

ART. VIII.—*Fossil Fish Remains from the Tertiaries
of Australia.*

PART I.

By F. CHAPMAN, A.L.S.,

Palaeontologist, National Museum, Melbourne,

AND

G. B. PRITCHARD,

Lecturer on Geology, Working Men's College, Melbourne.

(With Plates XI. and XII.).

[Read 14th July, 1904].

CONTENTS.

	PAGE
I.—Introduction - - - - -	267
II.—Description of Species - - - - -	268
III.—Range in time of Genera of Australian Sharks -	286
IV.—Distribution of Tertiary Species of Australian Sharks - - - - -	287
V.—Distribution of Tertiary Sharks outside Australia -	290
VI.—Comparative Table of the Selachian Remains from the Northern Hemisphere and Australia -	291
VII.—Summary of Conclusions - - - - -	292
VIII.—Bibliography - - - - -	293

I.—INTRODUCTION.

Fish remains form a very considerable portion of the fossil fauna of the Australian Tertiary deposits, but hitherto they appear to have been somewhat neglected. The previously recorded species are principally to be found in lists and catalogues of fossils, but seldom more than as a mere identification. Two of our species have, however, been well figured and described by the late Sir F. McCoy in the *Prodromus* of the Palaeontology of Victoria, and one other species by the late

Professor Ralph Tate in the Proceedings of the Royal Society of New South Wales. The majority of the species identified in this paper are new to Australia, though some have previously been recorded from New Zealand deposits. In some cases we feel assured that the earlier records are not always to be relied upon in view of the large amount of material we have had at our disposal.

The following have been previously recorded from the Australian Tertiaries:—

<i>Strophodus eocenicus</i>	= <i>Asteracanthus eocaenicus</i> .
<i>Otodus desori</i>	= <i>Oxyrhina desori</i> .
<i>Lamna elegans</i>	= <i>Lamna crassidens</i> .
<i>Lamna contortidens</i>	= <i>Odontaspis contortidens</i> .
<i>Lamna denticulata</i>	= <i>Lamna compressa</i> .
<i>Oxyrhina trigonodon</i>	= <i>Oxyrhina hastalis</i> .
<i>Oxyrhina hastalis</i> .	
<i>Oxyrhina woodsii</i>	= <i>Lamna apiculata</i> .
<i>Carcharodon angustidens</i>	= <i>Carcharodon auriculatus</i> .
<i>Carcharodon megalodon</i> .	

In working out the material herein dealt with, we have fully examined the collections in the National Museum and that made by one of us (G. B. Pritchard), and we are also indebted to the following gentlemen for the loan of specimens from their collections:—Messrs. J. R. Dixon, T. S. Hall, J. F. Mulder, F. Spry, and G. Sweet, to whom we desire to express our thanks.

The present paper contains references to eleven genera, representing twenty-five species of the Selachian group, and includes three new species. The remainder of the fish fauna we hope to deal with in another paper.

II.—DESCRIPTION OF SPECIES.

Order SELACHII.

Family *Notidanidae*.

Genus, *Notidanus*, Cuvier.

Notidanus jenningsi, sp. nov. (Pl. XI., Figs. 1, 2).

Description.—Small portion of the lower jaw partially enveloped in a phosphatic nodule bearing two anterior medial teeth and imperfect traces of others in the same parallel series.

The teeth preserved apparently belong to the left side of the lower jaw and represent two of the principal teeth. Each tooth is characterised by a marked anterior fold situated at about one-third the length of the tooth from the front; the anterior tooth has a very strong and broad main cusp which bears very fine serrations, the serrations of the basal part of the crown being much coarser and not a graduated series, but irregular in strength; the anterior slope of the adjoining tooth is finely, deeply and more regularly serrate; the posterior portion is wanting.

Dimensions.—Length, 11.5 mm.; height from base of jaw, 7.5 mm. These measurements refer to the perfect tooth.

Locality and Horizon.—From nodule band at the base of the cliffs Beaumaris, Port Phillip. Collected and presented by the late Mr. W. B. Jennings (Nat. Mus. Coll.). From the good state of preservation of our specimen it apparently belongs to the Kalimnan Beds.

Observations.—The relationships of our species point in the direction of *N. serratissimus*, Agassiz, from the English Eocene of the Isle of Sheppey and Highgate; but in the fineness of its serrations it shows an approach to the Pliocene, *N. gigas*, on the one hand, and to the recent Indian grey shark, *N. indicus*, on the other.

This species we have named in honour of the late Mr. Jennings, who did an immense amount of work on these beds, though he appears to have received very little credit for his labours.

Family *Spinacidae*

Genus *Acanthias*, Risso.

Acanthias geelongensis, sp. nov. (Pl. XI., Fig. 15).

Description.—Tooth with a somewhat slender and recurved cusp; base prolonged anteriorly; with a posterior notch and one or two crenulae on the posterior part of the base behind the notch.

Dimensions.—Length at base of tooth, 6 mm.; height, 5 mm.

Observations.—This species bears certain resemblances to *Acanthias orpiensis*, Winkler sp. (27, Pl. I., Fig. 17, and 32, Pl.

I., Figs. 1 and 2). It differs, however, in having a more slender cusp and a lower and more elongate base.

Locality and Horizon.—Orphanage Hill, Geelong (T. S. Hall Coll.)¹—Balcombian.

Family *Cestraciontidae*.

Genus *Cestracion*, Cuvier.

Cestracion cainozoicus, sp. nov. (Pl. XI., Figs. 5-8.

Pl. XII., Fig. 2).

Description.—Various lateral teeth showing variation comparable with that of the crushing teeth of the recent *C. philippi*. In shape the specimens vary from almost semicircular through subrhomboidal to elongate-oblong; the latter form usually showing a stronger incurvation of the outer lateral edge. In the best preserved specimens the surface towards the outer lateral edges shows the submedian ridge as a fine elevated band from which proceed anastomosing ridges giving rise to the pitted appearance at the extremities of the teeth. The arrangement of the ridges running off the submedian ridge is generally parallel and at right angles to it. As in common with other *Cestracion* teeth, the base of the outer concave side is usually excavate, giving rise to an articulating ridge at the junction of the crown with the root.

The surface of the crown is, generally speaking, strongly convex, and is apparently much smoother than that of the living species. An interesting point of agreement, however, is shown in one specimen which has flaked off superficially from the rest of the crown, a feature which may be readily tested in the living species.

Dimensions.—Specimen (a) (semicircular form)—Length, 13 mm.; breadth, 7 mm.; height, 5 mm.

Specimen (b) (subrhomboidal form)—Length, 18.5 mm.; breadth, 11 mm.; height, 7 mm.

Specimen (c) (elongate oblong form)—Length, 18 mm.; breadth, 7 mm.; height, 5 mm.

¹ Since presented to the National Museum.

Specimen (d)—Length, 26 mm.; breadth, 10 mm.; height, 7 mm.

Locality and Horizon.—From the nodule band at the base of the cliffs, Beaumaris, Port Phillip. National Museum Collection, collected by the late Mr. W. Kershaw, and the late Mr. W. B. Jennings; also in the private collections of Messrs. Dixon and G. B. Pritchard.

From the nodule band at the base of the upper beds Grange Burn, near Hamilton, Western Victoria. Nat. Mus. Coll., presented by Messrs. F. Spry and A. A. Kelley, also Coll. G. B. Pritchard.

The majority of the specimens hitherto obtained of this species have been from the Kalimnan Beds, but as many show considerable erosion it is probable that they may have been derived from the Balcombian. Curlewish Beds, near Geelong (Nat. Mus. Collection, presented by A. C. Curlewish); Murgheboluc (T. S. Hall Coll.)—Balcombian.

Warranooke, 23 miles north of Stawell (Nat. Mus. Collection from Mines Department, 3502).—Barwonian.

Observations.—The genus itself has been previously recorded from our Tertiaries by Tate (25, p. 246), and by Hall and Pritchard (12, p. 304), but no described Australasian Tertiary species has hitherto been known. For confirmatory evidence of the generic affinities of our specimens thin slices of the teeth have been microscopically examined, and they show the irregular habit of the pulp-canals and the characteristic outspread canaliculi near the upper surface, a feature which we have also seen in actual recent specimens, and which has also been well illustrated by Owen in his *Odontography* (22).

