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# THE KREFFT TOOTH—IS IT A HUMAN MOLAR?

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(Plate xiv and one Figure.)

This tooth fragment has had a long and somewhat varied career in Australian palaeontology in relation to the problem of man's existence on this continent. Its importance has been one of wax and wane—for there seems always to have been some doubt as to its authenticity as a human fossil fragment.

Through the courtesy of the Director of the Australian Museum, Sydney, the present writer has had the opportunity of making a close study of the specimen.

The question of the geological age of this tooth fragment involves the general material from the site of its discovery—Wellington Caves in New South Wales—and is outside the scope of the present study, which is solely a matter of dental anatomy. As the specimen never seems to have had the critical attention of anyone specially interested in human dental anatomy, the present account is an attempt seriously to review the question of its human origin or not.

The following references and brief extracts do not entail a complete bibliography of the Krefft tooth, but will be sufficient to give an outline of the history of this interesting specimen.

In 1867, in a list of fossil and recent Australian vertebrata, Krefft records: "Homo. Melanian variety. Bones of the extremities found in a cave at Wellington Valley—left and right femur, left and right tibia, left and right humerus, portion of fibula."

In 1870, in a museum guide to fossil remains exhibited, Krefft mentioned portion of a molar tooth he had found among fossil material from the Wellington Caves, associated with such remains as *Diprotodon* and *Thylacoleo*.

In 1871, in a later edition of the 1867 list of vertebrata, he wrote: "Of man, we have but scanty evidence regarding the length of his existence here; in not one instance were weapons or implements obtained with the remains of fossil animals." No reference was made to the tooth fragment.

In 1874, in an article discussing the finding of fossil remains of a large extinct wingless bird in Australia, Krefft made the following statement: "I have found the fractured crown of a human molar in the same matrix as *Diprotodon* and *Thylacoleo* at Wellington in this Colony. Man may therefore have been the contemporary of these animals and also of *Dromornis*."

In 1882, in connection with the Wellington Caves material, Krefft compiled a "List of photographs of Australian fossils", for transmission to Professor Owen. The description (p. 5) of the figures and the illustrations at the end of the volume (including two of the supposed human molar) do not appear to correspond. And incidentally, the list of descriptions for Plate II contains the statement: ". . . also the 5th metatarsal bone of a man (recent)." This may have been included among the bones referred to in the 1867 extract. The 1882 reference includes this metatarsal bone among fossils; and if it is to be considered as such, it seems to have been overlooked in subsequent discussions on Australian human fossil remains. Of its significance the present writer can make no suggestion. Also on page 7 of this 1882 publication is a reply from Owen to Krefft, which includes the statement: ". . . the only disappointment

was the absence of human remains and works." And later, page 13, is the statement: "In the Caves at Wellington, no vestiges of man, whether in the shape of bones, weapons, or works of art, have been discovered."

The above extracts show the doubtful occurrence of man as a fossil in the Wellington Caves.

R. Etheridge, junior, wrote a number of papers, ranging from 1890 to 1916, in which he made reference to the Krefft tooth. It will not be necessary to quote from more than one of his articles (1890) to show his views on this particular specimen. This paper includes a more lengthy account of the tooth fragment, thus providing a further chapter in its history. He wrote (p. 262): "We now come to what would at first sight appear to be the most reliable evidence of the geological antiquity of Australian man, but after a careful weighing of the facts I do not feel justified in attaching to it that amount of importance which the discovery would seem to warrant. I refer to the important statement by the late Gerard Krefft, which he published on at least two occasions, of the occurrence of a human tooth in the Wellington Cave breccia." On page 263 he went on to say: "That it is the crown of a human molar is, I think, beyond much doubt; but to guard against mistake I placed the specimen in the hands of Mr. P. R. Pedley,\* who corroborates Mr. Krefft's determination, and further suggests that it is probably of the upper right series." Then on page 264 follows a detailed account of the tooth fragment which will be referred to later. On page 265 he stated: "The tooth appears to be completely fossilised, for in comparing it with the teeth of the larger marsupials from the Wellington Caves, the mineral condition is without question similar." Then again: "To sum up, it may be fairly stated . . . that the molar crown found in the Wellington Breccia Cave appears to be that of a human being, and is to all intents and purposes a fossil."

