions, fractures and dislocations as a result of pressure and movements in the sediment.

The commonest kind of distortion suffered by bones preserved in a cave breccia results from overburden pressure and takes the form of overall flattening. Skulls whose endocranial cavities have not been filled with matrix are typically flattened as if they had been run over by a steamroller (Fig. 1c), while those which have been partly or wholly filled with matrix will be affected in accordance with the nature of the filling, the surrounding breccia and the force exerted. The whole skull is likely to be deformed, individual bones distorted and sutures sprung (Fig. 1b).

Apart from pressure exerted evenly from above, transverse shearing action is not unusual in a breccia both during and after its consolidation process. It frequently comes about as a result of partial collapse of the cave floor and associated shape adjustments in the sediment body above it. Oblique distortion of fossils is a common result (Fig. 1d).

In most breccias it is unusual for the matrix to be homogeneous. More typically it contains stones, bones and other hard objects. The application of pressure to a fossil enclosed in a heterogeneous matrix generally results in localised damage to that part of the bone in contact with any hard object. Thus the presence of a stone in contact with a skull will often result in damage restricted to the area of contact only, while the rest of the skull may suffer no damage at all.

Fig. 1e shows an Australopithecus mandible from Sterkfontein with distortion restricted to the right ramus only while 1f and 1g depict skulls of a Swartkrans hyaena and leopard, which have suffered localised damage to the muzzle and orbital regions respectively. In the case of the last specimen, part of the chert stone responsible for the damage may still be seen in the depressed area of the skull. There does not seem the slightest doubt that the localised damage suffered by these and a large number of other fossils from the australopithecine caves resulted simply from pressure applied to a heterogeneous matrix in which the bones were enclosed.

In view of this complication, it is frequently difficult to decide whether a fossil has suffered its damage before or after burial in a limestone cave deposit. As a first step it is essential to remove the specimen from its matrix with the greatest care, noting the position of any other object in the

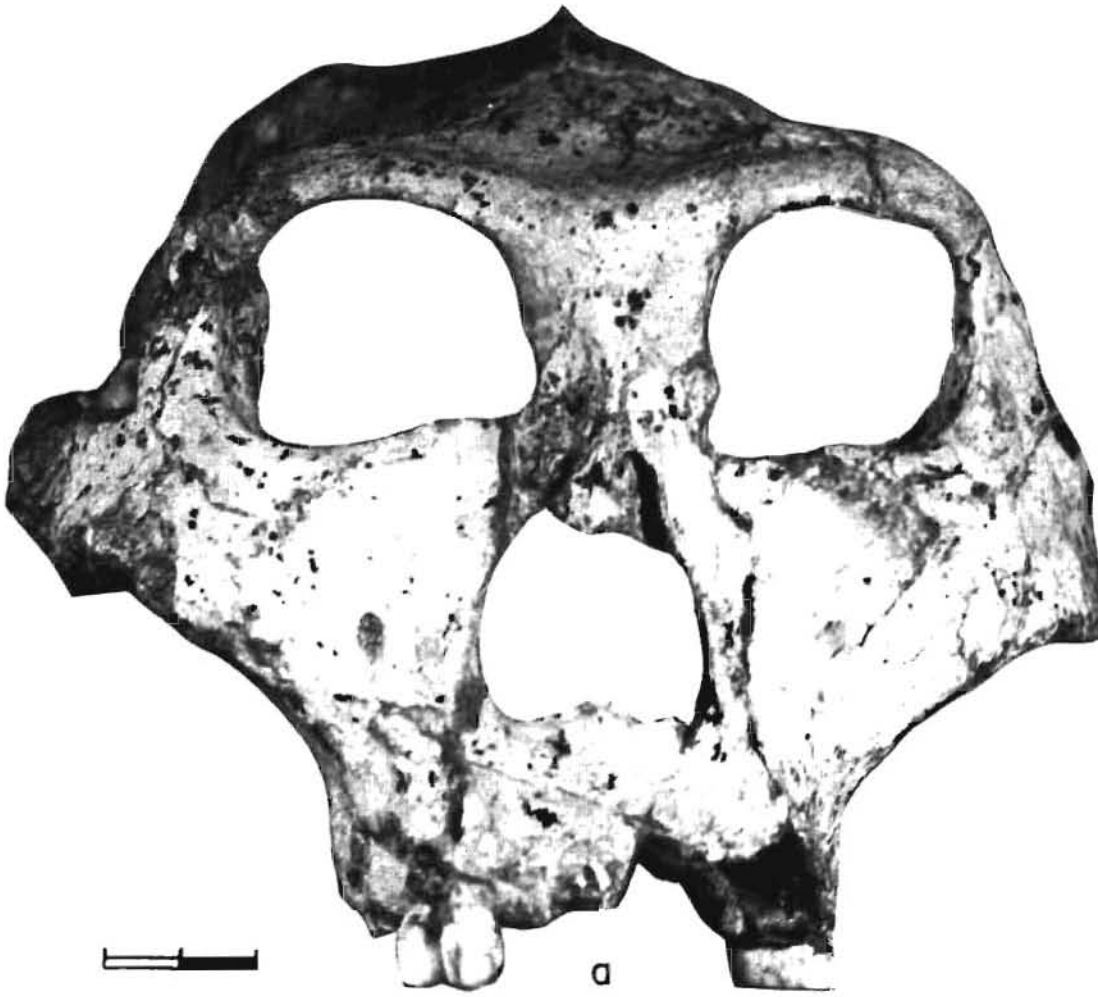

FIGURE 1
Examples of damage suffered by skulls during fossilisation in cave breccias:
(a) A filled and almost undistorted *Paranthropus* skull (SK 48) from Swartkrans.

surrounding breccia. As such information is not available for most of the fossils already extracted from the cave breccias, it may never be possible to say with certainty what the cause of the observed damage might have been.

