PELAGIC FOSSILS (ATURIA, PENGUINS, WHALES) FROM THE TERTIARY OF SOUTH AUSTRALIA

By M. F. GLAESSNER, University of Adelaide

Plates xxxiv-xxxvi and text fig. 1-7

INTRODUCTION

THE study of the fossil remains of pelagic animals is one of the most promising approaches to the problem of inter-regional stratigraphic correlation. The re-assessment of the relative ages of Tertiary strata in southern Australia which is now in progress, makes it necessary to record all available information on fossils representing pelagic animals, and therefore likely to be encountered in other areas. The four groups discussed in the present contribution, the Cephalopod genus *Aturia*, the penguins, squalodont whales and cetotheriid whales, are approached from different points of view. Ample material of *Aturia* is now available which makes it possible to revise taxonomic concepts and define the regional stratigraphic value of at least two species. The use of *Aturia* for inter-regional correlation will depend on a general revision of its morphogeny and taxonomy, based on direct comparison of specimens from different parts of the world which are traditionally placed in different species of unknown genetic relations.

The discoveries of penguin bones are recorded only from a stratigraphic and biostratonomic viewpoint, and a correction is made in the age determination of the only specimen which had been previously described. A morphological and systematic study of this material will be undertaken by Dr. G. G. Simpson, who is a noted specialist in this field and has better facilities for comparison at his disposal.

A single squalodont tooth is described mainly because of its excellent preservation and obvious differences from all known Australian cetacean teeth. It gives hopes of further discoveries in this field. Because of the rapid and comparatively well-documented evolution of this group, such discoveries will eventually lead to important stratigraphic conclusions.

The re-discovery of a long-lost, exceptionally well-preserved skull of a whale is announced. It is recognized as the first Australian representative of the Cetotheriidae, the ancestors of the whalebone whales. Detailed study and identification of this skull has to be postponed, but it is hoped that the recording of the occurrence will lead to further discoveries in the field.

ACKNOWLEDGMENTS

1. ATURIA IN THE TERTIARY OF SOUTH-EASTERN AUSTRALIA

ATURIA CLARKEI Teichert

Plate xxxiv, fig. 2, plate xxxv, fig. 3 and text fig. 1-3

1919 *Aturia aturi* (Basterot) Newton, Malac. Soc. London, Proc., vol. 13, p. 160, pls. 5, 6.

1939 *Aturia cf. A. ziczac* (Sowerby) Miller and Crespin, J. Paleont., vol. 13, p. 80, pl. 14, fig. 1.

1944 *Aturia clarkei* Teichert, J. Paleont., vol. 18, p. 79, pl. 15, fig. 1-4, pl. 16, fig. 1-2, text fig. 2.

1947 *Deltoidonautilus bakeri* Teichert, Min. Geol. J. Melbourne, vol. 3, No. 2, fig. 1-2.

1947 *Aturia nov. sp.*, Teichert, Min. Geol. J. Melbourne., vol. 3, No. 2.

1949 *Aturia clarkei attenuata* Teichert and Cotton, Rec. S.A. Mus., vol. 9, No. 2, p. 255, pl. 21.

Material. Types: Holotype of *A. clarkei*, U.W.A. No. 21406, paratype U.W.A. No. 21407; holotype of *A. clarkei attenuata* S.A.M. No. P9027, holotype of *D. bakeri* M.U.G.D. No. 1939.*

Other material. Christies Beach-Port Noarlunga section, S.A.M. P5219, P7153, P5944, P5954, P5937 (probably from this locality), A.U.G.D. F15102-5. Maslin Bay A.U.G.D. F15099-101, Campbelltown (north of Adelaide), from a

---

*The following abbreviations are used for collections in which specimens here referred to are kept: A.U.G.D.—Adelaide University Geology Department, M.U.G.D.—Melbourne University Geology Department, S.A.M.—South Australian Museum, U.W.A.—University of Western Australia Geology Department.

depth of 60 feet in a well, S.A.M. 7017. ?Northern Yorke Peninsula (between Clinton and Ardrossan), A.U.G.D. F15106. This specimen was found without a label in the old collections; its peculiar preservation in a silicified glauconitic limestone with sponge spicules suggests that it came from this area.

Preservation. Most of the 15 new specimens are well-preserved internal moulds of varying sizes, ranging from a diameter of only 35 mm. to a fragmentary large adult specimen with chambers 45 mm. long on the venter. The body chamber is partly preserved in only one specimen. The shell is present only in specimen F15102 in which parts of the surface are perfectly preserved. It is replaced by silica in F15106.

Remarks. *A. clarkei* was fully described by Teichert (1944). The abundant new material shows that it is impossible to distinguish the proposed South Australian subspecies *A. clarkei attenuata* from the Western Australian types in the manner proposed by Teichert and Cotton. The original description of *A. clarkei attenuata* does not enumerate the differences between it and *A. clarkei clarkei*, but the stated resemblances with *A. australis*, i.e., "the general proportions of the shell, particularly the narrowly rounded venter, and slight depression along a ventro-lateral zone," can be taken as indications of its diagnostic subspecific characters, particularly as *attenuata* was regarded as "intermediate between the two species" (Teichert and Cotton, 1949, p. 256). The study of the new material from the type locality and adjoining areas, including specimens more than twice the size of the specimen described by Teichert and Cotton, shows that these characters are not present in adult shells and that at the size of the holotype of *A. clarkei* the venter in the South Australian specimen is less "narrowly rounded" and the depression on the ventro-lateral flanks disappears.

