

# Additional chimaeroid specimens from the Early Cretaceous (Late Albian) Toolebuc formation, Queensland, Australia

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## ABSTRACT

Associated upper and lower tooth plates, comprising both vomerine dental plates, one incomplete left palatine dental plate and one partial left mandibular dental plate from a single individual of the chimaeroid *Ptyktoptychion wadeae* Bartholomai, 2008, have been collected from near Richmond, north-central Queensland, Australia. This material came from the usually poorly exposed, marine Early Cretaceous (Late Albian) Toolebuc Formation in the north of the Eromanga Basin. The new, associated tooth plates support the reference of palatine and mandibular dental plates identified by Bartholomai (2008) as all belonging to *P. wadeae*, possibly from a single individual; and also confirms the reference of an isolated vomerine tooth (QMF52605) from the west of the Basin to that species. The first chimaeroid fin spine from the Toolebuc Formation is tentatively referred to *?Ptyktoptychion* sp. □ *Chimaeroidei*, *Ptyktoptychion wadeae*, *?Ptyktoptychion* sp., *Eromanga Basin*, *Toolebuc Formation*, *Early Cretaceous (Late Albian)*.

The first chimaeroid (Chondrichthyes: Chimaeriformes) recovered from the Lower Cretaceous (Late Albian) Toolebuc Formation of the Eromanga Basin in Queensland was described as *Ptyktoptychion tayyo* by Lees (1986). Further chimaeroid remains from the Toolebuc Formation were subsequently added to the collections of the Queensland Museum by field work by museum staff, resulting in a more complete knowledge of the dental plates of *P. tayyo* and description of a further species, *P. wadeae* by Bartholomai (2008). Both species were based on isolated plates that show evidence of partial loss through fracturing. Older chimaeroid material identified as *Edaphodon eyrensis* by Long (1985) has been described from the Eromanga Basin

in the Aptian Bulldog Shale, west of Bopeechee Siding in northern South Australia.

Additional, recently discovered, chimaeroid fossils have been donated to the Queensland Museum and are described herein. Both specimens were recovered from excavations in quarries operated by the Richmond Council for road making purposes and reflect increasing interest in the Toolebuc fossil fauna resulting from the development of the Kronosaurus Korner display centre in Richmond and its promotion of public involvement in finding and excavating elements of the fauna. The appointment of professional palaeontological and technical curatorial staff at Kronosaurus Korner has also provided interpretation and identification support, leading to increased public interest in the local Toolebuc fauna and recognition and

recovery of more complete skeletons of fossil fishes. This has led to deposition of many new species to the Kronosaurus Korner collection and to the Queensland Museum, including the isolated chimaeroid spine (QMF43006) referred questionably to *Ptyktoptychion* sp.

The Eromanga Basin was part of the Great Artesian Superbasin (Jell *et al.* 2013) that was covered by a relatively shallow layered epeiric sea. The thin (25–45 m thick), organic-rich Toolebuc Formation reflected dysoxic to anoxic benthic conditions (Cook *et al.* 2013) and together with its conformable and similarly aged Allaru Formation, was not well exposed and is now best seen at the surface along the northern and western rims of the Basin. The Toolebuc Formation is rich in fossil vertebrates, including many actinopterygians (Bartholomai 2015), most of which are from predatory, pelagic species. Relatively rare occurrence of chimaeroids in the Lower Cretaceous sediments probably reflected their presence in both the general shallow-water environments of the Eromanga Basin exposed in what was most probably near-shore or even littoral deposits, and the paucity of bottom dwelling invertebrates resulting from the adverse benthic conditions. The Eromanga chimaeroid community is very restricted taxonomically when compared with Eurasian Albian-Cenomanian chimaeroid associations where, for example, 10 genera were present in the Upper Albian of Belgorod Province, Russia (Popov & Machalski 2014, Fig. 8).