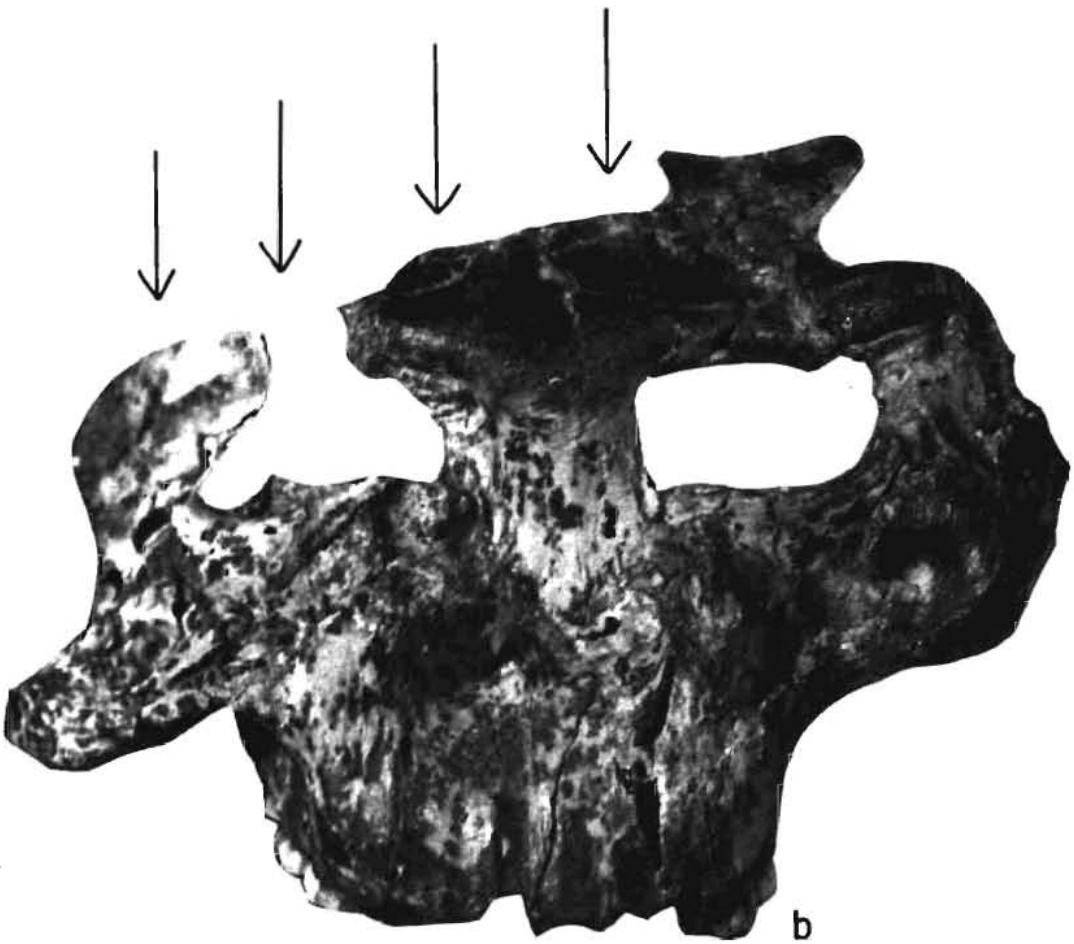

FIGURE 1
Examples of damage suffered by skulls during fossilisation in cave breccias:
(b) A partially filled *Paranthropus* skull (SK 79) whose cranial vault has collapsed due to downward pressure in the deposit.
Scale as in Fig. 1(a).

FIGURE 1
Examples of damage suffered by skulls during fossilisation in cave breccias:
(c) An unfilled hominid skull showing overall flattening as a result of pressure.
Scale as in Fig. 1(a).

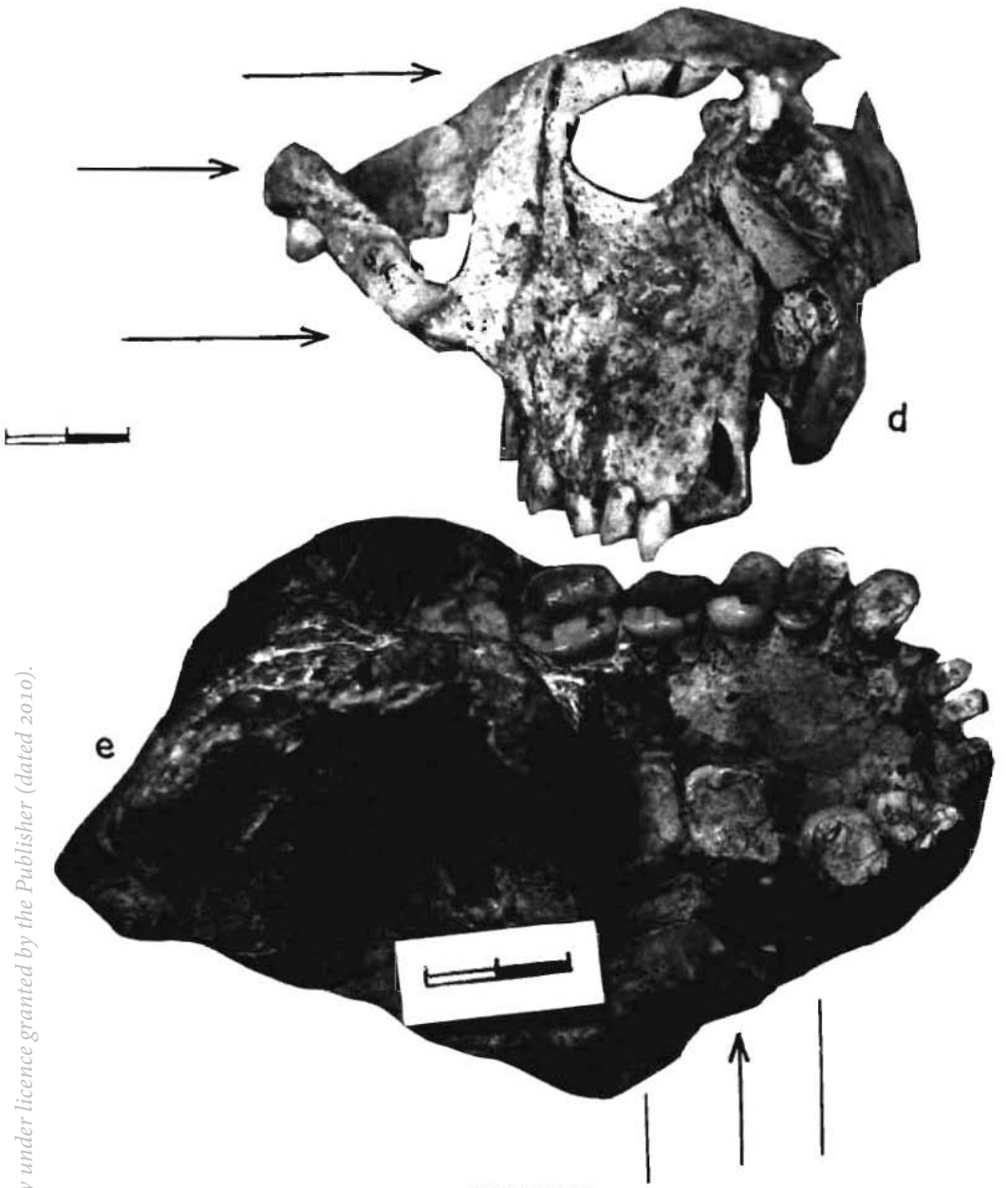

FIGURE 1

Examples of damage suffered by skulls during fossilisation in cave breccias:
(d) Baboon skull (SK 603 *Dinopithecus ingens*) showing transverse shearing.
(e) *Australopithecus* mandible, (Sts 7), showing localised damage to the right corpus only, caused by a stone in the matrix.

