Fossil Cetacea of New Zealand.

V.—*Mauicetus*, a Generic Name substituted for *Lophocephalus* Benham.

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In 1937 I published an account in these *Transactions* of a fragment of the cranium of an extinct whale found in the Upper Oligocene* of New Zealand; and to that whale I gave the name of *Lophocephalus parki* (1937a). After the distribution of reprints of that article, my attention was drawn by a zoologist in America to the devastating fact—which I confess I had overlooked—that this generic name had been bestowed already on three animals of widely different groups, viz., on a Gregarine, on a beetle, and on a fish! Hence it is necessary to substitute another name for this extinct whale.

I proposed (*Nature*, May 6, 1939, p. 765) to make use of a Maori prefix to the Greek word for whale, to wit, *Mauicetus*. The delay in rectifying this inexcusable nomenclatural error was due to my absence in Europe during the preceding year, and I was thus out of touch with my correspondence. The present article may indeed be termed a Confession of Errors, as will be seen from what follows.

A.—Further Notes on *Mauicetus parki*.

During the year 1940 I have been in communication with Dr. Remington Kellogg, the distinguished authority on extinct cetacea, who wrote to me to ask for some further details about this cranium, in order that he might compare it with certain allied American fossils. Let me here acknowledge with gratitude the kindness he has expressed in his letters to me, in which he has given me much help and encouragement. In these letters Dr. Kellogg conveys much information of value to one dealing with these animals, and I do not hesitate to incorporate some of the statements in the following account.

His inquiries led me to a more careful examination of each of the two crania mentioned in my former article, viz., the type, which I will term A in the succeeding narrative, which is in the Geology Department of the Otago University; and the skull B, in the Otago Museum. The omission to observe one detail in this skull led me into a number of speculations that have no foundation in fact.

This re-examination showed me that I had overlooked the existence of the fronto-parietal suture, having in my previous study interpreted it as cracks in the parietal bone, of which the skull does exhibit several in this region. But to my astonishment, as well as to my shame, the suture is in reality quite obvious in the skull A, and, indeed, on each side. They are even recognisable in the photograph of that skull as published (*loc. cit.*, pl. 1, fig. 1), and now that I see them it seems incomprehensible to me that I previously should have

* Or, according to Kellogg, Lower Miocene.

overlooked them. That figure was only obliquely dorsal. I now present a photograph of the true dorsal surface (Fig. 1). I went so far as to deny their existence, writing thus: " there is no sign of the suture separating the parietal from the frontal." I then went on to say that the skull was fractured across *behind* the junction of these bones.

Yet these sutures are visible to the unaided eye! Anyhow, this oversight led me to make a daring and wholly erroneous comparison of this *Mauicetus* with a Zeuglodont, one of the group that by many authors is regarded as primitive tooth-bearing whales, with which *Mauicetus* has no relation; I went so far as to give a sort of " restoration " of what the skull would look like were it entire! How true that one little error in life, one little sin if you like, leads one into further errors! For, having allotted the skull to a tooth-bearing whale, I associated certain teeth found at Clarendon and at Waimate with this creature.

Dr. Kellogg pointed out to me the similarity of this skull to that of a cetothere *Aglaocetus moreni* from the Argentine, described and figured by him in 1934.

Perhaps I may remind readers that the Cetotheres constitute a group of extinct baleen-bearing whales, which lived contemporaneously with tooth-bearing forms, just as to-day the Balaenids do with various Odontocetes such as sperm whale, porpoise, cowfish. Thus I fell into the deeper zoological error of associating teeth with the skull of what turns out to be a baleen whale! If any excuse can be offered, it must be due partly to lack of literature dealing with these ancient whales and to my ignorance.

I have referred to the similarity between the Argentine fossil *Aglaocetus* and the New Zealand *Mauicetus* as indicated by Dr. Kellogg in his letters to me. Nevertheless there are one or two features in which it appears to me to present differences which may or may not be of importance. The condition of the supra-occipital shield, its encroachment on to the dorsal surface, was detailed in my previous account. But I suggested that this position was due to downward pressure or crushing previous to fossilisation in my effort to make it conform to the condition in the Zeuglodont, where this bone is vertical. This assumption was gratuitous, for had such pressure occurred, cracks would have resulted in this region; moreover, the fact that both skulls exhibit the same obliquity of this bone was a warning that such a suggestion was wrong. Whereas in the Zeuglodont the supra-occipital is vertical or even slopes downwards and forwards towards the foramen magnum, in the Cetotheres this great forward growth over the parietals is the normal condition. In other words, the " telescoping " of the hinder region on to the anterior region has occurred as it does likewise in the baleen whales of the present time. But in these Cetotheres the anterior region—the rostral region—has likewise been subject to a telescoping action so that the nostrils and their accompanying bones—the nasals—are thrust backwards, reducing the extent to which the frontals appear on the upper surface, so that these bones form only a short band between the parietals and the nasals; only this narrow band appears