The first European Tertiary record of *Cestracion* was made by Winkler (27, p. 17) from the Bruxellian (Middle Eocene) of Belgium, and subsequently by A. S. Woodward (32, pp. 6, 7, 13) from the London Clay (Lower Eocene).

Genus *Asteracanthus*, Agassiz.

Asteracanthus eocaenicus, Tate, sp. (Pl. XI., Figs. 3, 4. Pl. XII., Fig. 1).

Strophodus eocenicus, Tate, 1894. Proc. Roy. Soc. N.S.W., p. 169, pl. 13, f. 6.

Description.—According to Professor Tate, this “species is somewhat comparable with *S. magnus*, Agassiz, but is narrower with coarser reticulate rugosities and the inner margin is very finely reticulate-punctate; the outline is subtrapezoidal, about three times as long as wide, broader at one end, which is convexedly truncate and narrower at the other, which is truncated; uniformly depressedly convex above.” This differs from *Cestracion*, amongst other points, in having a distinct articulating keel entirely round the tooth instead of on the outer side, and in the absence of the narrow submedian band on the upper surface. In the microscopical structure of the teeth there is also definite evidence of the affinity of this form with *Asteracanthus*, for in a vertical section the tubuli in the dentine layer are arranged in close more or less parallel bundles and quite distinctive from the structure seen in the teeth of *Cestracion*.

Dimensions.—Small specimen—Length, 17 mm.; breadth, 6.5 mm.; height, 2.5 mm.

Medium specimen—Length, 29 mm.; breadth, 11.5 mm.; height, 8 mm.

Large specimen—Length, 32.5 mm.; breadth, 11.5 mm.; height, 8.5 mm.

Locality and Horizon.—Geological Survey, T.M. 2. Limestone of the Moorabool Valley near Maude. Professor Tate’s figured specimen is recorded as from Cheltenham, Port Phillip, i.e., Beaumaris. He also mentions its occurrence in “Lower Murravian,” and refers to a specimen in Mr. Sweet’s collection from the limestones of the Moorabool River.¹

Observations.—The teeth of *Asteracanthus* are decidedly rarer in our Cainozoic Beds than *Cestracion*, but, judging from Professor Tate’s remark, “fish-plates, which are not of uncommon occurrence at Cheltenham,” he appears to have included *Cestracion* as referable to *Strophodus*. *Strophodus*, however, has been displaced in favour of *Asteracanthus*, and is now regarded as a synonym. The structure of the teeth of the above species is very distinct from that of *Cestracion*, as will be seen from the photograph, Pl. XII., Fig. 1.

¹This specimen has been since presented to the National Museum by Mr. Sweet.

Family *Carchariidae*.Genus *Galeocerdo*, Müller and Henle.*Galeocerdo davis*, nom. mut.

Notidanus marginalis, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 34, pl. 6, f. 7 (non. f. 8).

Galeocerdo sp., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 167.

Locality and Horizon.—Clays of the coastal sections near the Gellibrand River (Pritchard Coll.), 3 miles west of the mouth of the Gellibrand River (Geol. Surv. Vict., A.W. 9, Nat. Mus. Coll.).—Balcombian.

Grange Burn, near Hamilton (presented by A. A. Kelley, Esq., Nat. Mus. Coll.; also Pritchard Coll.). Beaumaris, Port Phillip (Dixon Coll.; Pritchard Coll.; Nat. Mus. Coll., presented by the late Mr. W. B. Jennings).—Kalmannan; but as mostly worn probably derived from the Balcombian.

Observations.—This species was first figured and described by Davis under the generic name of *Notidanus*, but, as was subsequently pointed out by A. S. Woodward (30, p. 167), Davis included a tooth of *Galeocerdo* with his *Notidanus*, and as the specific name *marginalis* has been retained for Davis' *Notidanus* by A. S. Woodward, the *Galeocerdo* before us may be conveniently referred to as *G. davis*.

This present form is somewhat intermediate between *G. latidens*, Ag., and *G. aduncus*, Ag., the somewhat depressed cusp reminding us of the former and the heavy base of the latter species; a good distinctive character of *G. davis* seems to be the marked regularity of the posterior slope. This form was originally recorded by Davis from the Waipara and the Oamaru Formations of New Zealand and regarded as equivalent to Upper Cretaceous and Oligocene respectively.

Galeocerdo latidens, Agassiz.

Galeocerdo latidens, Agassiz, 1843. Poiss. Foss., vol. iii., p. 231, pl. 26, figs. 22, 23.

Galeocerdo latidens, Ag., Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 444.

Locality and Horizon.—Grange Burn, near Hamilton (Pritchard Coll.). Kalimnan apparently derived from Balcombian. Beaumaris, Port Phillip. (Nat. Mus. Coll., presented by the late Mr. W. B. Jennings; also Pritchard Coll.).—Kalimnan, apparently also derived from Balcombian.

Observations.—A comparatively rare form in our beds, the commonest form being *G. davisi*, but it may be picked out by its more depressed character and narrow elongated root. This is a widely-distributed form occurring in various parts of Europe, North America, and Egypt, in beds of Eocene Age.

Galeocerdo aduncus, Agassiz.

Galeocerdo aduncus, Agassiz, 1843. Poiss. Foss., vol. iii., p. 231, pl. 26, figs. 24-28.

Galeocerdo aduncus, Ag., Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 444.

Locality and Horizon.—Beaumaris, Port Phillip (Dixon Coll., Nat. Mus. Coll., presented by the late Mr. W. B. Jennings). Kalimnan—one specimen in a good state of preservation, the other example in a worn condition.

Observations.—This species is also rare in our beds, but may be distinguished by its coarser serrations at the base of the cusp on the posterior side and the more erect and robust cusp. This has a wide geological range, being found in the Eocene, Miocene and Pliocene of Europe and North America.

Genus *Carcharias*, Cuvier.

Sub-genus, *Prionodon*, Müller and Henle.

Carcharias (Prionodon) acutus, Agassiz.

Carcharias acutus, Agassiz, 1843. Poiss. Foss., vol. iii., p. 242, pl. 36, f. 8, 9.

Locality and Horizon.—Wauru Ponds, near Geelong (Nat. Mus. Coll., purchased from Mr. J. F. Bailey).—Jan Jukian.

Observations.—The elongate and acute cusp with its lateral serrations places this form without much doubt under the above species, but unfortunately it is at present only represented by

one well-preserved specimen with part of the base wanting. This species was originally described from the Marly Chalk of Westphalia, and is Upper Cretaceous.

Genus, *Sphyrna*, Rafinesque.

***Sphyrna prisca*, Agassiz. (Pl. XI., Fig. 9).**

Sphyrna prisca, Agassiz, 1843. Poiss. Foss., vol. iii., p. 234, pl. 26a, figs. 35-50.

Sphyrna prisca, Ag., A. S. Woodward, 1889. Cat. Foss. Fishes Brit. Mus., Nat. Hist., pt. 1, p. 453.

Locality and Horizon.—Orphanage Hill, Fyansford, Geelong (T. S. Hall Coll.)¹—Balcombian.

Observations.—Although it is held that the separate teeth of *Sphyrna* and *Carcharias* are practically indistinguishable from one another, we have found it impossible to place our specimen under any other genus, as it agrees very closely with f. 50 of Agassiz's *S. prisca*. The measurement of our specimen from the top of the base to the apex is 5.5 mm. *S. prisca* is an Eocene and Miocene form, and is found in Europe and North America.

Family *Lamnidae*.

Genus *Odontaspis*, Agassiz.

***Odontaspis contortidens*, Agassiz.**

Lamna (*Odontaspis*) *contortidens*, Agassiz, 1843. Poiss. Foss., vol. iii., p. 294, pl. 37a, figs. 17-23.

Odontaspis contortidens, Ag., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 366.

