

THE RHODESIAN MAN¹

ALEŠ HRDLIČKA

On June seventeenth, 1921, a very remarkable human skull was discovered in the Broken Hill Mine, Northern Rhodesia. It was the skull of a man whose features were in many ways so primitive that nothing quite like it has been seen before; and coming from a part of the world which hitherto has given nothing similar and in which nothing of that nature was ever suspected, it aroused much scientific attention.

Fortunately the specimen was saved with but a minor damage, and later in the same year was brought by the manager of the mine to the British Museum of Natural History where, safely preserved, it constitutes one of the scientific treasures of that Institution.

The detailed circumstances of the find were, however, not as fully and definitely established from the start as would have been desirable. The specimen was found and taken out by a miner, there was no scientific man on the spot, and the wonder is that so much was saved and done. The whole occurrence is to the lasting credit of all concerned.

The lack of precise information on certain important points was soon felt by the students of the subject; and it now seems that even what was known at first suffered some subsequent confusion.

The sparse data about the Rhodesian find left a desire for more details about the position of the skull, about its surroundings, about the cave itself and its fillings, about the nature of the animal bones in the cave, about the general region in which the "broken hill" with its cave existed, and about possible other remains, as well as the native types of the territory. The skull was so remarkable that every view of it and every further word published upon it served only to intensify the feeling of need for more complete answers to the above questions. It was this motive, together with the recent discovery of the skull of a highly interesting anthropoid ape near Taungs, Bechuanaland, that induced the writer to extend his late journey to South Africa.

The success of his visit to Northern Rhodesia was due largely to the aid of Professor Dart of Johannesburg, and to the fine men in charge of the "Rhodesia Broken Hill Development Company." Of the latter particular thanks are due to Messrs. Ross K. Macartney, the General Manager; George W. Rudyerd, Assistant General Manager; W. E. Barron, former Captain of the Mine; and G. Chad Norris, Engineer.

¹This report represents a part of the results of the author's Smithsonian-Buffalo Society of Natural Sciences expedition, 1925.

But there were many other helping hands including Dr. Wallace, Messrs. Jolly, Zwigelaar, Hayward and still others, whose assistance is hereby gratefully acknowledged. The efficient and high-minded officials of the mine deserve the thanks of the whole scientific world, for it was due to them only that the Rhodesian skull was preserved and brought in safety to the British Museum. These gentlemen extended to the writer every facility. They would doubtless do this to any other qualified student, and they will henceforth watch keenly for all further discoveries on the site and in the vicinity.

Upon arrival at Broken Hill the writer was rather astonished to find the whole region for many miles in every direction to be a great, level, loosely forested plateau, without any hills with one slight exception. This exception is a small "kopje" situated near the railway tracks as one nears the Broken Hill mine and settlement. This little hill, only about 90 feet high, is said to resemble closely the former "broken" hill which gave us the Rhodesian man and which has now, through mining, been removed.²

The plateau of the town of Broken Hill is 3874 feet above sea level. Up to the time of the commencement of mining operations it was a part of a vast, featureless, more or less openly forested region. But the minerals in the two "kopjes"—lead and zinc—may have been known to the natives in earlier times. At all events, in digging ditches and in other surface excavations about the mines and in the town, there are being found, buried up to 8 feet in depth from the present surface, old primitive native smelters, with here and there some negro pottery, indicating probably former burials. Mr. J. H. Hayward in charge of the surface works, has found such an old primitive, probably negro smelter under the roots of a big tree, and he led the writer to a ditch where from 6 to 8 feet below the surface were seen *in situ* large fragments of thick black native pottery. There evidently existed here at one time a native settlement the men of which worked some metal. The smelters may, however, have been used for iron or other metal than those found in the two small local hills.

The "broken" kopje consisted of hard dolomitic limestone impregnated with lead, zinc salts and vanadium. It was originally full of crevices and holes, and, as shown in the course of mining also at least two large caves leading deep into the interior.

²In one of the accounts to be quoted later mention is made of several such small hills, but only one and the remains of the one that gave the skull were seen by the writer.

The cave of special interest became known as the bone cave. This cave in the course of time had become filled with sand, soil, bones of animals and detritus of various kinds, which in turn were impregnated by seepage carrying in solution mineral salts and lime. The salts formed incrustations on the walls, here and there new ore deposits and in general consolidated most of the contents, bones included, into a "paying ore."

The kopje that yielded the "Rhodesian skull" was situated approximately northwest to west of the present railroad station, and was about 50 feet high by 250 feet in its longer diameter. This entire elevation has now disappeared and where there was a hill there is now a deep hole, in and about which mining operations are still energetically proceeding.

Mining by white men is said to have begun at "Broken Hill" in 1895. Information about these times is hazy. The tradition is that the "broken" hill before mining looked much like the kopje now remaining; that its weathered and irregular surface was, as already said, honey-combed with holes and crevices; but that none of the openings apparently led to the cave that eventually proved to be the great bone, débris and ore-filled crevice which in 1921 gave the Rhodesian man.

The main part of the bone cave appears to have been entered by the miners accidentally in the course of their operations, was partly excavated and found to contain large quantities of more or less mineralized animal bones, with some stone implements. Of this occurrence there are reliable records.³ The initial notes on the subject are of such value, and at least one of the reports is so difficult to find, that the relevant parts are reproduced in full at the end of this paper.

So much for the earlier information about the Broken Hill cave, and nothing further appears to have been said in print about it until the latter part of 1921, when the Bulawayo and other South African papers brought news about the discovery of the "Rhodesian skull."

These earlier reports of which the writer saw copies at the office of the Broken Hill Development Company, are of the usual newspaper style and outside of signalling the discovery give little of value. The first more detailed notices of the find appeared on November 8, 9, 10 and 11, 1921 in the London "Times." Shortly after that, on November 17, the first brief scientific report of the find was published in "Nature" by Professor Smith-Woodward; and on November 19 a comprehensive and gorgeously illustrated report by W. E. Harris,⁴ as well as a descrip-

³Mennell (F. P.) and E. C. Chubb—On an African Occurrence of Fossil Mammalia associated with Stone Implements. *The Geological Mag.*, n. s., Decade V, IV, Jan.-Dec., 1907, 444 *et seq.* See Appendix I.

⁴See Appendix II.

tion of the skull itself by Sir Arthur Keith, was brought by the "Illustrated London News," with the addition of an ingenious restoration of the race of men represented by the specimen.

Four years have elapsed since then. In their course at least eight further brief scientific contributions on the subject of the "Rhodesian Man" have seen light. But a thorough, final study of the subject and the specimen is still wanting. It was expected from Professor Smith-Woodward in whose care the skull and other objects from the cave were placed. There is, however, a fear now, with Professor Smith-Woodward's retirement on pension from the British Museum, that such a report may be remote. And the skull, with the type and age of the human form to which it belonged, remains still largely a puzzle. Moreover, errors of a serious nature have crept into the accounts of the circumstances of the discovery and have already materially affected important conclusions.

What one learns definitely from the early notices of Broken Hill, by one of the chief officials of the mine (Engineer Franklin White), is that about 1907 the bone cave was found accidentally in tunnelling operations; that it was not known to have any outward opening; that it was nearly filled with large quantities—many tons—of more or less mineralized bones, clay, débris and ore; and that with the bones were fairly numerous quartz and chert implements, resembling in general those of Bushmen and perhaps other African natives of protohistoric and prehistoric times.

Some of the implements and bones were saved through the instrumentality of Mr. White and donated to the Bulawayo Museum. They were later studied by Mennell and Chubb. Still later the bones came to the British Museum and were examined by Andrews. They were diagnosed, with one probable exception, as belonging to recent forms of Rhodesian mammals. There were no human bones in the collection. The archeological objects were noted but the find was not followed up.

Then came the accidental great discovery of 1921. Again there was no scientific expert on the spot and none came after. The details were not noted in writing. The news circulated in the South African papers, but there was no authoritative account, the reports differed from the first and included inaccuracies.

Five months after the discovery the skull, and a number of human as well as other bones, were brought by Mr. Macartney, the Manager of the Mine, to England and were generously donated by the Company to the British Museum (Natural History). No written statement accom-

panied the donation. But from the oral account of Mr. Macartney, and above all from the good illustrated article by William E. Harris, an official of the mine, in "The Illustrated London News," November 19, 1921, there became established a notion of the details of the find which was gradually adopted by all writers on the skull and which is responsible for serious uncertainties. Above all it became an accepted idea that several human bones brought to England with the skull were found with the cranium and belong to the same body or same people, and from the characteristics of these bones deductions were made as to the morphological and even chronological status of the Rhodesian man. Some measurements of the skull and bones were published, also a few observations and thoughts on the endocranial cast which represents the brain; a tacit expectation was reached that a complete report on the case was being prepared by Professor Smith-Woodward; and active interest was gradually transferred to new discoveries.