on the dorsal surface. But, as I propose to show, this anterior telescoping has not occurred in *Mauicetus* to anything like the extent to which it reaches in such genera as *Aglaocetus, Cophocetus, Mixocetus* and others described by Kellogg (1934) and in many of those described in Van Benenden's great work (1886). In these forms, as the figures show, the rostral telescoping results, as I have just noted, in the extreme shortening of the frontals on the dorsal aspect of the cranium.

Thus in *Aglaocetus* the length of the frontals between the parietals and nasals is merely 24 mm., whereas in *Mauicetus,* in which no trace of the nasals appears in the fragmentary skull, the frontals extend for 45 mm. on the upper surface, but—and here is my point—the bones are fractured; they are 42 mm. thick, so that evidently they extended further forwards. In the second skull, B, while the dorsal region up to the fracture measures 40 mm., the frontal bone extends for at least another 105 mm. further forwards. Neither in the skull A nor in B is there any evidence of nasal bone nor of narial gutter.

Returning to the skull A, the frontal bone slopes steeply downwards on both sides to reach the broken edge 145 mm. below the dorsal line; the length is 90 mm. at about halfway down on the right side, and about 55 mm. on the left, and there is no indication of a horizontal plate, the supra-orbital plate, which is so extensive in most Cetotheres. There is no indication either of any outward projection to form the anterior boundary of the temporal fossa. No doubt these have been broken away. From the considerable length of these frontal bones it is apparent that the nasals must have been a great deal further forwards than in most Cetotheres; in other words, the rostral telescoping which is so characteristic of the group had not yet taken place in *Mauicetus.*

These matters may become clearer if we take the numbers as percentages of the length of the skull, etc. Unfortunately, we do not know the total length in *Mauicetus,* so that I will take the length from the upper margin of the foramen magnum to the fronto-parietal suture and compare the relative length of the frontal in the two genera *Mauicetus* and *Aglaocetus.*

In *Aglaocetus* this length is 408 mm. as measured on the text-figure (which is one-twelfth the natural size). That of the frontal halfway down the side is 25 mm., hence the percentage length of the frontal is 6·1.

The corresponding figure for *Mauicetus* is 32%. Another feature seems to differentiate the New Zealand genus from the more normal forms, so far as I can judge from the literature referred to. Namely, the greater length of the sagittal crest of the parietals. The length of this crest in *Aglaocetus* from the apex of the supraoccipital shield to the fronto-parietal suture is 72 mm., but in the shorter skull of *Mauicetus* it measures 85 mm.

But let us take as the length of skull the distance from the foramen magnum as above mentioned and we have these figures. The length of the sagittal crest as a percentage of the length is: in *Aglaocetus* 17·6%, in *Mauicetus* 30%.

Tabular Statement of These Facts.

	Aglaocetus.	*Mauicetus.*
Length of cranium	408 mm.	280 mm.
Percentage length at side of frontal ..	2.5	9+
Percentage length of sagittal crest ..	17.6	30

We thus have three facts for comparison of these two genera:

(a) the greater extent of the frontal on the dorsal surface in *Mauicetus;*
(b) the greater length of the sagittal crest;
(c) the forward position of the nasals and therefore of the nostrils, though by how much we do not know.

Dr. Kellogg, in his correspondence with me, suggests a similarity of our whale with *Aglaocetus;* no doubt he had in mind my unfortunate comparison with a Zeuglodont; but it does not seem to me that the similarity goes further than to point to our form as being a Cetothere. But though I hesitate to differ from so high an authority, yet the above facts compel me to express the opinion that *Mauicetus* does not fit into the definition of a Cetothere as usually accepted and as reproduced in Kellogg's article. I will not, however, venture to take the next step—to erect a new division of these baleen-whales in which the nostrils are far forwards.