Locality and Horizon.—Lower Aldinga Beds (Pritchard Coll.); Spring Creek, or Bird Rock Bluff, near Geelong, lowest zone (Pritchard Coll.); Wauru Ponds, near Geelong (Nat. Mus. Coll., purchased from J. F. Bailey, also Pritchard Coll.); Coast Section, Castle Cove, near Aire River (Pritchard Coll.)—Jan Jukian.

Lower Beds at Muddy Creek (Pritchard Coll.); Moorabool Valley [Batesford?] F. Spry Coll.; Fyansford, near Geelong (J. F. Mulder).—Balcombian.

¹ Since presented to the National Museum.

Belmont, near Geelong (J. F. Mulder).—Barwonian.

Grange Burn, Upper Beds (Nat. Mus. Coll., purchased from R. Lindsay; also presented by G. Robinson; also Spry Coll., and Pritchard Coll.); Beaumaris, Port Phillip (Dixon Coll.; Pritchard Coll.; Nat. Mus. Coll., purchased from J. F. Bailey).—Kalinman—all more or less worn, and therefore probably derived from Balcombian.

Observations.—This species was first recorded by the late Sir F. McCoy from “the Miocene of Victoria” in 1866 (15, p. 16). Authentic specimens of *O. contortidens* from the Lower Tertiary beds of Europe have assisted us towards this identification. The variations exhibited in the above series seem to be easily accounted for by the different positions which they occupied in the jaw. The species occurs in Europe and North America in strata of Eocene to Pliocene ages.

***Odontaspis incurva*, Davis, sp.**

Lamna incurva, Davis, 1888. Trans. Roy. Dublin. Soc., ser. 2, vol. iv., p. 17, pl. 3, f. 2-5.

Odontaspis incurva, Davis, sp., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 372.

Locality and Horizon.—Waurn Ponds (purchased J. F. Bailey, Nat. Mus. Coll., also Pritchard Coll.)—Jan Jukian.

Warranooke, 23 miles N. of Stawell (Nat. Mus. Coll. from Mines Dept., 3502).—Barwonian.

Grange Burn, Upper Beds (Pritchard Coll.). Beaumaris, Port Phillip (Nat. Mus. Coll., purchased from J. F. Bailey, Pritchard Coll.).—Kalinman.

Observations.—This species may be distinguished from the foregoing *O. contortidens*, Ag., by its more robust crown, convex outer face, depressed and smooth inner surface, the former being of a more slender type with a convex and striated inner surface. This species was originally described from the Waipara and Oamaru formations, New Zealand, Upper Cretaceous and Oligocene respectively.

***Odontaspis cuspidata*, Agassiz, sp.**

Lamna cuspidata, Agassiz, 1843. Poiss. Foss., vol. iii., p. 290, pl. 37a, figs. 43-50.

Odontaspis cuspidata, Ag., sp., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 368.

Lamna marginalis, Davis, 1888. Trans. Roy., Dublin Soc., ser. 2, vol. iv., p. 19, pl. 3, f. 8-10.

Locality and Horizon.—Clays of Cape Otway (Pritchard Coll.). Jan Jukian.

Black Beds east of Gellibrand River, A.W. 7, Geo. Surv., Vic. (Nat. Mus. Coll.)—Balcombian.

Beaumaris, Port Phillip. (Nat. Mus. Coll., purchased from J. F. Bailey, also Dixon Coll.) Grange Burn (Pritchard Coll.).—Kalinman (? derived).

Observations.—The teeth of this species are generally of an oblique habit, and probably include the forms figured by Agassiz under the names of *hopei*, *dubia*, and *ferox*. This species has been found in Europe and North America, and occurs in Eocene and Miocene formations. Also from the Waipara and Oamaru formations, New Zealand, Upper Cretaceous and Oligocene, under the name of *L. marginalis*, Davis.

Odontaspis attenuata, Davis, sp. (Pl. XI., Figs. 10, 11).

Lamna attenuata, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 19, pl. 3, f. 11a-c.

Locality and Horizon.—Lower beds of the Aldinga series, South Australia (Pritchard Coll.). Waurn Ponds (Nat. Mus. Coll., purchased from J. F. Bailey).—Jan Jukian.

Belmont (J. F. Mulder Coll.).—Barwonian.

Beaumaris, Port Phillip (Nat. Mus. Coll., purchased from J. F. Bailey).—Kalinman.

Observations.—The original specimens were described from teeth wanting the base. One of our specimens is fortunately well preserved, and shows that the root is strong and bifid with a well-marked median canal at the base of the crown. As the majority of the specimens show merely the crown, there appears to be a definite plane of weakness between the crown and the root. This species somewhat resembles *O. contortidens*, Ag., in having a striated inner coronal face, but these striations in the latter are fewer and more or less parallel, whilst in the former they are closer together, and have a tendency to coalesce. Another distinguishing feature is the very slender habit of *O. attenuata*, Ag.

Hitherto known only from the Oamaru formation, New Zealand—Oligocene.

Genus *Lamna*, Cuvier.

***Lamna crassidens*, Agassiz.**

Lamna crassidens, Agassiz, 1843. Poiss. Foss., vol. iii., p. 292, pl. 35, figs. 8-21.

Odontaspis (?) *crassidens*, Ag. sp., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 373.

Locality and Horizon.—Bird Rock Bluff, Spring Creek, near Geelong (Pritchard Coll.); Waurn Ponds (J. F. Mulder Coll.).—Jan Jukian.

Balcombe's Bay (Nat. Mus. Coll., collected by W. Kershaw; also Pritchard Coll.); Muddy Creek (Nat. Mus. Coll.).—Balcombian.

Observations.—This species is recorded from the Eocene of Europe and North America and the Miocene of Germany.

***Lamna apiculata*, Agassiz, sp.**

Otodus apiculatus, Agassiz, 1843. Poiss. Foss., vol. iii., p. 275, pl. 32, figs. 32-35.

Oxyrrhinus woodsii, McCoy, MS., T. Woods, 1862. Geo. Obs. S.A., p. 80, 2 figures.

Oxyrhina enysii, Davis, 1888. Trans. R. Dubl. Soc., ser. 2, vol. iv., p. 28, pl. v., figs. 17a-c, 18, 19, 20.

Oxyrhina subvexa, Davis, 1888, *ibid.*, p. 31, pl. vi., figs. 4a-c.

Locality and Horizon.—Waurn Ponds, near Geelong (Nat. Mus. Coll., purchased from J. F. Bailey); Pritchard Coll.; Mulder Coll.—Jan Jukian.

Lower Beds of Muddy Creek (Pritchard Coll.); Balcombe's Bay (Pritchard Coll.); Gellibrand coast section (Pritchard Coll.).—Balcombian. 9 miles west of Casterton (Nat. Mus. Coll., from Mines Department, No. 3493).—Barwonian.

Grange Burn (Spry Coll.).—Beaumaris (Dixon Coll.).—Kalinan, all worn and probably derived from the Balcombian.

Observations.—This species usually shows a backward curvature, and in the series before us the posterior teeth show a much stronger lateral curvature. Perfect specimens showing the

lateral denticles well-preserved are comparatively rare; the most usual condition in which they are found exhibits merely the smooth portion of the crown. This would account for Davis placing his specimens in the genus *Oxyrhina*. Agassiz records this species from the Tertiary of Vétéuil (or Verteuil), Charente, France.

The New Zealand representatives are from the Waipara and Oamaru formations—i.e., Upper Cretaceous and Oligocene respectively.

Lamna compressa, Agassiz.

Lamna compressa, Agassiz, 1843. Poiss. Foss., vol. iii., p. 290, pl. xxxvii., a. figs. 35-42.

Lamna macrota, Ag. (vel *compressa*), A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. 1, p. 402.

Lamna marginalis, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 19, pl. 3, figs. 8-10.

Locality and Horizon.—Table Cape (Nat. Mus. Coll., presented by the Rev. Mr. Legge).—Jan Jukian.

Warranooke, 23 miles north of Stawell (Nat. Mus. Coll., from Mines Dept., 3502).—Barwonian.

Grange Burn (Nat. Mus. Coll., purchased from R. Lindsay). Beaumaris, Port Phillip (Pritchard Coll.).—Kalimnan (worn specimens only).