The specimen of *Ptyktoptychion wadeae*, QMF55449, discussed and illustrated herein in Figs. 1 and 2, was located in one of the Richmond Council quarries exposing the Toolebuc Formation. This specimen was excavated and donated by Queensland Museum Honorary Research Fellow, Mr Ian Sobbe and was prepared by the Museum's preparator, Mrs Jo Wilkinson. It comprises associated dental plates. Such undoubted associated remains are important in confirming the original reference of disassociated dental plates to this species by Bartholomai (2008).

The originally described material, including the holotype palatine dental plate, QMF52601, came from the Toolebuc Formation exposures along the anabranches of the Flinders River at 'Boree Park' Station, as were the referred mandibular dental plates QMF52602 and QMF52603. An additional partial palatine tooth plate was also referred to the species from the Late Albian, Allaru Formation at 'Currane' Station, near Dartmouth in central Queensland. The vomerine tooth plate referred to *P. wadeae*, QMF52605, however, was found in the Toolebuc Formation on 'Canary' Station, near Boulia and, at that time, was the only chimaeroid specimen referable to *P. wadeae* recovered from the western rim of the Basin. Before location of the associated tooth plates, QMF55449, the vomerine tooth plate illustrated by Bartholomai (2008, Fig. 6) could have been of *P. tayyo* or even the Aptian 'E.' *eyrensis* rather than of *P. wadeae*. *Ptyktoptychion tayyo* is currently known only from the Boulia area. The holotype tooth plate of *P. tayyo*, QMF12987, was originally described by Lees (1986) as a mandibular tooth plate but the specimen was reinterpreted by Averianov (1992), supported later by Stahl (1999) to be a palatine tooth plate which was confirmed by Bartholomai (2008) who showed that it differed from that attributed to *P. wadeae*.

Terminology mostly follows that summarised by Stahl (1999). The higher level taxonomy generally follows that outlined in Popov & Machalski (2014) and Stahl (1999).

#### ABBREVIATIONS

adt	.....	additional outer tritor
aot	.....	anterior outer tritor
bp	.....	basal perforation
bt	.....	beak tritor
fbp	.....	field of basal perforation
fpl	.....	fragment pleromin
lbm	.....	labial margin
lgm	.....	lingual margin
mm	.....	mesial margin
mt	.....	median tritor

mtp-l ..... mandibular tooth plate (left)  
 pot ..... posterior outer tritor  
 pt ..... plesiosaur tooth  
 ptp-l ..... palatine tooth plate (left)  
 sm ..... symphyseal margin  
 st ..... shark tooth  
 vtp-l ..... vomerine tooth plate (left)  
 vtp-r ..... vomerine tooth plate (right)

Class CHONDRICHTHYES Huxley, 1880

Subclass HOLOCEPHALI Bonoparte, 1832

Superorder HOLOCEPHALOMORPHA  
 Nelson, 2006

Order CHIMAERIFORMES Obruchev, 1953

Suborder CHIMAEROIDEI Patterson, 1965

Superfamily CHIMAEROIDEA  
 Bonoparte, 1832

Family CALLORHYNCHIDAE Garman, 1901

Subfamily CALLORHYNCHINAE  
 Garman, 1901

*Ptyktoptychion wadeae* Bartholomai, 2008  
 (Figs 1A–B; 2A–B)

*Ptyktoptychion wadeae*, Bartholomai, 2008: 53–6.

**Material.** See Bartholomai (2008) for detail of QMF52601, holotype palatine tooth plate, and referred specimens QMF52602 (left mandibular tooth plate) and QMF52603 (right mandibular tooth plate), all from Early Cretaceous (Late Albian) Toolebuc Formation of ‘Boree Park’, near Richmond, NCQ., and QMF52605 (vomerine tooth plate), from same formation, ‘Canary’ Station, near Boulia, CWQ. QMF52604, (palatine tooth plate) from the Early Cretaceous (Late Albian) Allaru Formation, ‘Curran’ Station near Dartmouth, CWQ.