Van Beneden in his account of the fossil cetacea of the neighbourhood of Antwerp (1886) described a species named *Plesiocetus dubius,* of which he states on p. 7 that the median portion of the frontal bones, instead of being reduced in size, has a length similar to that of a normal (terrestrial) mammal, forming a considerable portion of the roof of the cranial cavity. This attracted my attention, and I requested the librarian of the Royal Society of New Zealand to allow me to examine the plates illustrating this species. He most obligingly, since the volume was rather too heavy to be sent by post, extracted the plates and sent them to me.*

In volume IX of these *Annales,* Fig. 2 of Pl. xii represents the dorsal aspect of the skull of *Pl. dubius,* which seems to bear a closer resemblance to *Mauicetus* than does *Aglaocetus,* for the frontal bone is very much longer on the dorsal surface than is usual in the Cetotheres, illustrations of which are available to me (if, indeed, this species is a "Cetothere," on which see later). I was thus able to make measurements of these bones for comparison with those already given for *Mauicetus.* While the frontal bones bear a close similarity in extent, the sagittal crest, on the other hand, has the shortness seen in normal Cetotheres.

Plesiocetus of V. Beneden is now placed in the genus *Plesiocetopsis,* and Kellogg remarks (1934, p. 77) that "*Plesiocetopsis* (*Plesiocetus auctorum*) cannot be allocated on the basis of the interdigitation of the rostral and cranial elements to any of Cabrera's three groups of Cetotheres." Hence it seems that I might be justified in excluding *Mauicetus* from that group.

* I wish to thank the librarians of both Canterbury University College and of the Royal Society for their courtesy in acceding to my requests for literature in which the Otago University is lacking. For without their help and that of Dr. Kellogg this paper would not have been possible.

The Cranium B.

Hitherto my remarks have been concerned with the type skull A, but the smaller one deserves a separate description if only on account of what seems to be a peculiar feature not yet recorded, so far as I am aware, in any other species. This is the presence of a long, narrow, smooth bone which appears to be a forward extension of the supra-occipital. I refer to it as the " Bayonet." The bone tapers somewhat as it passes forward, while at its hinder end it bifurcates, each of its divergent roots being continuous with a lambdoidal ridge. These roots are not quite symmetrical, though I don't lay any stress on this fact (Fig. 2).

When this fragmentary cranium reached me it was manifestly much weather-worn, and at certain places there were more or less extensive heaps of a dark brown semi-crystalline material forming encrustations which obscured certain features. One of these covered the anterior regions of the parietal bones and so concealed the fronto-parietal sutures, which became evident after I had laboriously cleared the encrustation away by scraping and washing.

The region of the parietals is much cracked and splintered, exposing the frontal even behind the suture, which is very irregular and undulating as it passes backwards and downwards to the broken edge of the bone. The frontal is also much crushed in the dorsal region, and is, of course, fractured at its anterior part, leaving near the middle line a narrow-topped ridge on the right side (that of the left is broken away). This ridge extends for a distance of 35 mm. It is not in line with the sagittal crest, for it is one of a pair and seems to be caused by the downward crushing of the frontal bones, one each side, leaving this portion upstanding as a ridge.

The frontals extend forwards beyond the suture as a broad plate on each side for a distance of 40 mm. (on the right side, but less on the left). At its anterior end it had been fractured (as in skull A). Here the fracture is oblique; its lower edge projects still further forwards, and its broken end is 70 mm. in front of the fronto-parietal suture. It is 38 mm. in thickness. On the left side more of the bone has been broken off, thus exposing certain bones belonging to the under surface of the cranium. In the median line is a grooved bone, presumably the vomer; and sloping downwards on either side is a thin bone, the palatine, which is exposed for a length of 40 mm., its breadth being 28 mm. On the right side this palatine is visible for only a short distance owing to the presence here of the frontal, which is above it.

The frontals are convex superiorly, but the parietals are concave at any rate in the upper moiety of their extent. Here as they approach the median line they slope upwards steeply to meet the " bayonet," parts of which are covered by very thin portions of the bones; there is no steep, sharply-marked " crest " as in the other skull. The left " root " is covered and so is a short area at about the middle; this covering part of the parietals is rounded, fitting closely over the " bayonet." The length of this peculiar bone is 65 mm., and the sagittal crest extends still further forward as a low, rounded ridge. No doubt this absence of a marked " crest " such as

exists on the other skull A is due to the great amount of weathering which this skull had undergone.