Observations.—The European specimens referable to *Lamna compressa* are said to show a range of form embracing the type of *L. macrota*, by which name the species has been more recently defined. As we have not hitherto found any teeth of the *macrota* series from any of our beds, but only those of the *compressa* type, we think it better for the present to retain the latter name for our representatives.

Generally distributed through Europe in the Eocene and Miocene, and in the Eocene of North America.

Waipara and Oamaru formations of New Zealand Upper Cretaceous and Oligocene respectively.

Lamna bronni, Agassiz.

Lamna (*Odontaspis*) *bronni*, Agassiz, 1843. Poiss. Foss., vol. iii., p. 297, pl. 37a, figs. 8-10.

Odontaspis bronni, Ag., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 360.

Locality and Horizon.—Wauru Ponds, near Geelong (Pritchard Coll.).—Jan Jukian.

Observations.—Our specimen agrees exactly with Agassiz's original figure of this species, and, failing a complete series, we are unable to refer this to any other species.

The European representatives are only found in the Upper Cretaceous of Holland and Belgium (Maastricht, Ciply, and Hainaut).

Genus, *Oxyrhina*, Agassiz.

Oxyrhina hastalis, Agassiz. (Pl. I., Figs. 12-14).

Oxyrhina hastalis, Agassiz, 1843. Poiss. Foss., vol. iii., p. 277, pl. 34, figs. 3-13, 15-17.

Oxyrhina xiphodon, Agassiz, 1843. Ibid., p. 278, pl. 33, figs. 11-17.

Oxyrhina trigonodon, Agassiz, 1843. Ibid., p. 279, pl. 37, figs. 17-18.

Oxyrhina plicatilis, Agassiz, 1843. Ibid., p. 279, pl. 37, figs. 14-15.

Oxyrhina acuminata, Davis, 1888. Trans. R. Dublin Soc., ser. 2, vol. iv., p. 29, pl. v., figs. 21a-c.

Oxyrhina hastalis, Ag., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 385.

Locality and Horizon.—Lower Beds of Muddy Creek, Western Victoria (Pritchard Coll.); Leigh River at Shelford (Nat. Mus. Coll.); Mitchell River, near Bairnsdale (Nat. Mus. Coll., presented by A. W. Howitt); Balcombe's Bay (Pritchard Coll.).—Balcombian.

Beaumaris, Port Phillip (Nat. Mus. Coll., collected by W. Kershaw, presented by C. D. Aplin, J. F. Bailey, and C. French, jr.; also Dixon Coll. and Pritchard Coll.).

Grange Burn (Nat. Mus. Coll., purchased from R. Lindsay, and presented by G. Robinson; also Spry Coll. and Pritchard Coll.).

Observations.—This is the commonest of our Australian sharks' teeth, and as a consequence we are enabled to obtain a

good idea of the variation in the teeth from different parts of the jaw. In common with previous authors we have included several of Agassiz's species which were evidently given to designate teeth from different parts of the same jaw; the more erect and typical *hastalis* representing the large anterior teeth, *xiphodon* those of an intermediate position, *plicatilis* those of a lateral position, and smaller oblique forms representing the postero-laterals.

In America this species is Eocene, whilst in Europe it is generally Miocene, but extends also into the Pliocene, some of which are evidently derived from older beds.

This species was recorded for Victoria by the late Sir F. McCoy under the name of *O. trigonodon* in 1866 (15, p. 17).

Oxyrhina desori, Agassiz.

Oxyrhina desorii, Agassiz, 1843. Poiss. Foss., vol. iii., p. 202, pl. 37, figs. 8-13.

Oxyrhina leptodon, Agassiz, 1843. Ibid., p. 282, pl. 37, figs. 3-5.

Oxyrhina grandis, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 30, pl. 5, figs. 15, 16.

Oxyrhina desorii, Ag., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 382.

Oxyrhina desorii, Ag., L. Seguenza, 1900. Boll. Soc. Geol. Ital., p. 482, pl. 5, figs. 1-12.

Locality and Horizon.—Wauru Ponds, near Geelong (Nat. Mus. Coll., purchased from J. F. Bailey, and from Mines Department [4766]; also J. F. Mulder Coll. and Pritchard Coll.).—Jan Jukian.

Birregurra (J. F. Mulder Coll.).—Barwonian.

Beaumaris, Port Phillip (Dixon Coll.; Pritchard Coll.); Grange Burn (Spry Coll.).—Kalmian.

Observations.—The figures given by Davis represent the strong anterior teeth, and we also have the more slender and more oblique laterals.

This species is Upper Eocene in North America, and Upper Eocene, Miocene, and Pliocene in Europe. In New Zealand it occurs in the Waipara and Oamaru formations, Upper Cretaceous and Oligocene respectively.

***Oxyrhina retroflexa*, Agassiz.**

Oxyrhina retroflexa, Agassiz, 1843. Poiss. Foss., vol. iii., p. 281, pl. 33, f. 10.

Oxyrhina crassa, Agassiz, 1843. Poiss. Foss., vol. iii., p. 283, pl. 37, fig. 16.

Oxyrhina vonhaastii, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 26, pl. 4, figs. 1-3.

Oxyrhina crassa, Agassiz., A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 389.

Locality and Horizon.—Three miles west of mouth of Gellibrand River (Geol. Surv. Vic., A.W. 9, Nat. Mus. Coll.).—Balcombian. Nine miles west of Casterton (Mines Department 3493 Nat. Mus. Coll.).—Barwonian.

Beaumaris, Port Phillip (Nat. Mus. Coll., purchased from J. F. Bailey, collected by W. Kershaw, presented by C. D. Aplin; also Pritchard Coll.). Grange Burn (Nat. Mus. Coll., presented by G. Robinson and A. A. Kelley, and purchased from R. Lindsay; also Spry Coll. and Pritchard Coll.).—Kalmian.

Observations.—The series before us shows more perfect gradation than those figured by Davis as *O. vonhaastii*; the anterior teeth are fairly well represented by Agassiz's figure of *O. crassa*, whilst the short recurved form is undoubtedly his *O. retroflexa*. The relative abundance and variation in this form affords us a parallel example in dentition with *O. hastalis*. *O. retroflexa* has been included in the synonymy of *O. hastalis* by A. S. Woodward in his British Museum Catalogue, but, as our series is large and representative, we have been compelled to regard it as a distinct type.

This species in Europe is recorded from the Eocene, Miocene and Pliocene, and from the Eocene of North America.

The New Zealand specimens are from the Oamaru formation, Oligocene.

***Oxyrhina eocaena*, A. S. Woodward. sp.**

Carcharias (*Scoliodon*) *eocaenus*, A. S. Woodward, 1889. Cat. Foss. Fishes, Brit. Mus. Nat. Hist., pt. i., p. 436.

Oxyrhina eocaena, A. S. Woodward, 1899. Proc. Geol. Assoc., vol. xvi., p. 11, pl. i., figs. 25, 26.

Locality and Horizon.—Beaumaris, Port Phillip (Dixon Coll. ; Pritchard Coll.). Grange Burn (Nat. Mus. Coll., presented by A. A. Kelley, and purchased from R. Lindsay ; also Pritchard Coll.).

Observations.—We have examined a fair number of specimens, which agree closely with the diagnosis and figures given by A. S. Woodward, but some of our examples are about twice the height of the type specimens. The original specimens came from the London clay, Highgate.

Oxyrhina minuta, Agassiz.

Oxyrhina minuta, Agassiz, 1843. Poiss. Foss., vol. iii., p. 285, pl. 36, figs. 39-47.

Oxyrhina fastigiata, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 30, pl. 6, figs. 1-3.

Locality and Horizon.—Wauru Ponds, near Geelong (J. F. Mulder Coll. ; Pritchard Coll.).—Jan Jukian.

East of Gellibrand River (Geo. Surv. Vic. A.W., 7, Nat. Mus. Coll.). Lower Beds of Muddy Creek (Pritchard Coll.).—Balcombian.

Belmont (J. F. Mulder Coll.).—Barwonian.

Grange Burn (Spry Coll. ; Pritchard Coll.).—Kalinman.

