

NEW ZEALAND,



NEW ZEALAND GEOLOGICAL SURVEY.

(P. G. MORGAN, Director.)

PALÆONTOLOGICAL BULLETIN No. 4.

THE CRETACEOUS FAUNAS OF THE NORTH-EASTERN PART OF THE
SOUTH ISLAND OF NEW ZEALAND.

BY

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ISSUED UNDER THE AUTHORITY OF THE HON. W. D. S. MACDONALD, MINISTER OF MINES



WELLINGTON.

By Authority: MARCUS F. MARKS, GOVERNMENT PRINTER.

1917.

LETTER OF TRANSMITTAL.

GEOLOGICAL SURVEY OFFICE,

SIR,—

Wellington, 1st December, 1916.

I have the honour to submit herewith Palæontological Bulletin No. 4, entitled "The Cretaceous Faunas of the North-eastern Part of the South Island of New Zealand." This important memoir is the work of Mr. Henry Woods, M.A., F.R.S., Lecturer in Palæozoology in the University of Cambridge, England, the author of a standard text-book on Invertebrate Palæontology, of a monograph on English Cretaceous Lamellibranchs, and of numerous scientific papers. It contains forty-one pages of letterpress, and is illustrated by two maps and twenty colotype plates.

New Zealand has indeed been fortunate in securing the entirely voluntary services of so eminent an authority as Mr. Woods. The results he has achieved in the almost untouched field of New Zealand Cretaceous palæontology are most valuable, and will interest the whole scientific world. Our thanks to Mr. Woods include also the acknowledgment of a debt of gratitude to the University of Cambridge, which, with its libraries, museums, laboratories, and association of trained workers, affords the facilities for research and encourages the love of learning that have formed so large a factor in the production of this and other memoirs on the fossils of southern lands.

I have the honour to be,

Sir,

Your obedient servant,

P. G. MORGAN,

Director, New Zealand Geological Survey.

The Hon. W. D. S. MacDonalD,
Minister of Mines, Wellington.

P R E F A C E.

IN February, 1912, Mr. Henry Woods, the author of this memoir, expressed his willingness to determine and describe a representative collection of New Zealand Cretaceous fossils. In May a few ammonites and belemnites were sent to him, and these were followed two months later by fairly representative collections of the lamellibranchs. In 1913 further material collected by Dr. J. Allan Thomson was forwarded.

The area from which the faunas described in this memoir have been obtained includes most of the well-known localities for Cretaceous fossils in New Zealand, but it should be clearly understood that both in the southern part of the South Island and in the North Island there are other localities with fossiliferous Upper Mesozoic strata. It was considered that the study of the cretaceous faunas would be best commenced by the description of the Mollusca contained in the rocks associated with the well-known Saurian beds or underlying the Amuri limestone, and therefore the selection sent to Mr. Woods was restricted to the Canterbury and Marlborough districts.

Owing to being engaged with his monograph on the Cretaceous Lamellibranchs of England, Mr. Woods was unable to begin work on the New Zealand material until 1913. His memoir was completed before the end of 1914, and was received in New Zealand early in 1915. Considerable delay ensued before it was decided to have the letterpress printed in New Zealand and the illustrations collotyped in Great Britain. Unfortunately, owing to war conditions, further delay occurred, and a crowning misfortune was the loss of the plates in the wreck of the "Tongariro" off the New Zealand coast last August. Instructions, however, were given to have the plates reproduced from the original blocks; and it is expected that the reprints, though not to hand at the date of writing, will arrive in time to enable Mr. Woods's memoir to be published early in 1917.

The galley proofs of this bulletin were personally read and corrected by Mr. Woods, whilst the reading of the final proofs has been done by Dr. Thomson. The indexes were prepared by myself, and checked by Dr. Thomson. It is therefore hoped that, although the author was necessarily unable to supervise the last stages, no error or misprint of any consequence will be found in the letterpress.

P. G. MORGAN

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THE CRETACEOUS FAUNAS

OF THE

NORTH-EASTERN PART OF THE SOUTH ISLAND OF NEW ZEALAND.

THE Cretaceous fossils described in this memoir were collected in the provinces of Canterbury and Marlborough by Mr. Alexander McKay and other officers of the Geological Survey of New Zealand. They were obtained at various places between the Malvern Hills (west of Christchurch) and Coverham (in the Clarence Valley), a distance of nearly 150 miles.

Two faunas are represented, and may conveniently be considered separately. The older, of Lower Utatúr age, is found in the northern part of the region; the newer, of Upper Senonian age, is found at Amuri Bluff and other places farther south.

PART I.—CRETACEOUS ROCKS OF EAST MARLBOROUGH, NORTH OF AMURI BLUFF.

North of Amuri Bluff (fig. 1) Cretaceous deposits outcrop between the Kaikoura Peninsula and Cape Campbell.* One strip runs either along or near the coast, and is continuous in the north, with another long strip in the middle of the Clarence Valley between the Kaikoura Range and the Seaward Kaikouras; this strip has been faulted down, and older rocks occur on either side. The fault is on the north-west of the strip, and on the south-east side the basal Cretaceous conglomerates rest unconformably on older rocks. Other outcrops of Cretaceous rocks occur in the upper part of the Awatere Valley.

* A geological map of this region is given in McKay's Report on the Eastern Part of Marlborough: Reports Geol. Explor. during 1885, Colon. Mus. and Geol. Surv. N.Z., No. 17, 1886, p. 27, and *ibid*, No. 20, 1890, p. 96.

At present very little is known of the palæontology of this region, and the deposits appear to vary rapidly in character. A few fossils have been obtained from places in the Clarence Valley and the upper part of the Awatere Valley.

1. THE CLARENCE VALLEY.

Near Coverham, in the northern part of the Clarence Valley (Ouse River and its tributaries—the Swale, the Nidd, and the Wharf), the following section has been given by Dr. Allan Thomson (fig. 2). It extends along the Sawpit Gully, across the Nidd, the Cover, and the Wharf. The thickness of the beds, if correctly estimated, is very great.

Amuri limestone (top)	} 2,500 ft.
Flint-beds (replaced limestone)	
Sawpit Gully mudstones (3,200 ft.).	
Nidd sandstones and mudstones (550 ft.).	
Cover Creek mudstones (2,000 ft.).	
Wharf Gorge sandstones (450 ft.).	
Wharf mudstones (1,550 ft.).	
Basal conglomerates (200 ft.).	

Only a few species of fossils have been found in these beds. *Gaudryceras Sacya* occurs in the Sawpit Gully mudstones, and *Turrilites circumtæniatus* in the Cover Creek mudstones; both of these species are found in the Lower Utatúr Group of Southern India, so that we may refer the beds from Cover Creek mudstones to the Sawpit Gully mudstones to the Lower Utatúr, which is of about the same age as the Upper Gault and Upper Greensand of England.*

This view of the age of the beds near Coverham is supported by the presence in the Cover Creek mudstones of *Inoceramus concentricus* and *Belemnites superstes*, and also by the occurrence in the Sawpit Gully mudstones of *I. concentricus* var. *porrectus* var. nov. which is found in the Lower Utatúr beds of Southern India. Further, *Aucellina euglypha* sp. nov., which is allied to *A. aptiensis* (d'Orbigny) from the Lower and perhaps Middle Gault of Northern Europe, is found in the Sawpit Gully mudstones.

In the Wharf mudstones *Aucellina euglypha*, a large form of *Inoceramus*, and *Belemnites superstes* have been found; no other species has been recognized, so that we can only say that these mudstones are probably of Lower Utatúr age, but may be slightly earlier. The Wharf Gorge sandstones have yielded no fossils except wood and poorly preserved plants. The Nidd sandstones contain large *Inocerami*.

In the section near Coverham the Amuri Group and the Greensand Group of Amuri Bluff do not appear to be represented, consequently we must infer that there is an unconformity at the base of the Amuri limestone; for even if the Cretaceous beds of Amuri Bluff are represented by part of the Amuri limestone, which in East Marlborough is much thicker (about 2,500 ft.) than at Amuri Bluff (about 600 ft.), there are still beds of intervening age (Cenomanian and Turonian), which have not been recognized in the district, to be accounted for.

In the Clarence Valley (fig. 1) fossils have also been obtained at Bluff River, about twenty miles south-west of Coverham, and at Seymour River, ten miles south-

* F. Kossmat, Rec. Geol. Surv. India, vol. xxviii (1895), p. 40; and Beitr. z. Paläont. u. Geol. Österr.-Ungarns u. d. Orients, vol. xi (1898), p. 130; A. de Grossouvre, Recherches sur la Craie Supér. (1901), p. 715, tab. xxxii.

west of Bluff River. The following succession of beds has been observed* in the Clarence Gorge, just below the junction of the Bluff River:—

- Limestones and grey marls (top).
- Volcanic rocks.
- Sandstones, conglomerates, and shales.
- Volcanic rocks, 50–200 ft.
- Sandstones and conglomerates with fossils.

In the lower sandstones, which are fine-grained and of light colour, the following fossils were found: *Trigonia glyptica* sp. nov., *Inoceramus* sp., "*Modiola*" *kaikourensis* sp. nov., *Thracia* sp., and *Belemnites superstes*.

At Seymour (or Herring) River, McKay† gives the following section:—

- Amuri limestone (top).
- Greensands.
- Sands and sandstones with concretions.
- Basaltic rock.
- Soft sandstones and grits, with bands of ironstone and discontinuous coal-seams.

In a conglomerate belonging to the lower division the following fossils were found: *Trigonia glyptica*, *T. meridiana* sp. nov., "*Modiola*" *kaikourensis*, *Inoceramus* sp., and *Belemnites superstes*. The conglomerate consists of rounded pebbles of a brown ferruginous tuff, a few fragments of basaltic rock, numerous grains of fresh feldspar, and fragments of *Inoceramus* and other shells; the whole is cemented by calcite, in which a few crystals of dolomite have been developed.

2. THE AWATERE VALLEY.

In the Upper Awatere Valley, which runs parallel with the Clarence Valley, but farther inland, fossils have been found at Gladstone and Middlehurst Runs (mainly from Limestone Creek), chiefly in a dark volcanic sandstone, but some also in shales. The volcanic sandstone consists of rounded grains and pebbles of glassy basalt, and fragments of augite, with a few grains of olivine; the cementing material is calcareous.

The fossils from this locality include *Arca* (*Barbatia*) sp., *Trigonia meridiana*, *Spondylus* sp., *Pecten* (*Syncyclonema*) sp., *P.* (*Camptonectes*) sp., *Lima marlburienensis* sp. nov., *Aucellina euglypha*, *Inoceramus concentricus* var. *porrectus*, *Panopea awaterensis* sp. nov., and *Belemnites superstes*.

There is no information available as to the field relationships of the deposits at Gladstone and Middlehurst Runs to those at Bluff River and Seymour River, but it is probable that the beds at these places are of approximately the same age. This is indicated by the occurrence of *Trigonia meridiana* and *Belemnites superstes* at both Seymour River and Gladstone and Middlehurst Runs, and by the presence of *Trigonia glyptica*, "*Modiola*" *kaikourensis*, and *Belemnites superstes* at Seymour River and Bluff River.

The occurrence at Gladstone and Middlehurst Runs of *Inocerami* similar to those of the Sawpit Gully and Cover Creek mudstones, as well as the presence of *Aucellina euglypha* and *Belemnites superstes*, makes it probable that the deposit is of the age of some part of the series of beds at Coverham; whilst the other fossils (*Arca*, *Pecten*, *Spondylus*), although not found at Coverham, present points of resemblance to species of Lower Utatú age from other regions.

* McKay, Reports Geol. Explor. during 1885 (Geol. Surv. N.Z., 1886), p. 97.

† *Ibid.*, p. 103. This locality is given in McKay's reports as "Seymour River," but is more generally known by the alternative name of "Herring River."

Since the two species of *Trigonia* found in this region cannot be identified with any forms already known elsewhere, they do not give any definite evidence of the age of the deposits. From general considerations, however, the characters of the two species seem at first to suggest an earlier age than the Lower Utatúr for these deposits, for, as Dr. F. L. Kitchin has pointed out, the degeneration of the ornamentation on the costate *Trigoniæ* (as in *T. meridiana*) and the development of the *v-scripta* type of ribbing (as in *T. glyptica*) were prevalent in the *Trigoniæ* of India and South Africa in Lower Cretaceous times. The occurrence of species with a *v-scripta* kind of ornamentation in the Gault of British Columbia (*T. diversicostata* Whit.) and in the Upper Greensand and Cenomanian of England (e.g., *T. pennata* Sow.) shows, however, that this feature continued to be developed up to at least the Lower Utatúr period; and according to Wilckens it also occurred in the Senonian (*T. hyriiformis* Wilck.). Similarly, examples of *Trigoniæ* in which the costate ornament has degenerated are found abundantly in beds of Gault or Cenomanian age in Shikoku, Japan (*T. kikuchiana* Yokoy., *T. rotundata* Yokoy.).

In the Upper Awatere Valley, near Gladstone, the Amuri limestone is very thin, and lies on volcanic tuffs containing fragments of *Inoceramus*, indicating that they are of Cretaceous age. Somewhat farther up the same valley there is a great development of volcanic rocks forming Mouat's Lookout. According to McKay the horizon of these volcanic rocks is below the Amuri limestone. They rest on a thick series of mudstones and muddy sandstones, from which Dr. Allan Thomson obtained *Inoceramus* and *Aucellina euglypha* in the upper part of the Winterton River (just under Mouat's Lookout), indicating that the beds belong to some part of the Coverham Series. Below these beds come massive sandstones containing imperfect remains of plants; these in turn rest on the basal conglomerates of the Cretaceous Series.

The fauna of the Utatúr beds, which is so widely distributed in the Indo-Pacific region, has not hitherto been recognized in New Zealand.* The fossils now described show that the Lower Utatúr stage is represented in the deposits of the Clarence and Awatere Valleys, but the number of species at present known is not sufficient for a detailed comparison to be made with the corresponding faunas of other regions. The species include such widely distributed forms as *Gaudryceras Sacya*, *Turrilites circumtæniatus*, and *Inoceramus concentricus*; the other fossils are lamellibranchs, which cannot yet be definitely identified with forms already known in other regions, but which—in some cases, at any rate—are related to species of Lower Utatúr age.

Around the Pacific the Lower Utatúr fauna has been found in Japan, the Queen Charlotte Islands, California, Peru, probably in Graham Land, and seems to be represented in the upper part of the Rolling Downs beds of Queensland; around the Indian Ocean this fauna is found in Trichinopoli, Conducia, Madagascar, Zululand, and other places.

The beds of Lower Utatúr age in New Zealand rest on deposits of much earlier date, showing that the widespread "Cenomanian overlap" extended to this remote region. Here the overlap begins in the Lower Utatúr period, as it does in Zululand, Pondichéry, and Japan; but in some other regions it started at a somewhat earlier period. The deposition of the beds of Lower Utatúr age in New Zealand was apparently followed by an uplift, since the Middle Utatúr beds with *Acanthoceras* (Lower Chalk), which occur in Pondichéry, Madagascar, Zululand, and Japan, are not known to be represented here.

* Its supposed absence has been noted by Lemoine, *Études géol. dans le Nord de Madagascar* (1906), p. 392.

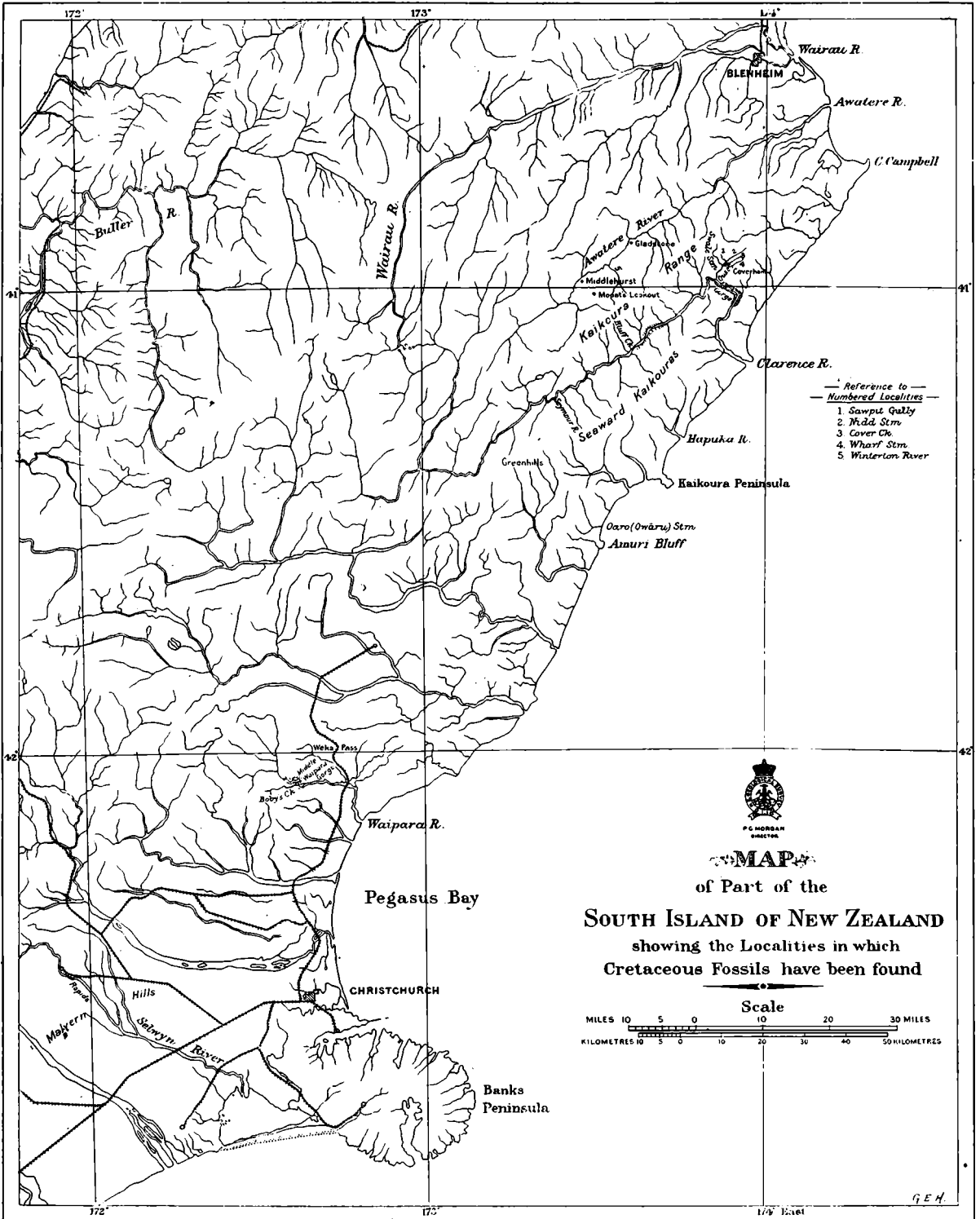


FIG. 1.

To face page 1.