C. Anderson (1926) considered the tooth may belong to a later period than the bones of the fossil breccia.

More recently, the late D. J. Mahony (1943) published an excellent paper summarizing the subject of man's antiquity in Australia. He referred to the Krefft tooth; but here again the authenticity of the specimen is left under a shadow of doubt.

Very little attempt has been made in the past to describe the fragment in detail. The following statement by Etheridge provides the most complete account of the tooth which has been given in earlier discussions. Although his description of the specimen provides little of dental anatomical detail, his wording, as well as the photograph (Pl. xiv, fig. 1) and the diagrams (Pl. xiv, fig. 2) in this paper, will be sufficient to give an idea of its features as they appealed to him. The aspects of the specimen shown in Pl. xiv, fig. 2, have been named in accordance with Etheridge's opinion that it represents an upper molar. The terms used are solely for convenience of discussion and not to be accepted as correct anatomical appellations.

Etheridge (1890, p. 264) described it thus: "The molar consists of about two-thirds of the crown broken off from the remainder of the tooth, the under surface exposing the fractured dentine. The entire crown is so much worn as to almost reach the alveolar border. Regarding the tooth as an upper right molar, the two inner cusps are almost worn away, leaving the sulcus dividing them now, as a ridge. The inner anterior cusp is the portion broken away, the inner posterior being ground quite flat. The outer cusps are worn almost into concavities exposing the dentine, the enamel forming a ring or wall round the inner margin."

\* Mr. P. R. Pedley was a well-known Sydney dentist who took a keen interest in Natural History. He was for many years a prominent worker in the Microscopical Section of the Royal Society of New South Wales. He and Robert Etheridge were fellow members of the Council of the Linnean Society of New South Wales at the time Etheridge's paper (1890) was published. He died in 1918.—Ed.

*Designation as a Tooth.*—That the specimen is a tooth fragment need not be a matter of doubt. The confirmation of its constituent structure by sectioning and microscopic examination might clarify the type of enamel represented—whether human or marsupial. But it is obvious that all who have examined the specimen agree that it shows a remnant of crown enamel and underlying dentine—the latter changed by fossilization.

The broken condition of the specimen and its state of wear have undoubtedly provided a problem concerning its origin, human or otherwise, and the kind of tooth it represents.

Kreffit went no further than describing it as “the fractured crown of a human molar”. From the quotation above, it is seen that Etheridge was apparently convinced that it represents a human tooth—the crown of a human molar. Also, that his consultant, Mr. P. R. Pedley, corroborated Kreffit’s determination and further suggested that it is probably of the upper right series.

*Description of the Fragment.*—For the purposes of description and development of subsequent argument, this coronal fragment is treated in its former designation as if it were portion of an upper right molar. But it must be remembered that the dental terminology here applied is solely for descriptive convenience.

Plate xiv, fig. 1, is a photograph of the specimen; Plate xiv, fig. 2, provides outline sketches of the specimen from various aspects; Plate xiv, fig. 3, is an enlarged diagram provided for descriptive references.

The bucco-lingual and mesio-distal diameters of the fragment are 11.6 mm. and 11.0 mm. respectively. The maximum thickness of the fragment is 7 mm.—in the disto-buccal region.

Viewed from the occlusal aspect (Pl. xiv, fig. 3) the sides of the fragment are marked: B, remnant of the buccal surface; D, distal border; L, lingual border; and M, M, the broken edges of the mesial aspect.

From the buccal view (Pl. xiv, fig. 2, B) only a portion of the enamel remains and the broken inner tissue is exposed.