Observations.—To this species we have referred numerous slender minute teeth which do not appear to belong to any other series, and are exactly comparable with the figures of both the above-mentioned forms. *O. minuta* has been recorded from the Lower Miocene of Osnabruck, Prussia, and Piedmont, Naples, and Sicily. It occurs in N. Zealand in the Oamaru formation (Oligocene).

Genus *Carcharodon*, Müller and Henle.

Carcharodon auriculatus, Blainville, sp.

Squalus auriculatus, de Blainville, 1818. Nouv. Dict. d'Hist. Nat., vol. xxvii., p. 384.

Carcharodon auriculatus, Agassiz, 1843. Poiss. Foss., vol. iii., p. 254, pl. 28, figs. 17-19.

Carcharodon angustidens, Agassiz, 1843. Ibid., p. 255, pl. 28, figs. 20-25, and pl. 30, f. 3.

Carcharodon angustidens, Agassiz, McCoy, 1875. *Prod. Pal. Vic.*, dec. ii., p. 8, pl. 11, f. 2, 3.

Carcharodon angustidens, Agassiz, Davis, 1888. *Trans. Roy. Dublin Soc.*, ser. 2, vol. iv., p. 9, pl. i., figs. 4-6, and pl. 6, f. 22.

Carcharodon auriculatus, Blainville sp., A. S. Woodward, 1889. *Cat. Foss. Fishes, Brit. Mus. Nat. Hist.*, part i., p. 411.

Locality and Horizon.—Wauru Ponds (Nat. Mus. Coll., purchased J. F. Bailey; Pritchard Coll.). Table Cape (Nat. Mus. Atkinson Coll.). Spring Creek or Bird Rock Bluff, near Geelong. (Nat. Mus. Coll., presented by A. E. Butler). West of Rocky Point, Spring Creek section (Hall Coll.).—Jan Jukian.

Nine miles W. of Casterton (Nat. Mus. Coll. from Mines Department, 3493). Casterton (Nat. Mus. Coll., presented by Miss Wilson).—Barwonian.

Grange Burn (Spry Coll.).—Kalmnan, probably derived from Balcombian.

Observations.—Specimens in our collection show the same range of variation as has already been indicated by the forms figured as *Carcharodon auriculatus*, *angustidens*, *heterodon*, *toliapicus*, etc.

This species appears essentially to belong to the Barwonian series, as our knowledge of its existence in the Kalmnan is restricted to one worn specimen.

Middle and Upper Eocene of Europe and North America, and from the Miocene and Pliocene of Europe. This species is also recorded from the Oamaru formation (Oligocene) of New Zealand.

***Carcharodon megalodon*, Agassiz.**

Carcharodon megalodon, Agassiz, 1843. *Poiss. Foss.*, vol. iii., p. 247, pl. 19.

Carcharodon megalodon, Agassiz, McCoy, 1875. *Prod. Pal. Vic.*, dec. ii., p. 9, pl. ii., f. 4 and 4a-c.

Carcharodon megalodon, Agassiz, Davis, 1888. *Trans. Roy. Dublin Soc.*, ser. 2, vol. iv., p. 12, pl. 2, figs. 1-3.

Carcharodon megalodon, Agassiz, A. S. Woodward, 1889. *Cat. Foss. Fishes, Brit. Mus. Nat. Hist.*, pt. i., p. 415.

Locality and Horizon.—Wauru Ponds (Pritchard Coll.); Spring Creek or Bird Rock Bluff (Nat. Mus. Coll. Geo. Surv. Vic.).—Jan. Jukian.

Grange Burn Lower limestones (Pritchard Coll.); ?Muddy Creek (Nat. Mus. Coll.); Muddy Creek (Sweet Coll.); Clays of Native Hut Creek, near Inverleigh (Pritchard Coll.).—Balcombian.

Grange Burn, near Hamilton (Nat. Mus. Coll., purchased R. Lindsay, much worn); Beaumaris, Port Phillip, conglomerate bed, probably derived (Pritchard Coll.).—Kalmannan.

Observations.—The specimen of this species figured by McCoy is about the smallest of the specimens known from the Australian Tertiary beds, but it is in a very good state of preservation. It may be interesting to note the measurements of a few of the largest specimens. From Muddy Creek, height 11 cm., breadth 10 cm.; from Grange Burn, height 12 cm. nearly, breadth 11 cm.; from Native Hut Creep, height 12 cm., breadth 10.5 cm. (approximate, owing to fracture).

Eocene of North America; Miocene and Pliocene of Europe; Miocene of Burma; Tertiary of Java; Oamaru formation (Oligocene) New Zealand.

There is also a record in the British Museum Catalogue of a plaster cast of a large tooth from the "Upper Tertiary," Lake Bonny, South Australia, which was presented to the Museum by Sir Samuel Davenport (op. cit., p. 420.).

***Carcharodon robustus*, Davis.**

Carcharodon robustus, Davis, 1888. Trans. Roy. Dublin Soc., ser. 2, vol. iv., p. 13. pl. 1, f. 7.

Locality and Horizon.—Wauru Ponds (Pritchard Coll.).—Jan. Jukian. Lower Beds of Muddy Creek below Mason's (Pritchard Coll.).—Balcombian.

Observations.—This species has been included in the synonymy of *C. megalodon* (30. p. 417) by A. S. Woodward, but the forms in our collection are so distinct a type of tooth that it necessitates the retention of Davis' species as distinct from *C. megalodon*. Davis records his species from the Oamaru formation (Oligocene), New Zealand.

III.—RANGE IN TIME OF GENERA OF AUSTRALIAN SHARKS AS HITHERTO KNOWN.

Genus.	Jurassic.	Cretaceous.	Eocene.	Oligocene.	Miocene.	Pliocene.	Recent.
Notidanus - -	—						—
Acanthias - -		—					—
Cestracion - -	—						—
Asteracanthus - -		—					
Galeocерdo - -			—				—
Carcharias - -			—				—
Sphyrna - -			—				—
Odontaspis - -				—			—
Lamna - -					—		—
Oxyrhina - -						—	—
Carcharodon - -							—

IV.—TABLE OF DISTRIBUTION OF TERTIARY SPECIES OF AUSTRALIAN SHARKS.

Species.	Localities.	Relative Abundance.	Stratigraphical Horizon.
1. <i>Notidanus jenningsi</i> , sp. nov. -	Beaumaris - - -	Rare -	Kalimnan
2. <i>Acanthias geelongensis</i> , sp. nov. -	Fyansford - - -	Rare -	Balcombian
3. <i>Cestracion cainozoicus</i> , sp. nov. -	Beaumaris, Grange Burn -	Common - (worn)	Kalimnan
	Curlewis, Murgheboluc -	Rare -	Balcombian
	Warranooke - - -	Rare -	Barwonian
4. <i>Asteracanthus eocaenicus</i> , Tate, sp. -	Beaumaris - - -	Rare -	Kalimnan
	Murray River, S.A.; Maude -	Rare -	Barwonian
5. <i>Galeocerdo davisi</i> , nom. mut. -	Beaumaris, Grange Burn -	Common - (worn)	Kalimnan
	Gellibrand Coast Sections -	Rare -	Balcombian
6. <i>Galeocerdo latidens</i> , Agassiz -	Grange Burn, Beaumaris -	Rare - (worn)	Kalimnan
7. <i>Galeocerdo aduncus</i> , Agassiz -	Beaumaris - - -	Rare -	Kalimnan
8. <i>Carcharias (Prionodon) acutus</i> , Agassiz -	Wauru Ponds - - -	Rare -	Jan Jukian
9. <i>Sphyrna prisca</i> , Agassiz -	Fyansford, Geelong - - -	Rare -	Balcombian
10. <i>Odontaspis contortidens</i> , Agassiz -	Beaumaris, Grange Burn -	Occasional -	Kalimnan
	Belmont - - -	Rare -	Barwonian
	Muddy Creek, Fyansford, Moorabool Valley - - -	Occasional -	Balcombian
	Lower Aldinga, Spring Creek, Wauru Ponds, Castle Cove -	Common -	Jan Jukian

TABLE OF DISTRIBUTION OF TERTIARY SPECIES OF AUSTRALIAN SHARKS. (*Continued*).