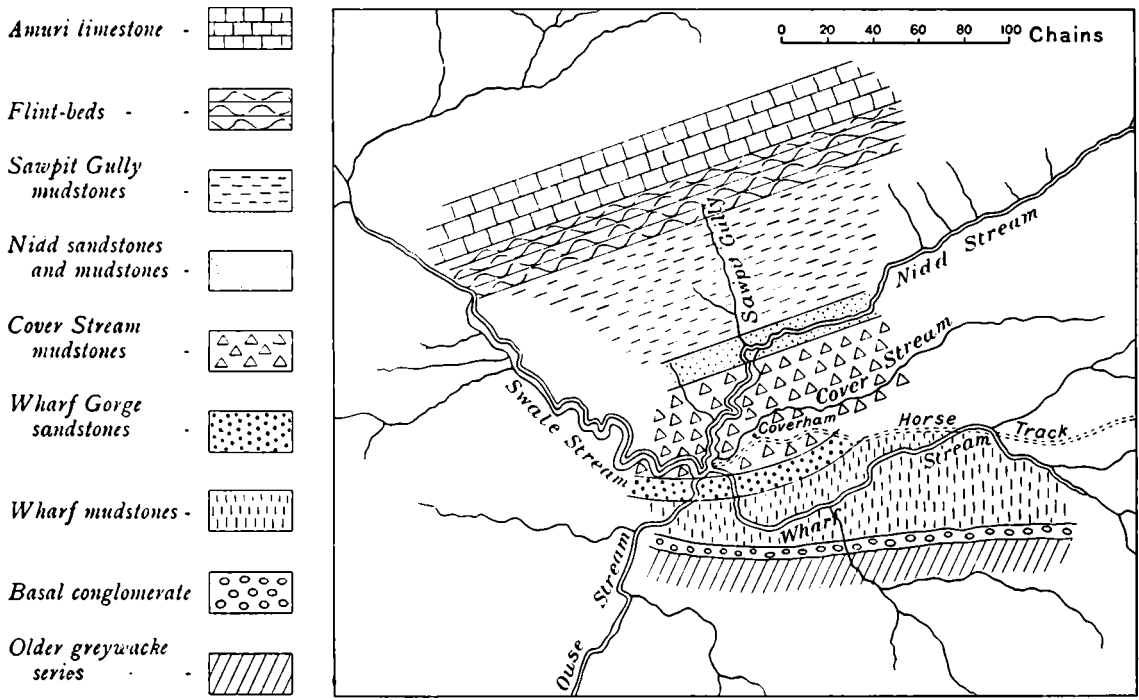


FIG. 2. GEOLOGICAL SKETCH-MAP OF THE NEIGHBOURHOOD OF COVERHAM BY DR. J. ALLAN THOMSON.

[To face page 5.]

TABLE SHOWING THE DISTRIBUTION OF SPECIES IN THE CLARENCE AND AWATERE VALLEYS.

	Wharf Mudstones.	Cover Creek Mudstones.	Sawpit Gully Mudstones.	Bluff River.	Seymour River.	Gladstone and Middlehurst Runs.	Remarks.
<i>Arca (Barbatia) sp.</i>	x	<i>Cf. B. marullensis</i> (d'Orb.) Gault.
<i>Trigonia meridiana sp. nov.</i>	x	x	
„ <i>glyptica sp. nov.</i>	x	x	..	
“ <i>Modiola</i> ” <i>kaikourensis sp. nov.</i>	x	x	..	Also from Cherwell Downs.
<i>Spondylus sp.</i>	x	<i>Cf. S. striatus</i> Sow., Upper Greensand and Cenomanian.
<i>Pecten (Camptonectes) sp.</i>	x	
„ (<i>Syncyclonema</i>) <i>sp.</i>	x	<i>Cf. P. orbicularis</i> Sow.
<i>Lima marlboroughensis sp. nov.</i>	x	
<i>Aucellina euglypha sp. nov.</i>	..	x	..	x	..	x	<i>Cf. A. aptiensis</i> (d'Orb.) Gault.
<i>Inoceramus concentricus</i> Park.	x	..	..	..	Gault and Upper Greensand.
<i>Inoceramus concentricus</i> Park., var. <i>porrectus</i> var. nov.	x	..	x	Lower Utatúr, Southern India.
<i>Panopea awatereensis sp. nov.</i>	x	
<i>Thracia sp.</i>	x	..	
<i>Turrilites circumtæniatus</i> Kossm.	x	..	..	..	Lower Utatúr, Pondichéry, and Madagascar.
<i>Gaudryceras Sacya</i> (Forb.)	x	..	..	Saghalien, Japan, Queen Charlotte Is., California.
<i>Belemnites superstes</i> Hect.	..	x	x	..	x	x	

DESCRIPTION OF THE SPECIES.

LAMELLIBRANCHIA.

Genus ARCA Linnæus.

Arca (Barbatia) sp. Plate I, fig. 1 a-c.

An imperfectly preserved specimen of *Arca* resembles *Barbatia marullensis* (d'Orbigny)* in form and in the general character of the ornamentation, but the valves are rather more convex, and the shell somewhat more inequilateral. *B. marullensis* is found in the Gault and the upper part of the Lower Greensand.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741).†

* For references see Woods, Mon. Cret. Lamellibr. England, vol. i (1899), p. 38, pl. vii, figs. 4-7.

† The numbers in parentheses are those attached to the specimens. A list of these, giving the localities and horizons, is published in Reports Geol. Explor. 1890-91, No. 21 (1892), p. 122. See also N.Z. Geol. Surv. Pal. Bull. No. 1, 1913, pp. 76 *et seq.*

Genus TRIGONIA Bruguière.

Trigonia meridiana sp. nov. Plate I, figs. 2-7.

Description.—Shell with oval or suboval outline, usually rather elongate, but becoming relatively higher in large specimens. Umbo at about two-fifths of the length of the shell from the front of the anterior margin.

Anterior margin convex, passing gradually into the slightly convex ventral margin, the posterior part of which curves upwards. Posterior margin short, rounded or sometimes nearly straight. Postero-dorsal margin long, with a gradual slope from the umbo to the posterior end.

On the early part of the shell (up to about 8 mm. from the umbo) strong concentric ribs are present on the flanks, radial ribs are seen on the area, and a sharp carina is developed. On the later parts of the shell this ornamentation is absent, and the shell is smooth, but is marked by regular concentric furrows, which are usually separated by wide slightly convex interspaces; near the ventral margin in the larger specimens the furrows become closer together. In most examples a broad shallow ante-carinal furrow extends from the neighbourhood of the umbo to the postero-ventral extremity, and causes a slight undulation in the course of the concentric furrows.

Affinities.—At present it is difficult to point to any form to which this species is probably related. The ornamentation found on the earliest part of the shell seems to indicate that this species is derived from a form belonging to the costate section of *Trigonia*. Similar degeneration of the costate ornamentation is seen in species from the Oomia beds of Cutch, described by Dr. F. L. Kitchin,* and in *T. kikuchiana* Yokoy., and *T. rotundata*, Yokoy., which are abundant in beds of Gault or early Cenomanian age in Shikoku, Japan.†

Remarks.—Eighteen specimens have been examined. In most of them the surface is rather poorly preserved, and the character of the early stages cannot be seen, but two small specimens have the umbonal part sufficiently well preserved to leave no doubt as to the costate character of the ornament in the young shell. One specimen shows the teeth of the left valve, but not sufficiently well for figuring. The proportion of the length of the shell to the height appears to be rather variable, and also the degree of development of the ante-carinal furrow; it is just possible that a larger amount of material might indicate the existence of two species.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741); conglomerate of Seymour River, Clarence Valley (570).

Trigonia glyptica, sp. nov. Plate I, figs. 8 a, b; Plate II, figs. 1 a, b, 2.

Description.—Shell elongate, more or less oval, moderately inequilateral, with compressed flanks. Antero-dorsal margin sloping obliquely forwards. Anterior margin convex, passing gradually into the slightly or moderately convex ventral margin, which curves upwards to join the short rounded posterior margin. Postero-dorsal margin long, slightly curved, sloping gradually backward. Umbones broad, not much elevated, curved inwards, situated at a distance from the anterior end of the shell equal to a third, or less than a third, of the length of the shell. Near the umbo the area is bounded by a carina, but this soon becomes rounded and, towards the posterior end, obsolete. The escutcheon is either not separated or only indistinctly delimited from the area. The area is at first ornamented with a few small oblique curved costellæ,

* Palæont. Indica, Jur. Fauna Cutch. vol. iii, pt. 2, No. 1 (1903), pp. 39-60.

† M. Yokoyama, Journ. Coll. Sci. Imper. Univ. Japan, vol. iv (1891), p. 357. S. Yehara, Cret. Trigoniæ from Miyako and Hokkaido, Science Reports Tôhoku Imp. Univ., ser. 2 (Geol.), vol. ii (1915), p. 44, pl. ii, figs. 1-9.

but is smooth posteriorly. For some distance from the umbo the area slopes steeply from the carina to the margin of the valve, but posteriorly its slope gradually decreases.

The flanks of the shell are ornamented with strong, rounded, dorso-ventral ribs, which are divided into an anterior and a posterior series by a line passing slightly forward from the umbo to the opposite margin; along this line some of the ribs of the two series meet at a very acute angle. The anterior ribs slope backwards from the antero-dorsal margin to the dorso-ventral line or to the anterior part of the ventral margin. On a narrow strip of the shell, near the anterior margin, ribs extend from the margin backwards for a short distance. The ribs of the posterior series cover about three-quarters of the valve, and are rather broader than the anterior ribs, but decrease in breadth towards the posterior end; they are separated by rounded furrows which may be narrower or wider than the ribs. The more anterior of these ribs are nearly straight and almost vertical, but the posterior ribs slope obliquely from the area to the posterior part of the ventral margin. In the later stages of large specimens the ribs may be divided transversely by concentric growth-furrows.

Affinities.—*Trigonia glyptica* resembles *T. v-scripta* Kitchin,* from the Oomia *Trigonia* bed (Lower Cretaceous) of Goonaree, Cutch, but is distinguished from that species by—(1) the smaller slope of the antero-dorsal margin and less elevated umbonal region; (2) the more anterior position of the dorso-ventral line separating the two series of ribs; (3) the more acute angle made by the two series of ribs; (4) the narrower, more numerous, and more closely placed ribs of the posterior series, and the smaller difference between the size of the anterior and posterior ribs; (5) the more nearly vertical direction of the anterior ribs of the posterior series; (6) the presence of ribs on the posterior part of the shell; (7) the absence or indistinct nature of the separation of the escutcheon from the area; and (8) the shortness (or possible absence) of the stage with concentric ribbing on the early part of the shell.

T. glyptica is distinguished from *T. hyriiformis* Wilckens† by—(1) the more acute angle made by the two series of ribs; (2) the more anterior position of the dorso-ventral line separating the two series of ribs; (3) the more closely placed anterior ribs, and the smaller curvature of those near the front margin. *T. hyriiformis* is at present imperfectly known; it was found at Snow Hill Island, Graham Land, and is stated by Wilckens to be of Campanian (Upper Senonian) age.

Remarks.—Only six valves, most of which are more or less imperfect, have been seen, so that the nature and extent of the variation cannot be determined. In all the specimens the shell near the umbo is abraded or imperfect, so that it is not possible to determine definitely if the earliest ribs were concentric, but it is possible that such may have been the case for a short period. Until the early stages in the development of *T. glyptica* have been made out, it is difficult to determine whether this species is really related to *T. v-scripta* or *T. hyriiformis*, or has been derived from an independent stock.

The occurrence of *T. diversicostata* Whiteaves,‡ in the Gault of British Columbia, and of *T. pennata* Sowerby,§ in the Upper Greensand and Cenomanian of England, is of interest, since they possess V-shaped ribs, but they do not appear to be allied to *T. glyptica*.

Distribution.—Conglomerate of Seymour River, Middle Clarence Valley (570); sandstone of Bluff River, at junction of the Clarence (615).

* Palæont. Indica, ser. ix, Jur. Fauna Cutch, vol. iii, pt. 2, No. 1, Genus *Trigonia* (1903), p. 70, pl. vii, figs. 6-8; pl. viii, figs. 1-3.

† Die Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreideformat. (Schwedisch. Südpol.-Expedit., vol. iii, pt. 12, 1910), p. 47, pl. ii, fig. 27.

‡ Mesoz. Foss., vol. i (Geol. Surv. Canada, 1876-1900), pp. 68, 230, 292, pl. x, fig. 1. Compare also *T. flexicostata*, Burwash, Proc. & Trans. R. Soc. Canada, ser. 3, vol. vii, section 4 (1914), p. 82, pl. iii, fig. 3.

§ Lycett, Brit. Foss. *Trigonicæ* (1875), p. 133, pl. xxiv, figs. 4, 5; pl. xxxvii, fig. 4.

Genus MODIOLA Lamarck.

"*Modiola*" *kaikourensis* sp. nov. Plate II, figs. 3-5.

Description.—Shell small, elongate, inflated but becoming gradually compressed towards the postero-ventral extremity; antero-ventral part flattened or concave, and sloping steeply toward the margin. Umbones terminal, slightly curved. Hinge-margin nearly straight, making a very obtuse angle with the posterior margin, which is nearly straight and almost parallel with the antero-ventral margin. Posterior extremity rounded. Surface with growth-ridges.

Remarks.—This species resembles in form the smaller examples of *Septifer lineatus* (Sow.), but there is nothing to show whether an umbonal plate is present or not; and the radial ornamentation appears to be absent, for although some specimens show fine radial lines they do not appear to represent ribs, since they are not visible when the surface of the shell is well preserved. The generic position of this species must therefore, for the present, be regarded as uncertain.

Distribution.—Conglomerate of Seymour River, Clarence Valley (570); sandstone of Bluff River, at junction with the Clarence (615); sandstone in cliff above lake, near Cherwell Downs, Greenhills district.

Genus SPONDYLUS Linnæus.

Spondylus sp. Plate II, fig. 6.

A valve of *Spondylus* is not sufficiently well preserved for exact determination, but is of interest, since it appears to belong to the same type as *S. striatus* (Sowerby),* found in the Upper Greensand and Cenomanian of England. The fine and uniform ribbing is also similar to that of *S. subcostulatus* Stoliczka,† from the Utatúr Group of Southern India.

Distribution.—Dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus PECTEN Müller.

Pecten (*Camptonectes*) sp. Plate III, figs. 1 a, b, 2.

Three right valves and one left valve were found in the dark volcanic sandstone of Gladstone and Middlehurst Runs (741). The surface of the shell is very imperfect, but one specimen shows fine radial ribs near the ventral margin.

Pecten (*Syncyclonema*) sp.

Two very imperfect valves of *Syncyclonema* may perhaps be examples of *P. (Syncyclonema) orbicularis* Sow.

From the dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus LIMA Bruguière.

Lima marlburiensis sp. nov. Plate III, fig. 3.

Description.—Shell semi-oval, much higher than long, convex between the umbo and the ventral margin, sloping steeply to the anterior margin, and gradually compressed towards the posterior and postero-ventral margins. Anterior margin nearly straight; ventral margin rounded; posterior margin slightly convex, its dorsal part curving rapidly towards the umbo. Ornamentation consists of narrow radial grooves (probably with pits), separated by broad nearly flat interspaces. The direction of the ribs sometimes changes where they cross a strong growth-ring.

* Woods, Mon. Cret. Lamellibr. England, vol. i (1901), p. 119, pl. xxi, figs. 1-5.

† Cret. Fauna S. India, vol. iii (1871), p. 449, pl. xxxiii, fig. 8; pl. xxxiv, fig. 2.

Affinities.—This species is at present imperfectly known, but appears to be distinct from any form already described. The character of the area and ears cannot be seen. The species may belong to the subgenus *Acesta*.

Distribution.—Dark volcanic sandstone of Gladstone and Middlehurst Runs (741).

Genus AUCELLINA Pompeckji.

Aucellina euglypha sp. nov. Plate III, figs. 4–8.

Description.—Right valve oval or nearly circular in outline, slightly inequilateral, the anterior part sometimes projecting forwards. Hinge-line straight. Right valve slightly, sometimes moderately convex, the anterior part usually flattened and less convex than the median and posterior parts. Anterior ear long, byssal sinus deep, curved. Posterior ear indistinct. Umbo small, nearly median.

Left valve inflated, inequilateral, with rounded outline, the posterior part projecting; dorsal part of posterior margin oblique. Umbo large, prominent, incurved, projecting over the hinge-margin. A broad shallow sulcus usually extends from the posterior side of the umbo to the posterior margin. Ears small, the posterior obtusely triangular. Ornamentation consists of strong radial ribs, separated by broad interspaces; both are crossed by numerous linear concentric ridges, which sometimes become laminar.

Affinities.—This species is allied to *Aucellina aptiensis* (d'Orbigny),* but the radial ribs are more distinct, less numerous, and more widely separated. *A. aptiensis* is found in the lower Gault, and probably also the middle Gault, of Hanover, Brunswick, Hildesheim, Méouille (Basse-Alpes), &c. *Aucellina* is represented in the Rolling Downs formation of Queensland and New South Wales by *A. hughendensis* (Etheridge),† but in that species the left valve is much more inequilateral than in *A. euglypha*.

In Southern India *Aucellina parva* (Stol.)‡ occurs in the Utatúr Group.

Remarks.—This species was gregarious, numerous examples being found close together. The specimens usually occur in hard calcareous concretions, and it is difficult to separate them from the matrix, consequently the form of the entire shell cannot often be determined satisfactorily, and the area and hinge have not been exposed in any specimen.

Distribution.—Wharf mudstones, cliff on left bank of Wharf River at half a mile below pack-track crossing; Sawpit Gully mudstones of Swale River, cliff on left side of river, the first exposure below the Amuri limestone; mudstones of Upper Winterton River, east of Mouat's Lookout, Upper Awatere Valley; shale and light sandstone of Gladstone and Middlehurst Runs, Upper Awatere Valley (741).

Genus INOCERAMUS Sowerby.

Inoceramus concentricus Parkinson. Plate III, figs. 9, 10 *a, b*.

Specimens of *Inoceramus* agree closely in essential characters with *I. concentricus*,§ but are of a larger size than the majority of the examples of that species found in England. An exact comparison with the larger specimens sometimes found in the Gault of England is difficult, since the latter occur in soft clay, and consequently the form of the shell is usually imperfectly preserved.

* Pompeckji, Neues Jahrb. für Min. &c., Beil.-bd. xiv (1901), p. 352, pl. xvi, figs. 1–3 (compare also figs. 4, 5); Wolleemann, Jahrb. d.k. Preuss. Geol. Landesanst., vol. xxvii (1906), p. 269, pl. vi, figs. 6–8; Pavlow, Enchaînement des Aucelles (1907), p. 87, pl. vi, figs. 28–32.

† Quart. Journ. Geol. Soc., vol. xxviii (1872), p. 346, pl. xxv, fig. 3; Jack and Etheridge, Geol. and Palæont. Queensland and New Guinea (1892), p. 460, pl. xxv, figs. 1–6; Etheridge, Mon. Cret. Invert. Fauna New South Wales (1902), p. 16, pl. v, figs. 6, 7.

‡ Stoliczka, Cret. Fauna S. India, vol. iii (1871), p. 404, pl. xxxiii, figs. 2, 3.

§ For the synonymy of this species see Woods, Mon. Cret. Lamellibr. England, vol. ii (1910), p. 265.

Although only a few examples of this species from New Zealand are available for study it is evident that variation was rather extensive, and was similar in character to that seen in English specimens; thus there are considerable differences in the extent of the curvature of the left umbo, and also in its breadth; variation is also seen in the size of the concave anterior part of the valves, and in the convexity of the right valve. Whilst the study of a larger series of specimens may, in the future, reveal some characters which would serve to distinguish the New Zealand form as a geographical variety of *I. concentricus*, at present it is difficult to point to any difference as great even as those which are seen between specimens found in different types of deposit in England.