The examination of the fragmentary holotype of *Deltoidonautilus bakeri* showed that the curved "suture lines" figured by Teichert (1947, fig. 3) are not external sutures but oblique sections across the inner portions of the septa on the deeply eroded right lateral surface of the specimen figured in Teichert's fig. 1. Preparation of the other flank revealed the true septa which prove that the specimen belongs to the genus *Aturia*. The apparently angular venter is the result of abrasion. The suture as now revealed (text fig. 1) resembles that of *A. clarkei* in the characteristic shape of the lateral lobe and saddle. In this small specimen they are close-set, but in a large specimen from the same locality, recorded by Teichert as *A. sp.*, they are more widely spaced, as in the typical *A. clarkei* (text fig. 2). Another point of agreement between the holotype of *A. clarkei* and this specimen is seen in the relative position of the tip of the lateral lobe and the ventrolateral shoulders of the ventral saddles of the preced-
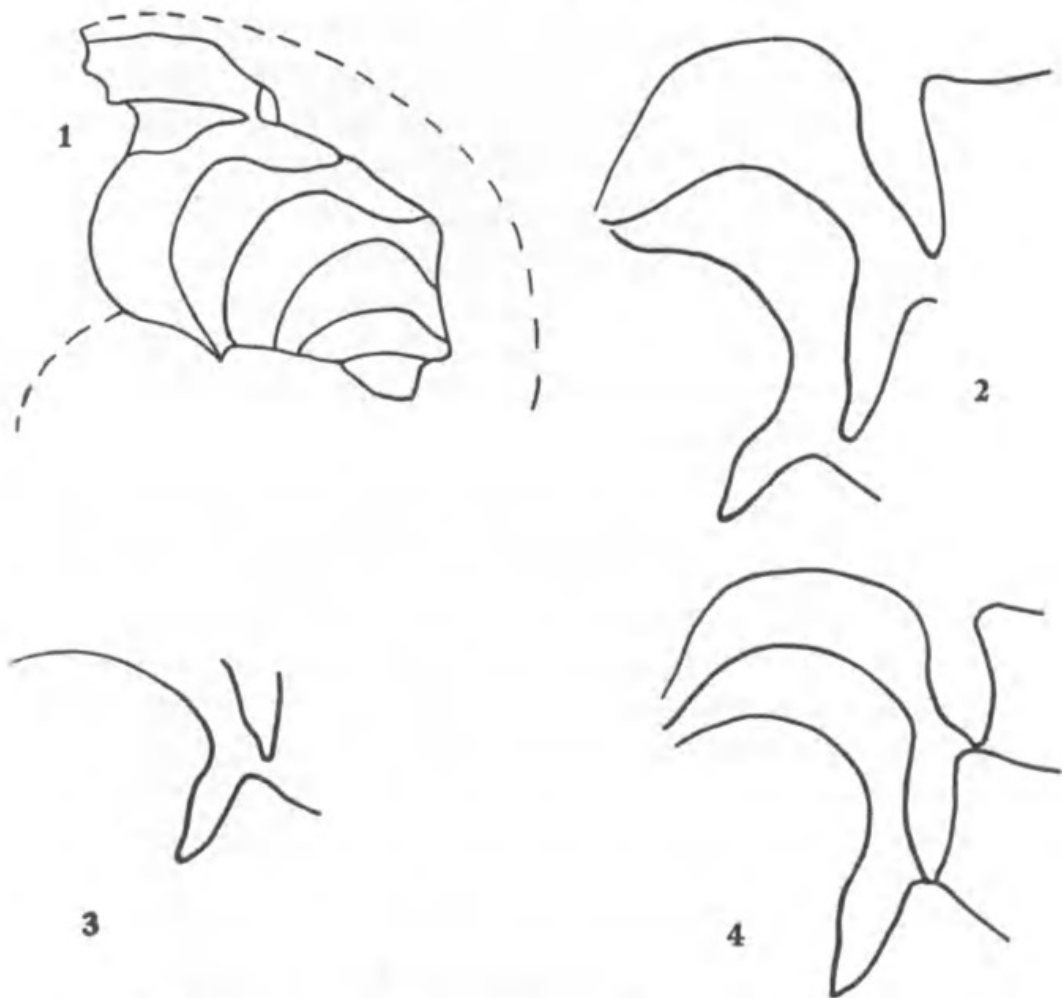
Fig. 1. *Aturia clarkei* Teichert. Suture lines of the fragment described as *Deltoidonautilus bakeri* Teichert, 1947. Diagrammatic. Further preparation has since revealed some additional details.

Fig. 2. *Aturia clarkei* Teichert. Suture lines of the fragment described as *Aturia nov. sp.*, Teichert, 1947.

Fig. 3. *Aturia clarkei* Teichert. Suture lines of holotype.

Fig. 4. *Aturia stansburiensis* Glaessner. Suture lines of holotype.

ing sutures. The tips of the lateral lobes are always placed a short distance towards the ventral side from the rectangular shoulders so that they come to lie against the straight transverse portion of the ventral saddle and the successive suture lines are "staggered" in this region. This is never found in the specimens from the type horizon of *A. clarkei attenuata*. In these the deepest points of the lateral lobes are very sharp and are in line with the sides of the ventral saddles. It is therefore necessary to emend the subspecies *attenuata*, basing it on the character and alignment of the lateral lobes alone. *A. bakeri*, which was based on a fragment, is probably a synonym of *A. clarkei clarkei*. The separation of the subspecies *attenuata* as emended appears to have some biostratigraphic significance as one specimen found recently *in situ* in the Blanche Point Marls at

Blanche Point, and another which comes probably from the equivalents of these marls on Yorke Peninsula (but was not labelled), have the "staggered" arrangement of the suture lines which is seen in the typical *A. clarkei*. The holotype of *A. clarkei attenuata* and all other South Australian specimens listed above which have the lateral saddles and ventral lobes aligned come from the underlying Tortachilla Limestone.