Subjects.	Localities.	Relative Abundance.	Stratigraphical Horizon.
11. <i>Odontaspis incurva</i> , Davis, sp.	Grange Burn, Beaumaris	Occasional - (worn)	Kalimnan
	Warranooke	Rare -	Barwonian
	Wauru Ponds	Occasional -	Jan Jukian
12. <i>Odontaspis cuspidata</i> , Agassiz, sp.	Grange Burn, Beaumaris	Rare -	Kalimnan
	Gellibrand River	Rare -	Balcombian
	Cape Otway	Rare -	Jan Jukian
13. <i>Odontaspis attenuata</i> , Davis, sp.	Beaumaris	Rare -	Kalimnan
	Belmont	Rare -	Barwonian
	Lower Aldinga, Wauru Ponds	Rare -	Jan Jukian
14. <i>Lamna crassidens</i> , Agassiz	Muddy Creek, Balcombe's Bay	Occasional -	Balcombian
	Spring Creek, Wauru Ponds	Occasional -	Jan Jukian
15. <i>Lamna apiculata</i> , Agassiz, sp.	Grange Burn, Beaumaris	Occasional -	Kalimnan
	Casterton	Rare -	Barwonian
	Muddy Creek, Balcombe's Bay, Gellibrand River	Occasional -	Balcombian
16. <i>Lamna compressa</i> , Agassiz	Wauru Ponds	Common	Jan Jukian
	Grange Burn, Beaumaris	Rare -	Kalimnan
	Warranooke	Rare -	Barwonian
	Table Cape, Tas.	Rare -	Jan Jukian
17. <i>Lamna bronni</i> , Agassiz	Wauru Ponds	Rare -	Jan Jukian
18. <i>Oxyrhina hastalis</i> Agassiz	Grange Burn, Beaumaris	Abundant -	Kalimnan
	Muddy Creek, Shelford, Bal- combe's Bay, Mitchell River	Occasional -	Balcombian

TABLE OF DISTRIBUTION OF TERTIARY SPECIES OF AUSTRALIAN SHARKS. (Continued).

Subjects.	Localities.	Relative Abundance.	Stratigraphical Horizon.
19. <i>Oxyrhina desori</i> , Agassiz - - -	Grange Burn, Beaumaris - -	Occasional -	Kalimnan
	Birregurra - - -	Rare -	Barwonian
	Wauru Ponds - - -	Common -	Jan Jukian
20. <i>Oxyrhina retroflexa</i> , Agassiz - - -	Grange Burn, Beaumaris - -	Common -	Kalimnan
	Casterton - - -	Rare -	Barwonian
	Gellibrand River - - -	Rare -	Balcombian
21. <i>Oxyrhina eocaena</i> , Woodward, sp. - - -	Grange Burn, Beaumaris - -	Rare -	Kalimnan
22. <i>Oxyrhina minuta</i> , Agassiz - - -	Grange Burn - - -	Common -	Kalimnan
	Belmont - - -	Rare -	Barwonian
	Gellibrand River, Muddy Creek -	Occasional -	Balcombian
	Wauru Ponds - - -	Occasional -	Jan Jukian
23. <i>Carcharodon auriculatus</i> , Blainville, sp. - - -	Grange Burn - - -	Rare -	Kalimnan
	Casterton - - -	Occasional -	Barwonian
	Wauru Ponds, Spring Creek, Table Cape, Tas. - - -	Occasional -	Jan Jukian
24. <i>Carcharodon megalodon</i> , Agassiz - - -	Grange Burn, Beaumaris - -	Rare -	Kalimnan
	Muddy Creek, Native Hut Creek, Grange Burn Lower Limestone - - -	Occasional -	Barwonian
	Wauru Ponds, Spring Creek - -	Occasional -	Jan Jukian
	Muddy Creek - - -	Rare -	Kalimnan
25. <i>Carcharodon robustus</i> , Davis - - -	Wauru Ponds - - -	Rare -	Balcombian
		Rare -	Jan Jukian
		Rare -	Balcombian
		Rare -	Jan Jukian

V.—DISTRIBUTION OF TERTIARY SHARKS OUTSIDE AUSTRALIA.

Species.	Geographical Distribution.	Geological Range.
<i>Galeocerdo davisii</i> , nom. mut. (= <i>Notidanus marginalis</i> , Davis, pars.)	New Zealand - - -	Upper Cretaceous and Oligocene
<i>Galeocerdo latidens</i> , Ag.	Europe, Egypt, and N. America -	Middle Eocene
<i>Galeocerdo aduncus</i> , Ag.	Europe and N. America -	Eocene to Pliocene
<i>Carcharias</i> (<i>Prionodon</i>) <i>acutus</i> , Ag.	Westphalia - - -	Upper Cretaceous
<i>Sphyrna prisca</i> , Ag.	Europe and N. America -	Eocene and Miocene
<i>Odontaspis contortidens</i> , Ag.	Europe and N. America -	Eocene to Pliocene
<i>Odontaspis incurva</i> , Davis, sp.	New Zealand - - -	Upper Cretaceous and Oligocene
<i>Odontaspis cuspidata</i> , Ag., sp.	Europe, N. America, and New Zealand -	Upper Cretaceous to Miocene
<i>Odontaspis attenuata</i> , Davis, sp.	New Zealand - - -	Oligocene
<i>Lamna crassidens</i> , Ag.	Europe and N. America -	Eocene and Miocene
<i>Lamna apiculata</i> , Ag., sp.	France, New Zealand -	Upper Cretaceous to Oligocene
<i>Lamna compressa</i> , Ag.	Europe, N. America, and New Zealand -	Upper Cretaceous to Miocene
<i>Lamna bronni</i> , Ag.	Netherlands - - -	Upper Cretaceous
<i>Oxyrhina hastalis</i> , Ag.	N. America, Europe, Canary and Cape de Verde Isles -	Eocene to Pliocene
<i>Oxyrhina desori</i> , Ag.	Europe, N. America -	Upper Eocene to Pliocene
<i>Oxyrhina retroflexa</i> , Ag.	Europe, N. America, New Zealand -	Eocene to Pliocene
<i>Oxyrhina eocaena</i> , A.S.W., sp.	England - - -	Lower Eocene
<i>Oxyrhina minuta</i> , Ag.	Germany, Italy -	Lower Miocene
<i>Carcharodon auriculatus</i> , Blainville, sp.	Europe, N. America, New Zealand -	Middle Eocene to Pliocene
<i>Carcharodon megalodon</i> , Ag.	N. America, Europe, Burma, Java, and New Zealand -	Eocene to Pliocene
<i>Carcharodon robustus</i> , Davis	New Zealand - - -	Oligocene

Species.	Geol. Range in N. Hemisphere.			Geol. Range in Australia.
<i>Carcharias acutus</i> , Ag.	-	-	-	Barwonian (Jan Jukian).
<i>Sphyrna prisca</i> , Ag.	-	-	-	Barwonian (Balcombian).
<i>Odontaspis contortidens</i> , Ag.	-	-	-	Barwonian (Jan Jukian and Balcombian), Kalimnan.*
<i>O. cuspidata</i> , Ag., sp.	-	-	-	Barwonian (Jan Jukian and Balcombian), Kalimnan.*
<i>Lamna crassidens</i> , Ag.	-	-	-	Barwonian (Jan Jukian and Balcombian).
<i>L. apiculata</i> , Ag., sp.	-	-	-	Barwonian (Jan Jukian and Balcombian), Kalimnan.*
<i>L. compressa</i> , Ag.	-	-	-	Barwonian (Jan Jukian).
<i>L. bronni</i> , Ag.	-	-	-	Barwonian (Jan Jukian).
<i>Oxyrhina hastalis</i> , Ag.	-	-	-	Barwonian (Balcombian), Kalimnan.*
<i>O. desori</i> , Ag.	-	-	-	Barwonian (Jan Jukian), Kalimnan.
<i>O. retroflexa</i> , Ag.	-	-	-	Barwonian (Balcombian), Kalimnan.
<i>O. eocaena</i> , A. S. Woodward, sp.	-	-	-	Kalimnan.*
<i>O. minuta</i> , Ag.	-	-	-	Barwonian (Jan Jukian), Kalimnan.
<i>Carcharodon auriculatus</i> , Blainville, sp.	-	-	-	Barwonian (Jan Jukian), Kalimnan.*
<i>C. megalodon</i> , Ag.	-	-	-	Barwonian (Balcombian), Kalimnan.*

* Probably derived.