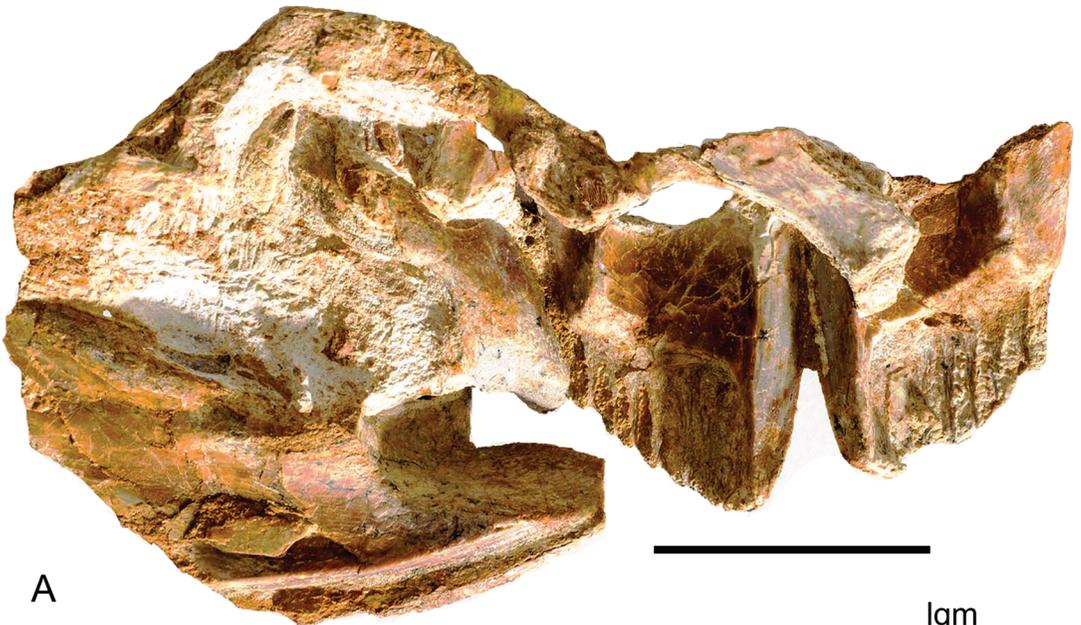
QMF55449, associated upper and lower dental plates comprising both vomerine dental plates, one incomplete left palatine dental plate and one partial left mandibular dental plate, together with an isolated chondrichthyan tooth. This is referable to *Echinorhinus australis* and was illustrated by Kemp (1991, Pl. 4W) as *Pseudocorax australis*. An additional, unidentifiable base of a shark tooth is also present, along with an

isolated plesiosaur tooth. The specimen was collected from a Richmond Council quarry on ‘Cambridge Downs’ Station, northwest of Richmond, NCQ., from calcareous shale of the Early Cretaceous (Late Albian) Toolebuc Formation.

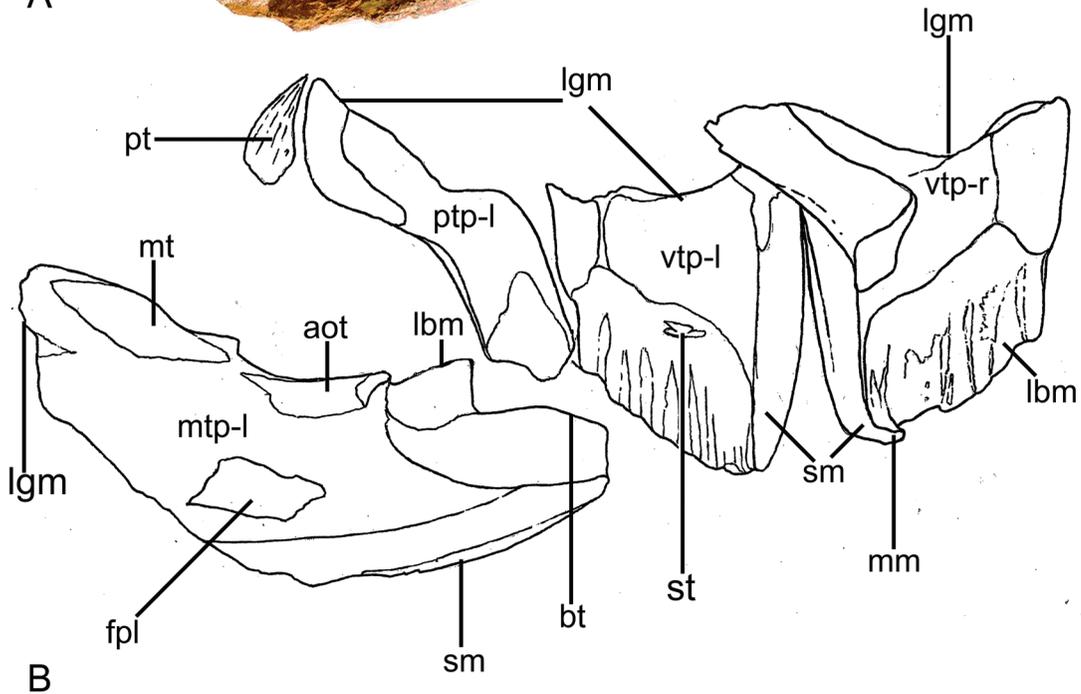
**Description.** The associated dental plates here referred to *Ptyktoptychion wadeae* are morphologically inseparable from those described by Bartholomai (2008). For that reason, a full revised description of the species has not been undertaken. Minor differences that add to the original description have been included with the following comments.