These were the data and that was the state of affairs when the chance to visit the Broken Hill locality came to the writer during the past summer.

With the utmost cooperation of the officials of the mine, and in fact, of every one approached, the first task was to learn on the spot as much as possible of the history of the 1921 discovery. This unexpectedly proved no easy matter, due to a scarcity of the old employés, but especially to the uncertainties of memory of those who had been present at that time. The following nevertheless appeared to be the consensus of the recollections:

Before mining began in this craggy "broken" kopje there was nothing to indicate the presence of any human habitations about the hill. If there was anything it was not conspicuous and escaped notice.

Mining was carried on from a side, but due to the conditions of the mineral deposits work was later commenced also from the top proceeding downwards. During the earlier operations from the side, a good sized cave or fissure was reached and found to contain dirt, ores and numerous bones. The bones were those of animals; if any others were present they were not noticed. They were mostly so mineralized that they were in the main smelted with the rest of the ore, and after the first impressions received little further attention.

When the excavations from the top reached in the center to approximately 90 feet below the surface of the ground surrounding the kopje, a large inclined plane was opened to the central funnel from near the side at which the original work began. At some distance this plane once

more encountered the large bone crevice that had been discovered before. The crevice passed here obliquely across part of the incline, and as in the earlier seen portion was filled with detritus, bones of bats or rodents, ore and more or less mineralized bones of larger animals. The extent and contents of this cave or crevice were only learned gradually in the course of the prolonged work of mining.

After the inclined plane reached the bottom of the central excavation, some of the workmen were directed to turn back and work on the ore and stone exposed by the plane; and it was in these parts, not long after, at a level of approximately 60 feet below the surface, that a Swiss miner, Mr. T. Zwigelaar, working with his black "boy" in some softer fillings, was confronted after a stroke of the boy's pick with the Rhodesian skull.

It is primarily to the lasting credit of this miner that the specimen was carefully taken out, saved, brought to the attention of his superiors, and reached the right hands. These hands, at the advice of the Manager of the mine were those of the Company physician, Dr. A. F. Wallace, and he safeguarded the specimen for three weeks in his office. It was then taken in charge by the Manager, Mr. Macartney, to be later in the year personally transported by Mr. Macartney to the British Museum. There was much more to all this than here expressed and some of the details were stated differently by different persons, but the above appear to be the simple essentials.

FURTHER EVIDENCE

After learning the generalities and being shown over the mine by Mr. Rudyard, the writer endeavored to reach personally every man concerned with the find or on the spot at that time, who might still be found at Broken Hill or reached through the mails, in order to obtain from each one independently as detailed and circumstantial information about the discovery as it might still be possible to get. As only four years have elapsed since the time that the find was made it was hoped that a number of the men who were concerned with it would still be found on the spot and that their memories of the find would still be quite clear and reliable.

As good fortune would have it, before the writer's departure from Broken Hill he was able to locate and interview five of the men concerned from the beginning in the discovery, including Mr. Zwigelaar who actually found the skull; and a sixth one was reached later by a letter. Each of these men was most willing to tell all he knew; but their memories regrettably were no longer clear as to the particulars. However, what was obtained is not without importance.

The most noteworthy information is that of the discoverer of the specimen, Mr. Zwigelaar. He was found to be a serious middle-aged man, not highly educated but of good common sense, and he tried hard to give the main facts of the find as he remembered them. The gist of his statements, repeated and reasserted, follows:

"It was about 10 a. m. one day. We were working back from the incline at its lower part. I had a colored boy (young man) with me and we were 'hand picking' in a pocket where there was much lead ore. The digging was not hard, not like stone, more loose. After one of the strokes of the pick some of the stuff fell off, and there was the skull looking at me. It was very strange and with some of the matter adhering to it looked so unlike an ordinary human skull that I thought it was a big gorilla. I took it out carefully, showed it to the officials of the mine and others, and later that day brought it in to Mr. Macartney who in turn sent it to Dr. Wallace. Soon after the find was made Mr. Macartney (I believe) took a photograph of me holding the skull against the place where it came from (Fig. 1),⁵ and other photographs were taken also.

The skull was at some depth under the pure lead ore and, as far as I can recall, about 10 feet below what seemed to be the floor of the bone cave further away. Where we were then I could see no connection between the material about the skull or the pocket it was in and the bone cave, though it may have been [and later was shown] to be the same old crevice. They were separated by the lead ore and the stuff in which the skull lay. That ore was very rich; it was not hard though necessitating the use of a pick. There was much of it further in and above.

There were no other bones close to or near the skull, and no other objects that aroused attention. But a little later and not far below the skull we came on a sort of a bundle which looked like a flattened roll of hide standing nearly upright; the hide was thick and was of ore; it showed no remains of a real hide but looked somewhat like it. Pieces of it were removed and shown about, the rest was smelted. There was nothing within the 'roll'—no bones nor any other object.

The skull was surrounded by softer stuff. There was something like bat bones. There were hard and soft spots in the digging. Next day we looked for the lower jaw but nothing was found.

Some time afterwards, but on the same day, we found outside of where the bundle was and to one side of it, about three feet away as near as I can remember, the leg bone of a man. There were no other

⁵This precious and unique photo was loaned by Mr. Zwigelaar to the writer and is here reproduced.

bones. Later and lower was found a skull said to be that of a lion; but that was not found by me.

The skull was taken first to the Manager's office and from there to the Doctor's. That's all I know."

So much for Mr. Zwigelaar. On repeated questioning his account re-



FIG. 1.

remained the same. He was positive the skull was alone, without the lower jaw and without any other bones in association. He also was positive that there was no covering of the skull and that the "roll" lay lower and not in connection with the specimen. Directly behind the skull there were some bat bones.

The next most important person still present at Broken Hill was the Mining Captain at the time of the discovery of the skull, Mr. W. E. Barron. Mr. Barron was found at the site of the new dam and power tunnel about 20 miles from Broken Hill and was brought back to the mine. Unfortunately

his recollections of the details of the discovery were already hazy. However he produced an old note book in which he had written, shortly after the find was made (a day or two later) the following valuable notes:

"Old Bone Cave: Skull found at side of incline about 60 feet level, by Zwigelaar, 17-6-21. A mass of small bones (probably bat bones) all around it.

In afternoon of same day big portions of animal skull with teeth in good condition (apparently lion) found in same place (speaking generally) by Angelo."

All other information regarding this lion's skull is to the effect that it was found at some distance away from the skull, possibly as much as 8 or 10 feet, and at a considerably lower level. It was impossible to ascertain conclusively what had become of this specimen. There is a somewhat mineralized lion's skull, proceeding doubtless from some part of the bone cave, in Mr. Macartney's office and it may be the specimen in question; or it may have been forwarded to the British Museum.

Mr. Barron assured the writer also that in the same digging there was found an artificially made quartz ball about 3 or a little over 3 inches in diameter (size of a fist). Zwigelaar upon re-interrogation in the presence of Mr. Barron was sure that there were no bones whatever, human or animal, near the human skull except the bat bones; neither could he remember anything about the stone ball. A stone ball answering to the description was later brought to the writer with a statement that it came from somewhere in the end part of the crevice and was taken by him with other objects to the Museum at South Kensington. However, two similar balls from the cave had also been taken to the Museum with the skull in 1921 (see later).

Mr. Barron's name in the English records of the find is given as "Barren," and as in the same records he is reported as the discoverer of the skull, the writer asked him for a written statement on both points. The result was the following letter which settles both questions:

Mulungushi, R. B. H. D. Co. Ltd.
Broken Hill, N. Rhodesia.
12th Dec. 1925.

Dear Mr. Hrdlička,

I was very glad to get your letter. I have come across the correspondence of Dec. 1921, which I mentioned to you, and, as it has bearing on the whole matter connected with the skull I am enclosing it all for your perusal. The copy of my letter to Mr. Moffat I have just made from a pencilling I had with the others.

It was Zwigelaar and his boy who saw the skull *in situ* and extracted it, and Zwigelaar brought it to my office. I was Mine Captain in charge of mining operations.

The collar bone and the case referred to in my letter to Mr. Moffat were certainly in the close vicinity of the skull, and we attributed them to the same skeleton at the time, the casting being taken for the fossilised remains of the skin he was wearing. . . .