From the distal aspect (Pl. xiv, fig. 2, D) the main feature of interest is an irregular “worn facet” on the buccal side of the surface (marked × and in dotted outline); this will be dealt with in more detail later.

The mesial aspect, M, presents mainly the markedly broken, irregular exposure of the inner material.

The lingual aspect is important. When viewed as in Plate xiv, fig. 2, L, its lingual features are not as striking as when viewed from an occluso-lingual angle. From this latter aspect it presents three slight convexities, better indicated by reference to Plate xiv, fig. 3, *c*, *d*, and *e*. Surfaces D and L show fine, vertical, brown-stained enamel fractures. But on surface L these three convexities are well defined by the presence of two main fracture lines, more complete and more deeply stained.

The occlusal surface is the most interesting and important as far as detailed examination of the specimen is concerned.

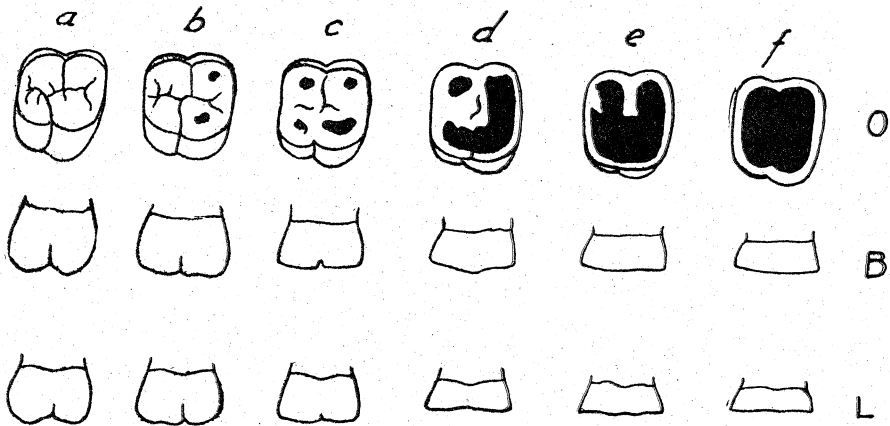
Reference to Plate xiv, fig. 3.—The peripheral margin of the fragment, *a*, *b*, *c*, *d*, *e*, has the appearance of enamel and has a definite translucency when examined by transmitted light. The worn margin at *a* forms approximately a right angle with the buccal surface; while those at *b*, and *c*, *d*, *e*, are worn rounded margins, particularly at *c*, *d*, *e*, which presents a well-rounded “angle” with the lingual surface. The area *f* is also a hard, polished, whitish tissue, continuous with the enamel margin *a* at the disto-buccal angle, and its central portion appears to be the basal portion of a former enamel eminence. The ridge portions marked *g*, *g*, *g*, *g* also are hard, compact tissue similar to *f*. The areas *h*, *h* are slight depressions associated with the *g* portions. This

*g* and *h* region also has the appearance of being a worn-down basic portion of what may have been an enamel ridge formation of the original occlusal surface, but more complex than any part of a human molar. The central main *g* eminence is a worn, but definite, transverse ridge; those towards the mesial side are smaller and less definite. The areas *i* and *j* are "cupped out" depressions (*i* much the larger and deeper) and have the appearance of being a softer material—indicated by scratches on the depression *i*, which has a dull surface compared with the enamel, and no doubt represents fossilized dentine. There is also a small depression due to fracture at the corner *k*.

The under surface of the fragment (Pl. xiv, fig. 2, U) presents an irregular broken mass of dentine. Apart from a fairly well-defined elongate depression at P, about two to three millimetres in depth, which has the appearance of being the remnant of a pulp cavity, this surface does not provide any features of significance.