The left mandibular tooth plate (Figs 1, 2) is incomplete, lacking the extreme tip of the mandibular beak and the majority of the lingual and posterosymphyseal margins. Distribution of the tritors is very similar to that seen in QMF52603 but because the specimen has a more complete labial margin, it shows more of the edge of the sharply angular, dentate labial margin and the extent of the beak tritor is slightly extended mesially. The symphyseal surface is more distinctly grooved close to the oral surface. The new specimen is slightly smaller than QMF52603 and appears less robust. An apparently disassociated, adhering piece of pleromin is present in the broad groove on the oral surface that opens towards the lingual margin. No pleromin body is seen to be associated with this floating fragment at the lingual surface of the plate. This floating fragment is in a similar position to a similar structure seen in QMF52603 that was incorrectly identified by Bartholomai (2008) as a posterior inner tritor. In that specimen, some vascular pleromin was evident with the fragment. No posterior outer tritor has been preserved in QMF55449.

The vomerine tooth plate in QMF55449 is also morphologically very similar to QMF52605, described as *P. wadeae* by Bartholomai (2008) but is very slightly smaller. The cupped shape of oral surfaces is similar, as is the presence of labial tritors as low, parallel ridges from the deep centre of the cupped surface. The mesial beak differs slightly, with the tip of the beak bent laterally around the innermost tritors. The labial margin is less dentate on the right



A



B

FIG. 1. *Ptyktoptychion wadeae*, QMF55449, associated tooth plates. **A**, photograph of the near complete dentition from a single individual showing both vomerine tooth plates, the partial left palatine tooth plate and the left mandibular tooth plate. Also present is an isolated chondrichthyan tooth of *Echinorhinus australis* in the middle of the left vomerine tooth plate and an isolated plesiosaur tooth; **B**, An interpretative line illustration of photograph 1A. Scale bar = 4 cm.