With kindest regards,

Yours sincerely,
(Sgd.) W. E. BARRON.

The "December 1921 letter to Mr. Moffat" referred to above, reads as follows:

Dear Mr. Moffat:

I got your letter about the skull.

The following is from my note book: "Old Bone Cave: Skull (which might be either man or monkey) found East side of Incline about 60 ft. level by T. Zwigelaar 17-6-1921.

A mass of small bones (probably bat bones) all around it.

In afternoon of same day big portion of skull with teeth in good condition (apparently lion) found in same place by Angelo. Block P 7."

I gave the above in my report, either fortnightly or monthly, of the period, which could be obtained from the Mine office in Broken Hill.

A spherical stone implement, a collar bone⁶ and a lot of casting (fossilised skin or matting) were found practically in the same place.

I have brought away with me none whatsoever of the bones or implements.

The skull, and a number of other fossilised bones which Dr. Wallace (of Broken Hill) considered of special interest,⁷ were packed in a box for Mr. Macartney to take to London with him.

There was quite an interesting lot of bones shelved in the office and the tool hut at the mine when I left. Mr. Macfarlane, my assistant, who took over from me, will know of them.⁸

One huge bone which appeared to be the thigh of an elephant or something of that kind, Mr. Macfarlane should have no difficulty in sorting out from the tool hut; an assay of a portion of it gave about 8% Pb. and 4% Zn; it was got from about the 40 ft. level many months ago. Another of special interest is in the Survey Office behind the Engineer's Office; it has the appearance of having been an elephant's hip bone or something of that sort, also from about 40 ft. level.

As the skull which is attracting so much attention was got from the East side of the incline at about 60 ft. level, and a great deal of bone debris is probably still intact in the incline itself, things should be watched with great interest when the time comes for mining away of the incline when hoisting commences at No. 2 shaft.

Yours faithfully,

(Sgd.) W. E. BARRON.

Another old employé who was present at the time of the discovery of the "Rhodesian Man" and who saw the specimen shortly after it was discovered could give no details of value. The importance of the find was not appreciated, no special effort was made to go into details, and the incident passed out of memory.

⁶No such bone was remembered by Zwigelaar, and no such specimen is in the British Museum of Natural History. A. H.

⁷This phrase deserves a close attention. There is no intimation that these bones were associated with the skull. A. H.

⁸This is doubtless one of the lots of bones found by the writer; see later. A. H.

The Manager of the mine, Mr. Macartney, remembers clearly the main items relating to the find. He saw the skull shortly after discovery and he also saw the place where it was found. He feels certain that the softer spot in which the skull lay contained quantities of detritus with bats' bones. He also remembers a thick layer (about 30 feet) of very pure and not very solid lead ore that lay between that part of the crevice or cave that contained the skull and the bulk of the cavity which was filled with more or less mineralized animal bones, detritus, etc. There is an uncertainty as to a possible connection of the contents of the two portions of the cave under the ore.

Dr. Wallace very kindly gave the writer a written account of his recollections. They are as follows:

"I only heard about the skull about two weeks after it was found. It was then at the Mine office, and the General Manager, Mr. Macartney, sent it down to my surgery where I had it for three weeks. I am quite sure that the lower jaw was never found. The skull was sent to me with a few other bones in a box. Amongst these bones was what might have been a human tibia. I did not recognize any of the other bones as being of human origin.⁹

Mr. Armstrong, who at the time was the metallurgist here, took a great interest in the skull. It was he who first told me about it. I think that among the bones sent with the skull were two pieces of what Mr. Armstrong thought was some fossilised material that had been wrapped round the body. Mr. Armstrong's idea was that this had been an animal's skin. I think Mr. Armstrong has a piece of this in his possession but I am not sure.

One of the teeth in the skull was loose and could be lifted out. When I sent the skull and the other bones back to the Mine Office I sent the tooth with them."

The writer wrote to Mr. Armstrong who meanwhile has moved to Australia and received from him the following notes:¹⁰

Sydney, 21st December 1925.

Dear Mr. Hrdlička,

I was extremely pleased to hear from Dr. Wallace of your visit to Broken Hill, and much regret that I was not there. . . . I was informed of the find a few minutes after the skull had been unearthed, and immediately went to the mine and collected all the bones exposed in the immediate vicinity.¹¹ The bones which were eventually taken to Kensington Museum proved to be (1) part of a human lower (upper) jaw; (2) a human leg bone; (3) a lion's skull.

⁹This is another important statement and made by one well acquainted with human bones. *A. H.*

¹⁰Certain personal references omitted.

¹¹Statements plainly somewhat erroneous. *A. H.*

At the time of the discovery I was in charge of the Works only and had no authority at the Mine. . . No systematic search was made for further important bones and the skull with the bones I had collected was left in the Mines Shelter Office.

In 1922 I left Broken Hill and came to Australia. At the request of Professor Burkitt I called at the Sydney University and gave him particulars of the find. I left the sample to which you refer with him. It was not a bundle (I know nothing of any bundle being found) it was part of a protective covering which completely encased the skull.¹¹ This had been broken off before I arrived at the mine. The importance I place on this is due to the fact that none of the other bones in the vicinity had any such covering.

In August, 1922, I went to London and called upon Professor Woodward at the Kensington Museum. He showed me the skull and the various bones which had been delivered to him by Mr. Macartney and I recognised the ones which he stated were the lower (upper) jaw, the leg bone and the lion's skull—these were all discovered within a foot of the skull.

I know little of Anthropology, but from the geological point of view and from close observation of the so-called "cave" in which the skull was found, I consider there is proof of a much greater age than the estimate given by Woodward.

Yours truly,

(Sgd.) A. S. ARMSTRONG.

The foregoing documents make it only too evident that the exact details of the rare find were by no one recorded; and that the remembrance of them has in the course of time become more or less confused even in those who were on the spot soon after the discovery. The statement of Mr. Harris in "The Illustrated London News" (see Appendix) made five months after the event is doubtless no less faithful but also no less defective than the others.

Hoping that something more precise might have been given to the British Museum (Natural History), the writer turned to Dr. Bather, the present very good Keeper at that Museum of the Department of Geology and Palaeontology, and was very kindly furnished with copies of all the official entries relating to the find and an earlier collection from the same cave. They read as follows:

Nov. 15th. 1921.

3379

Franklin White Esq.,

11a Harrington Gardens, S. W. 7.

4 stone implements and 3 pieces of worked bone collected by the donor in a cavern in the Broken Hill Mine, N. W. Rhodesia.

Nov. 24th. 1921.

3382

The Directors of the Rhodesia Broken Hill
Development Company, Ltd.
(per Edmund Davis, Esq., Chairman),
19, St. Swithin's Lane, E. C. 4.

A primitive human skull, with part of maxilla of a second skull, a sacrum, three pieces of femora, and a tibia; also 7 associated bones of mammals, and 2 round pounding stones; found in a cavern at the Broken Hill Mine, N. W. Rhodesia.

May 8th. 1922.

3438

Franklin White Esq.,
19 St. Swithin's Lane, E. C. 4.

Collection of stone implements from Broken Hill cave and other localities in South Africa.

As the collective sifted result of the information obtained from all quarters, with the results of the personal inspection of the mine and of what remains of the bone cave, and with the impressions left by the different men associated with the finds, the conclusion is that the real conditions had probably been somewhat as follows:

The "bone cave" was an extensive irregular crevice running for 120-150 feet inward and downward from near the base of the hill and reaching the maximum depth below the surface of about 70 feet.

There is no recollection of the mouth of the "cave" and this may have been covered or obstructed. Inside, the crevice enlarged to a cavern which at its maximum measured probably over 30 feet in breadth and twice as much in height.

For some distance from the mouth of the cavern the floor of the latter was nearly level or but moderately inclined, then there was a steeper descending slope, and after that the crevice ran irregularly downward and inward.

The outer part of the cavern was largely filled with more or less mineralized and consolidated bones of animals, cave detritus, large quantities of bones of bats or small rodents and nondescript earthy material, the walls being covered with crystals of the ores of zinc and vanadium. The larger bones were distributed unequally through the filling of the cave, in some places there being large quantities of them, in others few or none. They extended to and beyond the descent in the floor.

The lowest and innermost part of the cavern was filled by detritus, some bones and by a considerable layer or rather layers of very pure and more or less crumbly lead ore. The ore contained no bones or

foreign substance; but, it is not absolutely known whether the contents of the distal part of the cavern had a direct connection with the materials in the large outer portion through or underneath this lead ore.