I. concentricus is common in the Gault and Upper Greensand of Europe. Whitcaves* has recorded it from Queen Charlotte Islands (British Columbia), and specimens which I have seen from that locality enable me to confirm that identification. This species has also been recognized in the Vraconnian of Peru.†

Distribution.—Calcareous concretions in Cover Creek mudstones of Cover Creek, near Coverham.

Inoceramus concentricus var. *porrectus* var. nov. Plate IV, figs. 1 *a, b*, 2.

Specimens found in the Sawpit Gully mudstones agree in most respects with *I. concentricus*, but the left valve is less convex, its umbo is less prominent and projects to only a small extent beyond the hinge-margin; the posterior part of the valve is flattened and more extended. Fragments show that some examples attained a large size. In one specimen (fig. 1) the ribs are rather numerous and small, but in others (fig. 2) they are fewer, stronger, and more widely separated. A specimen similar in form but with rather fewer ribs occurs in the dark volcanic sandstone of Gladstone and Middlehurst Runs (741) (Plate IV, fig. 3), and probably belongs to this variety.

The form here described has evidently been derived from *I. concentricus*; for the present, with only a small amount of material available, it seems best to consider it as a variety of that species.

Inoceramus aff. *concentricus*, described and figured by Spengler‡ from the Lower Utatúr Group of Southern India, appears to be an example of this variety; it possesses a similarly flattened left valve, with an inconspicuous umbo, and the ribs show a similar curvature.

Some small specimens of *Inoceramus* found in the Cover Creek mudstones and the volcanic sandstone of Gladstone and Middlehurst Runs are of the *concentricus* type, and their small left umbo resembles the variety here described, but the valve appears to be relatively more convex.

Genus PANOPEA Ménard de la Groye.

Panopea awaterensis sp. nov. Plate IV, fig. 4 *a, b*.

Description.—Shell elongate-oval, inequilateral, moderately convex dorsally, less convex ventrally. Umbones small, inconspicuous, situated at about two-fifths of the length of the shell from the front margin. Dorsal margin nearly straight, and nearly parallel with the slightly curved ventral margin. Anterior and posterior margins rounded. Surface smooth except for inconspicuous growth-lines, and very fine radial ridges on the posterior part.

Remarks.—There is only one example of this species in the collection. I do not know any form to which it shows any close resemblance. Its principal characters are the little prominence of the umbones, and the nearly parallel dorsal and ventral margins.

* Mesoz. Foss., vol. i (Geol. Surv. Canada, 1876-1910), pp. 79, 241, 297.

† Schlagintweit, Neues Jahrb. für Min., &c., Beil.-bd. xxxiii (1911), p. 94.

‡ Beitr. z. Paläont. u. Geol. Österr.-Ungarns u. d. Orients, vol. xxvi (1913), p. 235, pl. xv, fig. 18.

Distribution.—Dark volcanic sandstone, Gladstone and Middlehurst Runs, Upper Awatere Valley (741).

Genus THRACIA Leach.

Thracia sp. Plate V, fig. 1.

A species of *Thracia* is represented by a left valve from the light sandstone of Bluff River (615).

CEPHALOPODA.

Genus TURRILITES Lamarck.

Turrilites circumtæniatus Kossmat. Plate V, figs. 2 *a*, *b*, 3.

1866. *Turrilites Gresslyi* F. Stoliczka, Ceph. Cret. S. India, p. 186, pl. lxxxvii, figs. 1-5.

1895. *Turrilites circumtæniatus* F. Kossmat, Südind. Kreidef. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, vol. ix), p. 141, pl. xviii, figs. 4, 5.

Remarks.—Portions of three specimens of *Turrilites* were found by Dr. Allan Thomson in a calcareous concretion. They agree closely with the smaller examples figured by Stoliczka as *T. Gresslyi* (pl. lxxxvii, figs. 1, 2); in those the ribs joining the tubercles are either indistinct or not developed. On account of the character of the ribbing which is developed in later stages of growth the species from the Utatúr Group is regarded by Kossmat as probably distinct from *T. Gresslyi* Pict. & Camp.; but as only small examples of this species are figured by Pictet and Campiche it is possible that it may be only an incompletely grown form of *T. circumtæniatus*.

T. circumtæniatus is found in the Lower Utatúr Group of Pondichéry, and in beds referred to the Cenomanian in northern Madagascar.* *T. Gresslyi* Pict. & Camp.† is found in the "Grés verts supérieur" of Ste. Croix, and is recorded from the Cenomanian of Madagascar. An allied form, *T. acutus* Passy,‡ occurs in the Cenomanian of England, France, and Zululand. In the larger of the two New Zealand specimens the siphuncle is preserved, and occurs on the upper slope of the whorls, above the upper row of tubercles.§

Distribution.—Cover Creek mudstones, at a quarter mile above Coverham station.

Genus GAUDRYCERAS Grossouvre (1893) emend. Kossmat (1895).

Gaudryceras Sacya (Forbes). Plate V, figs. 4 *a*, *b*.

1846. *Ammonites Sacya* E. Forbes, Trans. Geol. Soc., ser. 2, vol. vii, p. 113, pl. xiv, fig. 10.

1846. „ *Buddha* Forbes, *ibid.*, p. 112, pl. xiv, fig. 9.

1865. *Ammonites Sacya* F. Stoliczka, Ceph. Cret. S. India, p. 154, pl. lxxv, figs. 5-7; pl. lxxvi, figs. 2, 3.

1873. *Ammonites Sacya* var. *sachalinensis* F. Schmidt, Petrefakt. d. Kreidef. v. Sachalin (Mém. Acad. Impér. St. Pétersb., sér. 7, vol. ix), p. 15 (*partim*), pl. ii, figs. 3, 4.

1876. *Ammonites flicinctus* J. F. Whiteaves, Mesoz. Foss., vol. i (Geol. Surv. Canada), p. 43, pl. ii, figs. 2, 3.

1884. *Lytoceras Sacya* Whiteaves, *ibid.*, p. 203, pl. xxv.

1890. „ „ M. Yokoyama, Palæontographica, vol. xxxvi, p. 178, pl. xviii, fig. 12 (13 ?).

1894. „ „ K. Jimbo, Palæont. Abhandl., vol. vi, p. 34, pl. vi, fig. 1.

1895. *Lytoceras (Gaudryceras) Sacya* F. Kossmat, Südind. Kreidef. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, ix), p. 119 (23).

1902. *Lytoceras (Gaudryceras) Sacya* F. M. Anderson, Cret. Dep. Pacific Coast (Proc. California Acad. Sci., ser. 3, vol. ii), p. 82.

* Boule, Lemoine and Thevenin, Ann. de Paléont., vol. i (1906), p. 57, pl. xiii, fig. 4.

† Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 3, 1861), p. 132, pl. lvii, figs. 11-13.

‡ For references see Crick, Cret. Foss. Natal (3rd Ann. Rep. Geol. Survey, Natal and Zululand, 1907), p. 176, pl. xi, figs. 3, 4. This species is known in England as *T. Wiesti* Sharpe.

§ Cf. Diener, Lebensweise und Verbreitung des Ammoniten. Neues Jahrb. für Min., &c., Bd. ii (1912), p. 67.

A well-preserved specimen of this species, having a diameter of 50 mm., was found by Dr. Allan Thomson in a calcareous concretion in the Sawpit Gully mudstones. The shell is preserved, except on the last whorl, and shows clearly the character of the fine ribbing. The suture agrees closely with the one figured by Stoliczka.

G. Sacya is a widely distributed species in the Indo-Pacific region. The type, which is now in the British Museum (Geological Society Collection), came from the Lower Utatúr Group of Pondichéry. The species has also been found in Saghalien (Japan), Queen Charlotte Islands (British Columbia), and in the Upper Horsetown and Lower Chico beds of California; whilst forms which either belong to this species or are closely allied to it have been recorded from Conducia,* the north of Madagascar,† and Zululand.‡

Distribution.—Sawpit Gully mudstones, about 300 ft. below the flint-beds of Sawpit Gully.

BELEMNITES.

Belemnites superstes Hector. Plate V, figs. 5-7.

1886. *Belemnites superstes* J. Hector, Catal. Indian and Colon. Exhibit., New Zealand Court, Geol. Exhibits, p. 57, fig. 19A, 7.

1886. *Belemnites superstes* Hector, Rep. Geol. Explor., 1885, p. xxxii.

1890. „ „ Hector and McKay, *ibid.*, 1888-89, pp. xlvii, 159.

Remarks.—This species belongs to the same group as *Belemnites seclusus* Blanford,§ from the Lower Utatúr Group of Trichinopoli, which, as Spengler|| has pointed out, is sharply distinguished from the other species of *Belemnites* found in the Cretaceous rocks of India. In *B. superstes* the two grooves at the ventro-lateral margins extend backwards from the alveolar margin to a greater distance than in *B. seclusus*—sometimes to more than half the length of the guard. At first these grooves are deep, but when traced backwards they become gradually narrower and shallower. The guard in *B. superstes* is compressed dorso-ventrally, but in *B. seclusus* it is compressed laterally. Further comparison of the two species is difficult on account of the much larger size attained by *B. superstes* (see also p. 36).

Type.—The type came from the mudstones near Coverham, but cannot be identified, since Hector gave only an outline figure, without description of the species.

Distribution.—Wharf mudstones of Wharf River, below pack-track crossing; Cover Creek mudstones, of Cover Creek; sandstone of Bluff River, at junction with the Clarence (615); dark volcanic sandstone of Gladstone and Middlehurst Runs, Upper Awatere Valley (741); conglomerate of Seymour River (570).

* P. Choffat, Contrib. Conn. géol. Col. Portugaises d'Afrique. Crét. de Conducia (1903), p. 14, pl. i, figs. 2, 3.

† M. Boule, Lemoine and Thevenin, Ann. de Paléont., vol. i (1906), p. 184 [12], pl. ii, fig. 2.

‡ G. C. Crick, 3rd Rep. Geol. Survey, Natal and Zululand (1907), p. 170, pl. x, fig. 13.

§ H. F. Blanford and F. Stoliczka, Ceph. Cret. S. India (Palæont. Indica, 1861, 1866), pp. 4, 202, pl. i, figs. 43-51; pl. ii, fig. 8.

|| E. Spengler, Beitr. z. Paläont. u. Geol. Österr.-Ungarns u. d. Orients, vol. xxiii (1910), p. 153, pl. xiv, fig. 7.

PART II.—THE CRETACEOUS ROCKS OF AMURI BLUFF, WAIPARA AND WEKA PASS, AND THE MALVERN HILLS.

In the southern part of the district (South Marlborough and North-east Canterbury) fossils have been obtained in the Cretaceous deposits of—(I) Amuri Bluff, (II) Waipara and the Weka Pass, and (III) the Malvern Hills (fig. 1).

I. AMURI BLUFF.

Amuri Bluff* is about fifteen miles south-west of the Kaikoura Peninsula, on the east coast of Marlborough. The beds exposed here below the Amuri limestone are divided into two main groups: (1) the Amuri Group at the bottom, and (2) the Greensand Group at the top, above which comes the Amuri limestone.

1. *The Amuri Group.*

At Amuri Bluff the Amuri Group has, according to McKay, a thickness varying from 360 ft. to 585 ft. It rests unconformably on older beds, believed to be of Jurassic age, and consists of the following divisions, from above downwards:—

Black grit.
Greensands.
Grey sands.
Lower black grit.
Calcareous conglomerate { *Aporrhais* bed.
 { *Trigonia* bed.
 { *Belemnite* bed.
Lower or wood sands.

(a.) *The Calcareous Conglomerate.*—Nearly all the fossils from Amuri Bluff which are determinable come from the calcareous conglomerate, which contains a rich fauna. This conglomerate was divided by Hector and McKay into the *Belemnite*, the *Trigonia*, and the *Aporrhais* beds, but these beds evidently belong to one zone, and have no stratigraphical value; moreover, it is now known† that they are not persistent even within the limits of the Amuri Bluff district.

In the calcareous conglomerate, Cephalopods, with the exception of *Belemnites*, are not common, but examples of *Kosmaticeras*, *Gaudryceras*, *Baculites*, *Hamites*, and *Nautilus* have been found. Lamellibranchs and Gasteropods‡ are numerous, and indicate that the deposit was laid down in shallow water. The most abundant genera of Lamellibranchs are *Trigonia*, *Ostrea*, *Pecten*, *Callista*, *Cucullæa*, and *Astarte* (*Eriphyla*). Echinoderms, Brachiopods, corals, and sponges are rare or absent. A few fishes have been found—viz., *Ischyodus Thurmanni* Pict. & Camp., *Notidanus dentatus* Woodw., and *Scapanorhynchus*(?) *subulatus* (Ag.).

Only a small number of the fossils can be actually identified with species found in other parts of the world, but these and the affinities of the other species show that the fauna is of the Indo-Pacific type, and is of Upper Senonian age. Similar faunas occur

* A geological map of this region by McKay is published in Reports of Geol. Explor. 1874–76 (1877), p. 178.

† J. A. Thomson, N.Z. Geol. Surv., 6th Ann. Rep. (1912), p. 8.

‡ The Gasteropods were sent before the war to Professor Otto Wilckens, of Strassburg i E. for study.

in Southern India (Ariyalúr beds), Madagascar, South Africa (Umzamba beds), Japan, Vancouver.* Quiriquina (Chile), Southern Patagonia, and Graham Land.

Kossmaticeras is a genus which shows a great development in southern regions, and is represented in the Amuri Group by *K. (Madrasites) haumuriensis* (Hect.), which is allied to *K. (Madrasites) Bhavani* (Stol.) from the Trichinopoli and Ariyalúr groups. A variety of this species occurs in the Upper Senonian of Seymour Island, where the genus is profusely represented. A closely allied form is found in the Senonian of Vancouver. A species of *Gaudryceras* is allied to a form found in the Senonian of Vancouver—*G. Jukesi* (Whiteaves)—which is probably identical with *G. Kayei* (Forb.) from the Valudayúr beds. *Baculites* is represented by a species of the type of *B. vagina* found in the Ariyalúr Group. *Belemnites* are numerous, and belong to a group characteristic of Southern India and Australasia.

Trigonia pseudocumdata Hector is abundant, and belongs to a type found in India and other southern regions; it is similar to *T. tuberculifera* Stol., but the relationship is not sufficiently close to indicate the same horizon. *Trigonia Hanetiana* d'Orb. is also common, and is one of the characteristic species of the Quiriquina beds (Upper Senonian) of Chile; a similar form (*T. epecta* Wilck.) is found in the Senonian of Southern Patagonia. *Cucullæa* sp. shows some resemblance to *C. antarctica* Wilck., from the Senonian of the same region.

A species of *Modiola* is either identical with or closely allied to *M. typica* Forb., from the Trichinopoli Group of Southern India and the Senonian of Gosau and other places. *Modiola flagellifera* Forb. occurs in the Valudayúr beds (Upper Senonian) of Pondichéry, but has also been recorded from lower horizons elsewhere. *Pecten (Syncyclonema) membranaceus* Nilss. is abundant, and is found in the Senonian of Sweden, Rügen, Aachen, Gosau, &c.; and a form which may belong to this species was found in the Senonian of Cockburn Island. This or a closely allied species occurs in the Ariyalúr Group of Southern India. The *Inocerami* cannot be identified with known forms, but have affinities with Senonian types. *Astarte (Eriphyla) meridiana* sp. nov. is abundant in the calcareous conglomerate, and shows some resemblance to *A. Forbesiana* Stol., from the Ariyalúr Group, and also to *A. (Eriphyla) lenticularis* Goldf., which occurs in India, South Africa, and Europe. *Anthonya elongata* sp. nov. is fairly common, and is distinct from any known species; but the genus is represented in the Chico Group of Martinez. *Callista (Callistina) Wilckensi* sp. nov. is abundant, and resembles *C. sculpturata* (Stol.) from the Ariyalúr Group. A species of *Cardium* is probably related to *C. acuticostatum* d'Orb., one of the characteristic fossils of the Quiriquina beds. *Panopea* is common, and appears to belong to a species found in the Senonian of Seymour Island and Snow Hill Island (*P. clausa* Wilck.).

The few forms found in the Amuri Group which occur in Europe, or are allied to European species, are chiefly widely distributed types, such as *Pecten (Syncyclonema) membranaceus*, *Modiola typica*, and *Dreissensia lanceolata*.

(b.) *Upper part of the Amuri Group (above the Calcareous Conglomerate).*—The only species which have been recognized in the part of the Amuri Group above the calcareous conglomerate are *Pecten (Syncyclonema) membranaceus* Nilss., which occurs in the black grit and the greensand below it, and the following which occur in the black grit: *Pecten (Camptonectes) Hectori* sp. nov., *Inoceramus australis* sp. nov., *Synechodus sulcatus* (Davis), and *Callorhynchus Hectori* Newton. Examples of *Ostrea* and *Belemnites* are also found, but are not sufficiently perfect for determination. There is consequently very little evidence of the palæontological character of these beds, but in all probability they belong to the same zone as the calcareous conglomerate.

* The name Vancouver here and elsewhere refers to Vancouver and other islands off the coast of British Columbia, not to the town of that name. [P. G. Morgan].

2. The Greensand Group.

The Amuri Group is succeeded by the Greensand Group, above which comes the Amuri limestone. The Greensand Group has a thickness of from 485 ft. to 681 ft., and consists of the following divisions:—

- Teredo* limestone.
- Greensands.
- Grey sandstone.
- Lower *Teredo* limestone.
- Concretionary greensands.
- Saurian beds.

(a.) *Saurian Beds*.—From the Saurian beds of Amuri Bluff the following species of reptiles have been obtained*: *Cimoliosaurus australis* (Owen), *C. caudalis* Hutton, *C. Haasti* (Hect.), *C. Holmesi* (Hect.), *C. Hoodi* (Owen), *C. latibrachialis* (Hect.), *C. Mackayi* (Hect.), *C. tenuis* (Hect.), *Leiodon haumuriensis* Hector, and *Platecarpus Oweni* (Hect.). Dr. C. W. Andrews informs me that this assemblage of species certainly indicates a horizon near the top of the Cretaceous, and that it is very similar to the reptilian fauna of the Niobrara chalk of the United States, which is of Senonian age.

(b.) *Concretionary Greensands*.—Belemnites and Lamellibranchs occur in the concretionary greensands, but the only species which can be recognized are *Pecten (Synsyclonema) membranaceus* and *Lucina canterburiensis*, both of which occur in the lower part of the Amuri Group. A saurian was also obtained in the concretionary greensand of Amuri by McKay. It seems most probable that both the Saurian beds and the concretionary greensands are of Upper Senonian age.

(c.) *Beds above the Concretionary Greensands*.—At present the palæontological evidence is too meagre to justify the expression of an opinion as to the age of the beds above the concretionary greensands. The Amuri limestone itself, although a fine-grained chalky deposit of considerable thickness and wide distribution, has yielded few fossils. Some fishes found in it were described by J. W. Davis†, but Dr. Smith Woodward informs me that they may belong either to the Upper Cretaceous or the Eocene. One species, however (*Lamna marginalis* Davis), is identified by Dr. Woodward‡ with *L. macrota* (Ag.), found in the Eocene and Miocene of Europe, and is recorded by Davis from both the *Teredo* limestone and the Amuri limestone; this suggests that both deposits are of post-Cretaceous age. *Pecten (Amusium) Zitteli* Hutton§ known elsewhere from the Oamaru Formation, has been recorded from the Amuri limestone, and favours the view that that deposit is of Tertiary age. The only other fossils at present known in the Amuri limestone are Foraminifera, which have not yet been studied.