Stratigraphic position and age. Two of the South Australian specimens come from the type locality of the Tortachilla Limestone at Maslin Bay, where they were found just south of the hut known as "Uncle Tom's Cabin" (Reynolds, 1953), about 3 feet above the base of the formation. The specimens from Christie's Beach are also from the Tortachilla Limestone, about 7 miles north of Maslin Bay. The specimen from Campbelltown is preserved in a glauconitic limestone which is the probable subsurface equivalent of the Tortachilla Limestone in the Adelaide Plains Basin, about 22 miles northeast of Christie's Beach. The Tortachilla Limestone grades upward into the "transitional" member of the Blanche Point Marl in which *Hantkenina alabamensis compressa* and other distinctive Upper Eocene foraminifera were found by the late Mr. W. J. Parr. A single specimen of *A. clarkei* with the typical arrangement of septa was found at the top of the succeeding Banded Marl member of the Blanche Point Marls at the southern end of Blanche Point, about 40 feet above the Tortachilla Limestone. The type specimen of *"Deltoidonautilus bakeri"* came from a phosphatic nodule bed near Princetown overlain by strata containing smaller foraminifera which indicate a transition from "Janjukian" to "Balcombian" (Parr in Baker, 1944), *i.e.*, Late Oligocene or Early Miocene age. Teichert considered it and the larger *Aturia* as possibly derived from the Eocene of which lower members are preserved east of the Gellibrand River. The large specimen shows clear signs of wear prior to deposition, as the deeply worn surface of its internal mould is coated with fossiliferous calcareous material.

The Western Australian specimens of *A. clarkei* are probably also of Late Eocene age. I have previously suggested that age for the Plantagenet beds in which Newton's specimen was found (Glaessner, 1953), and the same age is now assigned to the Tertiary strata of the Kennedy Range in which is the type locality of the species (oral information from Dr. R. O. Brunnschweiler).

ATURIA STANSBURIENSIS sp. nov.

Pl. xxxiv, fig. 1a, b

Material. A single well-preserved and undeformed completely septate specimen, partly an internal mould and partly a cast. A.U.G.D. No. F15109, coll. O. S. Rogers, don. Dr. J. Verco.

Occurrence. Stansbury, Yorke Peninsula, in bryozoal limestone.

Description. A large specimen, diameter about 120 mm., maximum thickness about 50 mm., maximum height of last chamber 71 mm., median height of last chamber 50 mm. The shell is not preserved. The whorls are compressed, flattened laterally and narrowly rounded ventrally. The flanks are slightly inflated near the inner and compressed near the outer third of their height. There are 14-15 chambers in the last whorl. The sutures are shaped as in *A. clarkei,* and show the "staggered" arrangement described above.

Comparison. This form differs from *A. clarkei* clearly in the shape of the conch which is much more laterally compressed and has a more marked ventrolateral compressed zone. The chambers are shorter and more closely set. Otherwise the septation does not deviate from the typical shape of the suture in *A. clarkei.* It differs from *A. australis* in the shape of the suture line.

Stratigraphic position and age. This species comes from a bryozoal limestone which is the equivalent of the Port Willunga Beds of the Maslin-Aldinga Bay standard section. The typical foraminiferal fauna of the Port Willunga Beds with *Sherbornina* was found at Stansbury but has not yet been described. The age of these beds is considered as Late Oligocene.

<center>Aturia australis McCoy</center>

<center>Pl. xxxv, fig. 1a, b and 2</center>

1944 *Aturia australis* McCoy, Teichert, J. Paleont., vol. 18, p. 73, pl. 14, text fig. 3.

Material. 1. Muddy Creek, Victoria, A.U.G.D. No. 15108. 2. Naracoorte Quarries, South Australia, S.A.M. No. 10544, No. 8810, and probably also A.U.G.D. No. F15097-8 (received without label from Kingston School). Both collections include partial internal moulds of several specimens. 3. Table Cape, Tasmania, M.U.G.D. No. B118. 4. Mt. Gambier, South Australia.

Preservation. The specimens from Muddy Creek are mostly perfectly preserved shells. Those from Naracoorte are mostly large internal moulds which are perfect and not compressed, but tend to become disjointed. The specimen from Table Cape is a fragment of an outer whorl of a large conch with the chambers ventrally up to 40 mm. long. Only an internal mould of a single chamber is available from Mt. Gambier.

Remarks. The characters and affinities of this species were recently discussed by Teichert, who showed that an orally directed bulge in the septum just above the siphuncular orifice, the even curvature of the lateral saddle (Teichert, 1944, fig. 2, 3), and the compressed shape of the conch distinguish this species

from *A. clarkei*. Nothing can be added to his detailed description except the observation that the distinguishing characters are also clearly recognizable in internal moulds. The only new record is that from Naracoorte.

Stratigraphic distribution and age. Teichert had restricted the stratigraphic range of *A. australis* to Miocene, following Singleton. This is undoubtedly correct for its type locality, Muddy Creek, and for Beaumaris, in Victoria. Teichert questioned the New Zealand records which have since been eliminated, with the exception of a Late Oligocene or Early Miocene "*A. cf. australis*" (Fleming, 1945). Teichert also doubts the correctness of the record from the Gellibrand River, but neither this material nor the specimens from Brown's Creek to which Chapman referred are available for re-examination. The species also occurs at Spring Creek near Torquay (Victoria), Table Cape (Tasmania), and Mt. Gambier (South Australia). At all these localities a foraminiferal fauna which is older than that from Muddy Creek was found and the age of the strata is probably late Oligocene. The age of the limestone at Naracoorte has not yet been established, but it is probably not much younger than the Mt. Gambier limestone. *A. australis* has not been found in the Eocene where *A. clarkei* occurs. The relationship between the two species is therefore not one of contemporaneity in different areas, but one of substitution in time. This should make them most valuable index fossils.

2. THE OCCURRENCE OF TERTIARY PENGUIN REMAINS IN SOUTH AUSTRALIA

In 1938 Finlayson described the first fossil penguin bone from Australia, a left humerus, which he named *Palaeeudyptes cf. antarcticus* Huxley. Three more penguin bones have been found recently in the Tertiary of South Australia. Pending description and identification of these remains, which will be undertaken by Dr. G. G. Simpson at the American Museum of Natural History where the necessary comparative material is available, only a record of their discovery and stratigraphic relations is included in the present communication.