The skull was found at some distance beneath a layer—according to Mr. Zwigelaar's recollection about 10 feet thick—of this ore. It was not itself embedded in the ore but in a detrital material not mineralized to any extent, and containing a quantity of "bat" bones.

The skull was an isolated object. It lay upright. There was no lower jaw, nor any other bone in apposition. Beneath it was something which looked like a large flattened skin bundle, thoroughly mineralized. This may or may not have been merely a natural laminar formation of the lead ore. Barring a few fragments it was smelted.

Somewhere in the vicinity of the lower portion of this "bundle" was found a remarkably straight but otherwise not peculiar, full-sized human male tibia, and lower at some distance were portions of a mineralized lion's skull. In the vicinity there may have been found also one or two other human fragments, but here much is uncertain.

The larger part of the bony contents of the main part of the cave were so mineralized that they passed for a good grade of zinc ore and were smelted as such. Various portions of the cave fillings, however, were poorer and were brought out and thrown on a dump where, covered by poor rock and débris thrown out subsequently, they still repose. The ground and débris in the dump are still full of fragments and pieces of bone, with teeth, chips of quartz, etc.

Only traces of the great cave now remain in the mine, and as the work progresses they will disappear. The opposite wall of the mine shows an even larger old cavern, completely filled with less consolidated and somewhat darker materials than the surrounding rock. This cave has given no bones.

FURTHER SPECIMENS

While gathering this information the writer learned casually that some of the loose bones from the bone cave—part unknown—were saved and might possibly still be found in some of the offices and tool huts of the mine. Accordingly as soon as possible a search was instituted in company with Mr. Rudyerd, and before long several lots of such bones were located in the main office, in the designer's room, in another small office and in two small huts near the mine. Those in the main office were in a case with a series of mineral specimens from the mine and represented especially bones enclosed in mineral matrix; the

bones in the other places were loose and not encrusted, only more or less covered with earth and dust. All the bones, however, showed more or less mineralization.

In addition the officials of the Company very kindly gave the services of two "boys," with whose help digging was begun into the old dump, with the result that in two days numerous additional bones and teeth were added to those already located. All this material was then washed, dried, spread out on a large designer's table and sorted.



FIG. 2.

Even before this, however, while handling the dusty bones in the designer's office and in the tool house, the writer had found among them in the former place a large portion of the distal end of a human humerus, and in the hut a piece of a human parietal. Both of these specimens showed the same mineralization as the rest of the numerous bones and were plainly parts of the same lots. As there is not the slightest intimation that these many scores of animal bones, some of them very conspicuous, were found anywhere near the Rhodesian skull, they probably all proceed from other parts of the cave; and as the human bones among them were of the same color and mineralization, there is a strong probability that they were with these bones in the cave. Which means that human bones were found also elsewhere in the crevice, a fact having an important bearing on some at least of the human bones brought to England with the skull.

The total of several hundreds of animal bones proved to be of very considerable interest, and established in a short time the true nature of the bone cave. As they were sorted, bone by bone, it was seen first of all that they represented a very large variety of mammals with some birds and possibly one or two larger reptiles. The mass of the bones belonged to ungulates, but there were also a few carnivora. Nearly all the bones, however, showed characteristic old breaks and cleavings. The skulls and even the horns were all broken into large pieces; the hip bones and shoulder blades were broken much and irregularly; while the long bones, even those of the larger birds, were generally broken at or near their middle, addition to which a number of the extremities of the tibia and femur were cleft in two longitudinally so as to expose the whole

cavity. There were no marks of teeth on the bones, not even of the teeth of rodents, and little of artifacts outside the main breaks. But these breaks were produced, it was seen again and again, not accidentally or by the teeth of animals, or by man's tools sharp cutting and cleaving as ours, but evidently by stone implements.

The lesson was clear. These were the bones of animals utilized for food by some native group of men, and the bones had been purposely and systematically broken by these men to get at the marrow. The horns were broken for the same purpose. Moreover a number of the bones showed more or less the effects of fire; and in several instances there were found two or three pieces of what was originally the same bone, or again two bones proceeding plainly from the same animal. The lower halves of the two humeri of a young hyena, broken in the same manner as others, were among the collection.

All this indicates that the cave had been used for a long time by some group of native population as a habitation, or at least as a trysting place where parts of animals were brought, cooked or roasted and eaten.

Among the bones the writer found a few flakes and a piece of quartz that may have been partly shaped by man. It has a good cutting edge which would have been serviceable.

The main bone cave may therefore confidently be characterized as a cave of prolonged occasional or permanent human habitation in some part of the past, perhaps not very far distant. How far will depend on the identification of the animal forms whose bones were left in the cave. Bones from the outer part of the cave identified previously were, we have seen, practically all of forms that are still living.

The newly found human bones proceed from two skeletons; the arm bone is that of a strong adult male; the parietal, rather thin, is probably that of an adolescent. They apparently have no connection with the "Rhodesian skull." But lying as they did among the broken animal bones, and in the case of the humerus being fractured crosswise by a blow as was the rule with the animal bones, a suspicion is aroused that they may have belonged to human beings who suffered the same fate as the animals. The new evidence throws no light either upon the racial character or the antiquity of the remarkable cranium.

THE BONES IN ENGLAND

The two new human fragments, the mammalian teeth and a selection of the animal bones were deposited by the writer, together with a quartz ball and the above mentioned stone, in the British Museum (Natural

History), South Kensington, so as to be with the Rhodesian skull and the other specimens collected previously. On this occasion the writer was able once more to examine the Rhodesian skull, and also the other human bones that were received with the skull. They are, a portion of a separate upper jaw with two teeth; a tibia; two parts of a male adult femur; one shaft of a female adult (?) femur; a large part of a right female (large notch) *os coxae*; a large part of a male ilium (small notch) and one sacrum. Of these the upper jaw, mineralized, is somewhat different in color from the skull. While it is considerably heavier than normal, morphologically it is in all ways like the jaw of a modern negro, with modern teeth, and bears no resemblance to the corresponding part of the skull. The tibia is much more reddish-brown than the skull; the female femur is light ochre-yellow; the male femur pale to blackish-brown with thick walls. One of the pelvic parts is near in color to the skull, the other is distinct.¹² The male femur is in two parts with the middle portion missing; the breaks are old and both fragments show superficial slivering from knocks. The writer feels strongly that these bones should not be associated with the Rhodesian skull. They are all and in all respects of modern form and size. They may belong to the contents of other parts of the cave, or at least to entirely different human beings. They all, with the exception of the tibia, are broken (old breaks), which may be indication of cannibalism. At least it may be said that it would be unsafe, before further evidence may throw more light upon the matter, to build on the basis of these bones any conclusions as to the skeletal characters of the original owner of the Rhodesian skull.

THE RHODESIAN SKULL ITSELF

Although four and a half years have elapsed since the discovery of this highly remarkable and enigmatic skull, no thorough report of the

¹²In this connection the writer is glad to print the following letter referring to something that may but apparently does not wholly account for the differences in color and consistency of the bones (particularly one of the femurs) in question:
Department of Geology, British Museum (Natural History)

2 March 1926

Dear Dr. Hrdlička:

I have just had occasion to read your letter of the 12th November 1925, addressed to Dr. Bather. In it you state that the skeletal remains from Broken Hill differ from the skull and from each other in colour and state of mineralisation. May I point out that this is not really the case, and that the reason for varying colour is a difference in method of treatment by the preparators? The skull was painted over with a thin solution of shellac soon after it was received here; this darkened the colour a little. The remainder of the bones, with the exception of the two innominates, were soaked in "wulfite" about 12 months ago. This caused the dark colour and also increased the weight very considerably. The innominates have not been treated in any way; they represent the original condition of all the others.