II. THE WAIPARA AND WEKA PASS DISTRICT.

This district is about fifty miles south-west of Amuri Bluff, forty miles north of Christchurch, and some twelve miles inland. The beds are generally similar to those of Amuri Bluff, particularly in the middle part (the Saurian beds). The lower fossiliferous sandstones are not so thick, and in general only one bed, the *Ostrea* bed, is distinguished. Below it is a series of loose sands with coal and conglomerates. The Amuri limestone is present, and forms an escarpment. All the fossils come from the *Ostrea* bed and the Saurian beds, and in most cases are poorly preserved.

* Hector, Trans. & Proc. N.Z. Inst., vol. vi (1874), p. 333; Lydekker, Cat. Foss. Reptilia and Amphibia Brit. Mus., pt. i (1888), pp. 267, 270; pt. ii (1889), pp. 188, 215, 220, 245.

† Sci. Trans. R. Dublin Soc., ser. 2, vol. iv (1888), p. 1.

‡ Cat. Foss. Fishes Brit. Mus., pt. i (1889), p. 402.

§ Cat. Tert. Mollusca and Echinod. N.Z. (1873), p. 32; Zittel, Foss. Mollusk. u. Echinod. aus Neu Seeland (Novara Exped., Geol. Teil., Band I, 2, 1864), p. 53, pl. ix, figs. 1b, 3.

The *Ostrea* bed contains *Trigonia Hanetiana* d'Orb., *Ostrea* sp. cf. *dichotoma* Bayle, *Cucullæa*, "*Arca*" *Hectori* sp. nov., and *Pecten* (*Camptonectes*) *Hectori* sp. nov. The *Trigonia* and *Pecten* indicate that this bed belongs to the horizon of the Amuri Group, and is equivalent to the *Ostrea* bed of the Selwyn River (Malvern Hills). The *Ostrea* is similar to a species found in the Senonian of other regions.

The Saurian beds have yielded *Cimoliosaurus australis* (Owen), *C. candalis* Hutton,* *C. Haasti* (Hect.), *C. Hoodi* (Owen), *C. Holmesi* (Hect.), *Leiodon haumuriensis* Hect., *Malletia* (*Neilo*) *cymbula* sp. nov., *Mactra* sp., *Thracia* sp., *Trigonia waiparensis* sp. nov., *Cardium* sp., and *Belemnites*. The reptiles indicate that these beds are of the age of the Saurian beds of Amuri Bluff. The Lamellibranchs, however, have not been recognized either at Amuri or in the Malvern Hills, but *Malletia* (*Neilo*) *cymbula* and *Trigonia waiparensis* suggest that the age is Upper Senonian; the former is allied to *M. pencana* (Phil.) from the Quiriquina beds, and the latter is of the same type as *T. parva* Brügger and *T. crenifera* Stol., both from the Upper Senonian.

III. THE MALVERN HILLS.

Cretaceous deposits are found in the Malvern Hills about one hundred miles southwest of Amuri Bluff and nearly forty miles west of Christchurch, where they rest on an extensive series of volcanic rocks. No clear account of the district is available. The lowest beds are quartz sands and conglomerates of great thickness, containing coal at different horizons. Below the coal of Deans' Coal-mine there is an *Ostrea* bed similar to that of the Waipara district. An *Ostrea* bed, which is probably the same, is found above the coal on the south side of the Selwyn River, and contains *Trigonia pseudocundata* Hect., *T. Hanetiana* d'Orb., *Panopea malvernensis* sp. nov., *Pecten* (*Camptonectes*) *Hectori* sp. nov., and probably *Lucina canterburiensis* sp. nov. The species of *Trigonia* indicate that this bed belongs to the horizon of the lower part of the Amuri Group (the calcareous conglomerate).

A higher series of fossiliferous beds (the Selwyn Rapids beds) is found in the Selwyn River Rapids, and is followed by beds lithologically similar to the Saurian beds, above which come loose sands and volcanic rocks: the Amuri limestone is not present. The Selwyn Rapids beds contain *Pectuncululus selwynensis* sp. nov., *Ostrea* sp., *Pecten* (*Camptonectes*) *Hectori* sp. nov., *Pinna* sp., *Astarte* (*Eriphyla*) *lenticularis* (Goldf.), *Lucina canterburiensis* sp. nov., *Tellina* sp. cf. *Largillierti* (d'Orb.), *Callista* (*Callistina*) *Thomsoni* sp. nov., *Callista* sp., *Dosinia* sp., [•]*Cardium* sp., and *Panopea malvernensis*.

Of these species, only *Lucina canterburiensis* and *Pecten* (*Camptonectes*) *Hectori* have been recognized at Amuri, where they occur in the calcareous conglomerate of the Amuri Group.

Although very little palæontological evidence is at present available for correlation, it is probable that the Selwyn Rapids beds represent the upper part of the Amuri Group. They rest on the *Ostrea* bed, which contains species characteristic of the calcareous conglomerate, and are followed by the Saurian beds. An Upper Senonian age for the Selwyn Rapids beds is suggested by the presence of *Astarte* (*Eriphyla*) *lenticularis*, *Panopea malvernensis*, (which resembles *P. simplex* Hupé from the Quiriquina beds), *Tellina* sp. cf. *Largillierti* (d'Orb.) also from the Quiriquina beds, and *Callista* sp. (which may be compared with *C. sculpturata* Stol. from the Ariyalúr Group).

From the foregoing account it will be seen that in this region (Amuri to Malvern Hills) the only Cretaceous horizon which can be recognized at present is the Upper Senonian. There is no evidence for the existence of Cenomanian (Lower Chalk), Turonian, or Lower Senonian; so that we have here an instance of the Senonian transgression similar to that which occurs in Pondichéry, Madagascar, South Africa, and Quiriquina (Chile).

* Trans. and Proc. N.Z. Inst., vol. xxvi (1894), p. 354.

TABLE OF DISTRIBUTION OF SPECIES AT AMURI BLUFF, WAIPARA AND THE WEKA PASS,
AND THE MALVERN HILLS.

	Amuri.				Waipara and Weka Pass.		Malvern Hills.		Page.
	Amuri Group.		Greensand Group.		Ostrea Bed.	Saurian Bed.	Ostrea Bed.	Selwyn Rapids Bed.	
	Calcareous Conglomerate.	Black Grit.	Saurian Bed.	Concretionary Greensand.					
<i>Nuculana amuriensis</i> sp. nov.	X	..	..	..	..	..	..	..	18
" sp.	X	..	..	..	..	..	..	..	18
<i>Malletia (Neilo) cymbula</i> sp. nov. . . . .	..	..	..	..	..	X	..	..	18
<i>Barbatia Mackayi</i> sp. nov.	X	..	..	..	..	..	..	..	19
<i>Nemodon</i> ? sp. . . . .	..	..	..	..	X	..	..	..	19
" <i>Arca</i> " <i>Hectori</i> sp. nov. . . . .	..	..	..	..	X	..	..	..	19
<i>Cucullæa zealandica</i> sp. nov.	X	..	..	..	..	..	..	..	20
" sp.	X	..	..	..	..	..	..	..	20
<i>Pectunculus selwynensis</i> sp. nov. . . . .	..	..	..	..	..	..	..	X	20
" sp.	X	..	..	..	..	..	..	..	20
<i>Trigonia pseudocundata</i> Hect.	X	..	..	..	..	..	X	..	21
" <i>Hanetiana</i> d'Orb.	X	..	..	..	X	..	X	..	22
" <i>waiparensis</i> sp. nov.	X	..	..	..	..	X	..	..	23
<i>Modiola</i> sp. cf. <i>typica</i> Forbes	X	..	..	..	..	..	..	..	23
" <i>flagellifera</i> Forbes	X	..	..	..	..	..	..	..	24
<i>Dreissensia lanceolata</i> (Sow.)	X	..	..	..	..	..	..	..	24
<i>Ostrea</i> sp. cf. <i>dichotoma</i> Bayle . . . . .	..	..	..	..	X	..	X	..	24
" sp.	X	..	..	..	..	..	..	..	25
<i>Pecten (Syncyclonema) membranaceus</i> Nilss.	X	X	..	X	..	..	..	..	25
" (<i>Camptonectes</i>) <i>Hectori</i> sp. nov.	X	X	..	..	X	..	X	X	26
" (<i>Æquipecten</i>) <i>amuriensis</i> sp. nov.	X	?	..	..	..	..	..	..	26
<i>Lima (Limatula) Huttoni</i> sp. nov.	X	..	..	..	..	..	..	..	27
<i>Inoceramus australis</i> sp. nov.	X	X	..	..	..	..	..	..	27
" <i>pacificus</i> sp. nov.	X	..	..	..	..	..	..	..	28
" sp.	X	..	..	..	..	..	..	..	28
<i>Pinna</i> sp.	X	..	..	..	..	..	..	X	28
<i>Astarte (Eriphyla) meridiana</i> sp. nov.	X	..	..	..	..	..	..	..	28
" " <i>lenticularis</i> (Goldf.) . . . . .	..	..	..	..	..	..	..	X	29
<i>Anthonya elongata</i> sp. nov.	X	..	..	..	..	..	..	..	29
<i>Lucina canterburiensis</i> sp. nov.	X	..	..	X	..	..	?	X	30
<i>Tellina</i> sp. cf. <i>Largillierti</i> (d'Orb.) . . . . .	..	..	..	..	..	..	..	X	30
" sp. . . . .	..	..	..	..	..	..	..	X	30
<i>Mactra</i> ? sp. . . . .	..	..	..	..	..	X	..	..	30
<i>Cultellus cretaceus</i> sp. nov.	X	..	..	..	..	..	..	..	31
<i>Callista (Callistina) Wilckensi</i> sp. nov.	X	..	..	..	..	..	..	..	31
" " <i>Thomsoni</i> sp. nov. . . . .	..	..	..	..	..	..	..	X	32
" sp. . . . .	..	..	..	..	..	..	..	X	32
<i>Dosinia</i> sp. . . . .	..	..	..	..	..	..	..	X	32
" sp. . . . .	..	..	..	..	..	..	?	X	32
<i>Cardium</i> sp.	X	..	..	..	..	..	..	..	33
" sp. . . . .	..	..	..	..	..	..	..	X	33
<i>Panopea clausa</i> Wilck.	X	..	..	..	..	..	..	..	33
" <i>malvernensis</i> sp. nov. . . . .	..	..	..	..	..	..	X	X	33
<i>Thracia Haasti</i> sp. nov.	X	..	..	..	..	..	..	..	34
" sp. . . . .	..	..	..	..	..	X	..	..	34
<i>Nautilus</i> sp.	X	..	..	..	..	..	..	..	..
<i>Kossmaticeras (Madrasites) haumu-</i> <i>riensis</i> (Hect.)	X	..	..	..	..	..	..	..	34
<i>Gaudryceras</i> sp. (aff. <i>Jukesi</i> Whit.)	X	..	..	..	..	..	..	..	35
<i>Hamites (Anisoceras?)</i> sp.	X	..	..	..	..	..	..	..	35
<i>Baculites</i> sp. cf. <i>vagina</i> Forb.	X	..	..	..	..	..	..	..	36
<i>Belemnites Lindsayi</i> Hect.	X	..	..	..	..	..	..	..	36

DESCRIPTION OF SPECIES.

LAMELLIBRANCHIA.

Genus NUCULANA Link.

Nuculana amuriensis sp. nov. Plate VI, fig. 1.

Description.—Shell more or less oval, moderately inequilateral; convex between the umbo and the opposite ventral margin, becoming gradually compressed posteriorly. Antero-dorsal margin slightly concave; anterior margin rounded; ventral margin slightly or moderately convex, curving upwards to the posterior margin, which is more or less rounded, and forms a rounded angle with the straight or slightly concave postero-dorsal margin. Ornamentation consists of concentric ribs, which disappear or become indistinct towards the ends of the valves, and are best developed near the ventral margin or near a well-marked growth-ring; these ribs cut the ventral margin of the shell at an acute angle.

Affinities.—In form this species resembles some examples of *N. leia* (Wanner),* from the Danian and Mæstrichtian of Egypt and Tunis, but the concentric ornamentation is coarser, and recalls that of *N. lineata* (Sowerby)† from the Upper Greensand of England; in that species, however, the posterior part of the shell is more pointed, and the postero-dorsal region more compressed than in *N. amuriensis*. The posterior part is also less pointed than in *N. perdita* (Conrad).‡

Distribution.—Amuri Group (calcareous conglomerate); west wing of Amuri Bluff (13), and *Aporrhais* beds, east wing of Amuri Bluff (6).

Nuculana sp. Plate VI, fig. 2.

Another species is represented by an internal cast of a right valve only. On account of the upward slope of the posterior part of the ventral margin the height of the posterior part of the shell is less than in *N. amuriensis*.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus MALLETTIA des Moulins.

Subgenus NEILO Adams.

Mallettia (Neilo) cymbula sp. nov. Plate VI, figs. 3a, b.

Description.—Shell convex, but with the postero-dorsal part much compressed; length about twice the height; the posterior part not quite so high as the anterior part; slightly inequilateral. Anterior margin rounded, curving gradually to join the slightly convex ventral margin. Posterior margin slightly convex, somewhat oblique, forming an angle with the slightly concave postero-dorsal margin, rounded ventrally. Umbo incurved. Ornamentation consists of strong concentric ribs.

Affinities.—This species resembles *Mallettia pencana* (Philippi)§ from the Quiriquina beds, but is less inequilateral, more convex, less pointed posteriorly, and the ribs are more numerous and not so strong. The postero-dorsal part of the shell is more compressed than in the example figured by Wilckens. The hinge has not been seen,

* *Palaontographica*, vol. xxx, 2 (1902), p. 120, pl. xvii, figs. 16, 17; Quaas, *ibid.* (1902), p. 197, pl. xxxi, figs. 41–44; Pervinquière, *Études Paléont. Tunisienne*, vol. ii (1912), p. 96, pl. vii, figs. 15–19.

† Woods, *Mon. Cret. Lamell. England*, vol. i (1899), p. 7, pl. i, figs. 28–32.

‡ Lartet, *Ann. Sci. géol.*, vol. iii (1873), p. 50, pl. xii, figs. 1, 2.

§ *Tertiär. u. Quartär. Verstein. Chiles* (1887), p. 192, pl. xli, fig. 5; Wilckens, *Neues Jahrb. für Min., &c.*, Beil.-bd. xviii (1904), p. 230, pl. xix, fig. 6.

but from the external character of the shell it seems probable that it belongs to the subgenus *Neilo*.

Distribution.—Saurian beds, Middle Waipara (761).

Genus BARBATIA Gray.

Barbatia Mackayi sp. nov. Plate VI, figs. 4 a, b.

Description.—Shell elongate-oval, moderately inequilateral, height equal to about three-fifths of the length; flanks compressed. Antero-dorsal margin sloping rapidly forwards. Anterior margin rounded. Ventral margin nearly straight or slightly concave, almost parallel to the hinge-line. Posterior margin subtruncate or rounded. Umbones broad, not prominent, incurved.

Ornamentation consists of numerous small rounded radial ribs, which become more widely separated on the postero-dorsal part of the valve.

Affinities.—This species, known at present by only a single right valve, resembles *B. micronema* (Meek),* from the Colorado Formation, but the shell is less inequilateral and the radial ornamentation more distinct.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus NEMODON Conrad.

Nemodon ? sp. Plate VI, figs. 5 a, b.

An imperfect right valve possesses a hinge which resembles that of *Arca japetica* Forbes,† but the downward curvature of the anterior teeth is more marked. *A. japetica* is found in the Ariyalūr Group of Southern India, and was referred doubtfully by Stoliczka to the genus *Grammatodon*, but the hinge seems to agree more nearly with that of *Nemodon*. In the New Zealand specimen the surface of the shell is abraded, so that the nature of the ornamentation cannot be determined, and the umbo is missing.

Distribution.—*Ostrea* bed, McKay's Creek, Middle Waipara (149).

Genus ARCA Linnæus.

"*Arca*" *Hectori* sp. nov. Plate VI, figs. 6 a, b.

Description.—Shell subquadrate, rather short, moderately convex, with a distinct but rounded carina, which limits a flattened posterior area. Anterior margin convex, passing gradually into the slightly curved ventral margin, which is nearly parallel with the hinge-line. Posterior margin nearly straight, oblique, forming a rounded angle with the ventral margin and an obtuse angle with the dorsal margin. Umbones inconspicuous, situated at about one-third of the length of the shell from the anterior margin. Hinge-area low.

Ornamentation consists of numerous regular radial ribs which, except near the carina, are of two sizes, the stronger ribs being widely separated by from three to six small ribs.

Remarks.—This is a well-marked species, but is represented by one right valve only, and the hinge is not shown, so that the generic position cannot be determined. The ornamentation shows some resemblance to that of *Arca disparilis* d'Orbigny,‡ from Pondichéry, but the valve is less convex.

Distribution.—*Ostrea* bed, Boby's Creek, Waipara (277).

* Stanton, Colorado Formation (Bull. U.S. Geol. Surv., 106, 1893), p. 89, pl. xxi, figs. 1-4.

† Stoliczka, Cret. Fauna S. India, vol. iii (1871), p. 350, pl. xviii, figs. 9, 10.

‡ Voy. Pole Sud., Atlas géol. (1847), pl. viii, figs. 37, 38.

Genus CUCULLÆA Lamarck.

Cucullæa zealandica sp. nov. Plate VI, figs. 7 *a*, *b*; Plate VII, fig. 1.

Description.—Shell subquadrate, somewhat inequilateral, posterior part higher than the anterior part. Anterior margin slightly convex; ventral margin oblique, nearly straight. Umbones high, prominent, incurved. The carina present on the early part of the shell posterior to the umbo soon becomes indistinct.

The middle and anterior parts of the shell are ornamented with rounded radial ribs. At first the ribs are of uniform size, but on the later parts of the shell they become separated by broad interspaces, in which a small secondary rib appears. On the posterior part of the shell the radial ribs are smaller, less distinct, or perhaps absent in some cases. Numerous concentric growth-lines occur, some of which at intervals are more prominent than the others.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 13).

Cucullæa sp. Plate VII, figs. 2 *a-c*, 3.

Some specimens of *Cucullæa* from the Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 13), appear to differ from *C. zealandica* in having the ribs closer together, of uniform size, and with numerous transverse scale-like ridges. Owing to the small number of specimens and the imperfect preservation of the shell-surface, it is difficult to determine how far these differences may be due to preservation and variation. These specimens resemble *C. antarctica* Wilckens,* from the Senonian of South Patagonia, but have rather more numerous ribs, and apparently a more oblique and less curved ventral margin. Internal casts show the characteristic hinge of *Cucullæa*.

Genus PECTUNCULUS Lamarck.†

Pectunculus selwynensis sp. nov. Plate VII, figs. 4–7.

Description.—Shell somewhat inequilateral, globose, slightly concave between the umbo and the posterior margin. Height and length nearly equal. Anterior margin slightly convex, forming a rounded angle with the antero-dorsal margin, and curving rapidly to join the moderately convex ventral margin. Posterior margin relatively short, truncated, slightly concave, forming an angle with the postero-dorsal margin. Umbones rather broad, incurved. Inner margins of valves coarsely toothed. Anterior adductor impression larger than the posterior.

Ornamentation consists of strong radial ribs, with rounded summits (sometimes subangular on the posterior part of the shell), separated by concave interspaces. Both are crossed by numerous small growth-ridges.

Affinities.—The radial ribs in this species are similar to those of *P. Veatchi* (Gabb),‡ but are more numerous and rather narrower. Some specimens show fine radial lines, which may be comparable with the finer ornamentation of the ribs of *P. Veatchi*. The shell in *P. selwynensis* is, however, of smaller size and somewhat different shape. *P. Veatchi* is found in the Chico Group and also in the Vancouver Island region.