The first specimen was found by W. Burdett at Witton Bluff, at the southern end of Christie's Beach, about 16 miles south of Adelaide. The description given by Mr. Finlayson was based on the lateral (external) aspect of the bone (S.A.M. No. P7158). It has since been freed from the matrix which is a soft glauconitic marl. It comes from the "Transitional Marl" Member which forms the base of the Blanche Point Marls and overlies the Tortachilla Limestone at this locality as it does at Maslin Bay 7 miles further south (Reynolds, 1953), where W. J. Parr found *Hantkenina alabamensis compressa* and other Upper Eocene

foraminifera in the Transitional Marl. The foraminiferal faunas from this locality and from the matrix of Finlayson's *Palaeeudyptes* show close agreement. Their investigation is proceeding. Howchin had incorrectly considered the marine sequences at these localities (below transgressive Pliocene) as Miocene.

In 1952 I found another penguin bone, a right tibiotarsus (S.A.M. No. P10862) *in situ* just below the top of the Banded Marl Member of the Blanche Point Marls north of Port Noarlunga Jetty, at the base of the cliff extending southward from Witton Bluff, at high water level. This bed is, according to Miss M. Wade who mapped and measured the cliff section, about 20-25 feet above the Transitional Marl. There is no significant change in the foraminiferal fauna and the age of the bed is probably Late Eocene. The proximal end of the bone was eroded away by the sea and the distal end as found in the rock matrix was incomplete, probably because of weathering prior to embedding. The shaft of the bone is well preserved.

A third bone (pl. xxxvi, fig. 1a, b), a right humerus (S.A.M. No. P10863), was received soon afterwards from Mr. P. Pritchard, of Mt. Gambier. Mr. Max Pritchard had found it in Pritchard Brothers' building-stone quarry about $7\frac{1}{2}$ miles west-north-west of the town of Mt. Gambier. It was completely embedded in bryozoal limestone but the distal end was lost when a block of stone was cut during quarrying operations. The proximal part is completely preserved but its surface is worn. When the matrix was carefully removed from the surface of the shaft of the humerus it was found marked with several deep grooves running across it obliquely on both sides. They are sharp-edged, narrow, and slightly irregular on the external side, and shallower, with more rounded edges, on the internal side. They are obviously injuries inflicted by some animal, either in connection with or subsequent to the death of the penguin. They were infilled with bryozoal limestone matrix. The contrast between the sharp somewhat splintered cuts on one side and the corresponding smoother depressions on the other could be due to slight abrasion of the upper surface by current-driven sand on the sea floor prior to complete embedding. This was suggested to me by Mr. P. Lawson, of the South Australian Museum. It is thought that the parallel cuts were made by the bite of a shark or a squalodont whale. Large sharks' teeth occur in the Gambier Limestone, and the tooth of a *Squalodon*, found at the same time as this bone, is described below.

The fourth penguin bone, a small left femur (S.A.M. No. P10870) was found and presented to the writer by Mr. D. J. Leonard, of Adelaide, who discovered it while working on the surface of a Mt. Gambier building stone block. It was taken from the matrix undamaged, but both ends showed signs

TABLE 1

Age	St. Vincent Gulf Area °	Foram. Faunas	Aturia	Penguins	Whales	Murray—Mt. Gambier Area *	Victorian Stages
Lower Miocene	Port Willunga Beds	3	*A. australis	*Spec. 10863 and	*Aglaocetus? n. sp.	"Murravian"	"Batesfordian"
——?——		2	°A. stansburiensis	*Spec. 10870	*Squalodon gambierense and *Parasqualodon wilkinsoni	Gambier Limest.	"Janjukian"
Oligocene	Chinaman's Gully Beds					Knight Group	
——?——	Blanche Point Marls	1	°A. clarkei clarkei	°Spec. 10862 °Spec. 7158			
Upper Eocene	Tortachilla Ls.		°A. clarkei attentuata				

of wear and weathering prior to embedding. Bryozoal colonies were found in growing position attached to the surface of the bone. The proximal part was deeply splintered with a V-shaped edge, suggesting that this part may have been bitten off. Abrasion would have removed the projecting *caput femoris* rather than an adjoining triangular portion.

The Gambier Limestone, a thick-bedded aggregate of coarse bryozoal, echinoderm and molluscan fragmentary and complete specimens, is younger than the Blanche Point Marl and corresponds in lithology and general character of its foraminiferal fauna (which is being examined) to some of the Port Willunga Beds of the Maslin-Aldinga Bay Section. Typical Eocene and Miocene foraminifera are absent and the age of the deposit is considered as Oligocene. It rests unconformably on the paralic (intermittently marine) sands and clays of the Knight Group.

The stratigraphic position of the four penguin bones is shown in Table 1.

3. A CETACEAN TOOTH FROM THE GAMBIER LIMESTONE

SQUALODON GAMBIERENSE sp. nov.

Text fig. 5a-c

Material. One isolated perfectly preserved molariform tooth, probably from the right mandible.

Occurrence. Gambier Limestone, Pritchard Brothers' quarry, about $7\frac{1}{2}$ miles west-north-west of Mt. Gambier. Presented by Mr. P. Pritchard, of Mt. Gambier, 1952.

Age. Probably Late Oligocene.

Holotype. A.U.G.D. No. F15107.

Diagnosis. The species is based on a compressed molariform tooth in which both cutting edges are denticulate, the median cusp is large, the enamel is smooth on the labial and finely vertically ridged on the lingual side near the base; the roots are widely separated below a thin isthmus.

Description. The tooth, which is unworn, shows a compressed, triangular, denticulate crown and two widely separated roots which are joined below the crown by a thinner lamina ("isthmus") to about one-third of their length. The crown ends in a strong median point which has a long curved anterior and a shorter almost straight posterior cutting edge. The anterior edge of the tooth shows three denticles decreasing rapidly in size downward. The first (upper) resembles the median point in shape but is much smaller. The second and third