#### DISCUSSION.

As was stated in the above description, for purposes of discussion, the assumption of previous workers has been adopted—that the tooth is an upper right molar. But in Etheridge's acceptance of this and from his description it is difficult to decide what



Text-figure 1.

he actually meant when he wrote of "inner" and "outer" cusps. He said "... the two inner cusps are almost worn away, leaving the sulcus dividing them now, as a ridge". Presumably this ridge is the central transverse ridge *f* in Plate xiv, fig. 3. Then he went on to say "... the outer cusps are worn almost into concavities exposing the dentine, the enamel forming a ring or wall round the inner margin". The only portions which can be considered concavities are those marked *i*, *j*, and *h*, *h* in Plate xiv, fig. 3. One can only conclude that his descriptive terms are mixed and incorrect.

This previously accepted designation does not fit in with conditions seen in much-worn human molars, which can best be illustrated by comparison with conditions of wear seen in the molars of Australian aborigines.

For purposes of comparative study a series of drawings made from actual aboriginal molars is given in Text-fig. 1. These show progressive stages of occlusal wear and may be briefly described as follows:

As occlusal wear of a molar takes place, first the cusp apices are worn down until the underlying and corresponding "cusps" of dentine are exposed (Text-fig. 1, *b* and *c*). At the same time the superficial enamel grooves or crevations steadily become obliterated. Then attrition of the enamel proceeds with further cusp reduction, leaving larger areas of exposed dentine. These exposed dentine areas, being of softer material

than enamel, tend to be "cupped out", leaving some residual enamel as peripheral and transverse-inter-dentine ridges (Text-fig. 1, *d*). At this stage occlusal wear has reduced the height of the crown to about half of its original height. Further attrition obliterates the transverse enamel remnants or ridges, leaving the whole occlusal surface as an area of dentine surrounded by a narrow marginal ridge of enamel (Text-fig. 1, *f*). More extensive wear will reduce the crown height very considerably, and in extreme examples even the peripheral rim of enamel might disappear when the crown is reduced almost to gum level. A significant point is that on the first upper molar the occlusal reduction is greater on the lingual than on the buccal portion of the crown.

Comparing the aboriginal upper molars with the Krefft tooth and considering remaining crown height, the condition of the latter must be considered to represent a fairly marked degree of attrition—probably corresponding to stage *e* of the aboriginal series.

Considering the tooth, as Etheridge suggests, to be part of an upper right molar, the following points seem important.

(1) Examining it on the score of occlusal wear: If, as has been suggested, the portion of the crown showing greatest wear is the inner or lingual part, the state of crown reduction would probably correspond with the condition shown in stage *e* of the worn series in Text-fig. 1. A crown reduced to this extent could not present the definite residual transverse ridge of occlusal enamel as it occurs in the Krefft specimen at *g*, Pl. xiv, fig. 3. For the same reason it is difficult to explain the persistence of the lesser ridges marked *g*. There is no occlusal enamel which could remain in the particular manner presented in the Krefft tooth.

(2) An upper right molar does not present the marginal contour as seen in the Krefft tooth at L, Plate xiv, fig. 3. The two main convexities, *c* and *d* might be considered remnant curves of the disto-lingual and mesio-lingual cusps, but that at *e* entirely destroys the typical contour between the mesio-lingual cusp and the mesial margin of the crown. This feature is not in accord with the lingual or buccal contour of any human upper right molar, aboriginal or otherwise.

(3) If an attempt be made to complete the occlusal outline of the Krefft specimen in accord with the usual contour of an upper molar, its appearance would probably be something like that shown in Plate xiv, fig. 4, B. This is a result quite unlike any seen in the series of Text-fig. 1. Also this result would probably produce a type of crown in which the antero-posterior diameter would be greater than the bucco-lingual—a proportion not in keeping with usual conditions found in aboriginal or any other human upper molars. It seems that any attempt to restore the original outline gives a result incompatible with the outline of any upper human molar—that of a second or third upper molar even more so than a first.