Distribution.—Selwyn Rapids beds of Selwyn River (23), and Selwyn River Rapids (589).

Pectunculus sp. Plate VII, fig. 8.

An internal cast from the Amuri Group (calcareous conglomerate) of Amuri Bluff (13) indicates the existence of a species distinct from *P. selwynensis*.

* Ber. naturf. Gesellsch. i Br., vol. xv (1905), p. 36 [132], pl. vi, figs. 5, 6.

† The name *Glycymeris* Da Costa, is used by some authors in place of *Pectunculus*.

‡ Whiteaves, Mesoz. Foss. (Geol. Surv. Canada), vol. i (1903), p. 391, pl. xlvii, figs. 3, 4.

Genus TRIGONIA Bruguière.

Trigonia pseudocundata Hector. Plate VII, fig. 9; Plate VIII, figs. 1-5.

1880. *Trigonia amuriensis* J. Hector, Append. Catal. Internat. Exhib. Sydney, N.Z. Court, p. 12 (*nom. nud.*)

1886. *Trigonia pseudocundata* Hector, Catal. Ind. & Colon. Exhibit., Geol. Exhibits, p. 64, fig. 28, 7.

1886. *Trigonia amuriensis* Hector, *ibid.*, p. 16.

Description.—Anterior part of shell inflated, high; posterior part gradually compressed, flattened, and rapidly diminishing in height. Anterior margin convex, passing gradually into the strongly convex ventral margin, the posterior part of which bends rapidly upwards, and is nearly straight or only slightly curved. Posterior margin very short. Postero-dorsal margin concave. Umbones broad, strongly incurved, and with a small backward curvature. The umbones are situated at a distance equal to about a quarter of the length of the shell from the anterior margin. Escutcheon concave, with costellæ. Area narrow, with a linear longitudinal furrow. A ridge on the inside of the posterior part of the valves divides the siphonal region into a dorsal and a ventral portion.

Ornamentation consists of strong radial ribs. On the anterior inflated part of the valves the ribs are broad and rounded, and are separated by relatively narrow concave interspaces. The ribs, which start immediately behind the umbo, pass in nearly a straight line to the opposite ventral margin; the more anterior ribs pass to the anterior margin, and have usually a slight anterior curvature before they reach the margin. The ribs are crossed at intervals by strong concentric furrows, which are widely spaced except towards the ventral margin, where they gradually become more numerous and closer together. These furrows, according to their distance from one another, divide the ribs into elongate, or nearly square, or short and broad portions. On the posterior compressed part of the valves the ribs are usually smaller and more numerous than on the anterior part; they extend from the margin of the area to the posterior part of the ventral margin, and become more oblique posteriorly. These ribs are also crossed by concentric furrows, which are usually less distinct than on the anterior part of the valves. The decrease in size of the ribs in passing from the anterior to the posterior part of the valves is sometimes gradual, but usually rapid. The ribs of the two valves alternate in position. The inner margins of the valves are crenulated.

Affinities.—*T. pseudocundata* resembles, in form and in the general character of its ornamentation, *T. tuberculifera* Stoliczka* from the Trichinopoli Group of Southern India; but is distinguished from that species by its less elevated umbones, and the broader, closer, and usually more numerous ribs, and their less distinctly tuberculate character. The ribs also appear to be less curved. *T. tuberculifera* is allied to *T. ventricosa* (Krauss) and other southern species.

Remarks.—In all the specimens examined the umbonal part is abraded, so that the character of the ornamentation in the early stages cannot be determined. The figure of *T. pseudocundata* given by Hector represents imperfectly the character of the species, and was not accompanied by any description. The type has not been identified. *T. amuriensis* Hector (*nom. nud.*) is founded on internal casts of *T. pseudocundata*.

Distribution.—Common in the Amuri Group, calcareous conglomerate (*Trigonia* beds and *Aporrhais* beds), west wing of Amuri Bluff (13). Two specimens were found in the *Ostrea* bed, swamp south of Selwyn River, Malvern Hills (469).

* Cret. Fauna S. India, vol. iii (1871), p. 315, pl. xv, figs. 10-12.

Trigonia Hanetiana d'Orbigny. Plate VIII, fig. 6; Plate IX, figs. 1-6.

1842. *Trigonia Hanetiana* A. d'Orbigny, Voy. Amerique Mérid., vol. iii, pt. 4, p. 127; Atlas, viii (1847), pl. xii, figs. 14-16.
1847. *Trigonia Hanetiana* d'Orbigny, Voy. Pole Sud., Atlas géol., pl. v, figs. 23, 24.
1850. ,, ,, d'Orbigny, Prodr. de Pal., vol. ii, p. 240.
1854. ,, ,, Hupé, in C. Gay, Hist. fis. e pol. Chile, Zool., vol. viii, p. 327.
1854. ,, *obtusa* Hupé, *ibid.*, p. 327, pl. v, fig. 9.
1874. ,, *sulcata* J. Hector, Trans. & Proc. N.Z. Inst., vol. vi, p. 358.
1887. *Trigonia Hanetiana* R. A. Philippi, Tertiär. u. Quartär. Verstein. Chiles, p. 199, pl. xlii, figs. 1, 3.
1887. *Trigonia obtusa* Philippi, *ibid.*, p. 200, pl. xlii, fig. 2.
1887. ,, *glabra* Philippi, p. 200, pl. xlii, fig. 4.
1886. *Trigonia sulcata* J. Hector, Catal. Ind. & Colon. Exhib., N.Z. Court, Geol. Exhibits, pp. 16, 64, fig. 28, 5.
1895. *Trigonia Hanetiana* W. Möricke, Neues Jahrb. für Min., &c., Beil.-band x, p. 101, pl. vii, figs. 8, 9.
1904. *Trigonia Hanetiana* O. Wilckens, *ibid.*, xviii, p. 231.
1905. *Trigonia Hanetiana* Wilckens, Ber. nat. Gesellsch. Freiburg i Br. vol. xv, p. 38 [134], pl. vii, fig. 4.

Description.—Shell subtriangular, sometimes subquadrate, of moderate convexity, or with the sides compressed; length greater than height, but the relative proportions varying considerably in different individuals; moderately inequilateral, except in elongate specimens, which are considerably inequilateral. Anterior margin moderately or considerably convex, usually curving rapidly to join the ventral margin, which is slightly convex in the elongate forms, more convex in the shorter forms, and bends inward in front of the postero-ventral angle. Posterior margin more or less oblique, slightly convex. Postero-dorsal margin long, slightly curved or nearly straight, sloping gradually to the posterior end. Umbones broad, not much elevated, with a moderate backward curvature.

Area moderately broad, bounded by a carina which becomes more rounded and less distinct on the later part of the shell; the area is divided by a shallow furrow, and is ornamented by a few radial ribs, which may become indistinct on the posterior part. Escutcheon concave, with concentric growth-ridges. In front of the carina a broad sulcus extends from the umbo to the posterior part of the ventral margin, where it makes a rounded sinus in the margin.

In front of the sulcus the shell is ornamented with strong ribs, which increase gradually in breadth: they extend obliquely backwards from the dorsal and anterior part to the sulcus or to the ventral margin; the later parts are curved, and may become concentric near the sulcus. These ribs are broken up into rounded, oval, or elongate portions. On the anterior marginal part of the valves ribs may extend upwards from the edge for a short distance, and join the oblique ribs at an angle.

Affinities.—*T. cepecta* Wilckens,* from the Upper Chalk of Southern Patagonia, is believed by Wilckens to be allied to *T. Hanetiana*, but no other closely related form appears to be known at present. An examination of specimens shows clearly that *T. sulcata* Hector is identical with *T. Hanetiana*; the probability of this was suggested by Steinmann and Möricke, but the brief description (1874) and the unsatisfactory character of Hector's figure (1886) did not permit of a definite statement. A short form of *T. Hanetiana* was named *T. obtusa* by Hupé. *T. glabra* Philippi is believed by Wilckens to be a decorticated example of *T. Hanetiana*.

Remarks.—This species varies considerably in the relative proportions of its length and height, and consequently in outline and in the obliquity of the ribs. The state of preservation makes considerable differences in the appearance of the shell; this is seen particularly on the area, which in the less perfectly preserved specimens

* Ber. nat. Gesellsch. Freiburg i Br., vol. xv (1905), p. 37 [133], pl. vii, figs. 2, 3.

appears to be without ribs. The examples figured by Philippi are somewhat abraded. *T. Hanetiana* is a characteristic fossil of the Quiriquina beds; the type came from Quiriquina, and other examples have been found at Tomé, San Vicente, Hualpen, Cerro Amarilla (near Concepcion), and Algarrobo.

Specimens found in the *Ostrea* bed of the Waipara and Malvern Hills districts differ somewhat in appearance from those collected at Amuri Bluff; the sulcus is usually shallower, and the ribs are smaller and appear to become nearly concentric near the anterior margin in larger specimens. The shells are to some extent decorticated, and I am inclined to regard the apparent differences as being due mainly to differences in the state of preservation.

Distribution.—Amuri Group, calcareous conglomerate (*Trigonia* beds), west wing (13) and east wing (5) of Amuri Bluff. *Ostrea* bed of Middle Waipara (762); Boby's Creek, Waipara (277); and Selwyn River (23).

Trigonia waiparensis sp. nov. Plate X, figs. 1-3.

Description.—Shell small, more or less trigonal, inequilateral, moderately convex in the dorsal and median part; length greater than height. Umbones situated at one-third or rather less than one-third of the length of the shell from the front of the anterior margin. Anterior margin rounded, passing gradually into the ventral margin, which at first is moderately convex, but becomes less convex posteriorly, and slopes upward to form an angle with the short oblique posterior margin. Postero-dorsal margin long, sloping gradually from the umbo backwards. Carina indistinct.

Ornamentation consists of strong radial ribs, which appear to bear tubercles. On the flanks the ribs extend in nearly straight lines from the umbo and the carinal line to the opposite ventral margin, the posterior ribs sloping backwards. From the carinal line another set of ribs starts, forming an acute angle with those of the flanks; these ribs curve downwards from the carinal region to the postero-dorsal margin of the valve.

Affinities.—Two species which have a similar type of ornamentation, but are clearly distinguished by the shape of the shell, the direction of the ribs, and other characters, are *T. parva* Brüggem* from the Senonian of North Peru and *T. crenifera* Stoliczka† from the Ariyalūr Group of Southern India.

Remarks.—Only a few specimens of this species have been seen. The surface is rather imperfectly preserved, but external casts indicate the presence of tubercles on the ribs. So far as can be made out, the escutcheon does not appear to be delimited from the area.

Distribution.—Saurian beds of Middle Waipara (761). Amuri Group, calcareous conglomerate (*Trigonia* beds), west wing of Amuri Bluff (13).

Genus MODIOLA Lamarck.

Modiola sp. cf. *typica* Forbes. Plate IX, fig. 7; Plate X, figs. 4a, b.

1846. *Mytilus (Modiolus) typicus* E. Forbes, Trans. Geol. Soc., ser. 2, vol. vii, p. 152, pl. xiv, fig. 4.

1866. *Modiola typica* K. A. Zittel, Bivalv. d. Gosaugeb., pt. 2, p. 2 [78], pl. xi, fig. 5.

1871. „ „ F. Stoliczka, Cret. Fauna S. India, vol. iii, p. 377, pl. xxiii, figs. 13-15.

1883. „ „ A. Fritsch, Die Iserschichten, p. 106, fig. 73.

1897. „ „ Fritsch, Die Chlomeker Schichten, p. 59, fig. 70.

1906. „ „ J. Pethö, Paläontographica, vol. lii, p. 235, pl. xvi, fig. 16.

The collection contains four specimens of *Modiola*, which closely resemble *M. typica* Forbes from the Trichinopoli Group of Southern India and the Senonian of Gosau and

* Neues Jahrb. für Min., &c., Beil.-bd. xxx (1910), p. 754, pl. xxv, fig. 7; non *T. parva* Kitchin, 1893.

† Cret. Fauna S. India, vol. iii (1871), p. 318, pl. xv, fig. 13.

other places; but without more material for comparison it is difficult to feel quite sure of the identification, especially as the Indian and Gosau examples show considerable variation.

None of the specimens have the radiating striæ on the anterior slope preserved. The type of *M. typica* is in the Geological Society collection (British Museum).

M. Vishnu Nötling,* from the Mæstrichtian of the Mari Hills, is allied to *M. typica*.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Modiola flagellifera Forbes. Plate X, fig. 5.

The only specimen seen is the posterior part of a right valve; it agrees closely with the type of *M. flagellifera*† which is now in the British Museum (Geological Society collection). The type came from the Valudayúr beds (Upper Senonian), of Pondichéry; other examples have been described from the Senonian of Gosau and Fruska Gora, the Upper Greensand of England, &c.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus **DREISSENSIA** van Beneden.

Dreissensia lanceolata (Sowerby). Plate X, figs. 6 *a, b*.

The Amuri specimens agree perfectly with English examples of *D. lanceolata* (Sowerby).‡ In England this species has not been found above the zone of *Schloenbachia rostrata*, but specimens from the Senonian of Aachen are believed by Holzapfel§ to be referable to *D. lanceolata*. An internal cast from Skidegate (Queen Charlotte Islands) has been identified with this species by Whiteaves.||

Distribution. Amuri Group (calcareous conglomerate): *Trigonia* and *Aporrhais* beds, east wing of Amuri Bluff (5, 6); *Trigonia* beds, west wing of Amuri Bluff (13).

Genus **OSTREA** Linnaeus.

Ostrea sp. cf. **dichotoma** Bayle. Plate X, figs. 7 *a, b*; Plate XI, fig. 1.

There are several examples of a species of *Ostrea* of the same type as *O. dichotoma* Bayle¶ (including *O. Sollieri* Coquand), which is found in the Coniacian, Santonian, and Campanian of Algeria, and has also been recorded from Egypt, Persia, and Mexico.

In most of the New Zealand specimens the shell is much higher than long; the left valve is convex, very thick in large specimens, and often with a high ligament-pit; the right valve is flattened, but often convex between the umbo and the opposite margin. The ribs are numerous, either rounded or angular, and sometimes bifurcate.

In the New Zealand specimens the ribs are more numerous and smaller than in the figured examples of *O. dichotoma* and *O. Sollieri*; but Peron has shown that this feature, and also the form of the shell, vary considerably. Pervinquieré regards *O. semiarmata* Bosé,** from the Senonian of Mexico, as a synonym of *O. dichotoma*. Although the New Zealand specimens are fairly numerous, their state of preservation is not sufficiently good to allow a definite determination of the species to be made.

* Paleont. Indica, ser. xvi, vol. i, pt. 3 (1897), p. 44, pl. xi, fig. 3.

† For references to figures, see Woods, Mon. Cret. Lamellibr. England, vol. i (1900), p. 99; Pethő, Paleontographica, vol. lii (1906), p. 236, pl. xvi, figs. 17, 18; Scupin, *ibid.* (Suppl. band vi, 1912-13), p. 198.

‡ For references, see Woods, Mon. Cret. Lamellibr. England, vol. i (1900), p. 110.

§ Paleontographica, vol. xxxv (1889), p. 218.

¶ Mesoz. Foss. (Geol. Surv. Canada), vol. i (1884), p. 236, pl. xxxi, fig. 7.

¶ Coquand, Mon. *Ostrea*. Terr. Crét. (1869), pp. 56, 99, pl. xxvi, figs. 1, 2; pl. xxvii, figs. 1-7. For synonymy of *O. dichotoma*, see Peron, Descript. Brach., &c., Terr. Crét. Tunisie (1890), p. 156; and Pervinquieré, Études Paléont. Tunisienne, ii, Gastrop. et Lamellibr. Terr. Crét. (1912), p. 206, pl. xiv, figs. 20, 21.

** Senon. de Cárdenas (Bol. Instit. geol. México, No. 24 (1906), p. 44, pl. ii, fig. 1; pl. iii, figs. 1, 2; pl. iv, fig. 4; pl. v, figs. 1, 5.

Distribution.—*Ostrea* bed of Weka Creek (782), Middle Waipara (762), Upper Waipara Gorge, and Boby's Creek, Waipara (277); *Ostrea* bed, swamp south of Selwyn River (469); and Selwyn River (23).

Ostrea sp. Plate XI, fig. 2.

Portions of *Ostrea* are very abundant in the lower part of the Amuri Group (chiefly in the *Trigonia* bed) of the west wing of Amuri Bluff (13). Owing to the hardness of the rock and the foliaceous character of the shell, the specimens cannot be extracted so as to show the external character of the shell satisfactorily. The inner margin of the valves is crenulate.

Genus PECTEN Müller.

Subgenus SYNCYCLONEMA Meek.

Pecten (*Syncyclonema*) *membranaceus* Nilsson. Plate XI, figs. 3–5.

1827. *Pecten membranaceus* S. Nilsson, *Petrific. Suecana*, p. 23, pl. ix, fig. 16 (lower figure).
 1836. " " A. Goldfuss, *Petref. Germ.*, vol. ii, p. 75, pl. xcix, fig. 7.
 1837. " " W. Hisinger, *Lethæa Suecica*, p. 53, pl. xvii, fig. 6.
 1841. " *spatulatus* F. A. Römer, *Verstein. nord-deutsch. Kreidegeb.*, p. 50, pl. viii, fig. 5.
 1842. " *membranaceus* F. v. Hagenow, *Neues Jahrb. für Min., &c.*, p. 553.
 1847. " " J. Müller, *Mon. Petref. Aachen. Kreidef.*, i, p. 31.
 1866. " " K. A. Zittel, *Bivalv. d. Gosaugeb.*, ii, p. 31, pl. xvii, fig. 3.
 1870. " " C. Schlüter, *Neues Jahrb. für Min., &c.*, p. 951.
 1872. *Pecten Nilsoni* H. B. Geinitz, *Das Elbthalgeb. in Sachsen (Palæontographica*, xx, 2), p. 33, pl. ix, figs. 15–18.
 1889. *Pecten spatulatus* E. Holzapfel, *Die Mollusk. Aachen. Kreide (Palæontographica*, xxxv), p. 233, pl. xxvi, figs. 3, 5.
 1891. *Syncyclonema spatulata* J. Böhm, *Palæontographica*, vol. xxxviii, p. 85, pl. iii, fig. 37.
 1894. *Pecten membranaceus* A. Hennig, *Geol. Fören. i Stockholm Förhandl.*, vol. xvi, p. 518.
 1896. *Pecten membranaceus* Hennig, *Revis. Lammellibr. i Nilsson's "Petrific. Suecana,"* p. 37, pl. iii, figs. 6–8.

Examples of this species are abundant in the Amuri Group, and agree well with the European forms, especially those figured by Böhm and Holzapfel. The proportions of height and length, and consequently the size of the apical angle, vary just as in European specimens, but the form of the ears appears to be more constant.

P. membranaceus is found in the Senonian of Kopinge (Sweden), Rügen, Aachen, Gosau, and other European localities. The specimens from the Ariyalûr Group of Southern India, described and figured by Stoliczka,* are either closely allied to or identical with this species. An imperfect specimen from Cockburn Island is doubtfully referred to *P. membranaceus* by Wilckens.†

In Europe specimens from horizons below the Senonian have been identified with *P. membranaceus* by some writers.‡ Thus Geinitz figures the species from the Turonian and Cenomanian; and Römer (1870), Windmüller, Michael, and Söhle record it from the Cenomanian. Of these occurrences the one from the Turonian of Saxony (Geinitz) is accepted by Hennig as an example of *P. membranaceus*.