FIGURE 1
Examples of damage suffered by skulls during fossilisation in cave breccias:
(f) Skull of a hyaena, (*Leecyaena forfex* SK 314), showing extensive damage to the muzzle caused by a stone in the matrix.
Scale as in Fig. 1(g).

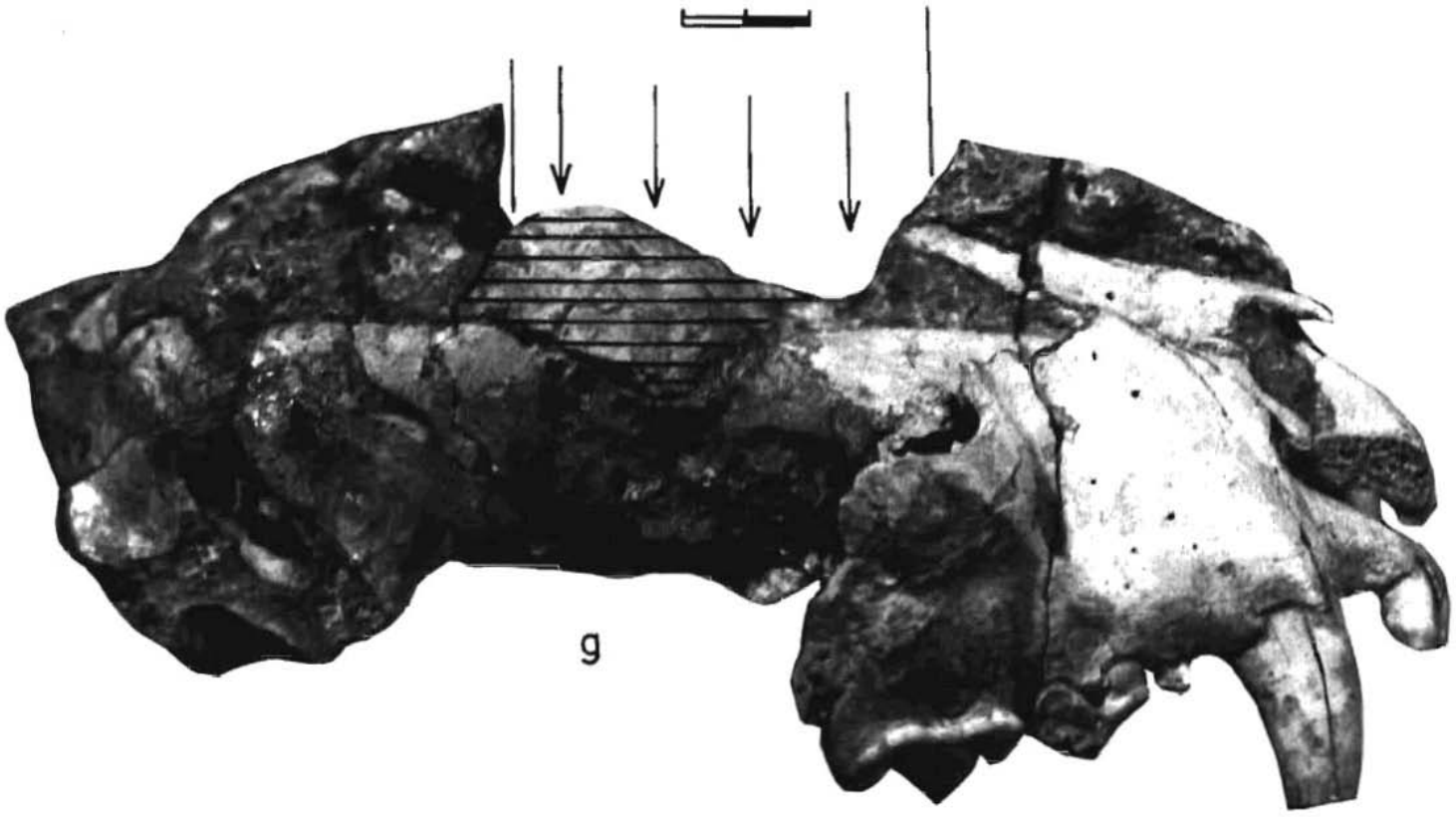

FIGURE 1
Examples of damage suffered by skulls during fossilisation in cave breccias:
(g) Skull of a leopard (*Panthera pardus* SK 349) showing damage to the orbital region by a stone, part of which is still adhering to the fossil.