VII.—SUMMARY OF CONCLUSIONS.

From the foregoing examination of our Tertiary fish remains the following principal points may be summarized :—

The genus *Asteracanthus* previously recorded by Tate from the Balcombian and Kalimnan, under the generic name of *Strophodus*, undoubtedly belongs to the former genus, evidence being rendered by the microscopic structure of the teeth. This extends beyond question the range of this hitherto Jurassic and Upper Cretaceous fish into the Tertiary seas round Southern Australia.

With regard to the identified species, two Upper Cretaceous species occur in our beds of Jan Jukian age, viz.—

Carcharias acutus and *Lamna bronni*.

One species—*Oxyrhina minuta*—is apparently a comparatively restricted Miocene form in the Northern Hemisphere, and occurs here in the Jan Jukian, Balcombian, and Kalimnan. Ten species have a comparatively wide geological range in the tertiaries, both in the Southern and Northern Hemispheres, namely :—*S. prisca*, *O. contortidens*, *O. cuspidata*, *L. crassidens*, *L. compressa*, *Ox. hastalis*, *Ox. desori*, *Ox. retroflexa*, *C. auriculatus*, and *C. megalodon*.

These data do not furnish any very clear evidence of our tertiary succession and relative age of the beds, since the fauna has a general tertiary aspect, but the occurrence of the few Mesozoic forms gives an aspect of antiquity to the older portion of our tertiary strata.

With regard to the occurrence of certain species found both in New Zealand and Australian strata, we gather some interesting information, which points to some affinity with the Cretaceous-Tertiary Group of the former area.

Name of Species.	New Zealand.		Australia.			
	1. Upper Cretaceous.	2. Oligo- cene.	3. Jan Jukian.	4. Bal- combian.	5. Barwon- ian.	6. Kalim- nan.
<i>Galeocerdo davisi</i> -	- 1	- 2	-	- 4	- 5	-
<i>Odontaspis incurva</i> -	- 1	- 2	- 3	-	- 5	-
<i>Odontaspis cuspidata</i> -	- 1	- 2	- 3	- 4	- 5	- 6
<i>Odontaspis attenuata</i> -	- 1	- 2	- 3	-	- 5	- 6
<i>Lamna apiculata</i> -	- 1	- 2	- 3	- 4	- 5	- 6
<i>Lamna compressa</i> -	- 1	- 2	- 3	-	- 5	- 6
<i>Oxyrhina desori</i> -	- 1	- 2	- 3	-	- 5	- 6

Oxyrhina retroflexa	-	-	1	-	2	-	-	4	-	5	-	6	
Oxyrhina minuta	-	-	1	-	2	-	3	-	4	-	5	-	6
Carcharodon auriculatus	-	1	-	2	-	3	-	4	-	5	-	6	
Carcharodon megalodon	-	1	-	2	-	3	-	4	-	5	-	6	
Carcharodon robustus	-	1	-	2	-	-	-	4	-	5	-		

From the state of preservation of the specimens in our beds, we have no hesitation in stating that we think the majority of the occurrences in the Kalimnan beds are due to their having been derived from the older Barwonian beds. This we think is somewhat analagous to the fact of so many Pliocene specimens being of a derived character in the Northern Hemisphere, and, where no indication of the state of preservation is given, the results of an inquiry into the distribution of species may be somewhat misleading.

The local terms, Kalimnan, Balcombian, Jan Jukian, and Barwonian, have been used by us owing to the very considerable confusion and difference of opinion surrounding the use of the ordinary terms such as Miocene, Oligocene, Eocene, and to the fact that as yet there is no absolute certainty on the stratigraphical succession of our beds.

As far as the evidence points up to the present, the older series has been termed Barwonian¹ with its two sub-divisions, Balcombian and Jan Jukian, of which the latter has been indicated as the older.² To this series various ages have been assigned, such as Eocene, Oligocene, and Miocene, for different portions of the same series.

Then for the series distinctly unconformable to the Barwonian and distinctly separable by its molluscan fauna the name of Kalimnan has been given³; and this series has been variously referred to as Oligocene, Miocene, and Pliocene.

VIII.—BIBLIOGRAPHY.

- (1). *Agassiz, L.*—Poissons fossiles, vol. iii., 1843.
- (2). *Davis, J. W.*—The Fossil Fish Remains from the Tertiary and Cretaceo-tertiary Formations of New Zealand.
Trans. R. Dublin Soc., vol. iv., ser. 2, 1888, pp. 1-48,
pls. i-vii.

¹ Proc. Roy. Soc., Vic., 1904, vol. xvi., n.s., pt. ii., pp. 297, 298.

² *Op. cit.*, 1902, vol. xiv., pt. ii., p. 75.

³ *Op. cit.*, 1902, vol. xiv., pt. ii. pp. 78, 80.

- (3). *Dennant, J., and Kitson, A. E.*—Catalogue of the described species of Fossils (except Bryozoa and Foraminifera) in the Cainozoic Fauna of Victoria, South Australia, and Tasmania.
Records of the Geol. Survey of Vict., vol. i., pt. 2, 1903, p. 94.
- (4). *Dennant, J., and Mulder, J. F.*—Geology of the Lower Leigh Valley.
Proc. R. Soc. Vict., n.s., vol. ix., pt. i, 1898, p. 66.
- (5). *Eastman, C. R.*—Maryland Geol. Survey—Eocene, 1901, pp. 102-110, pls. xiv., xv.
- (6). *Etheridge, R., jun.*—A Catalogue of Australian Fossils, 1878, pp. 171, 172.
- (7). *Hall, T. S., and Pritchard, G. B.*—Notes on the Lower Tertiaries of the Southern portion of the Moorabool Valley.
Proc. R. Soc. Vict., n.s., vol. iv., pt. i, 1892, pp. 18, 26.
- (8). *Hall, T. S., and Pritchard, G. B.*—The Older Tertiaries of Maude.
Proc. R. Soc., Vict. n.s., vol. vii., 1895, p. 185.
- (9). *Hall, T. S., and Pritchard, G. B.*—Remarks on the Eocene Rocks of Victoria.
Proc. R. Soc., Vict., N.S., vol. viii., 1896, pp. 158, 160.
- (10). *Hall, T. S., and Pritchard, G. B.*—Contribution to our Knowledge of the Tertiaries in the neighbourhood of Melbourne.
Proc. R. Soc., Vict. n.s., vol. ix., 1897, p. 194.
- (11). *Hall, T. S., and Pritchard, G. B.*—Geology of the Lower Moorabool.
Proc. R. Soc. Vict., n.s., vol. x., pt. i., 1897, p. 48.
- (12). *Hall, T. S. and Pritchard, G. B.*—Geology of the Barwon Valley about Inverleigh.
Proc. R. Soc., Vict. n.s., vol. xvi., pt. ii., 1904, p. 304.
- (13). *Johnston, R. M.*—Further Notes on the Tertiary Marine Beds of Table Cape, Tasmania.
Proc. R. Soc. Tasmania, 1877 (for 1876), p. 86.
- (14). *Martin K.*—Palaeontologische Ergebnisse von Tiefbohrungen auf Java. Sammlungen des Geologischen Beiträge zur Geologie Ost-Asiens und Australiens,

ser. i., Band iii., 1887. Reichs-Museums in Leiden.

Kitson, A. E.—See Dennant and Kitson.

Lydekker, R.—See Nicholson and Lydekker.

- (15). *M'Coy, F.*—On the Recent Zoology and Palaeontology of Victoria.

Exhibition Essay, 1866, p. 16 (see also *Annals Nat. Hist.*, 1867, vol. xx., p. 192.)

- (16). *M'Coy, F.*—Geol. Survey of Victoria—Report of Progress, No. i., 1874, p. 35.