* *Cret. Fauna S. India*, vol. iii (1871), p. 436, pl. xxxii, fig. 5; pl. xli, figs. 7, 8.

† *Die Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreideformat.* (Schwedisch. Südpol.-Expedit., 1901–3, iii, 12, 1910), p. 17, pl. i, fig. 9.

‡ References to these and some Senonian forms not mentioned in the synonymy are: Reuss, *Verstein. d. böhm. Kreideformat.*, pt. 2 (1846), p. 26, pl. xxxix, fig. 4; Kner, *Haidinger's Naturwiss. Abhandl.*, vol. iii, pt. 2 (1850), p. 28; Alth, *ibid.* (1850), p. 245, pl. xii, fig. 28; Strombeck, *Zeitschr. d. deutsch. geol. Gesellsch.*, vol. xv (1863), p. 154; Favre, *Mollusques foss. Craie de Lemberg* (1869), p. 140; Römer, *Geol. v. Oberschles.* (1870), pp. 333, 356, pl. xxvi, fig. 5, pl. xxxix, figs. 11, 12; Windmüller, *Jahr. d. k. preussisch. geol. Landesanst. für 1881* (1882), p. 21; Schröder, *Zeitschr. d. deutsch. geol. Gessellsch.*, vol. xxxiv (1882), p. 270; Söhle, *Geogn. Jahresh.*, 1896 (1897), p. 40; Greipenkerl, *Palæont. Abhandl.*, vol. iv (1889), p. 47; Michael, *Zeitschr. d. deutsch. geol. Gesellsch.*, vol. xlv (1893), p. 236; Leonhard, *Palæontographica*, vol. xlv (1897), p. 26; Gagel and Kaunhowen, *Jahrb. d. k. preussisch. geol. Landesanst.*, 1899 (1900), p. 231.

Distribution.—Amuri Group: Calcareous conglomerate (2, 5), greensand (7), and black grit (8), east wing of Amuri Bluff; Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13). Concretionary greensands, east wing of Amuri Bluff (10, 11).

Subgenus CAMPTONECTES Meek.

Pecten (Camptonectes) *Hectori* sp. nov. Plate XI, figs. 6-9; Plate XII, fig. 1.

Description.—Shell ovate, pointed dorsally, inequilateral, higher than long. Valves moderately and nearly equally convex. Antero-dorsal margin long, concave; postero-dorsal margin shorter, slightly convex. Anterior ear of right valve large, with its front margin nearly perpendicular to the hinge-line; posterior ear small, obtusely triangular. Anterior ear of left valve large, triangular, with its outer angle rather larger than a right angle; posterior ear small. Ornamentation of the left valve consists of numerous radial furrows curving outwards, with flat interspaces.*

Affinities.—The right valve resembles that of *Pecten occulte-striatus* Zittel,† from the Senonian of Gosau, but the antero-dorsal margin is relatively longer and slopes less steeply, and the byssal sinus is deeper. It is also similar to a species‡ from the Senonian of Pondoland, but the antero-dorsal margin is concave, and the shell more inequilateral.

Distribution.—*Ostrea* bed of Selwyn River (23); Weka Creek (782); Middle Waipara (762); above Deans' Coal-mine, Malvern Hills; and McKay's Creek, Middle Waipara (149). Selwyn Rapids beds of Selwyn Rapids (589). Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13); and black grit, east wing of Amuri Bluff (8).

Section ÆQUIPECTEN Fischer.

Pecten (Æquiptecten) *amuriensis* sp. nov. Plate XII, figs. 2-9.

Description.—Right valve ovate, slightly convex, somewhat inequilateral; height and length equal or nearly equal; outline rounded, with the umbonal region pointed. Antero-dorsal margin slightly concave or nearly straight; postero-dorsal margin slightly convex. Ears large; the anterior elongate triangular, with a few radial ribs; byssal sinus deep. Posterior ear obtusely triangular, with radial ribs crossed by regularly spaced concentric linear ribs. Shell apparently nearly smooth, but with faint radial ribs which are stronger near the posterior ear than elsewhere.

Left valve ovate, nearly equilateral, moderately convex. Ears large, triangular, with radiating ribs. Ornamentation consists of numerous narrow strong radial ribs, separated by broad flat or slightly concave interspaces, which are crossed at intervals by fine linear concentric ribs.

Remarks.—Although the two valves described above have not been found united in any case, it seems probable that they belong to the same species, since they occur abundantly in the same beds, and in some cases are found close together on the same block of rock. The surface of the right is not perfectly preserved, so that the exact character of the ornamentation cannot be determined; but on one specimen linear and concentric ribs, like those on the left valve, are seen.

Associated with the specimens just described are several left valves (Plate XII, figs. 10, 11) having the same form, but usually with more numerous radial ribs, which are sometimes alternately large and small; and the fine concentric ribs are not generally visible, but in one specimen they are seen near the umbo. It seems probable that

* Owing to imperfect preservation, the ornamentation is not seen on any of the right valves.

† Die Bivalv. d. Gosaugeb., pt. 2 (1866), p. 33 [109], pl. xvii, fig. 6.

‡ Woods, Ann. S. African Mus., vol. iv (1906), p. 297, pl. xxxv, figs. 12, 13.

this is not more than a variety of *P. amuriensis*; some of the apparent differences may be due to imperfect preservation.

Affinities.—The form of the right valve is similar to that of *P. subaratus* Nilsson,* from the Senonian of Sweden, but the radial ornamentation appears to be much less well developed, and on the left valve of that species the radial ribs are more numerous, and concentric ribs appear to be absent. The ornamentation of the left valve is somewhat similar to that of *P. tessellatus* Hennig,† from the Senonian of Sweden.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 6, 13); perhaps also black grit, east wing of Amuri Bluff (8).

Genus LIMA Bruguière.

Subgenus LIMATULA Wood.

Lima (*Limatula*) *Huttoni* sp. nov. Plate XII, figs. 12–16.

Description.—Shell small, oval, convex, inequilateral, rather oblique. Ventral margin rounded; anterior margin less convex than the posterior. Anterior ear larger than the posterior.

Ornamentation consists of numerous strong radial ribs, which cover all except the anterior part of the valves. The ribs have more or less angular summits, and become smaller on the posterior region. The interspaces are narrow, and often include a small radial rib. Numerous fine concentric ridges cross both ribs and interspaces, and sometimes give the former a serrate or tuberculate character. The anterior part of the valves is ornamented with fine concentric ridges only.

Affinities.—This is more oblique than most of the species of *Limatula*; in this respect it shows some resemblance to *Lima* (*Limatula*) *perisimilis* (Stoliczka)‡ and *L. (Limatula) antarctica* Wilckens,§ but is clearly distinguished from both by the character of its ornamentation.

Distribution.—Amuri Group, calcareous conglomerate (*Aporrhais* beds), east and west wings of Amuri Bluff (6, 13).

Genus INOCERAMUS Sowerby.

Inoceramus australis sp. nov. Plate XII, figs. 17–19; Plate XIII, figs. 1–3.

Description.—Shell more or less ovate in outline, very inequilateral, oblique; height greater than length. Valves moderately convex, sometimes becoming considerably convex during the later stages of growth. Hinge-line forming less than a right angle with the anterior margin, which is nearly straight. Umbones acute, only slightly curved. Anterior marginal part of valves flattened, often nearly perpendicular to the plane of the valves.

Ornamentation consists of concentric ribs with an unsymmetrical curvature; on the anterior part the ribs curve gradually, on the posterior part more rapidly and upwards. In some small specimens all the ribs are small and of equal size, but usually at intervals some of the ribs are stronger than the others; and in large specimens only the stronger ribs are found, and are separated by broad concave interspaces.

Affinities.—This species appears to be allied to some forms of *I. inconstans* Woods, but the angle between the hinge-line and the anterior margin of the valve is smaller, and the posterior ear is not developed. The smaller size of the angle mentioned also distinguishes this species from *I. labiatus* var. *latus* Sow. The obliquity of the

* Hennig, Revis. Lamellibr. Nilsson's "Petrific. Suecana" (1897), p. 46, pl. iii, figs. 16, 17.

† Bihang. Svenska Vet. Akad. Handl., vol. xxiv (1899), p. 10, pl. i, figs. 5, 6.

‡ Cret. Fauna S. India, vol. iii (1871), p. 420, pl. xxix, figs. 4, 5.

§ Annelid., Bivalv. u. Gastrop. d. Antarkt. Kreidiformat. (1910), p. 16, pl. i, fig. 8.

shell is similar to that seen in some Upper Senonian species of *Inoceramus*, such as *I. lobatus* Goldf. and *I. lingua* Goldf.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (5, 3, 14); black grit, east wing of Amuri Bluff (8).

Inoceramus pacificus sp. nov. Plate XIV, figs. 1, 2.

1877. *Inoceramus multiplicatus* J. Hector, Reports Geol. Explor. 1873-74 (Geol. Surv. N.Z.), p. xii; non *I. multiplicatus* Stol.

1886. *Inoceramus multiplicatus* Hector, Catal. Ind. & Colon. Exhibit. Geol. Exhibits, p. 17.

Remarks.—The shell is convex, and ornamented with numerous regular concentric ribs, which are of nearly uniform size, and have rounded summits. The ribs are separated by broad concave interspaces. Only four imperfect specimens of this species are present in the collection, so that the shape of the shell cannot yet be made out satisfactorily. The species appears to be allied to *I. cycloides* Wegner,* from the Senonian (*granulatus* chalk) of North Germany.

Some of the specimens in the collection bear Hector's label, but he gave no figure or description of the species, and there is nothing to show whether he regarded this as a new species or identified it with *I. multiplicatus* of Stoliczka.

Distribution.—Amuri Group (calcareous conglomerate), east and west wings of Amuri Bluff (13, 14).

Inoceramus sp. Plate XIV, figs. 3, 4.

Another species of *Inoceramus* is represented by a few internal casts, and resembles some forms of the *I. Lamarcki* group. The hinge-line forms approximately a right angle with the anterior margin of the valve. Strong concentric ribs occur at intervals, with small ribs in the interspaces.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (14).

Genus PINNA Linnæus.

Pinna sp. Plate XV, fig. 1.

A few specimens of *Pinna*, too imperfect for specific determination, have been found in the *Trigonia* beds (5), east wing of Amuri Bluff; in the Amuri Group of Oaro Creek, Amuri Bluff (14); and in the Selwyn Rapids beds of Selwyn Rapids (589).

Genus ASTARTE Sowerby.

Subgenus ERIPHYLE Gabb.

Astarte (Eriphyla) meridiana sp. nov. Plate XV, figs. 2-7.

Description.—Shell with rounded outline, slightly or moderately inequilateral; height usually rather greater than length, but in some cases equal to or somewhat less than the length. Valves usually regularly convex, sometimes with the postero-dorsal part sloping to the margin more rapidly than the anterior part. Antero-dorsal margin concave; postero-dorsal margin moderately convex; the anterior, ventral, and posterior margins more convex, and often forming a regular curve. Umbones relatively high, curved anteriorly. Lunule broad, deep, concave, limited by a sharp edge. Escutcheon very narrow.

Ornamentation consists of numerous, fairly regular, concentric ridges separated by narrow furrows. In many cases some of the ridges and furrows, at intervals, are stronger than the intervening ones.

* Zeitschr. d. deutsch. geol. Gesellsch., vol. lvii (1905), p. 162, pl. vii, fig. 3, text-figs. 5, 6. Compare also Scupin, Palæontographica, Suppl.-band vi (1912-13), p. 212, pl. ix, fig. 14.

Hinge: One strong cardinal tooth in each valve; one lateral tooth next the lunule, and in the right valve another lateral tooth below and extending in front of the lunular tooth. Pallial sinus relatively deep, rounded.

Measurements. —	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)
	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Length	24	31	32	33	35	35	36
Height ..	25.5	31	34	35	35	36.5	37

Affinities.—This species differs from *A. (Eriphyla) Forbesiana* Stoliczka* by its less orbicular outline, which is due to the greater slopes of the antero-dorsal and postero-dorsal margins, the more elevated umbonal region, the somewhat greater height of the valves, and the more concave antero-dorsal margin. Also the lunule is larger, the valves more convex, and there are some differences in the ornamentation.

In similar respects this species is distinguished from *A. (Eriphyla) lenticularis* (Goldfuss).

A. (Eriphyla) Forbesiana is found in the Ariyalūr Group of Southern India. For distribution of *A. (Eriphyla) lenticularis* see below.

This is probably the species referred to *Lucina americana* Forbes by Hector.†

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13); Belemnite beds (3), *Trigonia* beds (5), and *Aporrhais* beds (6), east wing of Amuri Bluff.

Astarte (Eriphyla) lenticularis (Goldfuss). Plate XV, figs. 9, 10.

The collection contains five examples of this species, which agree closely with specimens found in the Senonian of Aachen (the locality of the type), and with the figures given by various authors.‡

A. (Eriphyla) lenticularis is a widely distributed species; it has been found in the Senonian and Turonian of Europe, in the Trichinopoli Group of Southern India, and in the Senonian of Pondoland and Zululand.

Distribution.—Selwyn Rapids beds of Selwyn Rapids, Malvern Hills (589).

GENUS ANTHONYA Gabb.

Anthonya elongata sp. nov. Plate XV, figs. 11–13; Plate XVI, figs. 1–3.

Description.—Shell extremely inequilateral, greatly elongated, compressed, blade-like, tapering slightly. Anterior margin rounded; dorsal margin nearly straight, and almost parallel to the slightly curved ventral margin. Umbones small, at a short distance from the anterior end of the shell. Postero-dorsal part of the shell flattened, making a faint ridge where it joins the slightly convex ventral part. The latter is ornamented with small growth-ridges, which cut the anterior margin.

Hinge: Three long, more or less oblique, cardinal teeth in the right valve, and two similar teeth in the left valve. Anterior adductor impression below the umbones, deep, with its dorsal margin steeply inclined.

Affinities.—This species is remarkable for the great elongation of the shell. The external characters, the deep anterior adductor impression, and the hinge (so far as it can be made out) are similar to those of the few specimens known of *Anthonya*. In England this genus has not been found above the zone of *Pecten asper*, but the type (*A. cultriformis* Gabb) comes from later beds—the Chico Group of Martinez.

Distribution.—Amuri Group, calcareous conglomerate (*Trigonia* and *Aporrhais* beds), east and west wings of Amuri Bluff (5, 13).

* Cret. Fauna S. India, vol. iii (1870), p. 181, pl. vi, figs. 14–16.

† Catal. Ind. & Colon. Exhibit., Geol. Exhibits (1886), pp. 16, 64, fig. 28, 8.

‡ For references to figures and descriptions of this species, see Woods, Cret. Fauna of Pondoland (Ann. S. African Mus., vol. iv, 1906), p. 301; Scupin, Die Löwenberger Kreide (Paläontographica, Suppl.-band vi, 1912–13), p. 179.

Genus LUCINA Bruguière.

Lucina canterburiensis sp. nov. Plate XVI, figs. 4, 5 a-c.

Description.—Shell more or less oval, somewhat pointed dorsally, slightly convex; length rather greater than height, the anterior part rather longer than the posterior part. Antero-dorsal margin long, nearly straight or slightly concave, sloping anteriorly, forming a rounded angle with the slightly convex anterior margin; the latter curves rapidly to join the slightly convex ventral margin. Posterior margin relatively short, slightly curved, forming an obtuse angle with the slightly convex postero-dorsal margin. Postero-dorsal part of valves compressed, limited by a shallow sulcus passing from the umbo to the postero-ventral extremity. Umbones moderately prominent, curved slightly forward. Lunule elongate, narrow.

Ornamentation consists of regular lamellar concentric ribs, separated by broad flat interspaces bearing fine linear ribs. The ribs become sinuous where they cross the sulcus.

Affinities.—This species resembles *Lucina subnummismalis* d'Orbigny,* from the Senonian of Aachen, Faxö, &c., but is distinguished by the greater ventral slope of the antero-dorsal margin, the presence of a sulcus, and the relatively shorter shell. A similar type of ornamentation is seen in *L. Cornueliana* d'Orbigny, *L. plicato-costata* d'Orbigny, *L. Downesi* Woods, and *L. cretacea* (Conrad).

Distribution.—Selwyn Rapids beds of Selwyn River (23) and Selwyn River Rapids (589). *Ostrea* bed (?) of Malvern Hills (754) and MacIlwraith's Coal-mine, Malvern Hills (763). Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13), and concretionary greensand, east and west wings of Amuri Bluff (10, 13).

Genus TELLINA Linnæus.

Tellina sp. cf. *Largillierti* (d'Orbigny). Plate XVI, fig. 6.

Some internal casts, with a portion of the shell imperfectly preserved in one case, closely resemble in form *T. Largillierti* (d'Orbigny)† from the Quiriquina beds, but it is not clear if they show the flattening of the postero-dorsal marginal region seen in that species. An exact determination cannot be made until better specimens have been obtained.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Tellina sp. Plate XVI, fig. 7.

Some internal casts differ from the above in the smaller ventral slopes of the antero- and postero-dorsal margins, consequently the apical angle is larger. They resemble *T. æqualis* Gabb‡ from the Martinez Group, but are rather more elongate.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Genus MACTRA Linnæus.

Mactra (?) sp. Plate XVI, figs. 8 a, b.

A specimen from the Saurian beds, Middle Waipara (761), resembles *Mactra Mævusi* Coquand§ from the Cenomanian and Senonian of Tunis, but the shell is imperfectly preserved, and the hinge is not exposed, so that definite determination cannot be made.

* Müller, Petrefact. Aachen Kreidef., i (1847), p. 25, pl. ii, fig. 5; Böhm, Grünsand v. Aachen (1885), p. 114; Holzzapfel, Palæontographica, xxxv (1889), p. 187, pl. xix, figs. 1-3; Ravn. Mollusk. Danmarks Kridtafl. i, Lamellibr. (1902), p. 61, pl. iv, fig. 21. If Böhm's measurements represent the usual size of the shell, then Holzzapfel's figures must be enlarged about twice.

† Voy. Amérique mérid., vol. iii, pt. 4 (1842), p. 128, pl. xv, figs. 9, 10; D'Orbigny, Voy. Pole Sud., Atlas géol. (1847), pl. v, figs. 5, 6; Philippi, Tertiär. u. Quartär. Verstein. Chiles (1887), p. 194, pl. xxxi, fig. 7; Wilckens, Neues Jahrb. für Min., &c., Beil.-bd. xviii (1904), p. 248.

‡ Geol. Surv. California, Palæont., vol. ii (1869), p. 182, pl. xxix, fig. 73.

§ Geol. Pal. S. Constantine (1862), p. 191, pl. vii, figs. 3, 4; pl. viii, figs. 9, 10; Pervinquier, Études Paléont. Tunisienne, vol. ii (1912), p. 281, pl. xx, figs. 18, 19.

Genus *CULTELLUS* Schumacher.*Cultellus cretaceus* sp. nov. Plate XVI, fig. 9.

Description.—Shell elongate, very inequilateral, convex dorsally, gradually compressed ventrally and posteriorly. Anterior margin rounded; ventral margin nearly parallel to the dorsal margin, curving upwards at the posterior end, which is rounded. Postero-dorsal margin long, nearly straight. Ornamentation consists of concentric growth-ridges.