are conical. The cutting edge which is pronounced on the first and second denticle vanishes on the third. In some places, such as the base of the main point and the anterior edge of the upper denticle, is seems to show a minute secondary denticulation. The posterior edge of the tooth shows four well-developed denticles which decrease regularly in size downward, and a minute trace of a fifth. The cutting edge extends to the posterior end of the fourth denticle and shows a fine secondary denticulation on the posterior edge of the third. The maximum antero-posterior diameter of the tooth lies above the base of the crown, owing to the pronounced curvature of the edges of the third anterior and fourth posterior denticles. The general outline of the crown is broadly triangular, the points of the denticles being directed upward rather than
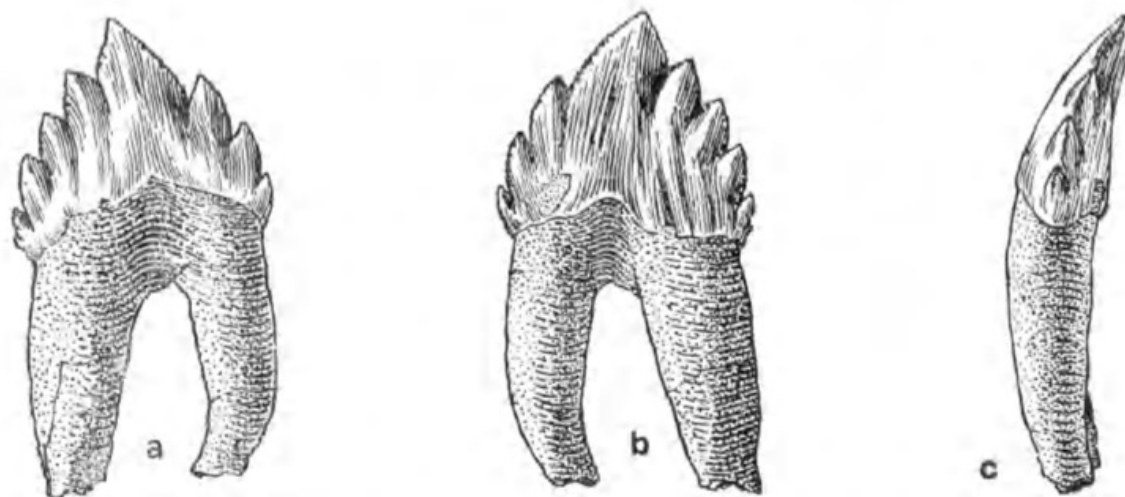

Fig. 5. a-c. *Squalodon gambierense* Glaessner. Holotype. *a*, labial view; *b*, lingual view; *c*, anterior view. Nat. size (approx.).

forward or backward. The bases of the denticles are separated by pronounced "valleys" extending up the slopes of the crown. There is also a short, wide, median depression leading from the centre of the crown towards the isthmus. On the labial side the surface of the enamel is perfectly smooth and only slightly fluted by the "valleys" between the denticles. On the lingual side there are faint straight vertical rugosities which converge in the direction of the main point and disappear without reaching it. They do not form any prominent projecting points on the surface. The base of the enamel crown is a sinuous line, faintly S-shaped above each root base and rising to an angular deep embayment labially and a rounded shallower embayment lingually. The roots are constricted below the crown, with irregular shapes and roughly triangular transverse sections. The maximum antero-posterior diameter of the posterior root exceeds that of the

anterior root, but there is little difference between their transverse diameters. The distance between the roots varies little though the lower end of the anterior root is slightly curved backward. The isthmus ends below in a sharp edge which is pierced in the middle by a pin-hole opening.

Measurements. Antero-posterior diameter (maximum) 30 mm., antero-posterior diameter at base of crown 27·4 mm., median height of crown on lingual surface 22·0 mm., median height of crown on labial surface 20·3 mm., maximum height of crown (from lowest level of enamel vertically to main point) 26·0 mm., maximum thickness of crown 11·0 mm., length of isthmus (labial) 12·5 mm., length of isthmus (lingual) 9·0 mm., length of anterior root over 30 mm., length of posterior root over 29 mm., transverse diameter of roots about 10 mm., antero-posterior diameter of posterior root 13·2 mm., antero-posterior diameter of anterior root 10·1 mm., maximum antero-posterior diameter at maximum convexity of roots 29·2 mm., same immediately below crown 27·2 mm., total length (height) of tooth as preserved 54 mm.

Discussion. In 1881 Sanger established the species *Zeuglodon harwoodi* on a molariform serrate tooth "and the fragments of a second" which was left undescribed. The type material seems to have been lost (Hall, 1911). It came from a fossiliferous yellow calcareous clay on the River Murray near Wellington, South Australia. None of the fossils from that locality as named by Sanger, who considered them as "Eocene," gives any definite indication of age, but they are definitely pre-Pliocene. The accompanying fauna consisted of sharks, *Aturia*, lamellibranchs, gastropods, and echinoids. The exact locality is not known. The tooth is compressed and rather small, the antero-posterior diameter being 23 mm. and the median height of the crown 19 mm. There are four denticles on the anterior and six on the posterior edge. The median cusp is not much larger than the adjoining lateral denticles. The surface of the enamel is not described in the text but appears smooth in the drawing which is probably correct. Coarse rugosities such as appear on other Australian squalodont teeth would have attracted the author's attention and would have been mentioned in his otherwise detailed description. The roots are broken off below a thin connecting "isthmus" and the author was "inclined to think that possibly the isthmus was wanting in the portion broken off, so that the pillars became two distinct fangs" (p. 299). These details are important in the interpretation of this fossil.

The species was discussed by Hall (1911), who attributed to it a tooth from Mt. Gambier on account of a similarity in the thickness of the roots which he considered as different from those of *Parasqualodon wilkinsoni* McCoy. He

thought that "such a marked difference in the proportionate size of the roots would probably be correlated with differences in the strength of the jaws" (p. 258) while he considered the "variation in the ornament" as less important. On that basis he established the genus *Parasqualodon* for McCoy's species and the genus *Metasqualodon* for Sanger's species, describing it as follows:

"Roots of molariform teeth slender and only a little longer than the height of the crown, the two fangs connected by a thin 'isthmus' much as figured by Lydekker in *Prosqualodon*, but the fangs more nearly approaching one another. The material does not inform us as to whether the fangs were connected throughout their length by the isthmus, or whether they projected freely beyond it. Lateral cusps rather large. Ornament as in *Parasqualodon*."