Yours truly,

(Sgd.) ARTHUR T. HOPWOOD

MEASUREMENTS OF THE RHODESIAN SKULL

	Elliot ¹ Smith	Smith ² Woodward	G. L. Sera ³	Eugene Dubois ⁴	Arthur Keith ⁵	Hrdlička (new)
<i>Vault:</i>						
Capacity, cc.	1280	abt. 1280	—	1400 (estim.)	1305 (displace- ment of intra- cranial cast) 1370 (estim. from ext. meas- urements)	— nr. 20.8
Length Maximum.	—	abt. 21.—	21.— (prob. af- ter S. Woodward)	—	21.—	—
" glabella-inion.	—	—	—	20.7	—	—
" optryon-maximum ⁶ .	—	—	—	—	—	19.9
" less frontal and occipital bulgings.	—	—	—	—	18.6	—
Breadth maximum.	—	abt. 14.5	14.5 (prob. af- ter S. W.)	14.5 (prob. af- ter S. W.)	14.5 (prob. af- ter S. W.)	14.87
Height, basion-bregma.	—	—	13.1	13.—	—	13.—
" auricular line-vertex.	—	—	—	—	10.7	—
Cephalic Index.	—	69.—	69.—	70.—	69.—	71.2
" " with optryon length.	—	—	—	—	—	74.4
" " corrected ⁷ length (Keith).	—	—	—	—	78.—	—
Mean Height Index (with length to optryon).	—	—	—	—	—	74.9
<i>Intracranial:</i>						
Length (mean of the two hemispheres).	—	—	—	17.1	17.1	—
Breadth maximum.	—	—	—	13.4	—	—
Height (basion-vertex).	—	—	—	12.2	—	—
Intracranial Index.	—	—	—	78.4	—	—
<i>Face:</i>						
Height, Alveolar pt.-nasion.	—	—	—	9.2	—	9.5
Breadth, bizygomatic maximum.	—	—	—	—	—	abt. 14.8 ($\frac{1}{2}$ = 7.4)
Breadth, from notch (or angle) to notch on the temporal border.	—	—	—	13.4	—	13.6
Breadth, across the angular processes of the frontal.	—	—	—	13.9	—	—
Facial Index, anatomic.	—	—	—	—	—	n. 64.2

<i>Nose:</i> Height.....	—	—	—	—	5.9
Breadth.....	—	—	—	—	3.1
Index.....	—	—	—	—	55.4
<i>Orbits:</i> Height (mean).....	—	—	—	—	3.9
Breadth ".....	—	—	—	—	4.3
Index.....	—	—	—	—	90.7
Diameter frontal minimum.....	—	—	—	10.4	—
Height of alveolar process (subnasal pt. to alveolar pt.).....	—	—	—	—	3.7
Basion-nasion.....	—	—	—	11.1	11.1
Basion-subnasal pt.....	—	—	—	—	10.1
Basion-alveolar pt.....	—	—	—	11.7	11.8
Basion-union.....	—	—	—	9.9	—
Facial angle (between basion-alv. pt. and alv. pt.-nas. diameters).....	—	—	—	—	62°
Alveolar angle.....	—	—	—	—	54°
<i>Palate:</i> (dental arch)	—	—	—	—	—
External length (max.).....	—	—	—	—	7.7
" breadth ".....	—	—	—	—	8.5 ⁹
Index.....	—	—	—	—	82.4
Length to back of 3rd molars.....	—	—	—	5.95	Max. ht. nr. 1.8
Length "from socket of median incisors to a line drawn across back of 3rd m's".....	—	—	5.1	—	—
Breadth "outside measurement across the 2nd molars".....	—	—	7.8	—	—
Width bet. the sockets of the 3rd molars.....	—	—	5.1	—	—

¹Smith (G. Elliot)—The Rhodesian Skull. *Brit. Med. J.*, Feb. 4, 1922, 197-8.

²Smith (A. Woodward)—*Nature*, Nov. 17, 1921, 371-2; and *Sci. Progress*, 1922, XVI, 574-9.

³*Rev. Biol.*, 1922, IV.

⁴*Trans. K. Ak. Wetensch. Amst.*, 1922, XXIV, 326 *et seq.*

⁵The Antiquity of Man, 2nd ed., 1925, II, 386.

⁶From a pt. 3.5 cm. above nasion (comp. glis.); from a pt. 2.8 above nasion = 20.2.

⁷14.5, repeated probably by authors after Smith-Woodward seems erroneous; two separate measurements with a well-tested instrument gave the writer 14.8 (14.7-14.8) and the fine cast of the skull on which the other measurements are, exceptionally for a cast, correct, measures also 14.8 cm. (or 14.75). In its perfect state, before an injury to the right lower portion of the vault, this measured surely 14.8, if not a trace over. It is probable that the original and then simply repeated low measurement was due to an inaccuracy of the instrument, which is only too common.

H

(L+B):

⁸Alveolar process shows externally some swellings without which the breadth would be about 8.1; index 86.4.

specimen has yet been given. It was expected that Professor Smith-Woodward, who gave two preliminary notices of the find,¹³ would prepare such a report, but this now seems uncertain. Notes on the skull were published later by Eugene Dubois,¹⁴ Sera,¹⁵ Martin,¹⁶ Hambruch,¹⁷ and Boule,¹⁸ while Elliot Smith¹⁹ commented mainly on the brain.

The most complete account of the specimen so far published, however, is that of Sir Arthur Keith in the recent second edition of his "Antiquity of Man;"²⁰ but unfortunately it includes some of the misinformation about the circumstances of the discovery (p. 382, upper paragraph) with its consequences.

The writer does not wish to anticipate the complete description of the specimen by his English colleagues. But he has been kindly allowed to take a few measurements on the original which may be of service before the final data become available. These measurements, with those previously published by others, are given in the accompanying table. The specimen is difficult to measure, which, with instrumental imperfections doubtless accounts for some of the differences in individual determinations.

SUMMARY AND CONCLUDING REMARKS

The Rhodesian find of 1921 is more complex than has been generally appreciated. Due to the absence on the spot of any scientific man exact details of the find have not been ascertained. Of what was learned but little was recorded, and of the rest much has since become confused. The precise circumstances of the discovery are therefore, and must remain, deficient.

The main part of the bone cavern was for a long time a habitat or a feasting place of the ordinary Africans, bushmen or negro. The larger bones were none of them brought in by animals, but were the remains of

¹³Smith-Woodward (A.)—A new Cave Man from Rhodesia, South Africa. *Nature*, 1921, CVIII, 371-2; The Problem of the Rhodesian Fossil Man. *Sci. Progress*, 1922, XVI, 574-9.

¹⁴Dubois (Eugene)—On the Cranial Form of *Homo Neanderthalensis* and of *Pithecanthropus erectus* determined by Mechanical Factors. *Konink. Akad. Wetensch.* Amsterdam, 1922, XXIV, 313-332.

¹⁵Sera (G. L.)—*Rivista di Biologia*, 1922, IV, 2.

¹⁶Martin (R.)—Der neue Schädelfund von Rhodesia. *Mannus, Z. f. Vorgeschr.*, 1922.

¹⁷Hambruch (P.)—Der Schädel von Broken Hill Mine in Nord Rhodesia. *Arch. f. Anthropol.*, 1923, N. F. XIX, 52-56.

¹⁸Boule (M.)—Fossil Man, 8°, Edinburgh, 1923, 481-6.

¹⁹Smith (G. Elliot)—*Brit. Med. J.*, 1922, I, 197; *Atlantic Monthly*, Apr., 1922.

²⁰London, 1925, II, 377-393, 5 illustr's.

See also "The Sufferings of the Rhodesian Man," *Lancet*, 1922, 1206-7; and Siffre—"L'Ineptitude dentaire des hommes préhistoriques." *La Semaine dentaire*. 1925, VII, Nos. 12 and 13, 300-8, 322-8.

the repasts of the black man. A very large majority were broken for the marrow. Similarly broken human bones suggest cannibalism. There were apparently no human burials in the cave. How the strange Rhodesian skull got in is unexplainable.

The skull was found alone in the lowest and most remote part of the cave, some distance beneath considerable accumulations of soft pure lead ore. There was no lower jaw. There was no skeleton. One human bone, the tibia, and parts of a lion's skull, it is well established, lay from a few to about ten feet from and at a lower level than the skull.

As to the other human bones deposited at the British Museum with the skull and those now added, all that may be said is that they proceed from several skeletons of modern size and form; that some of them, at least, probably came from other parts of the cave; and that there is no proof, and but a remote possibility, of any of them belonging to the skull.

The skull itself is positively not the skull of any now known African type of man or their normal variants. Neither is it any known pathological monstrosity, such as gigantism or leontiasis. It is a most remarkable specimen of which the age, provenience, history and nature are still anthropological puzzles.

Morphologically the skull is frequently associated now with the Neanderthal type of Europe. This may be fundamentally correct, but only to that extent. In its detailed characteristics the specimen in some respects is inferior, in others superior to anything known as yet of the Neanderthal man.

Meanwhile mining operations at Broken Hill are proceeding. They will gradually do away with what may still remain of the former bone crevice; and they will soon, if they have not already, involve the second kopje with its crevices. All this work should be intently watched, for any day it may uncover new evidence of much importance.