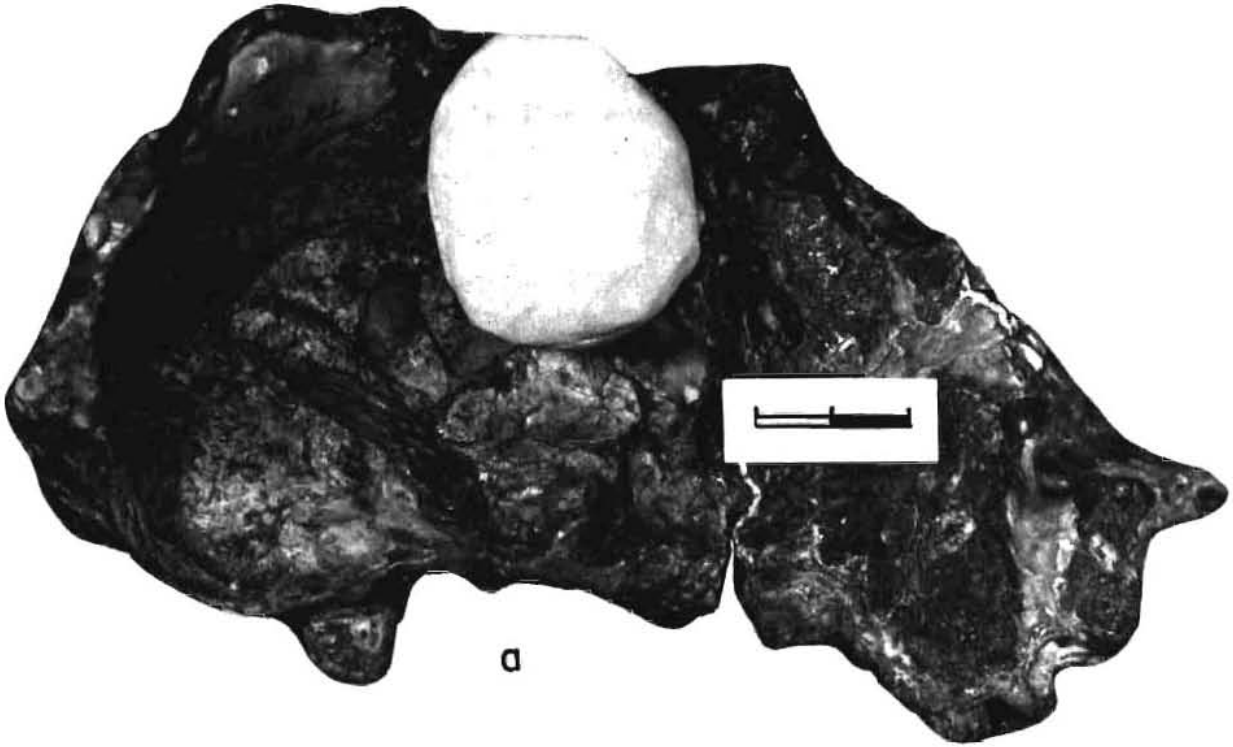

FIGURE 2
Fossils for which claims of interpersonal violence have been made:
(a) *Paranthropus robustus*, type skull (TM 1517), internal view showing a reconstructed stone in its original position.

COMMENTS ON THE PUBLISHED EVIDENCE FOR VIOLENCE

1. ROBUST AUSTRALOPITHECINES

Two authors have claimed that robust australopithecine (Paranthropus) skulls show evidence of interpersonal violence. The specimens involved are the type skull of *Paranthropus robustus* from Kromdraai and the calvaria of a child, SK 54, from Swartkrans.

(a) The Paranthropus type skull, T.M. 1517 (a)

The specimen consists of various skeletal fragments of an adult individual, but the only piece to concern us here is a part of the left side of the face and braincase (see Fig. 2a). This is all that was recovered of the cranium at the time of the discovery in 1938. After initial description by Broom (1938 (a) and (b) and 1939), the specimen was entrusted to Dr. G.W.H. Schepers for a study of its endocranial contours. It was his task to remove the matrix filling the left temporal region of the braincase and about this he wrote (Schepers, 1946):

> "While excavating this matrix a large flint-like rock was found embedded in it. The parietal bone had been driven into the endocranial cavity ahead of this rock. It could not be preserved as it was necessary to undercut the rock by destroying the bone, otherwise it would have been well-nigh impossible to remove it.
>
> "The presence of this rock is evidence suggestive of the claims that have been previously made that the Homunculi represented by the Australopithecoid and Plesianthropoid fossils, were skilled enough to employ missiles or weapons for defensive, offensive and predatory purposes. It is certainly remarkable that both the *Plesianthropus endocranial cast type 2* and the *Paranthropus* specimen bear evidence of depressed fractures of the calvarial vault. But one has to face the possibility that these deformities may have arisen as the result of rockfalls or the settling of the deposits under which the fossilising bones were buried. It must be remembered, however, that a skull is constructed in such a way that any gradually exerted strain, such as that of settling floor deposits, would either slowly warp the respective bones and distort the whole skull, or would be referred to the suture lines, which would tend to be prized apart in a completely desiccated skull. A rockfall on an exposed skull within a cave will probably result in complete splintering of the skull; if the momentum of the rock were to be great enough to cause a depressed fracture, such a rock would have to be large and heavy. The Sterkfontein caves, where the *Plesianthropus cast, type 2,* was found, had no great depth. Less is known about the nature of the caves in which the *Paranthropus* fossil was possibly buried, as it was found on an exposed site at Kromdraai, where all evidence of an earlier cave had disappeared. Further evidence in favour of ante-mortem reception of the depressed fracture is found in the relationship of the imbedded rock to the position in which the fossil was found. The skull was lying neither on nor under the rock. If the foreign body had penetrated the skull as a result of rockfall, it is to be presumed (though this argument does not necessarily prove it) that the skull fragments inside the endocranial matrix would have been found lying under the foreign body as viewed from the weathered surface. This was not the case. If the stone was forced into the skull from below by the weight of debris accumulating on top of it, the bone fragments should have been superficial to the stone. Of

course, the skull may have been lying with the vault upward or downward and may have been rolled on to its side after being pierced by the stone. Such a supposition presumes a factor capable of causing a major disturbance, for the skull as well as the rocks would have to be moved around, and there are very few forces inside a cave capable of leading to such a result."

In his paper on the implemental technique of Australopithecus, Dart (1949b) provides a photograph of the internal aspect of the Kromdraai specimen with the stone, to which Schepers refers, still in place. From this it can be established that the stone was oval in outline, approximately 3,5 cm long and 3 cm across. The thickness of the stone cannot be established, but appears to be between 1 and 2 cm. The breccia matrix from which the specimen came is very rich in chert blocks and fragments, derived from the dolomite country rock by normal weathering. These bear a superficial resemblance to flint and it is extremely likely, though it cannot be proved, that the stone observed by Schepers was a piece of chert.

On the basis of the estimated size of the piece, its weight would have been about 75 g. For a stone of this size to have penetrated the parietal bone of a living australopithecine, it would have had to be hurled at a very considerable velocity.

Since a piece from the left side of the cranium only has been found, it is impossible to establish whether the calvaria was more complete when it came to rest in the cave deposit or not. It can be argued that the entire right side of the cranium was missing prior to fossilisation and that the stone, together with associated matrix, simply filled in the hollow skull fragment, the stone causing damage to the parietal during the breccia consolidation process.

In my opinion, Schepers' claim for deliberately inflicted injury in the case of the Kromdraai skull is based on an uncritical appraisal of the evidence. A natural explanation for the observed damage can readily be found.

(b) The Swartkrans child skull, SK 54.

The specimen consists of much of the calvaria of a subadult hominid, thought to have been a *Paranthropus*. It was found at Swartkrans in 1949 and subsequently prepared by Dr. J.T. Robinson in Wisconsin, using the acetic acid technique.