Remarks.—This species is represented by a single left valve. The specimens from Brazil, referred to this genus by White* (*C. paraensis*), are much more elongated.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Genus *CALLISTA* Mörch.Section *CALLISTINA* Jukes-Browne.*Callista* (*Callistina*) *Wilckensi* sp. nov. Plate XV, fig. 8; Plate XVI, figs. 10 *a, b*, 11; Plate XVII, figs. 1 *a, b*, 2 *a-d*, 3.

Description.—Shell oval, considerably inequilateral, moderately convex, with the postero-dorsal part sloping rapidly to the margin. Antero-dorsal margin concave. Anterior margin rounded, passing gradually into the uniformly convex ventral margin. Posterior margin rounded or subtruncate, often forming a very obtuse rounded angle with the convex postero-dorsal margin. Umbones broad, close together, with a considerable anterior curvature. Lunule ovate, slightly concave, but raised in the middle, limited by a distinct groove. Escutcheon narrow.

Ornamentation consists of numerous concentric ribs, separated by narrow furrows: on the later part of the shell the ribs often become less distinct, and at intervals more prominent concentric grooves occur.

Hinge: In the left valve one strong, elongate, antero-lateral tooth parallel to the lunular margin; three diverging cardinal teeth, of which the anterior is straight and grooved at the summit, the median is somewhat stouter and curved, the posterior is much elongated, curved, and separate. Pallial sinus rather large, angular, horizontal or slightly ascending.

Affinities.—This species resembles *Callista sculpturata* Stoliczka,† from the Ariyalur Group of Southern India, but it appears to differ in having a relatively shorter shell and less prominent and less widely separated ribs. Wilckens states that *C. auca* (d'Orbigny),‡ from the Quiriquina beds, is closely allied to *C. sculpturata*. *C. Wilckensi* also resembles *C. auca*, but possesses a rather shorter shell; and the pallial sinus, instead of being rounded as in Wilckens's§ figure of *C. auca*, is angular. Another similar form is that identified by Whiteaves|| as *Cythera* (*Callista*) *laciniata* Stoliczka, and found in Hornby Island and Sucia Islands.

Remarks.—This species is abundant in the Amuri Group, and shows some variation in the relative length and height of the shell, and in the position of the umbo. Some of the specimens were examined by the late Mr. Jukes-Browne, who agreed with me in placing the species in the section or subgenus *Callistina*.

Distribution.—Amuri Group (calcareous conglomerate): *Trigonia* beds, east wing of Amuri Bluff (5); *Trigonia* and *Aporrhais* beds, west wing of Amuri Bluff (13).

* Archiv. Mus. Nac. Rio de Janeiro, vol. vii (1887), p. 112, pl. viii, figs. 1, 2.

† Cret. Fauna S. India, vol. iii (1870), p. 173, pl. vii, figs. 7-9.

‡ For references see Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 243.

§ *Ibid.*, pl. xix, fig. 14.

|| Mesoz. Foss. (Geol. Surv. Canada), vol. i (1879), p. 148, pl. xvii, fig. 13; pl. xix, fig. 4.

Callista (*Callistina*) *Thomsoni* sp. nov. Plate XVII, figs. 4, 5 *a, b*, 6.

Description.—Shell large, more or less oval, subangular posteriorly, moderately inequilateral, convex; postero-dorsal part sloping rapidly to the margin. Antero-dorsal margin concave. Anterior margin rounded, passing gradually into the moderately convex ventral margin, which forms a rounded angle with the short oblique slightly convex posterior margin. Postero-dorsal margin long, convex, with a large ventral slope. Umbones rather large, curved forward. Lunule ovate, depressed, limited by a linear furrow. Escutcheon narrow, deep, limited by a ridge.

Ornamentation consists of strong concentric ribs.

Affinities.—This species resembles in form *C. (Callistina) Wilckensi* described above, but is much larger, the slope of the antero-dorsal margin is less rapid, and the concentric ribs are stronger. It is also similar to some forms of *C. sculpturata* Stoliczka, but is larger, and the postero-dorsal margin is more strongly curved. The concentric ribs appear to be stronger, but the surface of the shell is not well preserved. The hinge is not shown in any specimen, but the form of the shell closely resembles that of *Callistina*.

Distribution.—Selwyn Rapids beds of Selwyn Rapids (589).

Callista sp. Plate XVII, fig. 7.

This species is represented by an imperfect left valve and the posterior portion of a right valve. It is ornamented with strong sharp angular ribs, separated by relatively broad furrows in which smaller ribs are sometimes seen. The anterior curvature of the umbones is smaller than in *C. (Callistina) Thomsoni* described above. The hinge is not shown.

Distribution.—Selwyn Rapids beds of Selwyn River (589).

Genus DOSINIA Scopoli.

Dosinia sp. Plate XVIII, fig. 1.

The collection contains four imperfect valves of *Dosinia*, which in form resembles Peron's figure of *D. cataleptica* (Coquand)* from the Turonian of Tunis. The ornamentation consists of numerous concentric ribs separated by narrow furrows, and appears to be similar to that of *D. cataleptica*: at intervals some of the ribs are slightly stronger than the others. Pervinquièrè† considers that *D. cataleptica* is a synonym of *D. inelegans* (Sharpe)‡ from the Turonian of Portugal, and that *D. brasiliensis* White,§ from the Turonian of Brazil, also belongs to this species.

Without more material I am unable to identify definitely the New Zealand species.

Distribution.—Selwyn Rapids beds of Selwyn River Rapids (589).

Dosinia sp. Plate XVIII, fig. 2.

A specimen from the same locality (589) and another from MacIlwraith's Coalmine, Malvern Hills (763, probably *Ostrea* bed), differ from the last species in having a relatively higher shell and more convex valves: they appear to belong to a distinct species.

* Peron, Descript. Moll. Foss. Terr. Crét. Tunisie (1890), p. 311, pl. xxix, figs. 15, 16.

† Etudes Paléont. Tunisienne, vol. ii (1912), p. 271.

‡ Quart. Journ. Geol. Soc., vol. vi (1850), p. 177, pl. xx, fig. 3.

§ Archiv. Mus. Nac. R. de Janeiro, vol. vii (1887), p. 97, pl. viii, figs. 13, 14.

Genus *CARDIUM* Linnæus.*Cardium* sp. Plate XVIII, figs. 3 *a, b*.

An internal cast of a left valve from the *Trigonia* beds of the west wing of Amuri Bluff shows radial ribs, which are prolonged at the posterior margin; it seems probable that it belongs to the same group of species as *C. acuticostatum* d'Orbigny,* from the Quiriquina beds.

Cardium sp. Plate XVIII, figs. 4, 5.

There are several specimens of a small form of *Cardium*, but all are either internal casts or have only a thin layer of shell preserved, so that specific determination cannot yet be made. The internal casts show radial rows of what appear to be tubercles (fig. 4), but in specimens in which some of the inner layers of the shell are preserved (fig. 5) the rows of "tubercles" seem to alternate with ribs, and are separated by transverse bars. At present it is not possible to make out the real character of the ornamentation, but there seems no doubt that radial ribs were present. The inner margins of the valves are coarsely toothed.

Distribution.—Selwyn Rapids beds of Selwyn River (23) and Selwyn Rapids (589).†

Genus *PANOPEA* Ménard de la Groye.*Panopea clausa* Wilckens. Plate XVIII, figs. 6 *a-c*, 7.

1910. *Panopea?* (*Pleuromya?*) *clausa* O. Wilckens, Die Annelid. Bivalv. u. Gastrop. d. Antarkt. Kreideformat., p. 68, pl. iii, fig. 10.

Internal casts of *Panopea*, sometimes with small portions of the shell preserved, are common in the Amuri Group, and agree closely with *P. clausa*, which, as pointed out by Wilckens, resembles greatly the European *P. gurgitis* var. *plicata* Sow.

Distribution.—Amuri Group, calcareous conglomerate (Belemnite, *Trigonia*, and *Aporrhais* beds), east and west wings of Amuri Bluff (3, 5, 6, 13).

Panopea malvernensis sp. nov. Plate XVIII, figs. 8 *a, b*, 9; Plate XIX, figs. 1 *a, b*, 2.

Description.—Shell elongate-oval, slightly or moderately inequilateral, convex, with compressed flanks; depressed in front of and behind the umbones. Anterior margin very convex, rounded, passing gradually into the nearly straight ventral margin. Posterior margin subtruncate, rounded. Postero-dorsal margin with a small posterior slope. Umbones broad, incurved. Posterior gape small. Surface of shell with inconspicuous growth-ridges.

Affinities.—This species shows some resemblance to *P. simplex* Hupé,‡ from the Quiriquina beds, but the umbones are broader and the concentric ridges less distinct. It may also be compared with *P. nagorzanyensis* Favre,§ from the Senonian of Galicia.

Remarks.—The specimens are fairly numerous, and several have considerable portions of the shell preserved, but in most cases the form of the shell has been altered by pressure.

Distribution.—Selwyn Rapid beds of Selwyn River (23) and Selwyn Rapids (589). *Ostrea* beds, swamp south of Selwyn River, Malvern Hills (469).

* Voy. Amérique mérid., vol. iii (1842), p. 120, pl. xii, figs. 19–21; Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 231.

† A *Cardium* of larger size, but with somewhat similar ornamentation, occurs in the Saurian beds of Middle Waipara.

‡ Gay's Hist. Chile, vol. viii (1854), p. 374, pl. vi, fig. 7; Philippi, Tertiär. u. Quartär. Verstein. Chiles (1887), p. 166, pl. xxxiv, fig. 4; Wilckens, Neues Jahrb. für Min., &c., Beil.-band xviii (1904), p. 263, pl. xx, fig. 10.

§ Mollusques Foss. Craie de Lemberg (1869), p. 104, pl. xi, fig. 9.

Genus THRACIA Leach.

Thracia Haasti sp. nov. Plate XIX, figs. 3a-c.

Description.—Shell sub-elliptical, moderately convex, nearly equilateral, slightly inequivalve. Height equal to about three-fifths of the length. Anterior margin very convex, rounded, passing gradually into the regularly convex ventral margin. Posterior margin truncated, nearly straight and perpendicular. Postero-dorsal margin concave. Umbones broad, curved slightly backwards. A carina passes in a curve from the umbo to the postero-ventral angle, and is at first sharp, but becomes rounded posteriorly. Surface of shell ornamented with growth-rings.

Affinities.—This species shows some resemblance to *Thracia subtruncata* Meek,* from Nanaimo (Vancouver Island) and the Sucia Islands, but the ventral margin is more convex and the umbones more anterior. It is also similar to *Periplomya truncata* Whitfield,† from the Raritan Formation of New Jersey, but the valves are less convex, the carina is not so sharp, and the posterior part of the shell is relatively longer.

Distribution.—Amuri Group (calcareous conglomerate), west wing of Amuri Bluff (13).

Thracia sp. Plate XIX, figs. 4 a, b.

A large species of *Thracia* is represented by three imperfect right valves. It shows some resemblance to *T. semiplanata* Whiteaves,‡ but without more material a satisfactory comparison cannot be made. The great convexity of the specimen figured is due partly to dorso-ventral crushing.

Distribution.—Saurian beds, Middle Waipara (761).

CEPHALOPODA.

Genus KOSSMATICERAS de Grossouvre, 1901.

Subgenus MADRASITES Kilian and Reboul, 1909.

Kossmaticeras (Madrasites) haumuriensis (Hector). Plate XIX, figs. 5 a-c; Plate XX, fig. 1.

1886. *Ammonites haumuriensis* J. Hector, Catal. Indian and Colon. Exhibit., N.Z. Court, Geol. Exhibits, p. 58, fig. 20, 7.

Remarks.—Two incomplete specimens, which were named by Hector, are in the collection, but the type has not been found. These specimens resemble *K. (Madrasites) Bhavani* (Stoliczka),§ but the umbilicus is relatively smaller and the whorls rather less compressed. So far as can be made out from these specimens, umbilical tubercles were either absent or indistinct. The suture resembles that of *K. (Madrasites) Bhavani* as figured by Kossmat.

K. (Madrasites) Bhavani occurs in the Trichinopoli and Ariyalūr Groups of Southern India. Varieties of this species from the Senonian of Seymour Island have been described by Kilian and Reboul,|| and an allied form is figured by Whiteaves¶ from the Senonian of the Queen Charlotte Islands.

Distribution.—Amuri Group (calcareous conglomerate), east wing of Amuri Bluff (2).

* Bull. Geol. and Geogr. Surv. Territ., vol. ii (1876), p. 363, pl. ii, fig. 4; Whiteaves, Mesoz. Foss. (Geol. Surv. Canada), vol. i (1879), p. 140, pl. xvii, fig. 7.

† Brach. and Lamellibr. Raritan Clays and Greensand Marls, New Jersey (Mon. U.S. Geol. Surv., ix, 1885), p. 220, pl. xxviii, figs. 20, 21.

‡ Mesoz. Foss. (Geol. Surv. Canada, vol. i, 1884), p. 221, pl. xxix, fig. 5.

§ Cephalop. Cret. Rocks, S. India, vol. i (1865), p. 138, pl. lxix, figs. 4-7; Kossmat. Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, xi, 1897), p. 38, pl. viii, figs. 5, 6.

|| Les Céphalop. Néocrét. des Îles Seymour et Snow Hill (Schwedisch. Südpol.-Expedit. 1901-3, band iii, lief. 6, 1909), pp. 29, 30.

¶ Mesoz. Foss. vol. i (Geol. Surv. Canada, 1884), p. 208, pl. xxiv, fig. 1.

Genus GAUDRYCERAS GROSSOUVRE.

Gaudryceras sp. aff. *Jukesi* (Whiteaves). Plate XX, fig. 2.

Remarks.—A specimen, consisting of portions of three whorls only, resembles closely a form from the Senonian of the Vancouver Island region figured by Whiteaves,* and identified by him with *Ammonites Jukesi* Sharpe,† from the hard chalk (zone of *Belemnitella mucronata*) of County Londonderry, Ireland. The type of that species is in the Museum of Practical Geology, London; it consists of parts of three imperfectly preserved whorls, and possesses more numerous ribs than the form figured by Whiteaves.

The form found in the Vancouver Island region has been identified by Kossmat,‡ by Kilian and Reboul,§ and by Pervinquière|| with *G. Kayei* (Forbes), which is found in the Valudayúr beds of Pondichéry, and has also been recorded from Tunis, Pondoland, Snow Hill Island (Graham Land), Quiriquina, &c.

Ammonites Jukesi Sharpe is doubtfully identified by Kilian and Reboul with *Gaudryceras varagurense* Kossmat,¶ from the Upper Trichinopoli Group of Southern India; this species, however, seems to be distinguished from *Am. Jukesi* by its more numerous ribs, which are more distinctly curved and sickle-shaped. A specimen from the Senonian of Seymour Island is identified by Kilian and Reboul as *G. varagurense*.

Distribution.—Amuri Group (calcareous conglomerate), *Trigonia* beds, east wing of Amuri Bluff (5).

Genus HAMITES Parkinson.

Hamites (*Anisoceras*?) sp. Plate XX, figs. 3 a-c, 4.

This species is represented by two fragments, which perhaps belong to the same individual. The shell is slightly oval in section. It is ornamented with many small ribs, which become weaker on the internal margin. On the straight part of the shell the ribs are transverse, but on the hooked part they become somewhat oblique. Each rib bears two tubercles, which are placed symmetrically on either side of the external margin. Between the tubercles the shell is somewhat flattened. The suture is not seen.

In the character of the tubercles this species resembles *Hamites interruptus* Schlüter,** *H. Wernickei* Wollemani,†† and *H. Carolinus* d'Orbigny,‡‡ from the Senonian, but does not closely agree with them in other respects. The ribbing, except for the presence of tubercles, is similar to that of some forms of *H. (Anisoceras) indicum* Forbes,§§ from the Valudayúr Group of Southern India.

Distribution.—Amuri Group (calcareous conglomerate), east wing of Amuri Bluff (2).

* Trans. Roy. Soc. Canada, ser. 2, vol. i (1895), p. 129, pl. ii, figs. 1, 2; Mesoz. Foss., vol. i (Geol. Surv. Canada, 1879), p. 111, pl. xiii, fig. 3.

† Mollusca Chalk of England, Cephalop. (1855), p. 53, pl. xxiii, fig. 11.

‡ Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, ix, 1895), p. 124.

§ Les Céphalop. néocrét. des Îles Seymour et Snow Hill (Schwedisch. Südpol.-Expedit., 1901-3), band iii, lief. 6 (1909), p. 12.

|| Études Paléont. Tunisienne, i, Cephalop. (1907), p. 69.

¶ Kossmat. *op. cit.*, p. 122, pl. xvii, fig. 9; pl. xviii, fig. 2.

** Paläontographica, vol. xxi (1872), p. 105, pl. xxxii, figs. 8, 9.

†† Fauna d. Lüneburger Kreide (1902), p. 95, pl. iv, figs. 4, 5; Pervinquière, Études Paléont. Tunisienne, i, Céph. (1907), p. 86, pl. iii, fig. 33.

‡‡ Hébert, Mém. Soc. géol. de France, ser. 2, vol. v (1855), p. 371, pl. xxix, fig. 5.

§§ For references to figures see Kossmat, Südindische Kreideformat. (Beitr. z. Paläont. u. Geol. Österr.-Ungarns u.d. Orients, bd. ix, 1895), p. 145, pl. xix, fig. 4.

Genus BACULITES Lamarck.

Baculites sp. cf. *vagina* Forbes. Plate XX, figs. 5 a-d.

1886. *Baculites anceps* Hector, Indian and Colon. Exhibit., N.Z. Court Cat. Geol. Exhibits, p. 64, fig. 28, 6.

An imperfectly preserved specimen, which was referred to *B. anceps* Lam. by Hector, is probably an example of *B. vagina* Forbes. At the smaller end of the specimen the section is oval; at the larger end it is ovate, with the siphonal margin sharp but apparently not carinate.* *B. vagina* is found in the Ariyalūr Group of Southern India and in the Quiriquina beds of Chile,† and a closely allied species occurs in California and the Vancouver Island region.

Distribution.—Amuri Group, calcareous conglomerate (*Aporrhais* beds), of Amuri Bluff.

BELEMNITES.

Belemnites Lindsayi Hector. Plate XX, figs. 6-11.

1874. *Belemnitella Lindsayi* J. Hector, Trans. & Proc. N.Z. Inst. (1873), p. 356.

1877. *Belemnites Lindsayi* Hector, Rep. Geol. Explor. 1873-74 (Geol. Surv. N.Z.), p. xii.

1878. „ *australis* Hector, Trans. & Proc. N.Z. Inst., vol. x. (1877), p. 487, pl. xxiii.

1886. *Belemnites australis* Hector, Catal. Indian and Colon. Exhibit., N.Z. Court, Geol. Exhibits, p. 64, fig. 28, 1-3.

This species belongs to a group of *Belemnites* found in Southern India, Australia, and New Zealand, the principal species being *B. seclusus* Blanford,‡ from the Lower Utatūr Group of Southern India: *B. superstes* Hector, from Coverham (p. 12); *B. australis* Phillips,§ *B. Canhami* Tate||, *B. oxyis* Tenison-Woods,¶ and *B. Kleini* Gürich.** from the Cretaceous of Queensland and New South Wales. It is difficult to compare *B. Lindsayi* satisfactorily with the Indian and Australian species without seeing specimens. *B. Lindsayi* is larger than *B. seclusus*, the lateral furrows are relatively longer and not so near the ventral margin, and the dorsal furrow appears to be absent. *B. Lindsayi* differs from *B. superstes* (p. 12) in the less elongate guard, in the form of the alveolar part which is somewhat compressed laterally, and in the lateral furrows, which are farther from the dorsal surface, usually curved, and not so long.