APPENDIX I

ABSTRACTS FROM ORIGINAL REPORTS ON
THE RHODESIAN CAVE

1907—Mennell (F. P.) and E. C. Chubb. On an African Occurrence of Fossil Mammalia Associated with Stone Implements.²¹

"Our investigations have been chiefly based on specimens in the Rhodesia Museum presented by the Broken Hill Company, Mr. Franklin White, Mr. Marshall Hole and others, as well as on other material for the opportunity of examining which we are indebted to Mr. White and to Mr. F. G. Colville.

The Rhodesian Broken Hill Mine is situated about 150 miles north of the Kafue River in North-Western Rhodesia. It contains extensive zinc and lead deposits which have a prominent outcrop in the shape of two small hills or "kopjes" rising out of a "vlei" or swampy flat. The surrounding country is chiefly limestone, which is associated, in proximity to the ore-body, with schistose rocks, evidently altered sandy and shaly sediments, together with crushed bands of the limestone itself. There is granite not many miles distant, but the ores do not appear to have any direct connection with an igneous rock; they seem rather to be related to faulting and shearing of the limestone at its junction with the schists. Surface specimens of the limestone are usually somewhat coarsely crystalline, and white or grey in color with few impurities save quartz. Lower down in the workings they are often black or reddish in color and closely resemble the Carboniferous Limestone of Somersetshire. Under the microscope, however, they differ *in toto*, having a foliated structure in even the most compact-looking specimens. It is probable therefore that the sugary appearance of the outcropping rock is due to some form of surface alteration. It cannot be attributed to pressure or contact metamorphism, as it would in that case be just as apparent below ground as it is above. The limestone is highly magnesian and sometimes approaches a true dolomite in composition. No definite silicate minerals can be detected under the microscope.

The feature of the ore-body with which we are now chiefly concerned is the extraordinary accumulation of mammalian bones in No. 1 Kopje. Beautifully crystallized phosphatic minerals have also been found in No. 2 Kopje, but although it would seem a natural inference that they are due to the interaction of the metalliferous solutions with the lime phosphate of bones, none of the latter have been met with. The amount of bones in No. 1 Kopje is enormous. They occur in the central part of the kopje and almost continuously beneath it, below the level of the surrounding flats. It would appear that the bone deposits represent the infilling of a large cavern in the limestone, perhaps with a kind of swallow-hole leading down from the top of the kopje, though there is no actual opening at the present time. It is difficult from the data at present available to determine with any certainty the relative ages of

²¹Proc. Rhodesia Sc. Ass., Bulawayo, VI, 1907.

the different layers of bones, but their accumulation must have taken a very long period of time. There are masses of bones almost free from other substances, and there are interspersed muddy layers containing zinc compounds, but free from bones. Much of the material, however, which shows no large bones, yields on disintegration innumerable bones of rats, shrews, birds etc. The bones are in nearly all cases partly or wholly converted into zinc phosphate (hopeite?). They are therefore truly fossil, the organic matter having disappeared and having been completely replaced by mineral substances. Vughs in the deposit are often lined with magnificent crystals of the rare mineral hopeite and they also show at times more or less dendritic coatings of a substance which at first was taken for amorphous zinc phosphate, but which is rich in vanadium and may really be a calcium vanadate. The new triclinic zinc phosphate "tarbuttite" occurs in No. 2 Kopje with cerussite, hemimorphite, hopeite, pyromorphite and vanadinite or descloizite, and does not seem to be found in the bone deposit.

The bones make up vast accumulations of isolated broken fragments. Whole bones are the rarest exceptions, and are exceedingly difficult to extract even when discovered. There never appear to be a number of bones belonging to the same animal occurring together, as would be the case if they had died naturally on the spot or been accidentally engulfed, in the way suggested for the well-known occurrence at the Winnats, Castleton, Derbyshire. It seems certain that the deposits as a whole represent the materials accumulated during alternating occupations of the original cavern by animals and human beings, with intervening periods when the cave was untenanted probably owing to flooding with water. The animal occupants were such as are found together in the Rhodesian caves of the present day, namely hyaenas and porcupines, no doubt accompanied by owls and bats. Some of the bones show signs of having been gnawed by hyaenas, and there can be little doubt that many of them were dragged into the place when it served as a hyaena den. Most of the smaller bones are probably to be accounted for in a somewhat similar fashion, the rats, shrews, etc. having formed the prey of owls and the bones having been ejected in the usual pellets after the birds had assimilated the more digestible portions of the bodies. An examination of modern owl pellets entirely confirms this view, as these latter show the same predominance of head and leg bones as do the washings of the Broken Hill deposit. As usual with mammalian remains, lower jaws are particularly prominent. Those parts of the deposit which contain implements, no doubt owe their accumulation in great part at least to human agency, the bones being relics of the food supply of the ancient inhabitants. It may at once be stated that the contemporaneity of the implements and bones is entirely beyond question. Masses of the deposit full of bones when disintegrated by soaking in water, are found to contain embedded implements. These latter are of a rude order and mostly made of quartz, owing of course to the absence of any more suitable material in the vicinity. There seems to be a strong prejudice in England against the genuineness of implements

made of quartz, and it may therefore be well to emphasize the fact that some are made of chert brought from a distance, and it may also be well to point out that quartz is a very common material for Bushman implements, which the Broken Hill ones much resemble. Knives, scrapers, and grooved scrapers are the common types. Some of the bones show indications of having been cut previously to their mineralisation, as if to make implements, though no finished bone implements have so far been brought to light. One tibia of a moderate-sized ungulate in the Rhodesia Museum has had a nearly circular hole made in it prior to its replacement by zinc salts. This may be attributed to a wound from an arrow of the Bushman type or it may have been bored with a view to making an implement or ornament: in either case it must be due to human agency.

With regard to the age of the deposit it must represent a long period of time in all, but it will be noted from the subjoined list that nearly all the bones appear to be referable without much doubt to recent species inhabiting the country at the present day. It is probable, however, that some may represent closely allied but really ancestral forms, and this certainly appears to be the case with the species of *Diceros* (rhinoceros) of which two well-preserved bones are now in the Rhodesia Museum. It is unfortunate that we are not in possession of skulls or teeth of this animal, but we think there can be little doubt as to its being new, and it has therefore been thought well to give it a name for convenient future reference.

The mineral condition of the bones and the obvious changes in the physical features of the locality since the deposit was formed are entirely in accord with the idea of its being of very great age from an anthropological point of view. There consequently appears to be every justification for our belief that the evidence affords the strongest presumption of the great antiquity of man in this part of the world, and that further investigations, which we hope shortly to undertake, will reveal even more convincing proof on this head.

LIST OF VERTEBRATE REMAINS

BY C. E. CHUBB

The following is a list of the vertebrates represented by teeth or bones, and identified as accurately as is possible with the scanty material at my disposal for comparison. "R. M." after a description indicates a specimen in the Rhodesia Museum.

MAMMALIA

INSECTIVORA

An almost complete skull, two or three upper jaws, and numerous lower jaws of shrews. (R. M.)

CARNIVORA

Felis leo, Linn. A right ramus and a few odd teeth.

Felis spp. The canine of an animal about the size of a leopard, and one about the size of *Felis ocreata*. Also two lower jaws apparently belonging to *Felis serval*.

Hyaena sp. A right ramus belonging to a hyaena, but it does not agree exactly with *H. crocuta*. (R. M.)

Viverridae. The right ramus of a member of this family about the size of a large genet.

RODENTIA

Tatera sp. Several upper and lower jaws. (R. M.)

Otomys sp. A number of lower jaws showing the characteristic laminated molars and grooved incisors. There are also one or two odd incisors and molars. (R. M.)

Mus spp. Great numbers of lower jaws and a few portions of upper jaws belonging to several different-sized species. (R. M.)

Bathyergidae. A right ramus without teeth, approximating to *Georchus capensis* in size. (R. M.)

Hystrix sp. A complete ramus and an odd incisor.

UNGULATA

Phacochoerus aethiopicus, Pall. A right upper tusk and a portion of an upper tusk, showing scraping and chipping by human agency. A lower tusk.

Elephas africanus, Blumen. The proximal portion of a humerus, and part of a scapula.

Diceros, Gray. Two complete bones, a left humerus and a right tibia, of a rhinoceros excavated by Mr. Franklin White, were presented by him to the Museum. (R. M. No. 546) On comparing these with bones of the modern *D. bicornis* I find they differ so materially as to warrant their recognition as belonging to a distinct species. This may be known, after the discoverer, as *Diceros whitei*, sp. nov.