This generic description is obviously influenced by Hall's assignment of the tooth from Mt. Gambier (in the National Museum of Victoria) to Sanger's species. The study of more complete remains of toothed whales shows clearly that Hall's basic assumption was wrong and that the ornamentation of the surface is a valid taxonomic character while the "proportionate size of the roots" depends on the position of the teeth in the jaws. Kellogg (1923, p. 20) stated: "The ornamentation of the enamel crown (of the tooth from Mt. Gambier) suggests a closer relationship with *Parasqualodon wilkinsoni*. In that case this tooth represents one of the posterior premolars." Flynn (1948) fully described a fine skull of *Prosqualodon davidi* and on this occasion revised Hall's identifications. This led to the following revision of the legend to Hall's plate 36:

	Hall		Flynn		Locality
Fig. 1	*?Parasqualodon wilkinsoni*		?		Waurn Ponds
Fig. 2.	,,	,,	*Prosqualodon davidi*		,, ,,
Fig. 3.	,,	,,	,,	,,	Spring Creek
Fig. 4.	,,	,,	,,	,,	Table Cape
*Fig. 5.	,,	,,	*Parasqualodon wilkinsoni*		Castle Cove
Fig. 6.	*Metasqualodon harwoodi*		*?Parasqualodon wilkinsoni*		Mt. Gambier
*Fig. 7.	,,	,,	*Metasqualodon harwoodi*		Wellington

(Figures of holotypes are marked in the above list with *.)

Though neither Kellogg nor Flynn are quite definite in assigning the tooth of Hall's fig. 6 to McCoy's species, it obviously does not belong to *Metasqualodon* or to Sanger's species. The genus *Metasqualodon* rests therefore on the lost

specimen from Wellington only, and until another similar specimen is found it cannot be redefined or properly understood. The new tooth from Mt. Gambier resembles Sanger's fig. A (=Hall's fig. 7) only in the smooth crown, but differs in the size and number of denticles and particularly in the very large size of the main cusp. Its substitution as a neotype of *Metasqualodon harwoodi* would not be justified.

Abel (1913) had tentatively placed *Zeuglodon harwoodi* in the genus *Microzeuglodon* Stromer (Type *Zeuglodon caucasicum* Lydekker). The discovery of a new specimen from the Oligocene of the Caucasus, belonging or at least closely related to Lydekker's species (Rjabinin, 1938) proved that the skull of the Caucasian form has the character of the Archaeoceti and not that of the squalodontids. Abel had proposed the establishment of a family Microzeuglodontidae within the Archaeoceti. A distinction between Archaeoceti and Squalodontidae on the basis of isolated teeth is difficult but not impossible, and perhaps not very important if there has been a gradation from the older to the younger group as some authors postulate. The differences in the teeth have not been clearly stated, but in his description of *Kekenodon onamata* Hector, Kellogg (1923, p. 27) says: "The unusual appearance of the accessory cusps, the character of the enamel surface of the crown, and the large size of the teeth are peculiarities which place this form among the zeuglodonts. Such features are unknown for any squalodont." He assigned to the Archaeoceti *Phococetus vasconum* (Delfortrie), which was based on a single tooth, as their youngest representative (Lower Miocene). The appearance of the accessory cusps and the character of the enamel surface, revealed by further preparation of the holotype, which will be redescribed elsewhere, place *Squalodon serratus* Davis (Lower Oligocene, White Rock River quarries, Okuku River, North Canterbury, New Zealand) in the vicinity of *Kekenodon*, but it is much smaller than any of the teeth of *K. onamata*. It had been suggested by Flynn (1948, p. 186) that Davis' species might belong to *Parasqualodon wilkinsoni* McCoy, but this proved to be incorrect.

The new tooth from Mt. Gambier differs in the character of the accessory cusps, the main cusp, the enamel surface and the roots from all these genera and species, including *Parasqualodon* and *Prosqualodon*. Although it resembles typical Archaeoceti such as *Dorudon* in the outline of the crown and the separation of the roots, it is smaller and much more compressed and resembles more closely species of the genera *Neosqualodon* and *Squalodon*. The teeth of *Neosqualodon* are much smaller. The teeth of *Squalodon* are often of the size of the present specimen, but in most species their surface is more rugose. It is signi-

ficant that a species distinguished mainly by smooth enamel, *S. dalpiazi*, was recently described by Fabiani (1949). He has also shown that the roots of *S. scillae* (Agassiz) (*S. melitensis* Blainville sp. in Kellogg, 1923) are straight and not convergent at their lower ends. The median cusps of molariform teeth of *Squalodon* are often strongly developed, as in the present species. For these reasons it is best assigned to the widespread genus *Squalodon*, though confirmation from at least the discovery of complete jaws is still required. Benham (1942, p. 267) has referred isolated more strongly sculptured teeth from the Middle Oligocene of New Zealand to a species *Squalodon andrewi*. This material requires further investigation.

4. FIRST RECORD OF A CETOTHERIID WHALE FROM AUSTRALIA

In 1885 R. Tate, in a paper on the geology of the Murray River Basin, under the heading "Species of the Lower Murravian," stated:

"This series is characterized rather by lithological than palaeontological characters, which latter are somewhat negative, as the species are few in number
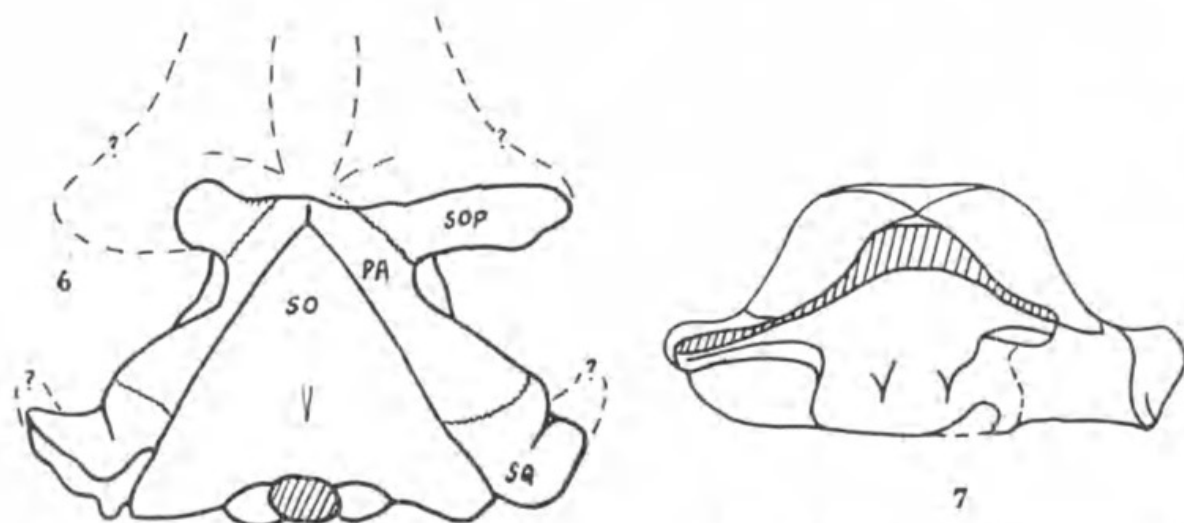

Fig. 6, 7. *Aglaocetus?* sp. nov. 6. Diagrammatic dorsal view of cranium. SO—supraoccipital shield, PA—parietals, SOP—supraorbital process of frontal, SQ—squamosum. About 1/9 nat. size. 7. Diagrammatic frontal view of broken cranium, showing slope of supraorbital processes.

and somewhat sparsely distributed. Cetacean remains have occurred to me only at this horizon, notably at MacBean's Pound, four miles from Blanchetown, whence I obtained the entire lower jaw of a balenoid whale, six feet long, and at Murbko, 14 miles north of Blanchetown, whence I obtained a cranium. The anterior half of a Paguroid (*sic*) fish in excellent preservation was obtained at Morgan from these beds." (Tate, 1885, p. 41.)

Since that time there seems to have been no further reference to the whale cranium from Murbko. Enquiries have now resulted in the re-discovery of this skull in the collections of the South Australian Museum (No. P63). Incidentally, Tate's pagroid fish was found in the collections of the Adelaide University Geology Department (No. F15110) and is now being described by Mr. T. Scott. The beds termed "Lower Murravian" by Tate are currently placed in the Lower Miocene.

The posterior portion of the skull is well preserved and entirely undistorted (fig. 6, 7). It is 480 mm. wide between the broken ends of the zygomatic processes and over 300 mm. long from the occipital condyli to the broken anterior edges of the supraorbital processes. Its maximum height is about 240 mm. and the distance from the upper margin of the foramen magnum to the apex of the supraoccipital shield is 213 mm. The frontorostral portion is missing, but an undistorted transverse section (fig. 7) near the orbital plane is exposed on the broken face of the specimen. The palatal surface was well preserved and has been freed from the matrix by a previous investigator. The skull is filled with yellowish limestone matrix in which small fossils occur.

This skull, which was discovered by Tate more than 70 years ago, is the first member of the family Cetotheriidae, a group of ancestral whalebone whales, from Australia. Kellogg (1928, p. 185) described the main characters of this family as follows:

" . . . we find that the skulls of all known edentulous Miocene cetotheres have supraorbital processes that slope gradually outward from the dorsal surface of the interorbital region to the rim of the orbit and are never abruptly depressed basally below the level of the former as in the balaenopterine whales. Many of these cetotheres retained a well defined intertemporal region, constituted entirely by the parietals, which meet along the median line in front of the supraoccipital shield. In most species the braincase is short and broad, but the supraoccipital shield is quite variable in shape and extent, depending in part upon the degree of forward overthrust."

Kellogg goes on to discuss the relative position of the maxillaries to the frontals and the relations between rostrum and braincase generally. The relevant portion of the skull is not preserved in the present specimen.

More recently, the same author (Kellogg, 1940, pp. 3-4) confirmed his diagnosis of the Cetotheriidae: "The extinct whalebone whales belonging to the family Cetotheriidae were the precursors of the Recent Mysticeti. These cetaceans differ from one another in the extent of the forward overthrust of the supraoccipital shield and in the degree of interdigitation of the posterior ends of the rostral bones with the interorbital region. Skulls of all Recent whalebone whales

differ from those of the archaic less highly modified cetotheres in one very important detail, namely, the abrupt depression of the basal portions of the supraorbital processes below the median interorbital portions of the frontals. On all these cetothere skulls the supraorbital processes slope gradually downward and outward from the level of the dorsal surface of the interorbital region. Thus these cetothere skulls are particularly distinguished from all Recent whalebone whale skulls by the fact that the proximal portions of their supraorbital processes have not as yet been abruptly depressed below the level of the median interorbital elevation of the frontals."

Kellogg has also described a number of new genera (*Mixocetus, Cophocetus, Aglaocetus* Kellogg, 1934) of which the last named, from the Lower Miocene (?) Patagonian Formation, is nearest to the South Australian specimen. This shows in dorsal view a very large triangular supraoccipital shield without a distinct median crest. Its apex reaches forward to just beyond the level of the posterior margins of the supraorbital processes of the frontal. The parietals form a short sharp sagittal crest in front of the apex and separate it from the rostral elements. Differences in the posterior and palatal aspects of the skull and deficiencies in its preservation, particularly of the terminations of the zygomatic processes, make it difficult to decide, without further detailed study and comparison, whether the South Australian specimen can be placed in the South American genus or in one of the other closely related genera, but the characters mentioned above and illustrated in fig. 6 and 7 justify the inclusion of this fossil in the family Cetotheriidae under the provisional designation of *Aglaocetus ? nov. sp.*

It is of considerable interest that Kellogg (quoted by Benham, 1942, pp. 261, 263) had considered the fragmentary skulls from the Upper Oligocene of New Zealand, described by Benham first (1937) as *Lophocephalus* (*nom. preocc.*) and later (1942) as *Mauicetus parki*, as similar to *Aglaocetus*. The arguments given by Benham against this view do not seem to carry much weight. These and other New Zealand cetacean remains need careful re-preparation, re-examination, and comparison with Australian and other material which is likely to yield important results in the fields of phylogeny and biostratigraphy.