As this " bayonet " is such a conspicuous feature in skull B and does not appear in skull A, I supposed that it might be present but concealed by the strongly upstanding crest, for the two skulls have so much in common that they no doubt belong to the same species. Inserting a knife in the narrow slit between the two laminae of the sagittal crest in A, I chipped away one of these laminae to a depth of about 12 mm. and exposed near the hinder end a slender median bone, narrower than the " bayonet " and not so smooth, but harder than the parietal bones. The difference in its appearance from that of skull B is no doubt due to the great amount of weathering that B had undergone, this exposing the " bayonet," whereas in A it has remained covered by the parietals and thus protected. The whole of the occipital region in B has suffered from this action of the weather, for even the lambdoidal ridges have been shorn down considerably.

As to the nature of this " bayonet "; lying as it does between the two parietals, one naturally thinks of an " interparietal " such as occurs in various mammals; and which has been described by Ridewood (1922) for certain foetal whales, for example, in a skull of *Balaenoptera borealis* (p. 256). This bone, however, is a broad plate about half the width of the supra-occipital; it is overlapped by this bone behind and by the parietals at the sides. Ridewood refers to the fact that Smets had recorded a similar " interparietal " in *B. sibbaldii,* and there is a similar bone in *B. acuto rostrata,* which as the animal develops becomes fused with the supra-occipital.

In these whales, however, this interparietal is a subcircular, broad, flat plate, unlike this " bayonet." This does not exclude the possibility that the latter may be of the same nature.

A glance at the figures of the two crania (Figs. 1 and 2) will show that there are one or two apparent differences between them; for instance, the length of the supra-occipital shield is less in B than it is in A, while the angle made by the lambdoidal ridges is somewhat greater than in A. These differences may be due to the effects of crushing and weathering. But the length of the parietal and of the sagittal crest is considerably greater in B than in A; so perhaps we have here two distinct species. But I do not feel competent to decide. Or, further, they may be due to growth differences, for in photographs which Kellogg has sent me of two stages in the age-growth of a Cetothere, similar though slighter differences exist.

B.—Notes on Some Bones of a Cetotherian Whale.

Being an Appendix to my Article IV—" Notes on Some Bones of *Kekenodon onamata* Hector."

Dr. Kellogg drew my attention to certain differences that exist between the vertebrae of Archaeocetes, such as *Kekenodon,* and those of Cetotheres. He went to the trouble of having photographs made of the axis and atlas described in my article as those of *Kekenodon* (1937c), and on them indicated the the various points in which they resemble those of a Cetothere and differ from an Archaeocete, of which he also sent similarly marked photos.

I wish here to acknowledge his kindness in thus helping us in New Zealand, lacking as we do so much of the literature necessary, and to thank him for the readiness and courtesy with which he has helped so materially a neophyte attempting to do work on extinct whales. It is true that I had previously consulted his monograph of the Archaeoceti (1936), but had failed to appreciate the importance of the small differences that exist between the vertebrae of the two groups. But I also assumed that all the bones collected by McKay, identified by Hector and exhibited together in one exhibition case in the Dominion Museum under the title of "*Kekenodon onamata*" belonged to the same species whose teeth were described by Hector.

I was influenced, too, by certain remarks by Kellogg in his memoir on p. 227, where he includes under the name of *Kekenodon* not only the teeth on which Hector founded the genus, but also certain "referred specimens" which he enumerated. I quote his words: "McKay (1882) records the finding of the following additional remains of *K. onamata* in the Wharekauri basin . . . (1) a nearly complete skeleton some 23 feet in length; (2) fragments of a skull but no teeth, with tympanic bullae, both scapulae, sternum, numerous vertebrae (including an atlas and axis) and ribs; (3) cervical vertebrae, including the axis and ribs; and (4) vertebrae, principally caudals, which were found near the type specimen."

It appears, then, that Kellogg at that time accepted the view that all these remains collected at and about the same locality were those of the same animal.

There is nothing in McKay's reports that suggested to me that some of these remains might belong to a different genus or species, although I had already found that a jaw with teeth, ascribed by Hector to *Kekenodon,* and so labelled was in reality quite a different whale, *Microcetus hectori* (1936). Yet, apart from that, I took the identity of the rest for granted.

It was after the publication of his *Review of the Archaeoceti* that Kellogg obtained from Dr. Oliver photographs of these various bones of "*Kekenodon.*" He at once recognised the differences presented by them from those of the Archaeocetes. In his letter to me he not only enclosed photographs of the atlas and axis of a Cetothere for comparison with these bones which I had figured as being those of *Kekenodon,* but was good enough to refer me to certain figures illustrating these vertebrae in his *Review,* namely, on pp. 39 and 40 figures relating to *Basilosaurus,* and pp. 131, 132, 133 referring to *Zygorhiza.* When one compares these with the illustrations given by me, one may recognise that the atlas in these Archaeocetes has a hypophysis which is wanting in the Cetotheres: that the axis has a "spout-like" odontoid somewhat like that of ungulates, instead of the low, rounded, conical process of the Cetotheres. These and other details of differences become manifest when they are pointed out.