To proceed a little further with consideration of the specimen being a human molar fragment by completing its contour: With more justification it might have been looked on as portion of a lower molar. All who have previously examined the tooth seem to have considered it an upper molar, but no specific and detailed reasons were given for such a designation. By again viewing the occlusal aspect an outline restoration as in C of Plate xiv, fig. 4, might suggest the appearance of a lower left first molar, the convexities (*c*, *d* and *e* of Plate xiv, fig. 3) representing remnants of the mesio-buccal, disto-buccal and distal (or 5th) cusps of the buccal border. Such an interpretation of this border would be more in accord with usual conditions than treating it as the lingual margin of an upper molar.

However, again applying the criteria of amount of wear and persistence of enamel ridges, the present writer feels that any assumption of it being a lower molar remnant is also unjustified. In the aboriginal lower molar, the greater wear is on the buccal side, again with obliteration of the occlusal enamel features.

*The "Worn Facet"*.—On the assumed distal surface, and involving the disto-buccal angle, is an irregular facet (Pl. xiv, fig. 2, D, x). This feature also attracted the attention of Professor A. N. Burkitt, who mentioned it to the writer in a private communication as possibly similar to the worn facets on the proximal surfaces of aboriginal teeth. But close examination shows it to be quite unlike the usual interproximal worn facet seen on aboriginal molars. Instead of being a flat or evenly curved facet, that seen on the Krefft tooth is an irregular, shallow depression. Moreover, the position of the facet is not the same as in aboriginal teeth. In the latter, if the wear has not been sufficient to form a facet extending appreciably both buccally and lingually, then it commences more to the lingual side of the distal surface of a molar and not towards the buccal angle, as situated in the specimen under discussion.

As an experimental study to further this examination, the writer has taken an aboriginal and a modern white upper molar, both of dimensions approximately comparable with the Krefft fragment, and ground them down to simulate the broken shape and the stage of wear presented by the fossil tooth. The result is shown in Plate xiv, fig. 5. It will be seen that the features of the occlusal aspect of the ground specimens bear little resemblance at all to those of the Krefft tooth and provide further support to the above lines of argument.

As mentioned above, the under surface of the fragment in its present state provides no evidence which helps in its designation.

Consideration of the above points of detail in which the Krefft specimen is so much at variance with the typical conditions of upper aboriginal molars—or any other human tooth—has convinced the present writer that the previously suggested designations of the fragment are incorrect. The criteria of wear, contour, transverse enamel ridge persistence, all go to make it unacceptable as a fragment of any human tooth.

It seemed that the next step should entail an intensive comparative study of this fossil tooth with marsupial teeth, modern and fossil. Mr. H. H. Finlayson, Honorary Curator in Mammalogy at the South Australian Museum, has examined the specimen and his investigations are published in this issue of the *Records*.\* It is likely that only by such a study, and possibly with sectioning and microscopic examination of the specimen, will it be possible to secure a complete explanation of the Krefft tooth—a dental fragment which has occupied a rather special niche in Australian scientific literature for about eighty years.

The writer wishes to express thanks to Dr. A. B. Walkom, Director of the Australian Museum, Sydney, for the opportunity of examining the Krefft specimen in detail; to Miss G. D. Walsh for her painstaking work in the illustrations; to P. S. Hossfeld, H. H. Finlayson and Dr. Chas. Fenner for helpful consultation in the preparation of these notes; to Mr. H. M. Hale, Director of the South Australian Museum, for facilities provided in this study.

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\* See pages 164-170.

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EXPLANATION OF PLATE XIV.

Fig. 1.—The Krefft tooth. View of occlusal aspect.

Fig. 2.—Diagrammatic outlines of various aspects of the Krefft fragment.