- (17). *M'Coy, F.*—*Ibid.* No. iii., 1876, p. 269. See also No. iv., 1877, p. 157.

- (18). *M'Coy, F.*—*Ibid.* No. v., 1878, p. 176.

- (19). *M'Coy, F.*—Geol. Survey of Victoria. Prodrum of the Palaeontology. Decade ii., 1875, pp. 8-10, pl. xi., fig. 2-4.

Mulder, J. F.—See Dennant and Mulder.

- (20). *Nicholson, H. A., and Lydekker, R.*—Manual of Palaeontology, vol. ii., 1889.

- (21). *Noetling, F.*—Fauna of the Miocene Beds of Burma. *Pal. Indica*, new series, vol. i., No. 3, 1901.

- (22). *Owen R.*—Odontography, London, 1840-5.

Pritchard, G. B.—See Hall and Pritchard.

- (23). *Seguenza, L.*—I Vertebrati Fossili della Provincia di Messina, Pt. i. *Boll della Soc. Geol. Ital.*, vol. xix., fasc. 3, 1900, pp. 443-520, pls. v-vi.

- (24). *Seguenza, L.*—I Pesci Fossili della Prov. di Reggio (Calabria).

Ibid., vol. xx., fasc. 2, 1901, pp. 254-262.

- (25). *Tate R.*—Census of the Older Tertiary Fauna of Australia. *Journ. R. Soc., N.S. Wales*, vol. xxii., pt. ii., 1888, p. 246.

- (26). *Tate R.*—Unrecorded Genera of the Older Tertiary Fauna of Australia.

Ibid., vol. xxvii., 1893, p. 169.

- (27). *Winkler, T. C.*—Mémoire sur quelques Restes de Poissons du Système Heersien, *Archives du Musée Teyler*, 1876, vol. iv., fasc. i., pp. 1-15.

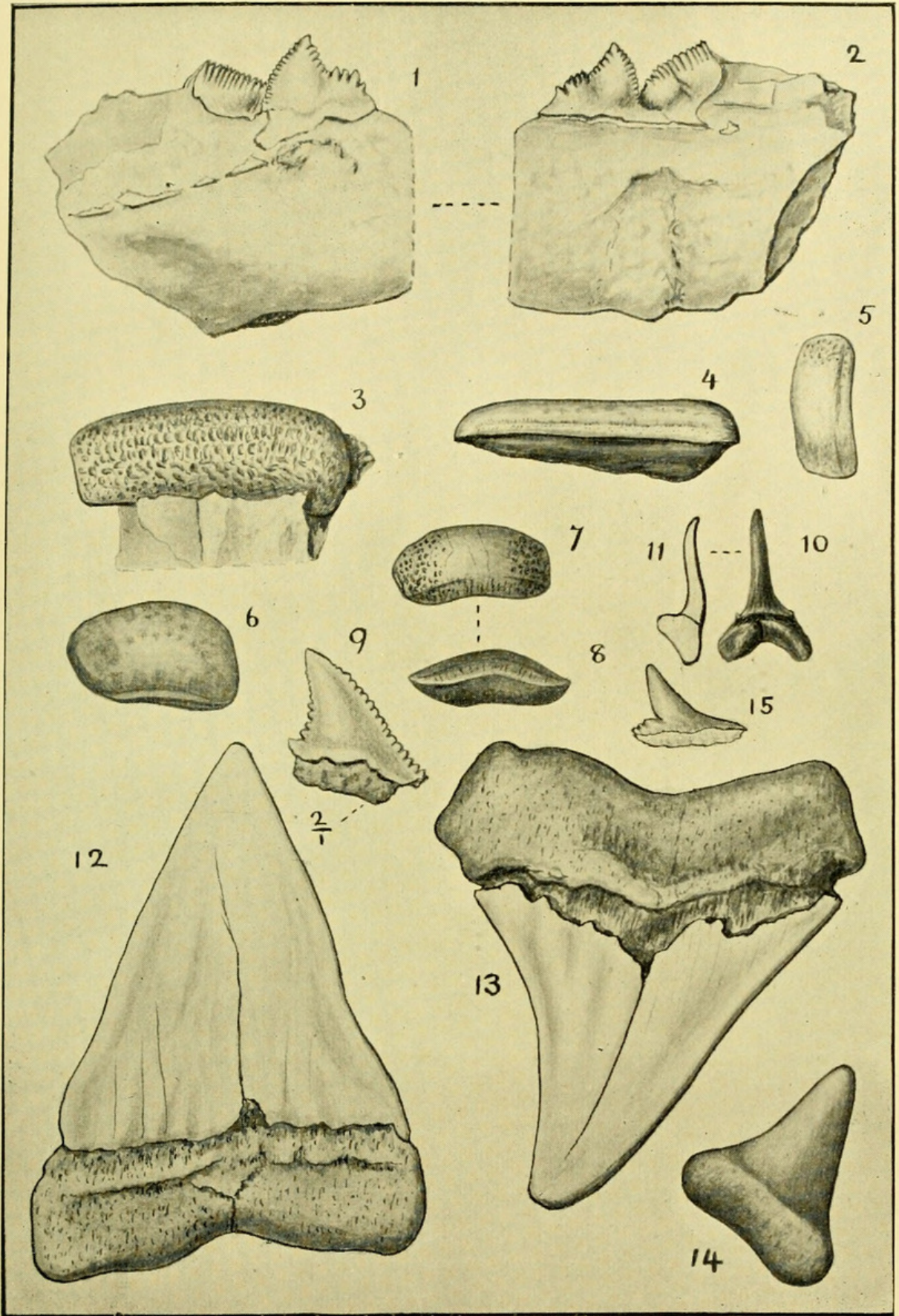
- Idem.*—Deuxième mémoire sur des Dents de Poissons Fossiles du Terrain Bruxellien. *Ibid.*, pp. 16-48, pls. I. and II.
- (28). *Woods, J. E. T.*—Geological Observations in South Australia. London, 1862, p. 80, figures.
- (29). *Woodward, A. S.*—On the Selachian Genus *Notidanus*. Geol. Mag., Dec. iii., vol. 3, 1886, pp. 205-217, pl. vi.; also pp. 253-259.
- (30). *Woodward, A. S.*—Catalogue of Fossil Fishes, British Museum (Nat. Hist.), Pt. i., 1889.
- (31). *Woodward, A. S.*—Outlines of Vertebrate Palaeontology for Students of Zoology. Cambridge, 1898.
- (32). *Woodward, A. S.*—Notes on the Teeth of Sharks and Skates from English Eocene Formations. Proc. Geol. Assoc. Lond., vol xvi., 1899 (vol. for 1899-1900), pp. 1-14, pl. i.
- (33). *Zittel, K. von.*—Text Book of Palaeontology. English Edition (Eastman), vol. II. London, 1902.

EXPLANATION OF PLATES.

PLATE XI.

[The numbers in square brackets refer to registered specimens in the National Museum, Melbourne.]

- Fig. 1. *Notidanus jenningsi*, sp. nov. Part of (?) left lower jaw, outer side; from Beaumaris. Natural size. [5368].
- Fig. 2. *Notidanus jenningsi*, sp. nov. Inner side of jaw; from Beaumaris. Natural size. [5368].
- Fig. 3. *Asteracanthus eocaenicus*, Tate sp. Upper surface of tooth; from Moorabool River. Natural size. [5378].
- Fig. 4. *Asteracanthus eocaenicus*, Tate sp. Lateral aspect of tooth; from Moorabool River. Natural size. [5379].
- Fig. 5. *Cestracion cainozoicus*, sp. nov. Upper surface of lateral tooth from middle of series; from Beaumaris. Natural size. [5372].





Chapman, Frederick and Pritchard, G B. 1904. "Fossil fish remains from the Tertiaries of Australia. Part I." *Proceedings of the Royal Society of Victoria* 17(1), 267-297.

View This Item Online: <https://www.biodiversitylibrary.org/item/34812>

Permalink: <https://www.biodiversitylibrary.org/partpdf/301780>

Holding Institution

MBLWHOI Library

Sponsored by

MBLWHOI Library

Copyright & Reuse

Copyright Status: NOT_IN_COPYRIGHT

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.