The accumulation of different species of extinct whales in the same deposit, often mixed together in a confused mass, has been recorded by Kellogg, but at the time McKay made the collections that fact was unexpected. In one of his letters to me, Kellogg writes: "During the past twenty years I have collected nearly every year in the Miocene Calvert marine formation of Maryland and Virginia.

I have been puzzled time and again over the jumbled association of parts of skeletons of two or three different kinds of cetaceans in a space of a few feet. At times we have found two kinds of whale-bone whales mixed with skeletal parts of porpoises. In some instances we did not discover the mixture until the block of matrix was being worked by the preparator.—It is quite likely that the skeletal elements mentioned under Band D in my previous letter belong to some Cetothere." These refer to those skeletal elements described by me in my article on *Kekenodon.*

The upshot of these remarks is that the atlas and axis vertebrae described and figured by me (1937c, Pl. 8) as belonging to *Kekenodon* are parts of some Cetothere. The only member of this group that has been recorded from New Zealand is *Mauicetus parki.* The measurements of the articular surface of the atlas on the one hand and of the occipital condyles of the skull A suggest, if they do not make it fairly certain, that these two bones belong to *Mauicetus.* The distance between the outer margins of the occipital condyles is about 180 mm. As the right condyle had been broken off, the width was estimated by taking the width of the left one, multiplying by two, and adding the width of the foramen magnum; while the anterior surface of the atlas is 180 mm.

In the article referred to I also described and figured (Pl. 9) the scapula, sternum and pelvis which were amongst McKay's finds. Comparison with those of Archaeocetes makes it evident that they do not belong to *Kekenodon,* but are parts of some Cetothere. In that account I pointed out that these bones bear some resemblance to the corresponding bones of living Mystacocetes. Thus on p. 18 I wrote of the scapula: "This is like the blade bone of Mystacocetes, but differs from modern Odontocetes." On p. 19 I noted that the sternum is "not very unlike the condition in Balaenids." And in regard to the pelvis—"the pelvis of *Kekenodon* agrees closely with that of Mystacocetes rather than with that of Odontocetes." Little did I suppose that these bones were really those of a baleen-bearing whale. I had not the courage or the knowledge to question Hector's identification of them as belonging to the toothed *Kekenodon;* moreover, no Cetothere had then been recorded from New Zealand; my own knowledge of the differences in the bones of the two groups was insufficient to allow me to express any doubts on this identification.

We may, I think, assume that the bones described and figured by me in 1937 belong, not to *Kekenodon,* but to *Mauicetus parki.*

C.—THE CLARENDON TEETH—OF *Squalodon andrewi* n.sp.

In my article on *Lophocephalus* (1937a) I attributed to that skull certain teeth obtained years ago from the Clarendon quarry as well as some fragments from Waimate. I figured these teeth (Pl. 3); but as has been mentioned, this skull is now recognised as being that of a Cetothere, which group has no teeth, and so I have a further error to confess.

I remarked, however, on p. 6 of that article that these teeth present the "usual character of shark-toothed whales or Squalodonts," and indicated the resemblances to and differences from those of *Prosqualodon hamiltoni* Benham (1937b), but since I was under

the impression that the new skull under description belonged to the Archaeoceti or Zeuglodonts, I saw no inconsistency in regarding them as probably those of "*Lophocephalus.*"

Now that we know the facts about this *Mauicetus,* we must re-examine the matter of these teeth. They differ from those of *P. hamiltoni,* not only in details of pattern, but in the fact that the two fangs of the root are not united by cement as they are in that species. This seems to be the only difference between the two genera *Squalodon* and *Prosqualodon;* and I am not competent to discuss the question whether it is a sufficient generic character, or what other characters are concerned. However, at the end of that article I referred to a tooth figured, but not described, by Andrew in 1905. Of the four more or less fragmentary teeth one of them shows quite clearly that the two fangs are widely divergent. Other resemblances are to be seen, and I wrote: " This (tooth) may be attributed to the same whale," meaning that described as *Lophocephalus.* As this is the first two-fanged Squalodont tooth to be figured and recorded from New Zealand, I propose for this new toothed whale, whose skull is at present unknown, the title of *Squalodon andrewi* n.sp., to which the Clarendon teeth, figured by me, also belong.