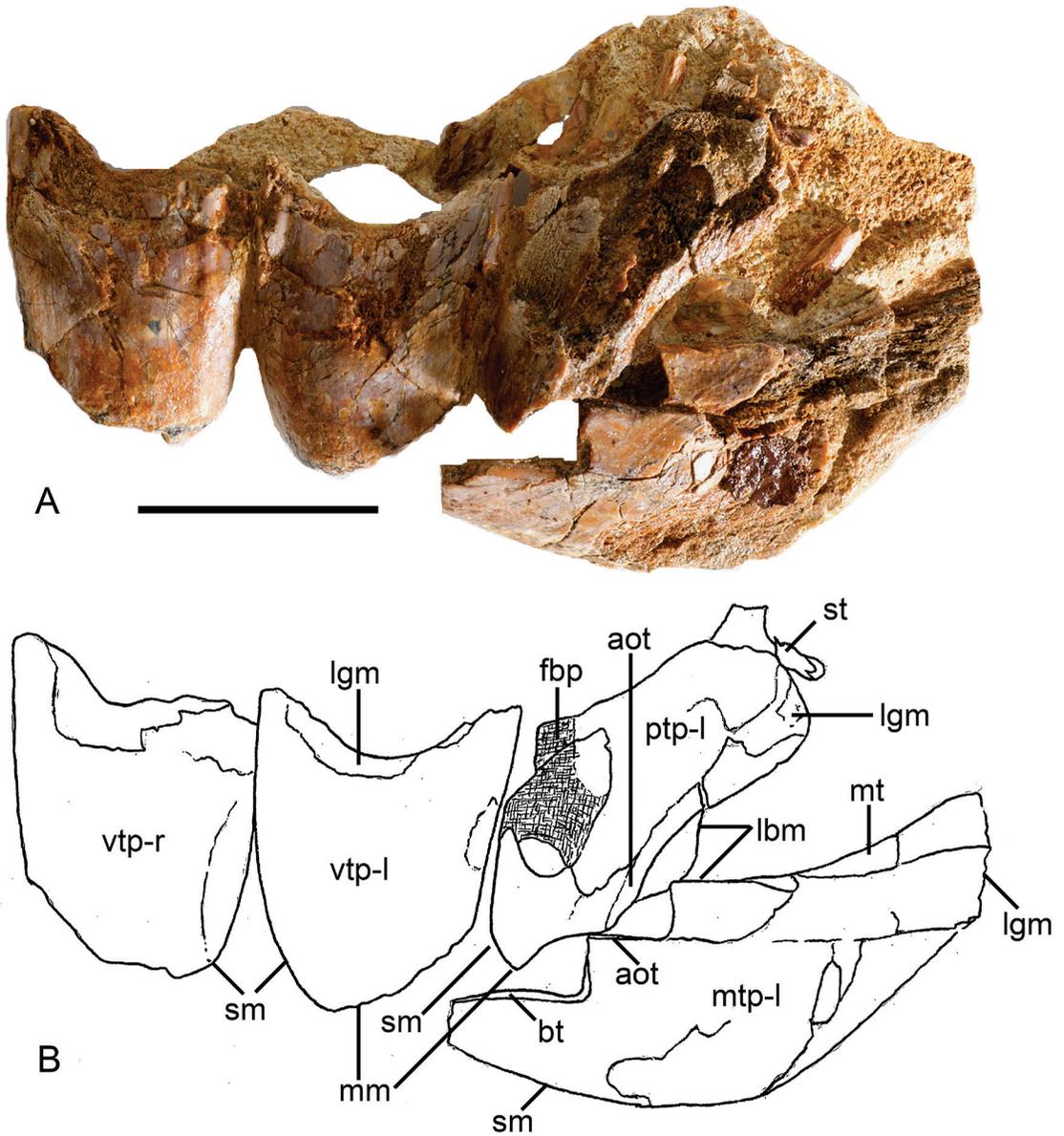


FIG. 2. *Ptyktoptychion wadeae*, QMF55449, reverse view of associated tooth plates. **A**, photograph of the near complete dentition showing both vomerine tooth plates, the partial left palatine tooth plate and the left mandibular tooth plate; **B**, an interpretive line illustration of photograph 2A. Scale bar = 4 cm.

vomerine plate than on the left as a result of fracturing and loss of the plate edge.

Although incomplete, the palatine tooth plate in QMF55449, shows more of the morphology of the anterior of the beak than that in QMF52601, the holotype of *P. wadeae*, where breakage and margin loss has reduced its mesial and anterolabial indentation. The occlusive surface of the beak is deeply excavated in QMF55449. The tip of its mesial margin is convexly rounded, leading posteriorly into a shallow but broad groove in the aboral surface and with the indentation of the anterior of the labial margin sharply shelved to the middle ridge above the basal pocket of the plate. Only a short remnant of the symphyseal descending lamina is preserved. Otherwise, the preserved remains of the palatine dental plate are similar to that of the holotype.