Left and right parietal bones are present, together with part of the occipital and much of the frontals. The frontals have been distorted downwards, approximately across the width of the coronal suture, while the whole specimen has been somewhat flattened by pressure in the deposit. Two small holes are present in the back of the skull, one in each parietal bone close to lambda. These have been referred to by Robert Ardrey (1961: 300) as follows:

"But a curious case of what could only have been intentional, armed assault came my way in 1955 when Oakley, in London, gave me the plaster cast of a small portion of an australopithecine skull from Swartkrans. The skull showed two small round perforations, about an inch apart. The holes could not have been of animal origin, since no carnivore has canines set so closely together.

"I was on my way at the time to Pretoria, and so Oakley asked me to inquire of John Robinson whether the original specimen (this was only a cast) showed the crystals of

fossilization down into the holes. Could the marks, in other words, have been of post-fossilization origin? In Pretoria, Robinson gave the answer. The holes showed crystals all the way through. The living australopithecine, three quarters of a million years ago, had been struck with something. Not only had he been struck once. He had been struck twice. The holes came from slightly different directions."

The damage referred to by Ardrey has recently been reviewed in detail (Brain 1970). It was possible to show that the spacing of the two holes in the hominid skull is matched exactly by that of the lower canines of a leopard; moreover, various lines of argument lead to the conclusion that leopards were involved in building up the bone accumulation at Swartkrans. It is therefore suggested that the Swartkrans hominid, SK 54, is more likely to have been killed by a leopard, or similarly sized carnivore, than by a fellow australopithecine.

2. *GRACILE AUSTRALOPITHECINES*

All the published claims for violence in *Australopithecus africanus* have been made by Prof. R.A. Dart. In a series of papers dating back to 1934, he has elaborated a theory of the "bone bludgeon hunting technique" of these ape-men e.g. Dart (1934; 1949a & b; 1957). He has described localised damage on baboon crania from the sites of Taung, Sterkfontein and Makapansgat which, in his opinion, was caused by bone clubs wielded by australopithecines. In fact he claimed (1949b) that 80% of the 58 baboon skulls examined from the three sites showed indications of australopithecine battering. In addition to these, however, he has suggested that the damage observed on the single australopithecine skull from Taung, on three from Sterkfontein and on virtually all the hominid remains from Makapansgat Limeworks can be attributed to intraspecific violence.

(a) The Taung child skull, *Australopithecus africanus*

Dart (1949a) described the specimen as follows, together with his estimation of the cause of the observed damage:

"Complete facial portion of skull articulating with an endocranial cast, which filled virtually the whole of the right side of the cranial cavity (and part of the left side in the frontal and parietal regions), but is deficient for the remainder of the left side of the cranial cavity (and that portion of the base which intervenes between the pterygoid laminae and the foramen magnum). A piece of bone, approximately half an inch square, lies free on the lime-encrusted left surface of the cast, showing that the skull must have been sufficiently lacking on the left side to have allowed of the entrance of this fragment into its cavity.

OBSERVED DAMAGE

"The coronal suture was sprung slightly to the right and left of the bregma. The irregularity of the cast in the left frontal region suggests that the bone suffered from a fracture laterally

which extended posteriorly into this region. This supposition is consistent with the fact that the roof and lateral wall of the orbit were fractured. The left ramus of the mandible was broken and the right temporal bone has disappeared. Apparently the fossil, though very little if at all distorted had suffered an extensive defect in the antero-lateral portion of its neural wall.

SUGGESTED CAUSE

"A lateral blow on the left fronto-temporal region of the skull."

The calvaria was seriously damaged during the mining process with the result that much of the bone which surrounded the endocranial cast has disappeared. As noted by Dart, the cast fills the right side of the calvaria only, indicating that the skull was lying on its right side during the fossilisation process and that the fine-grained sediment composing the cast entered largely through the foramen magnum. The horizontal upper surface of the cast was then frosted over with white calcite crystals. I cannot agree with Dart that the calvaria must have had a hole in it on the left side before burial in the deposit. If it had, the cast would have filled the entire endocranial cavity, rather than only the right side of it. The piece of bone referred to by Dart which lies free on the lime-encrusted upper surface of the cast could, it appears, represent a bone from the interior of the skull, such as perhaps the petrous part of the temporal (Fig. 2b). Until the surrounding lime is removed however, identification is not possible.

Dart suggests that the skull suffered a lateral blow on the left fronto-temporal region. Unfortunately since the entire left side of the calvaria, posterior to the orbit was lost during the mining, the affected parts are not available for study. Dart's claim can neither be substantiated nor refuted.

(b) Australopithecus africanus from Sterkfontein

Endocranial casts of three skulls are involved, previously designated as *Plesianthropus transvaalensis* type 1, 2 and 3. They are now classified as *A. africanus*, type 1 of which is numbered STS 60 (Transvaal Museum), while the other two are unnumbered and are housed in the Anatomy Department of the University of the Witwatersrand.

Dart (1949b) has described the specimens and their damage as follows:

"*Plesianthropus transvaalensis* type 1. A fragmented skull (without mandible or much of face) and a fronto-parietotemporal endocranial cast lacking the right parietal and occipital regions. The right maxilla, premaxilla and malar are fairly complete and little crushed; the left maxilla is better preserved but less complete. The base and the vault are sufficiently preserved to yield accurate reconstruction of the general cranial dimensions.

OBSERVED DAMAGE

"The general volume and shape of the endocranial cast have been altered by compression. The squashing of the cast is maximal anteriorly and the temporal height is estimated to be reduced by at least 1 cm by the left temporal bone overriding the parietal at their suture. The left temporal lobe tip was absent from the cast. Crushing and distortion is evident also