D.—The Balfour Jaw.

Towards the end of the year 1938 I received from Mr. Sorensen, Director of the Southland Museum, information that fragments of an extinct whale had been recovered by him from the limestone quarry at Balfour, in Southland, the geological horizon of which is the Hutchinsonian, in other words, Lower Miocene.

In the *Otago Daily Times* of October 30, the following note appeared: " The body of the skeleton was badly shattered and only a few parts were available, but the head was in a much better state of preservation. The impression which is clearly perceptible in the limestone formation indicates that the length of the head is seven feet and the width three feet, and the thickness of the backbone six inches through." Naturally, this whetted my appetite for " more whales," and I got into communication with Mr. Sorensen, who kindly sent me some of the fragments of bone that he had recovered from the block, which had been removed from the quarry-face to the Southland Museum. These fragments were quite loosely attached to the matrix and fell away when the block was being handled by the quarrymen. Most of them were thin, flat pieces which had no doubt belonged to the palate: two are portions of the mandible; others unrecognisable. But the tympanic bone was included. This was much smashed and had been mended, but is too imperfect for me to describe it.

Fortunately Mr. Sorensen had made a sketch of the " head " while still *in situ* and recorded on it the dimensions (see Pl. 47, Fig. 4). He noted the presence, too, of the tympanic. As the whole block was too large to transport to Dunedin—the mountain would not go to Mahomet—I went down to Invercargill to inspect this new fossil whale. When I saw it the block had been broken across near the anterior end during transport. The specimen is the impression in limestone of the under surface of a skull, bordered on each side by the impress of the mandible, of which here and there are pieces

of the bone. As the figure (Pl. 46, Fig. 3) shows, the mandibles form a delicate curve on each side of the mass which represents the palatal surface. From the hinder end a wide furrow runs forward in the median line; it is six inches (152 mm.) wide, and as it passes forwards flattens out so as to become almost a plane surface 10 inches (254 mm.) wide at a point about 18 inches (458 mm.) behind the anterior end of the fragment. The palate is, of course, convex in the skull. Mr. Sorensen had measured the specimen before it was removed from the quarry wall, and the dimensions are given in the outline sketch. The measurements were taken from the anterior edge of this tympanic bone. The length of the fragment—for it was broken at the hinder end when he saw it—is 69½ inches (1785 mm.) and the width at the hinder end is 20 inches (500 mm.). The tympanic bone was in position when the fossil was seen at the time the measurements were taken, lying almost flush with the surface of the palatal impression, hence the skull would be still longer than these figures indicate. The hinder end is irregularly broken, for more is lacking on the left side than on the right. The palatal impression is bounded by a deep groove evidently the impress of the mandible. This is about 2½ inches (64 mm.) across, tapering somewhat as it passes forwards. The whole of this palate was covered with or lined by flat bone, of which fragments remain, about ¼ inch thick, most of which had fallen away. Posteriorly this groove widens out to a flattish area and then bifurcates the outer limb, still 2½ inches wide, and is separated from a wider furrow by a broad area. This inner furrow may perhaps represent the condyle of the mandible. In parts of this outer groove near the anterior end were some fragments of bone of dark brown colour.

Amongst the fragments of bone submitted to me were two portions of the mandible. One, the larger, is from the posterior region. It measures about 90 mm. in length, 60 mm. in height and 50 mm. across; the section (Fig. 5) is subcircular and exhibits a thin layer of light brown bone on the outside, which is broken away on the upper surface; this surrounds a thick layer of shiny dark brown bone of very solid texture, about 10 mm. in depth, though this is not uniform as the figure shows; within this solid bone is a layer of very loose cancellous texture which in its turn encloses the matrix of limestone. On the outer side of this loose tissue, on one side, are a number of holes filled with brownish material, each surrounded by a thin envelope of pale brown. These I take to be blood vessels.*

The other fragment, from near the anterior end of the jaw, is a compressed oval in section (Fig. 6): it measures 80 mm. in total length, though its broken ends are irregular, it is 50 mm. in height and 25 mm. in thickness from side to side. This region of the jaw is solid; it presents no central matrix, but the centre is traversed by a number of blood vessels and surrounded by the solid dark brown bone, enclosed in the other fragment by a thin layer of buff-tinged bone.

* The relations of the various layers is analogous to the parts of a peach; the light buff superficial coating is the "skin"; the solid dark brown part is the "flesh"; the cancellous layer the "stone"; and the matrix recalls the "kernel" or seed.