**Discussion.** The associated dental plates in QMF55449, discussed and illustrated herein in Figs 1 and 2, are partially masked by matrix left during preparation to maintain the original configuration of the elements as they were found. Allowing for this and for the incompleteness of the partially preserved palatine dental plate, the morphology of all of the elements is very similar to those upon which the callorhynchine chimaeroid, *Ptykyoptychion wadeae* Bartholomai, 2008, was based.

Popov (2011) considered that *Edaphodon eyrensis* Long should be transferred to *Ptykyoptychion*, but did not formally make a new combination. In a later paper, Popov & Machalski (2014), concluded that *Edaphodon* was not present in the Eromanga Basin, but they recorded *Ischyodus* cf. *thurmanni*, in Fig. 8, from the Basin. It is therefore inferred that they favoured referral of *Edaphodon eyrensis* to *Ischyodus* over *Ptykyoptychion*, but did not discuss this in detail. Due to this uncertainty of the generic placement, '*Edaphodon*' *eyrensis* is thus placed in inverted commas. Thus, the chimaeroid fauna of the Eromanga Basin is currently considered to be restricted to species of two genera, endemic *Ptykyoptychion* and '*Edaphodon*' *eyrensis* which might have affinities with the cosmopolitan genus *Ischyodus*.

Sufficient morphological features are present, especially relating to the tritor development, to maintain separation of '*E. eyrensis*' and *P. wadeae*. It was noted by Bartholomai (2008) that the holotype of *P. wadeae* and the referred specimens, QMF52602 and QMF52603, were all collected from 'Boree Park' Station near Richmond. They could have come originally from the same individual but full details of their collection had been lost when located in the effects of Dr Mary Wade following her death. The 'Boree Park' specimens were therefore treated as separate specimens in the original paper. Not only does the current associated specimen (QMF55449) confirm referral of the vomerine dental plate (QMF52605) from near Boulia, CW Qld to *P. wadeae* but the remainder of its upper and lower dental plates validates the assumptions for association of all of the referred dental plates described for this species by Bartholomai (2008).

*Ptykyoptychion wadeae* was shown to differ from the type species, *P. tayyo* Lees, 1986, currently known only from the western exposures of the Toolebuc Formation in the Eromanga Basin, and the morphological differences between the species were discussed in Bartholomai (2008). The holotype tooth plate of *P. tayyo*, QMF12987, was originally described by Lees (1986) as a mandibular tooth plate but the specimen was reinterpreted by Averianov (1992), supported later by Stahl (1999) to be a palatine tooth plate which was confirmed by Bartholomai (2008) who also showed that it differed from that attributed to *P. wadeae*. Popov (2011) initially suggested that the two species of *Ptykyoptychion*, could be conspecific but later maintained them as separate taxa (Popov & Machalski 2014, Fig. 8).

**?*Ptykyoptychion* sp.**  
(Fig. 3A– B)

**Material.** QMF43006, an isolated, incomplete dorsal fin spine with detached distal tip and lacking an undetermined amount of the inserted portion of the spine, collected from the Richmond Council 8-mile pits on the Richmond-Croydon road, from calcareous shale of the Toolebuc Formation of Early Cretaceous (Albian) age. Collected and donated to the Queensland Museum by Mr. John Towning.

**Description.** Preserved portion of the dorsal fin spine measures 22.3 cms in length and is slightly curved posteriorly and laterally. Spine is laterally compressed, sub-triangular in cross section, with near flat posterior wall meeting lateral walls around rounded corners and with lateral walls meeting anteriorly to form a sharp keel distally, becoming sharply rounded proximally. Spine widest basally, tapering apically. Keel lacks denticles. Lateral walls with numerous, fine, longitudinal striations, finer towards keel.

Distally, each posterolateral margin with a single row of numerous, small, sharply lunate, posteroventrally curved, hooked denticles that diminish slightly in size away from dorsal tip of the spine. Bases of denticles are ovate and are generally organised in an en eschalon way with the axes directed anteromedially. The tip of each denticle is formed by a sharp, acutely curved and posteriorly directed, scooped margin around the back of the denticle tip. Each denticle is smooth, formed of a thin coating of enameloid. The lateral rows of denticles are separated by a shallow, longitudinal, medial groove that extends proximally beyond the area occupied by the denticles.