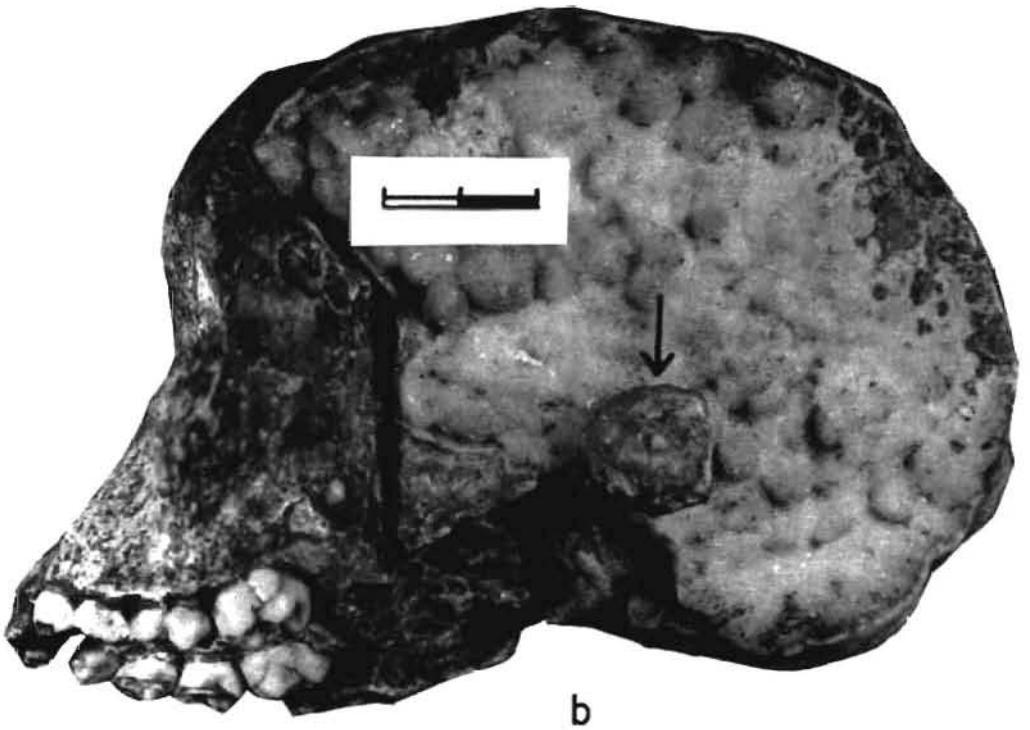

FIGURE 2

Fossils for which claims of interpersonal violence have been made:
(b) Taung child skull, lateral view. The arrow indicates the piece of bone referred to by Dart.

in the chiasmatic and inferior frontal regions. The left temporal bone was so damaged that it was removed piecemeal.

SUGGESTED CAUSE

"A lateral blow on the left temporo-parietal region of the skull."

The skull from which the endocast came is extremely fragmentary, while the compression shown by the cast itself reflects the distortion of the calvaria in which it formed. Such distortion is widespread among Sterkfontein fossil skulls, both of hominids and other animals. To single this instance out as resulting from deliberate violence is, to my mind a dubious procedure.

"*Plesianthropus transvaalensis* type 2. Fronto-parietotemporal endocranial cast. Left fronto-parietal region deficient and occipital region and base entirely absent. The frontal portion of the sagittal sutural line has been deflected more than 15 degrees to the right of the parietal portion of the sagittal suture.

OBSERVED DAMAGE

"The bregmatic angles of both parietal bones are the seat of two depressed fractures in the right parietal bone that hinge together on each side of an irregular line; the left margin of the fractured area follows roughly the sagittal suture. The lateral margins of the area are depressed: the right 12 mm and the left 4 mm below the remainder of the parietal bones. Running across these broken fragments and the frontal bones run radiating fracture lines to the left and right lateral orbital margins both of which were fractured transversely. Owing to the great distortion in the right Sylvian notch region the temporal bone overrode the parietal for a centimeter.

SUGGESTED CAUSE

"A vertical blow just behind and to the right of the bregma with a double-headed object."

Apart from the depressed area in the right parietal bone, (Fig. 2c), Schepers (1946) showed that the skull in which the endocast formed was distorted in such a way that the anterior part of the mid-sagittal plane is deflected 15 degrees relative to its posterior part (see Fig. 3). This kind of distortion is frequently seen in skulls preserved in breccia and undoubtedly occurs once the skull has been enclosed in the surrounding and supporting matrix. Examination of the endocast shows that the skull was resting upside-down during fossilisation process. Fine-grained sediment entered presumably through the foramen magnum but did not completely fill the endocranial space, perhaps due to the collapse of the calvaria after a certain time.

The roof of the calvaria has unquestionably suffered a depressed fracture (see Fig. 2c) as Dart has claimed. It has occurred in that part of the skull which would have been in contact with the cave floor when it came to rest, prior to becoming buried and fossilised. Unfortunately we have no record of the nature of the breccia which surrounded the skull. Was there, for instance, a stone in the matrix corresponding to the depressed area? Unfortunately we will never know and Dart's claim of ante-mortem injury resulting from violence can neither be substantiated nor refuted.

Dart's description of the third specimen from Sterkfontein is as follows:

"*Plesianthropus transvaalensis* type 3. Parieto-occipital endocranial cast fractured (in blasting) horizontally through the occipital poles and coronally through the parietal region in the vicinity of the vertex. (Fig. 2d).

OBSERVED DAMAGE

"Fragments of bone in the substance of the cast show that the skull must have been open in some region or other (as in the Taungs specimen). The sagittal and lambdoid sutures have both been sprung. In addition to minor fracture lines a major line of fracture runs completely across the cast through the parietal regions and skirting the anterior margin of the right parietal area fragment. The postero-medial portion of the left parietal area is depressed below the right parietal area at the sagittal suture and even more deeply below the antero-lateral portion of the bone both anteriorly and laterally.

SUGGESTED CAUSE

"A vertical blow slightly to the left of mid-parietal region with a bludgeon."

FIGURE 2
Fossils for which claims of interpersonal violence have been made:
(c) *Australopithecus* endocast 2 showing its depressed fracture.
(d) Endocast 3, with arrows indicating lines of fracture or displacement.
(d) same scale as (c).

As is the case with the preceding endocast, the specimen has lost its stratigraphic context. No associated skull is known, nor is there any information on the nature of the original matrix. The skull was certainly fractured in the mid-parietal region but it is highly doubtful whether it could ever be proved that the damage occurred before or after the death of the hominid.

(c) Australopithecus africanus from Makapansgat

Australopithecine specimens have been found at all levels in the Makapansgat Limeworks deposit, but they are, like the other bones, specially concentrated in the basal grey breccia. Dart has argued (e.g. 1957a) that the vast bone accumulation in the grey breccia was built up by australopithecines and that many of the bones were used as tools. These form the basis of the osteodontokeratic culture. The fact that the australopithecine bones were indiscriminately mixed with the other faunal remains and that they appear to have been treated in the same way, suggested to Dart that the Makapansgat ape-men were not only carnivorous but cannibalistic. In addition however, Dart attributed observed damage on several specimens to interpersonal violence. These included the following:

MLD 1 : OCCIPITAL FRAGMENT

The specimen, consisting of most of the occipital bone and the posterior third of each parietal, has been fully described by Dart (1948a), who also referred to the damage as follows (1949b: 38):

> "Separation from remainder by transverse shattering of the vertex and avulsion of the front and rear halves of the skull.
>
> "Probable cause: A severing transverse blow with bludgeon on the vertex and tearing apart of the front and back halves of the broken skull."