To what whale can this mandible belong? The jaw is much too long to be that of *Prosqualodon hamiltoni*, and, moreover, there are no signs of teeth either in the jaw or in the neighbourhood of the fossil, for the foreman made a careful search for them after the visit of Dr. Uttley and Mr. Sorensen. Hence I suggest that this is the remains of the skull of a Cetothere and possibly, even probably, of *Mauicetus parki*, the only member of that group hitherto recorded from New Zealand. The fact that the Balfour limestone is of Lower Miocene age, at which time the Cetotheres flourished, adds to the probability.

If this jaw belongs to a skull of *Mauicetus*, then the skull must have been about the same length as that of *Aglaocetus* (Kellogg, 1934). This is 1800 mm. in length, measured on the text-figures; with a width at the zygome of 804 mm. But its length from the tympanic bone to the symphysis of the mandibles is 1740 mm. The Balfour jaw is 1785 mm. from the anterior margin of the tympanic, and its breadth at this level is 510 mm. It is thus approximately the same.

Kellogg, in his paper on *Nannocetus* (1929), writes of the wide distribution of these Cetotheres as follows: "A rather large number of Cetotheres are known from (Miocene) deposits; the occurrences extending intermittently from southern Russia to Belgium, and on the Atlantic coast of the United States to Patagonia in the south, and in the north on the Pacific coast to California and Oregon." "The closing of the Miocene . . . witnessed the extinction and elimination of even the most progressive of the small Cetotheres and at the same time our modernised whale-bone whales were supplanting Cetotheres in world-wide fossil horizons."

As to the geological age of these whales, I have followed Finlay and Marwick (1940), who place these in the Upper Oligocene, whereas Kellogg, who regards these extinct whales as of great value in determining the age of the rocks, would put these fossils of New Zealand in the Lower Miocene. The former authorities rely chiefly on the character of the mollusca and foraminifera as determinants.

Literature.

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FIG. 1—Cranium A of *Mauicetus parki* dorsal aspect (about two-thirds natural size). *f.*, frontal bone; *f.p.*, fronto-parietal suture; *la.*, lambdoidal ridge; *p.*, parietal bone; *s.cr.*, sagittal crest; *s.oc.*, supra-occipital shield.

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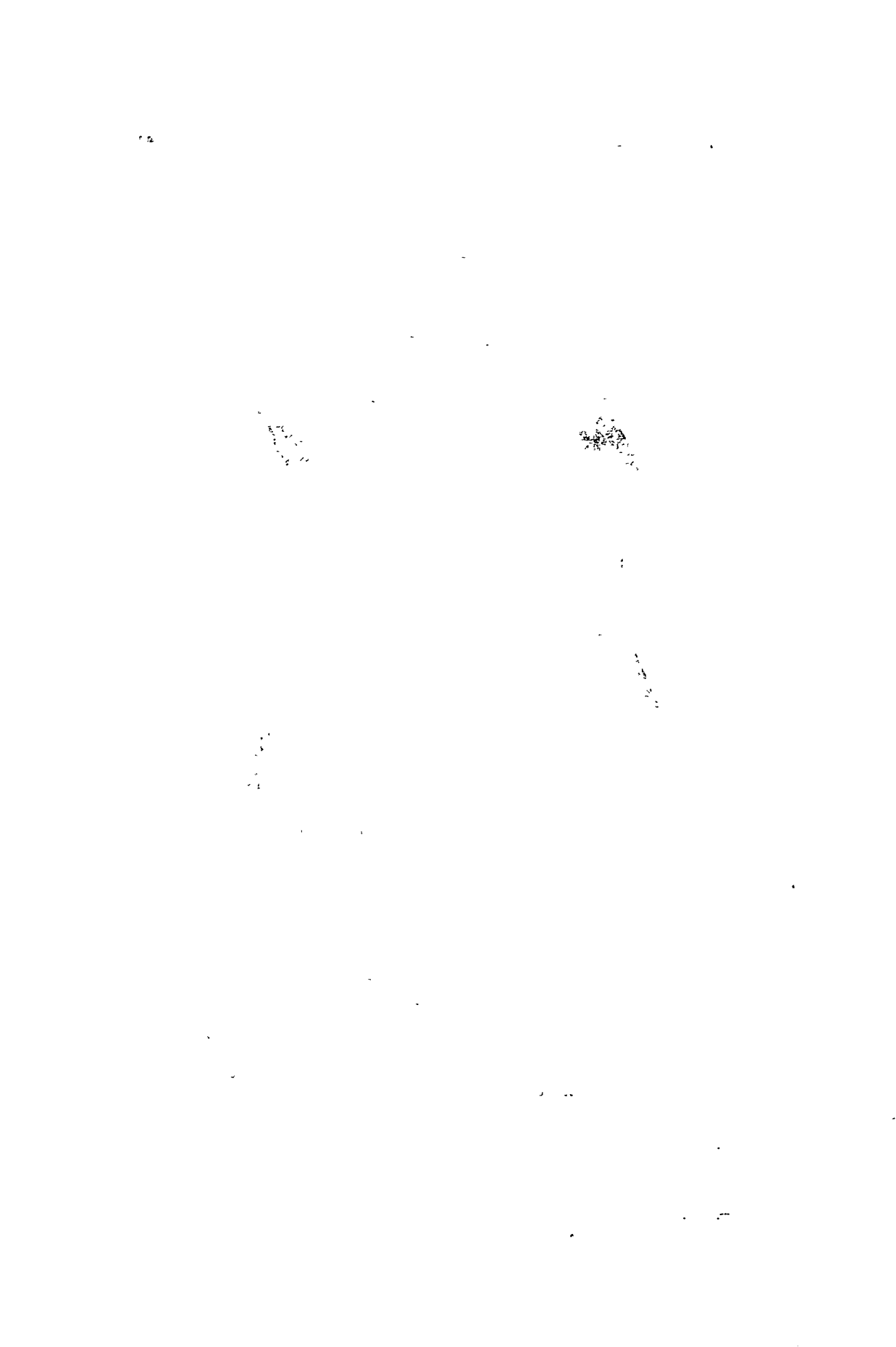