Lateral compression of the spine is evident proximally, making it difficult to see the structure of the spine in section. It appears that the keel consists of solid trabecular tissue, probably with fine vascular canals. Posterolaterally, the vascular canals are larger on each side of the median groove, while the lateral surfaces are of lamellar tissue, apparently free of vascular canals. A central, large pulp cavity has allowed partial inward crushing of part of the lateral walls but the shape of the cavity is masked by the compression.

**Discussion.** Dorsal fin spines are not diagnostic to species or even to genera within a family when not found associated with dental or skeletal elements (Takeuchi & Huddleston 2006, Popov pers. comm. 2015). Two genera, *Ptyktoptychion* and another taxon that is possibly referable to *Ichthyodus* (see above) are represented in the Toolebuc Formation, neither

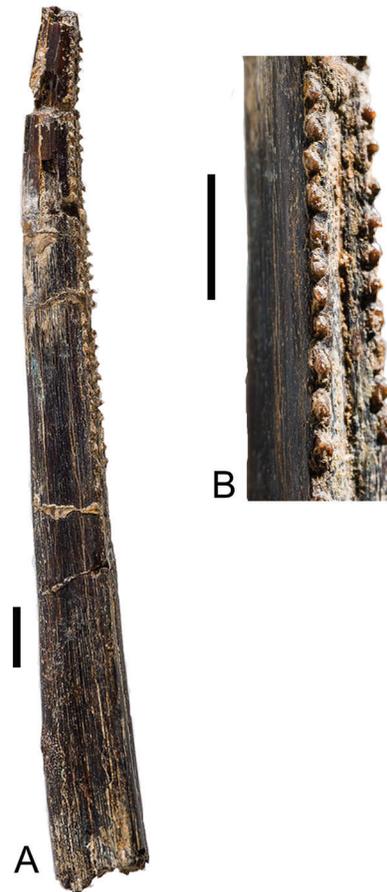


FIG. 3. *?Ptyktoptychion* sp., QMF43006, isolated dorsal fin spine. **A**, photograph of spine in left lateral view; **B**, Further enlargement of left side of spine showing double row of denticles along posterior margins and median groove. Scale bar A = 1 cm, B = 1 cm.

of which was preserved with associated dorsal fin spines.

QMF43006 has generalised similarities to those referred to *Ischyodus*, and they were described by Ward & Grande (1991) as laterally compressed, smooth or longitudinally striated, with a double series of posterior denticles. Spines of *Edaphodon* also have similarities, e.g., in particular to the spine described and illustrated by Duffin & Reynders (1995) from the Maastrichtian of Belgium as *Edaphodon* sp.

and further material illustrated by Takeuchi & Huddleston (2006) and Stahl (1999). QMF43006 has insufficient morphological differences to enable it to be shown to have unquestioned referral to either *Ptyktoptychion* or *Ischyodus*. Its possible reference to *Ptyktoptychion* is based solely on the observation that species of that genus are the more widely distributed in the Toolebuc Formation. As has occurred with the tooth plates described above, this suggestion can only be clarified at the generic and/or specific levels when associated tooth plates and a dorsal fin spine are found.

Although the preserved part of the spine QMF43006 lacks a large percentage of its overall length and part of its distal tip, an additional, non-associated dorsal spine from the Toolebuc Formation in the Richmond Council Quarry, (Kronosaurus Korner collection, KK F553 from Site 2, 8 mile pits, 20° 38' 43.75" S, 143° 5' 40.23" E) is near complete and appears to differ only slightly from QMF43006. The Kronosaurus Korner specimen has a shorter series of posterior denticles immediately below the dorsal tip, which is separated by a short gap from the remainder of the denticles. In this it differs from QMF43006, although both spines have similar curvature and their proportions are similar as is the morphology of individual denticles. The Kronosaurus Korner specimen measures 46 cms in length and 2.9 cms across its proximal base and its basal opening to accommodate basal cartilage extends slightly more than 18% up the base of the spine. This virtually complete specimen is considered by Popov (pers. comm. 2015) to be one of the largest fossil chimaeroid spines known.

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