More recently Dart (1961b, 1962c) has suggested that the occipital fragment had also been used as a container or bowl by the Makapansgat ape-men. Although it is the only hominid "Skull bowl" known from the site, Dart (1961b: 132) states that he has found "no fewer than thirteen examples of posterior portions of skulls that had been completely severed from the rest of the skull by blows that could only have been delivered by a bladed weapon." He suggests that the blows were probably delivered by scapulae or the lower borders of mandibles. Furthermore the edges of the "skull bowls" are typically smoothed and rounded, apparently by long use. (Fig. 2e).

MLD 2 : ADOLESCENT MANDIBLE

The specimen consists of a mandible without ascending rami. In addition to erupted first and second permanent molars, a worn second deciduous molar was retained on the right side. On the basis of the dentition Dart (1948b) concluded that the mandible had belonged to an adolescent Australopithecus, comparable in development to a 12-year-old human child. He speculated as to whether this and the occiput had not perhaps come from the same individual and, concerning the damage suffered by the mandible he wrote:

> "Whether the two specimens came from the same individual or not, the mandible

corroborates the evidence of the occiput and other australopithecine remains that the living creature (or creatures) to which they belonged met their death by manually applied violence. The fractures exhibited by the mandible show that the violence, which probably occurred in fatal combat, was a localised crushing impact received by the face slightly to the left of the midline in the incisor region, and administered presumably by a bludgeon. The result of that decisive blow, as far as the mandible is concerned, was that the four permanent incisors (and perhaps the left second deciduous molar) were sprung from their sockets and the bone was shattered. Seen from the front the mandible displays abrasion and fine cracking over the upper half of the left canine region (or canine alveolar jugum) together with two diagonally situated fractures that course downwards and leftwards from the right first premolar and left second premolar sockets respectively. Seen from above and below it is apparent that the posterior and rightward direction of the force applied was so great as to split the left half of the massive body longitudinally in several places. Thus most of the lateral part of the left side of the body behind the second premolar socket (and therewith apparently the left ramus behind the second permanent molar) became separated from the remainder of the bone. But the slight degree of displacement of the fractured parts, their hinged relationship to one another and the absence of any evidence of healing at the fractured margins, shows collectively that death was virtually instantaneous and that the fractured parts of the bone were held during desiccation in approximate apposition by some of the attached surrounding tissues until they became embedded in the limestone matrix." (Fig. 2f).

MLD 39 : DISTAL HUMERAL FRAGMENT

The specimen (Fig. 2g) comes from the Makapansgat grey breccia and, according to Dart (1961a), was fashioned as a "scoop" by a hominid from the distal end of an australopithecine humerus using the "crack and twist" technique. He wrote:

> "A single well-controlled impact enough only to crack the bone enables one to twist the ends apart between the hands contrariwise". He continued: "This particular australopithecine scoop, prepared from an australopithecine humerus also supports the inference made from the bowl-shaped condition in which the first female australopithecine occiput was found that *Australopithecus prometheus* was cannibalistic. The fact that it is the distal end of a right humerus suggests that already some concept may have germinated in its fabricator's mentality that by its use he embodied some of his defunct opponent's vitality."

The majority of other "scoops" described by Dart from Makapansgat Limeworks had been made from the distal ends of bovid metapodials. For them the "crack and twist" technique had not been used, but rather a process of repetitive percussion with a pointed object.

In addition to the specimens listed above, for which specific evidence of violence is cited, several other hominid specimens from Makapansgat are thought by Dart to have owed their presence in the cave to australopithecine cannibalism. These include the juvenile pelvic fragments, MLD 7, 8 and 25, the half-mandible MLD 40, the pink breccia skull MLD 37 and 38 and others (Dart, 1957, 1962b, and a).