FIG. 2—Cranium B of the same (about two-thirds natural size). *b.*, "bayonet"; *pal.*, palatine; *vo.*, vomer; exposed by fracture of the frontal bone. Other letters as in Fig. 1.

Fig. 3—The Balfour jaw (*?Mauicetus parki*). Photograph by Mr. Sorensen of the block of limestone with impression of the jaw (much reduced).

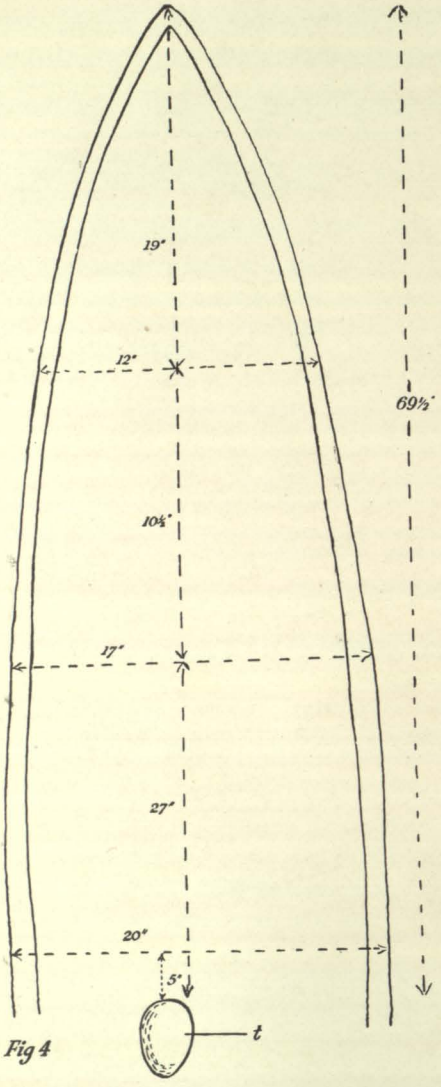

Fig 4

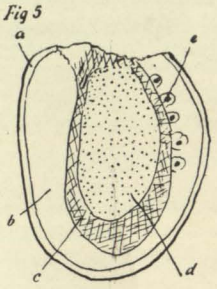

Fig 5

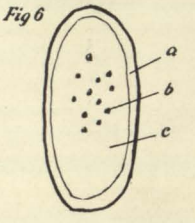

Fig 6

FIG. 4—Outline of the jaw with measurements in inches, enlarged from Mr. Sorensen's sketch at the quarry. *t*, position of tympanic bone.

FIG. 5—Transverse section near the posterior end of mandible. *a*, the "skin"; *b*, the "flesh"; *c*, the "stone" or cancellous bone; *d*, the "kernel" or matrix; *e*, blood vessels.

FIG. 6—Transverse section of mandible near the anterior region. *a*, the "skin"; *b*, blood vessels; *c*, the "flesh."