Diceros whitei, sp. nov. The humerus of this species differs most remarkably from that of *D. bicornis* in the shape of its distal end. The olecranon fossa is very much narrower than in *D. bicornis* being 29 mm. in diameter, as compared with 51 mm. for a specimen of the latter. Indeed, the whole bone, although evidently that of a fully adult individual, is smaller and much slighter in proportion to its length, which is 330 mm. from the trochlea to the head of the humerus, while *D. bicornis* measures 358 mm. The tibia, although not differing to the same extent as the humerus, is nevertheless slightly narrower in proportion and a little shorter. This species is evidently a form of rhinoceros smaller and less heavily built than *D. bicornis*. For this reason it is also distinct from *D. simus*, and from *D. simplicidens*, Scott. which is likewise larger than *D. bicornis*. I hope shortly to publish figures showing fully the differences between the species.

Equus sp. Several molars probably belonging to a zebra.

Connchoetes taurinus, Burch. The basal portion of a horn-core.

Strepsiceros strepsiceros, Pall. An imperfect horn-core.

Taurotragus oryx, Pall. Portion of a horn-core.

In addition to the above there are in the Rhodesia Museum a number of bones and teeth of various other antelopes, not identifiable with certainty.

AVES

An incomplete pelvis of a small bird, an ulna and several leg-bones.

AMPHIBIA

The ischial portion of a frog's pelvis; also an astragalus and calcaneum.

FURTHER NOTES

1908.—A second and even more intimate report on the Broken Hill cave soon follows (September 26, 1908). It is a communication by Engineer Franklin White, at that time employed by the Broken Hill Mining Company, to the Rhodesian Scientific Association.²² The paper, the title of which is "Notes on a Cave Containing Fossilized Bones of Animals, Worked Pieces of Bone, Stone Implements and Quartzite Pebbles, Found in a Kopje or Small Hill Composed of Zinc and Lead Ores at Broken Hill, North-Western Rhodesia" gives in the main the following information:

"The geological formation is limestone with some beds of sandstone conglomerates and phyllites. The country in general is very flat, excepting where the sandstone ridges rise a few feet above the general level. . . . Around Broken Hill, however, there is a series of kopjes or small rugged hills composed chiefly of ores of zinc and lead, the top of the highest (No. 2) being about 90 feet above the ordinary ground level. . . . The outcropping zinc and lead ores have been much weathered, forming crevices, rough crests and ledges which at times are sufficient to form lairs for wild beasts, or even to afford a slight shelter for human beings, such as Bushmen, but nothing which can be properly called a cave has been found from the outside of these kopjes neither are there any indications of blocked-up entrances to passages or caverns. Owing to the flat nature of the country, the water in the rainy season stands in numerous pools and can be found in shallow excavations a foot or two in depth. During the dry season the numerous crevices in the limestone afford passage for the water to drain off and the natural water level is then about 18 feet below the ordinary surface. There is therefore an annual rise and fall in the water level underground which will vary according to the rainfall, which is from 23 to 40 inches per annum, the wet months being November to March. . . . A deposit of fossilized bones, teeth and cores of horns had however been found on the North-east side of the hill when a large quantity of carbonates of zinc, lying on the flank of the hill, was quarried away. The bones were found in a layer of sandy clay about four feet thick, the top being about 3 feet below the surface level.

Beneath the bone layer was a stratum of damp clay, and this rested on ore of the ordinary class. This bone deposit was quite covered over by calamine ore. The bones were highly mineralized, the phosphates of lime being converted into phosphates of zinc. The fragments found were very small, seldom being obtained more than six inches long and

²²*Proc. Rhodesia Sc. Ass.*, VII, 1908, Part 2, 13-21.

were not at all in well defined layers. The northern end of the deposit has not yet been excavated. A lower tunnel $17\frac{1}{2}$ feet below the others, was driven later on from the south west to north east right under the hill, the entrance being from inclines commencing some 20 feet away from the foot of the slope of the hill. At 34 feet from where the tunnel began, the solid ore was replaced by a mixture of rather dull yellow clay in which were embedded numerous fragments of broken bones, teeth and cores of horns of animals and splinters and flakes of white quartz. It was considered advisable to ascertain how much space was taken up by this mixture of clay and a cross-drive or tunnel was made towards the north west extending for 44 feet. The tunnel reached a face of solid ore dipping steeply to the north west. No examination was made on the south eastern side of the lower tunnel. A cross tunnel was then driven westwards from the main or surface adit, at 45 feet from the entrance, and at 25 feet the cavity was again reached the top being nearly level with the tunnel. The width from east to west was thus shown to be some 24 feet. The length, on a line running nearly north and south is at present proved to be 80 feet.

Description of the Cave. This cannot be given very completely at present as the work of excavation is suspended for a time. The north western end at the lower level, and the south eastern end at the upper level are exposed, and the position of the north eastern edge can be fairly accurately determined by the points of intersection at the lower tunnel, by the cross-drive, and by the fact that the southshaft is in solid ore. The south western edge is still undetermined.

There is clay and earthy material still in the bottom of the cross-drive at the end. There are only a few pieces of bone below a line drawn 4 feet above the floor, or say $13\frac{1}{2}$ feet below the surface level. This may be due to the permanent water level being close by and therefore this portion of the cave would be less frequently occupied. The black earthy and clayey materials forming the lower half of the cross-drive are in distinct layers. In one layer were found some small lumps of sulphide of lead which had apparently been formed there. A section of this end of the cave and its filling shows the following features: The layer, in which bones are most abundant, dips a little to the south east. Present roof of cave. This is composed of a soft, easily disintegrated clay, in which lie pieces of quartz, broken bones of larger animals and innumerable little bones of small animals, some of which have been identified. The roof is thickly studded with beautiful clear white crystals of phosphate of zinc (hopeite). Towards the north another class of small crystals becomes frequent. These are dull red or brown and resemble short moss. The solid face of ore is covered with them. The yellow clay stratum comes within about $1\frac{1}{2}$ feet from the roof and with the aid of a strong light it can be seen that this open space extends for some distance upwards. On top of the clay, crystals of phosphate of zinc are also numerous. In the clay stratum pieces of bone, teeth etc. are in large numbers and in the side of the tunnel a piece of a large bone some 8 inches wide was found. Below the yellow stratum the filling lies in

very distinct thin layers which however do not run evenly, but dip in several directions as shown. A thin seam of carbonate or lime crystals runs downwards through this filling which is of a blackish colour and corresponds to the residue which would be left from the decomposition of limestone. The fragments of bone became very scarce towards the bottom of the tunnel. It will be noticed that the filling in of the tunnel has receded or settled down from the roof and back from the end of the cave.

Another noteworthy feature is that the roof at this place is neither ore nor limestone but clay and with it are mingled innumerable small bones and also some pieces of large bones. These facts will be referred to later in the paper. The portion of the cave exposed in the tunnel from the upper drive presents some different features. The roof is limestone, the bone layer is not so thick but the bones are larger. They lie on a bed of soft black debris, are considerably altered, evidently by contact with zinc bearing solutions and are coated with a thin blackish film which cements them together so firmly that great care is required to separate them from each other. The bones identified as a species of rhinoceros were found here in a position which indicates that they must have been thrown in as it were in a corner. In no instance do the bones lie in such a manner as would indicate that they formed part of an entire animal. They are generally broken, but show no signs of having been gnawed by carnivora. On the other hand there is distinct evidence that the cave was occupied by human beings of a very low type.

Evidences of Human Occupation. These can be summarised as follows: Stone implements, chiefly flakes of white opaque quartz, not at all suitable for such purposes, some nevertheless showing distinctly the chipping, cutting or scraping edges and notches. Implements of a close grained reddish stone, one being distinctly serrated. Bones showing cuts or notches, one being chipped into a rough hexagonal form. Pieces of bone, ivory or horn, shaped as if used for digging roots. Large rounded pebbles of quartzite which must have been brought from a distance and were probably used for breaking up marrow bones. The size of some of the bones and position and manner in which they are found makes it very improbable that they are the remains of animals which have died in the cave from natural causes or have been dragged in by beasts of prey.

Formation or Origin of the Cave and its Subsequent Filling in. Although, in view of the little exploratory work done, it is rather premature to advance theories regarding these points, the following suggestions may be put forward as affording a possible explanation. The well defined, nearly vertical face of solid ore which forms the north west end of the cave may be the result of subsidence caused by the ore or rock below having been dissolved away by underground currents of water, or by thermal springs. This large cavity having been formed, it may have become filled up by clayey matter, bones etc. washed in from above, and a subsequent subsidence having taken place, a portion of the filling may have remained behind, thereby forming the roof of the present

cave. No entrance has been found, although the southern face of the hill has been scraped clean in benches in taking away ore.