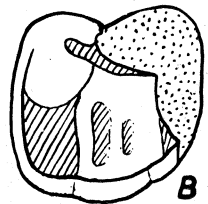
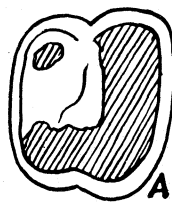
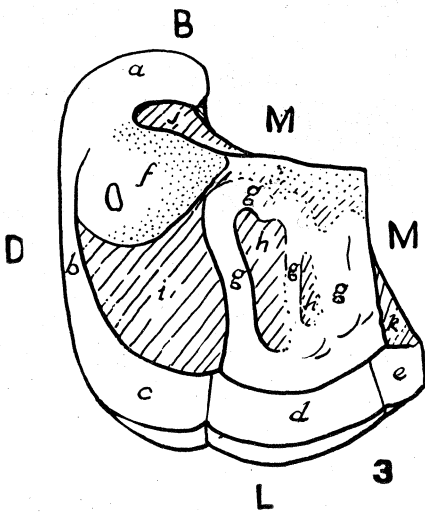
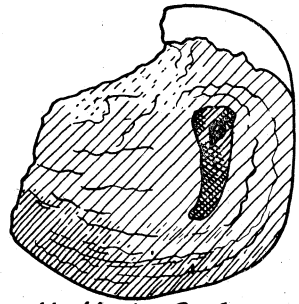
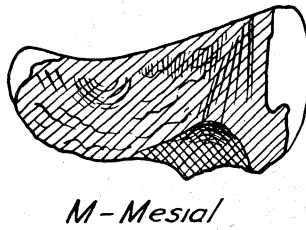
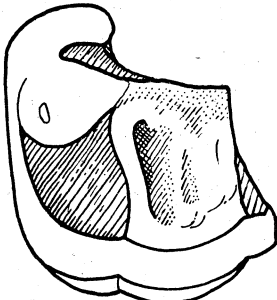
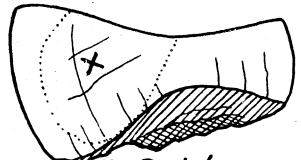
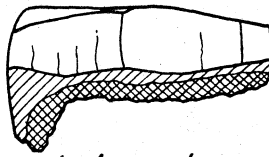
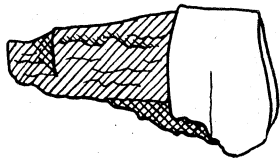
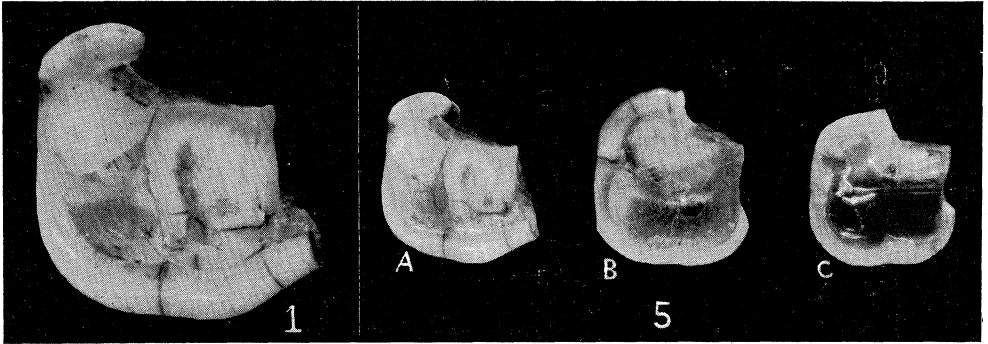
Fig. 3.—Enlarged diagrammatic outline of the occlusal surface of the Krefft fragment, showing its main features.

Fig. 4.—A, outline of a worn upper right Australian aboriginal molar. B, outline of Krefft fragment continued to represent an upper right molar. C, outline of the Krefft fragment continued to represent a lower left first molar.

Fig. 5.—Occlusal views of: A, the Krefft tooth; B, an Australian aboriginal upper right first molar; C, a modern white upper first right molar.

Text-fig. 1.—Outlines of a series of Australian aboriginal upper right first molars, showing progressive stages of occlusal attrition. O, occlusal; B, buccal; L, lingual.





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