REFERENCES.

Abel, O. (1913) : Die Vorfahren der Bartenwale. Denkschr. Akad. d. Wissensch. Wien, vol. 90, pp. 155-224.

Baker, G. (1944): The geology of the Port Campbell district. Proc. Roy. Soc. Vic., vol. 56, pp. 77-108.

Benham, W. B. (1937): On Lophocephalus, a new genus of zeuglodont cetacea. Trans. Roy. Soc. N.Z., vol. 67, pp. 1-14, pls. 1-7.

Benham, W. B. (1942) : Fossil Cetacea of New Zealand, V. Mauicetus, a generic name substituted for Lophocephalus Benham. Trans. Roy. Soc. N.Z., vol. 71, pp. 260-270, pls. 44-47.

Chapman, F. (1915) : New or little known fossils in the National Museum, Pt. 17, Some Tertiary Cephalopods. Proc. Roy. Soc. Vic., vol. 27, n.s. pp. 350-361, pls. 3-8.

Chapman, F. (1921) : The specific name of the Australian Aturia and its distribution. Proc. Roy. Soc. Vic., vol. 34, n.s. pp. 12-16.

Fabiani, R. (1949) : Gli Odontoceti del Miocene Inferiore della Sicilia. Mem. Inst. Geol. Univ. Padova, vol. 16, 32 pp., 2 pls.

Fleming, C. A. (1945) : Some New Zealand Tertiary Cephalopods. Trans. Roy. Soc. N.Z., vol. 74, pp. 411-418.

Flynn, T. T. (1948) : Description of Prosqualodon davidi, a fossil Cetacean from Tasmania. Trans. Zool. Soc. London, vol. 26, pp. 153-197, pls. 1-6.

Finlayson, H. H. (1938) : On the occurrence of a fossil penguin in Miocene beds in South Australia. Trans. Roy. Soc. S. Aust., vol. 62, pp. 14-17, pl. 1.

Glaessner, M. F. (1953) : Conditions of Tertiary sedimentation in southern Australia. Trans. Roy. Soc. S. Aust., vol. 76, pp. 141-146.

Hall, T. S. (1911) : On the systematic position of the species of Squalodon and Zeuglodon described from Australia and New Zealand. Proc. Roy. Soc. Vic., vol. 23, n.s., pp. 257-265, pl. 36.

Kellogg, R. (1923) : Description of two squalodonts recently discovered in the Calvert Cliffs, Maryland; and notes on the shark-toothed Cetaceans. Proc. U.S. Nat. Mus., vol. 62, art. 6.

Kellogg, R. (1928) : The history of whales, their adaptation to life in the water. Quart. Rev. Biol., vol. 3, pp. 29-76, 174-208.

Kellogg, R. (1934) : The Patagonian fossil whalebone whale, Cetotherium moreni (Lydekker). Carnegie Inst. Publ. No. 44, pp. 63-81.

Kellogg, R. (1936) : A review of the Archaeoceti. Carnegie Inst. Publ. No. 482.

Kellogg, R. (1940) : On the Cetotheres figured by Vandelli. Bol. Mus. Min. Geol. Univ. Lisboa., No. 7-8.

Miller, A. K. and Crespin, I. (1939) : An Aturia from the Northwest Division of Western Australia. J. Paleont., vol. 13, pp. 79-81.

Newton, R. B. (1919) : Aturia aturi from Western Australia. Proc. Malacol. Soc., vol. 13, pp. 160-167, pls. 5, 6.

Reynolds, M. A. (1953) : The Cainozoic succession of Maslin and Aldinga Bays, South Australia. Trans. Roy. Soc. S. Aust., vol. 76, pp. 114-140.

Rjabinin, A. (1938): Microzeuglodon aff. caucasicum (Lydekker) from the Upper Maikop Beds of Kabristan. Probl. Paleont., Moscow Univ., vol. 4, pp. 137-185, 16 pls.

Sanger, E. B. (1881): On a molar tooth of Zeuglodon from the Tertiary beds of the Murray River near Wellington. Proc. Linn. Soc. N.S. Wales, vol. 5, pp. 298-300.

Tate, R. (1885): Notes on the physical and geological features of the basin of the Lower Murray River. Trans. Roy. Soc. S. Aust., vol. 7, pp. 24-46.

Teichert, C. (1944): The genus Aturia in the Tertiary of Australia. J. Paleont., vol. 18, pp. 73-82, pls. 14-16.

Teichert, C. (1947): New nautiloids from the older Tertiary of Victoria. Min. Geol. J. Melbourne, vol. 3, No. 2.

Teichert, C. and Cotton, B. C. (1949): A new Aturia from the Tertiary of South Australia. Rec. S. Aust. Mus., vol. 9, pp. 255-256, pl. 21.

EXPLANATION OF PLATES

PLATE XXXIV

Fig. 1a, b. *Aturia stansburiensis* Glaessner. Holotype. 5/6 nat. size.

Fig. 2. *Aturia clarkei attenuata* Teichert and Cotton. S.A.M. Spec. No. 7153. 5/6 nat. size.

PLATE XXXV

Fig. 1a, b. *Aturia australis* McCoy. A.U.G.D. Spec. No. F15097. Nat. size.

Fig. 2. *Aturia australis* McCoy. Topotype. A.U.G.D. Spec. No. F15108. Nat. size.

Fig. 3. *Aturia clarkei attenuata* Teichert and Cotton. S.A.M. Spec. No. F5219. Nat. size.

PLATE XXXVI

Fig. 1a, b. Humerus of penguin showing bite marks diagonally across the shaft. Note that the lower end (fig. 1a) was cut off with a saw which also left marks at a steeper angle than the matrix-infilled bite marks. Mt. Gambier. S.A.M. Spec. No. P10863. Nat. size.

Fig. 2. Femur of penguin, as extracted from the matrix, showing the proximal end fractured, probably by a bite. S.A.M. Spec. No. P10873. About ×2.