In Dart's view, the great majority of the bones at Makapansgat were collected by

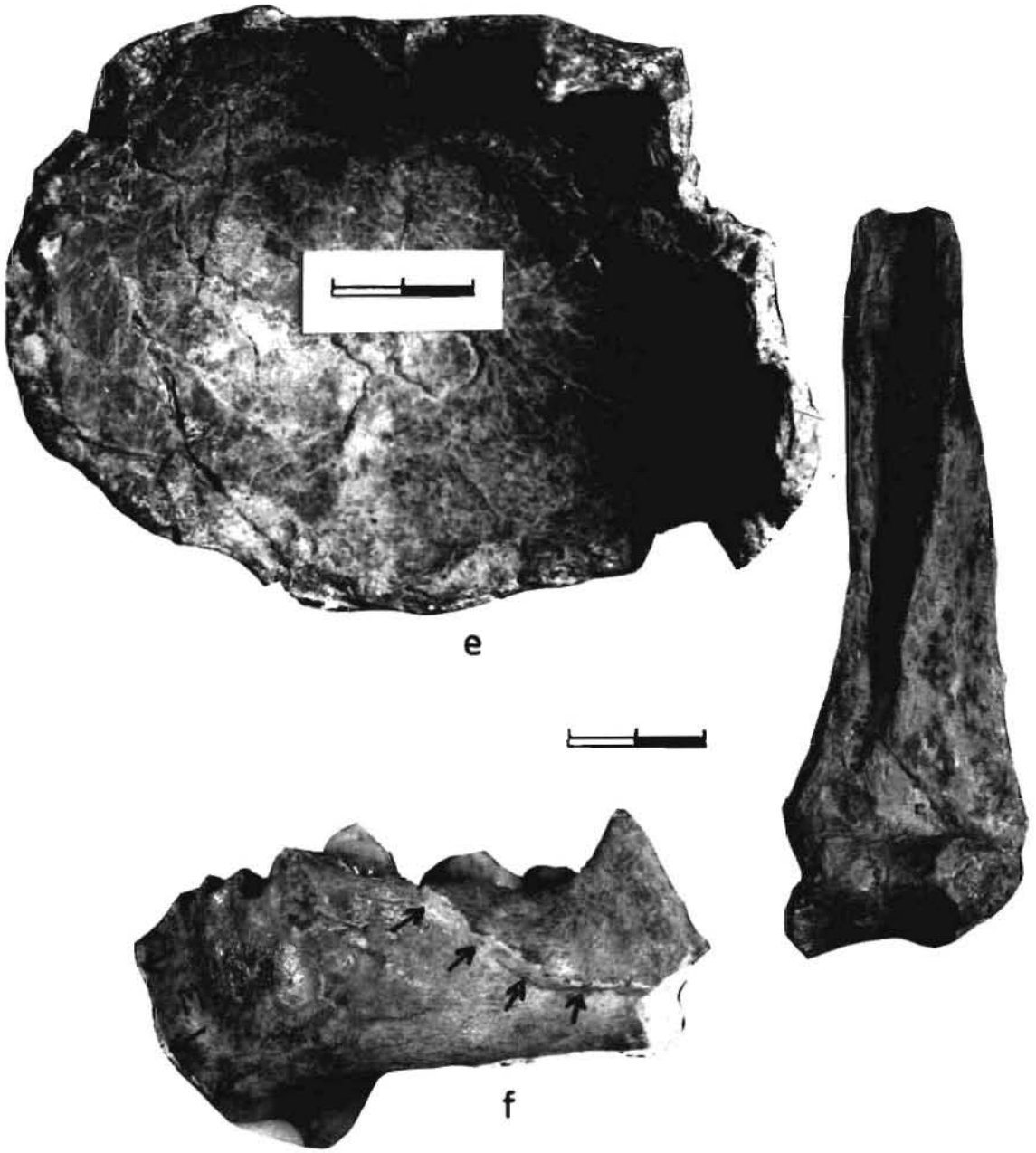

FIGURE 2

Fossils for which claims of interpersonal violence have been made:

(e) Occipital fragment, MLDI, from Makapansgat.
(f) *Australopithecus* adolescent mandible, MLD 2. Arrows indicate fractures.
(g) Humeral "Scoop", MLD 39, from Makapansgat.

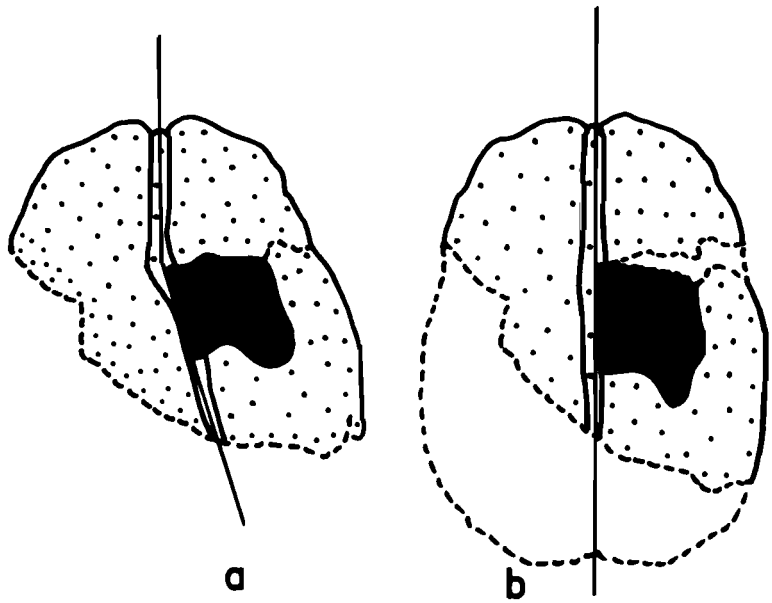

FIGURE 3
Dorsal aspect of the *Australopithecus* endocast (Ples. 2) from Sterkfontein. The black area represents the depressed fracture.
(a) Distorted form as when found,
(b) with distortion corrected.

australopithecines not only for the sake of the meat they carried but also for cultural uses. This implies that the scant australopithecine fossils, scattered among the faunal remains, had all been treated in the same way as those of the animals which fell prey to the Makapansgat hominids.

Anthropologists who accept Dart's osteodontokeratic culture will also doubtless be inclined to agree that the Makapansgat remains may be taken as evidence of interpersonal violence and cannibalism. Critics of the theory will rightly point out that bone accumulations in caves are invariably built up by more than one agency and to assume that all the Makapansgat bones were collected by australopithecines will inevitably prove to be an oversimplification. It can be argued that the occipital fragment MLD 1 was not deliberately broken from the skull by an australopithecine and that the smoothing of its jagged edges resulted from weathering rather than habitual use. Likewise in the case of the adolescent mandible, it is not necessary to assume that the incisors were "sprung from their sockets" by a blow from a bludgeon. These straight-rooted teeth are frequently lost from mandibles prior to fossilisation. The corpus of the mandible itself has certainly been severely cracked, the point of impact being in the left canine region as Dart has pointed out. Can it be proved however that the crack resulted from the impact of a bludgeon rather than pressure in the deposit transmitted to that point by an adjacent bone?

Critics of the cannibalism concept will also point out that the distal humerus is not unquestionably that of an australopithecine. Opinion is divided as to whether it belonged to a primate or a carnivore.

CONCLUSIONS

The interpretation of damage suffered by australopithecine fossils is greatly complicated by the fact that remarkable effects may be induced by the fossilisation process in a cave breccia. Damage or distortion may affect an entire fossil or may be sharply localised to a certain area of it. Likewise, fossils preserved in one part of a cave deposit may show characteristic damage totally absent from those preserved in an adjacent area.

Proper evaluation of a damaged fossil therefore requires, in addition to knowledge of forensic medicine, fullest possible information about the nature of the surrounding matrix and the forces to which it may have been subject. Unfortunately none of the specimens reviewed here resulted from carefully controlled excavation. In all cases, information about the surrounding matrix is lacking. In my opinion the damage on all these specimens could have resulted from influences other than inter-personal aggression.

Returning to the initial question as to whether damaged fossils from the South African australopithecine era can throw light on the phylogeny of human aggression, the answer is ambiguous. Dart and others have drawn attention to some provocative evidence, based largely on specimens which have come from mining rather than palaeontological operations. Further specimens are urgently needed from situations where ante-mortem damage may be isolated conclusively from post-fossilisation effects. Until such evidence is forthcoming, the question of the incidence of inter-personal violence among australopithecines must remain an open one.

ACKNOWLEDGEMENTS

Thanks are due to Prof. P.V. Tobias for making many of the fossil specimens available to me for study; to Mr. A.R. Hughes for much valued assistance and to Prof. R.A. Dart for numerous stimulating discussions.

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