The second filling up of the cave may have been as follows: In the yearly rise and fall of water due to the recurring rainy and dry seasons, the fine particles remaining from the disintegration of the limestone would sink down until the bottom was raised to such a level that it would for a great part of the year serve as a habitation for human beings. During each rainy season the rising water would force the inhabitants to retire or occupy the upper part of the cave, and season by season fresh layers of bones, rubbish, stones etc. would raise the floor still higher.

The entrance may not yet have been discovered, it may be small. It may have been blocked up by falls of rock or covered over by gradual deposition of ore from solutions, as was the case with the bone deposit on the eastern side. It is probable that the entrance was closed up in some way, and that gradually the earth, clay and bones forming the floor or filling settled down and receded from the sides and roof during the recurrent dry seasons. During this period the beautiful crystals of different minerals already referred to, would be deposited from the solutions permeating the mass of ore in the hill. . . . Many of the animal remains have been examined in the Rhodesia Museum by Messrs. F. P. Mennell, the Curator, and Mr. E. C. Chubb, the Assistant Curator with the result that the following identifications have been made."

Mr. White's communication is followed by Mr. E. C. Chubb's "List of Vertebrate Remains" from the cave (already given), and to this is added a Discussion which brings out or accentuates a number of further points of interest:

"Mr. Marshall Hole: What interested me and probably many others in the room most was the evidence afforded on the immense antiquity of man in South Central Africa. I paid a visit to the cave in June of the present year and was struck by the fact that the chipped implements of which I found and brought away several specimens, were confined to a small portion of the cave and that the deepest. I also found a bone which had been perforated probably for use as an ornament and this is now in the Bulawayo Museum.

Father Goetz asked: (1) In what part of the cave were the stone implements found? (2) In what part of the cave were the bones of the extinct animals found? (3) How was the cave formed? Was it not a subterranean cave whose top had fallen in, so that the filling up had come from above?

Mr. Colville: I believe the extinct species was found in the upper level in which the greatest number of large bones are found. The stone implements lay thickest in the lower level anywhere where bones were found but there were also some near the large bones in the upper part. I think it likely that at different periods the cave was occupied by humans and then abandoned for some reason when hyaenas and other animals would occupy it, then probably by humans again for a period and so on for ages.

Mr. Chubb: Among the bones examined by me and which have now gone to the British Museum there was one at least which appeared to show evidence of having been gnawed by hyena; I suggest that for a certain period the cave may have formed a hyena den. This would account for a certain amount of the larger bones found in the cave. But to account for the small mammal remains I think that the cave might possibly have provided a roosting place for owls and the pellets of bones which these birds throw up, accumulating for years would yield a great quantity of remains. On the other hand it may be that a large area of surrounding country had been subjected to sudden flooding, in which case all the smaller terrestrial animals would be drowned and carried away by the torrent which might have led into the cave; and the water then draining through would leave the bones behind. It is well known that in the valleys of some of the large South American rivers all the small mammals are often killed in this way.

Mr. Mennell: The paper is of much interest as dealing with the first instance out of Europe and the Mediterranean region of stone implements being found in association with extinct animal remains. Besides the rhinoceros described by Mr. Chubb the jaws of lion and hyena from the deposit did not altogether agree with modern examples and it is quite possible that a number of extinct species will be found."

APPENDIX II

THE FINDING OF THE BROKEN HILL SKULL²³

THE MYSTERY OF THE GREAT BONE CAVE

The ancient skull which has just recently arrived from Rhodesia and has excited the keenest interest in scientific circles, was unearthed at a depth of 60 feet below water level in the Rhodesia Broken Hill Development Company's mine at Broken Hill, Northern Rhodesia and has been presented by the proprietors of the mine to the British Museum.

No little excitement was caused in the far-away mining camp when it was known that a skull had been found in the mine, and many heated discussions took place among the miners, as to whether it was a large ape's skull or that of a human being. The native laborers were not so interested however; so after the native foreman had sent the skull to the "white boss" they went on with their digging, and so broke into pieces what would have been a far more important discovery, that of the complete skeleton of this early ancestor of man. It was after the manager of the property had seen the skull that it was decided to put it aside and make a search for further remains, and so we were able to recover a leg bone, collar bone, portion of shoulder blade, also portion of the pelvis with coccyx attached, and part of a lower jaw, together with various parts of other bones not identified, and most of the pieces of the mineralised cast of the body. The only other large bone found near these human remains was a smashed skull of an animal similar to a lion; also a round stone similar in shape and size to the stones the present-day natives use for various grinding purposes.

²³By William E. Harris, "The Illustrated London News," Nov. 19, 1921, p. 680.

One can easily imagine a fight to a finish between man and beast in those far-off, dim ages.

The mine, which is at present an open quarry, has been famous for its "Bone Cave" amongst geologists and travellers for some years, and is situated some 650 miles north of Bulawayo. It was at the foot of this "Bone Cave" that the skull and other human bones mentioned were found, constituting the only human remains out of the many hundreds of tons of bones that have been removed during mining operations. Fossilised and partly fossilised remains of elephant, lion, leopard, rhino and hippo, also of antelope and other cattle, together with tons upon tons of bones of small animals and birds, have been found. The writer has stood at a place where this "Bone Cave" has been cut through and has pulled out from the *débris* various fossilised bones, such as jaw bones, skulls of small animals and teeth all of which were destined to be passed through the smelters to obtain the metals which have replaced the lime of the bones; for chemical examination has shown that the lime has been largely replaced by the phosphates of zinc and lead.

The discovery of this skull is made doubly interesting when the mine and particularly the "Bone Cave" itself are considered. Before mining operations commenced, there stood at this spot a kopje or hill 50 to 60 feet high, with a slight depression in the centre. Mining operations have demolished this hill, and have excavated to the depth of over 90 feet below ground level where the hill stood, and it was at this depth that the skull was discovered. The entrance to the "Bone Cave" was at ground level. One of the early prospectors who visited it before mining operations commenced, has described the cave as being practically filled with *débris*. After one had crawled over this obstruction and stood upon the floor of the cave proper, it could be seen that bones of various animals were scattered all around. The floor was made of loose *débris* and fairly dry. The walls and roof were studded with crystalline deposits, which, when lighted up with the rays of a candle or lamp, reflected back the light, making a veritable fairy cavern, whilst bats and owls, disturbed by the unaccustomed lights, flew around, much to the visitors' discomfort.

It is believed that the cave extended some 120 to 150 feet in a horizontal or slightly dipping direction, from west to east. The walls and roof consist of dolomite and zinc silicate, the floor of loose material to a depth varying from 4 to 12 feet, consisting almost entirely of fossilised or partly fossilised remains of animals. Under this carpet of loose material is rock similar to the walls and roof. Thirty feet below the level of the entrance of the cave is the original water level. At about 10 feet below water level, the cave takes a decided dip, and is filled to the roof with loose *débris*. At 40 to 50 feet the walls have disappeared altogether, and the bones are surrounded with a soft, friable, lead-carbonate ore. As this constituted the main body of the ore around the lower portion of the cave, the theory has been put forward that the zinc in the ore has been leached out by the action of water and so caused a general subsidence which would account for the depression on the

top of the original kopje and also for the subsidence of the cave from its supposed original horizontal position.

How did these bones get into this cave and how long have they been accumulating? How did the skull and other bones of the skeleton, the only human remains found there, come to be at the toe of this cave, with tons upon tons of bones above them?

One prominent geologist has suggested that the bones have been placed in the cave by human agency. In amplification, another suggestion has been that the original cavern may have been an extremely ancient mine-shaft which was later used as a dumping pit for animal refuse by a tribe of hunters. But the obviously great antiquity of the skull would discountenance the mining theory, while the enormous quantity (some hundreds of tons) of animal bones and the fact that more than 90 per cent of them are so small that the animals must have been far too little to serve as food for human beings, rather tends to cast doubt on the dumping theory.

Another theory, that these bones have been washed into the cave by periodic floods at the times of rains, cannot stand, as all the bones are loose and not cemented together with mud, as might be expected if they had been washed off the surrounding veldt. Also, where could such masses have come from?

The theory that these animals were engulfed whilst taking refuge from some natural upheaval, such as fire or flood, is likewise untenable, inasmuch as at the toe, where the skull was discovered, apart from the skull only small bones have been found. The larger bones were deposited nearer the mouth, and from their condition must have been a far more recent deposit than that of the skull or surrounding bones.

Truly, the whole subject is an astounding mystery.