The name *B. Lindsayi* was given to this species by Hector in 1874 and 1877, but in his description of 1878 it was identified with *B. australis* Phillips: this identification, however, is not accepted by Etheridge, with whom I am inclined to agree. The name *B. Lindsayi* was first given to specimens from the concretionary greensand of Amuri Bluff (1874) and from the black grit (1877). The specimens from these horizons were not described or figured, and consequently the examples found in the

* The specimen may be compared with some of the examples figured by Stoliczka, Foss. Ceph. S. India (1866), pl. xci, figs. 1, 2; also Kossmat, Südindisch. Kreideformat. (1895), p. 155, pl. xix, figs. 13, 14.

† Steinmann, Neues Jahrb. für Min., &c., Beil.-bd. x (1895), p. 89, pl. vi, fig. 4, text-figs. 8-10; Wilckens, *ibid.*, xviii (1904), p. 188.

‡ Blanford and Stoliczka, Ceph. (Cret. S. India (Palæont. India, 1861, 1866), pp. 4, 202, pl. i, figs. 43-51; pl. ii, fig. 8. E. Spengler, Beitr. z. Paläont. u. Geol. Österr.-Ungarns u. d. Orients, vol. xxiii (1910), p. 153, pl. xiv, fig. 7.

§ Quart. Journ. Geol. Soc., vol. xxvi (1870), p. 258, pl. xvi, figs. 1, 2; Jack and Etheridge, Geol. and Palæont. Queensland and New Guinea (1892), p. 487, pl. xxxv, figs. 1, 2.

|| Phillips, *ibid.*, pl. xvi, figs. 3, 4; Tate, Proc. R. Soc. S. Australia, 1879-80 (1880), p. 104, pl. iv, fig. 2; Jack and Etheridge, *op. cit.* (1892), p. 490, pl. xxxv, figs. 3, 4, 7-9, 12-14; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 45, pl. viii, figs. 8, 9, pl. ix, fig. 2.

¶ Proc. Linn. Soc. N.S.W., vol. viii (1883), p. 237, pl. xiii, figs. 1-3; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 48.

** Neues Jahrb. für Min., &c., Beil.-bd. xiv (1901), p. 489, pl. xix, figs. 2, 3; Etheridge, Cret. Invert. Fauna N.S.W. (1902), p. 47.

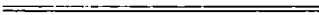
calcareous conglomerate which were figured and described in 1878 must be taken as the types.

It is probable that the group of species to which *B. Lindsayi* belongs should be regarded as a special section of *Belemnites*; for although, as pointed out by Spengler in the case of *B. seclusus*, it shows some resemblance to *Duvalia*, yet it is clearly distinguished from that section. It may also be pointed out that the alveolar end of the guard is somewhat foliaceous, as in *Actinocamax*, and that similar lateral grooves, but much less distinct, can be traced in some species of *Actinocamax*. On the other hand, the alveolus is deeper than in *Actinocamax*, and the slit in the alveolar end of the guard appears to be absent. In *B. Lindsayi* and *B. superstes*, and probably in other species of this group, the alveolar end of the guard is thicker on the ventral than on the dorsal side.

Distribution.—Amuri Group (calcareous conglomerate) of Amuri Bluff. Perhaps also black grit and concretionary greensand.

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PLATE I.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Arca (Barbatia)* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs. *b*, dorsal view of *a*; *c*, ornamentation near middle of left valve, $\times 4$. (Page 5.)
- Figs. 2-7. *Trigonia meridiana* sp. nov. 2-6, Gladstone and Middlehurst Runs; 7, conglomerate, Seymour River; 3*b*, dorsal view of 3*a*; 6, part near the umbo, $\times 2$. (Page 6.)
- Fig. 8. *Trigonia glyptica* sp. nov. *b*, dorsal view of *a*. Conglomerate, Seymour River. (Page 6.)



1a



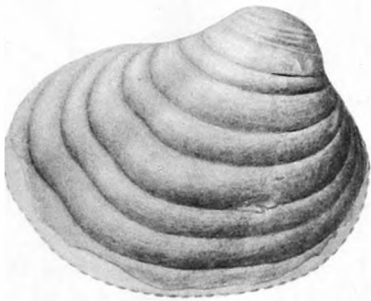
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1c



2



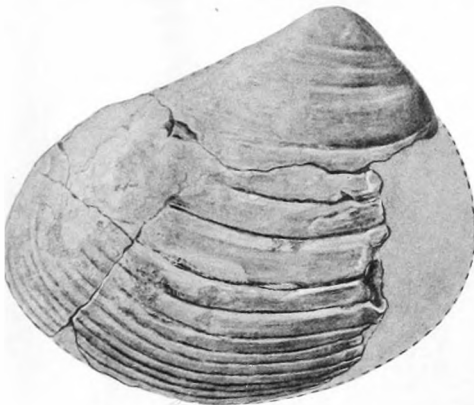
3a



3b



4



5



6



8a



7



8b

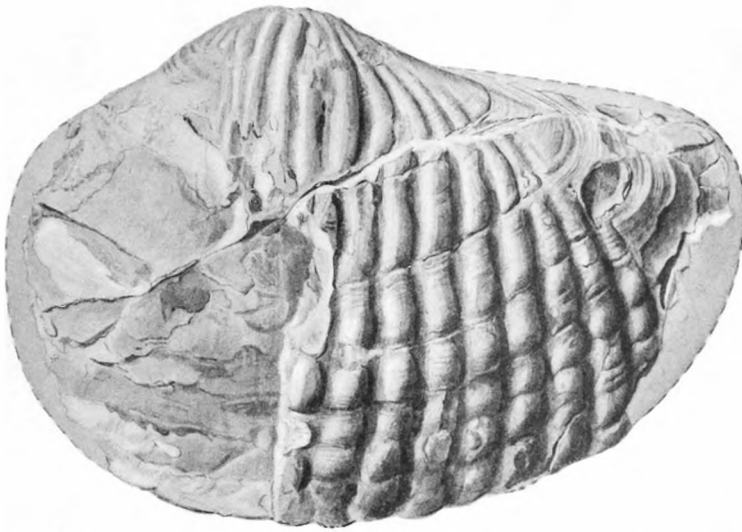
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PLATE II.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1, 2. *Trigonia glyptica* sp. nov. Conglomerate, Seymour River. 1*b*, dorsal view of 1*a*.
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- Figs. 3-5. "*Modiola*" *kaikourensis* sp. nov. 3, 4, sandstone, Bluff River; 5, sandstone
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- Fig. 6. *Spondylus* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs.
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1a



1b



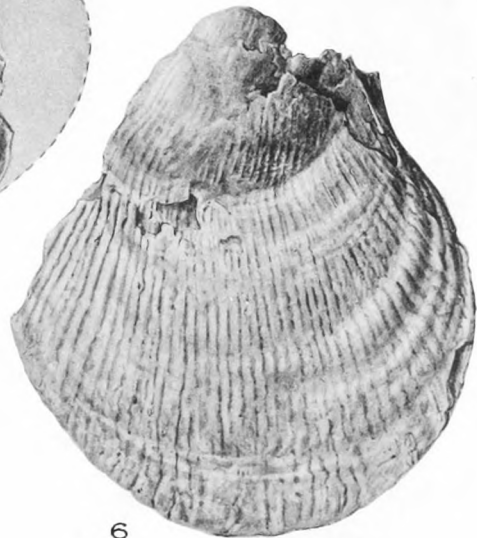
2



5a



5b



6



3a



3b



4

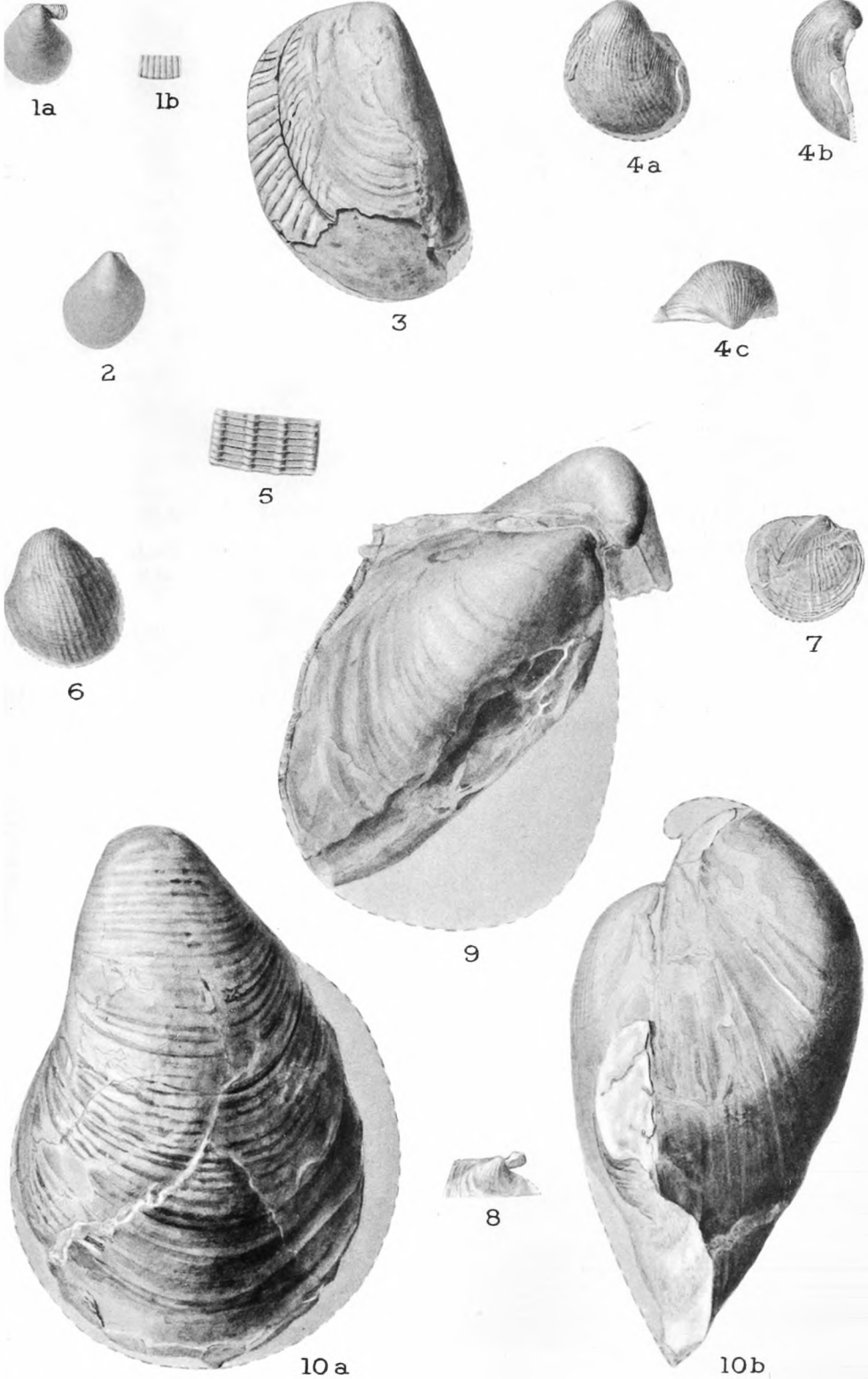
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PLATE III.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1, 2. *Pecten (Camptonectes)* sp. Dark volcanic sandstone, Gladstone and Middlehurst Runs. 1b, portion near ventral margin of 1a, $\times 6$. (Page 8.)
- Fig. 3. *Lima marlburicensis* sp. nov. Dark volcanic sandstone, Gladstone and Middlehurst Runs. (Page 8.)
- Figs. 4-8. *Aucellina euglypha* sp. nov. 4-7, Sawpit Gully mudstones, Swale River; 8, Wharf mudstones, Wharf River; 4b, c, posterior and dorsal views of 4a; 5, ornamentation of left valve, $\times 9$; 6, left valve, $\times 1\frac{1}{2}$; 7, right valve, $\times 1\frac{1}{2}$; 8, dorsal part of right valve, $\times 2$. (Page 9.)
- Figs. 9, 10. *Inoceramus concentricus* Park. Cover Creek mudstones, Cover Creek. 10b, anterior view of 10a. (Page 9.)



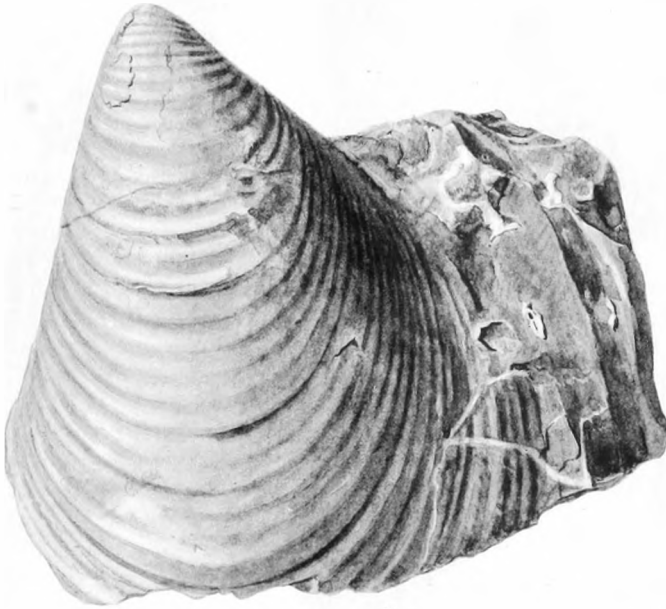
T. A. BROCK DEL.

London Stereoscopic Co. Ltd.

PLATE IV.

(The figures are of natural size, unless the amount of enlargement is stated.)

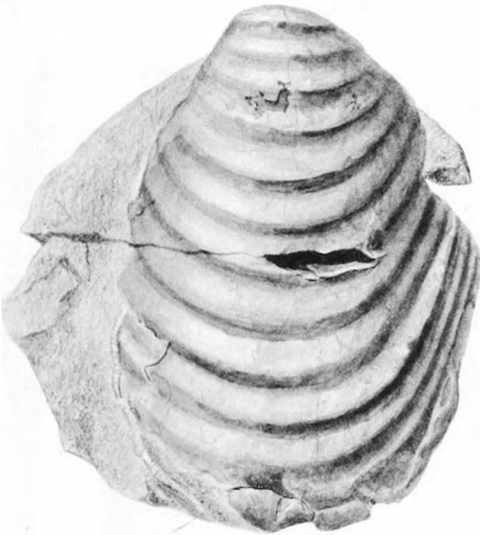
- Figs. 1, 2. *Inoceramus concentricus* var. *porrectus* var. nov. Sawpit Gully mudstones, Sawpit Gully. 1, from 150 ft. below flint-beds; 2, from 30 ft. below flint-beds; 1*b*, anterior view of 1*a*. (Page 10.)
- Fig. 3. *I. concentricus* var. *porrectus*? Dark volcanic sandstone, Gladstone and Middlehurst Runs. (Page 10.)
- Fig. 4. *Panopea awaterensis* sp. nov. Dark volcanic sandstone, Gladstone and Middlehurst Runs; 4*b*, dorsal view of 4*a*. (Page 10.)



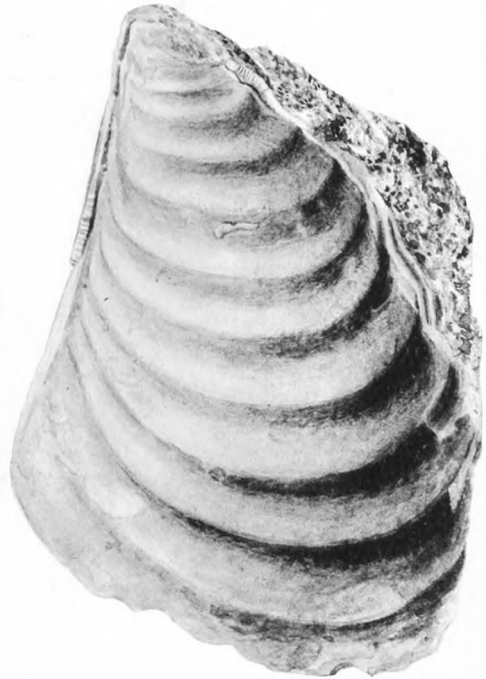
1a



1b



2



3



4a



4b

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PLATE V.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Thracia* sp. Light sandstone, Bluff River. (Page 11.)
- Figs. 2, 3. *Turritites circumtenuatus* Kossmat. Cover Creek mudstones, a quarter of a mile above Coverham station. 2*b*, base of 2*a*. (Page 11.)
- Fig. 4. *Gaudryceras Sacya* (Forb.). Sawpit Gully mudstones, Sawpit Gully. 4*b*, the central part of 4*a*, $\times 2$. (Page 11.)
- Figs. 5-7. *Belemnites superstes* Hector. Wharf mudstones, left bank of Wharf, half a mile below pack-track. 5 *a*, *b*, ventral and lateral views; 5*c*, alveolar end (margin incomplete); 6 *a*, *b*, *c*, ventral, dorsal, and lateral views; 7*a*, *b*, ventral and lateral views. (Page 12.)



1



2a



2b



3



4a



4b



5c



5a



5b



6a



6b



6c



7a



7b

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PLATE VI.

(The figures are of natural size, unless the amount of enlargement is stated.)

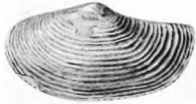
- Fig. 1. *Nuculana amuriensis* sp. nov. Calcareous conglomerate (*Aporrhais* beds), Amuri Bluff; $\times 1\frac{1}{2}$. (Page 18.)
- Fig. 2. *Nuculana* sp. Calcareous conglomerate, Amuri Bluff. (Page 18.)
- Fig. 3. *Malletia (Neilo) cymbula* sp. nov. Saurian beds, Middle Waipara. 3b, dorsal view of 3a. (Page 18.)
- Fig. 4. *Barbatia Mackayi* sp. nov. Calcareous conglomerate, Amuri Bluff. 4b, dorsal view of 4a. (Page 19.)
- Fig. 5. *Nemodon?* sp. *Ostrea* bed, McKay's Creek, Middle Waipara. Umbonal part missing. 5b, hinge and interior of 5a. (Page 19.)
- Fig. 6. "*Arca*" *Hectori* sp. nov. *Ostrea* bed, Bobby's Creek, Waipara. 6b, dorsal view of 6a. (Page 19.)
- Fig. 7. *Cucullæa zealandica* sp. nov. Calcareous conglomerate, Amuri Bluff; 7b, dorsal view of 7a. (Page 20.)



1



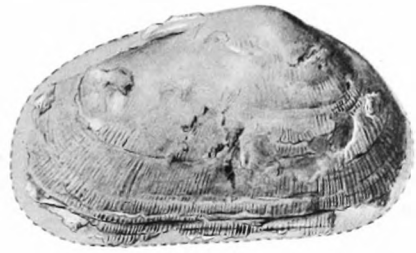
2



3a



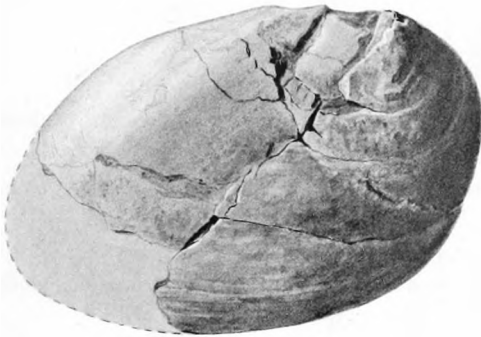
3b



4a



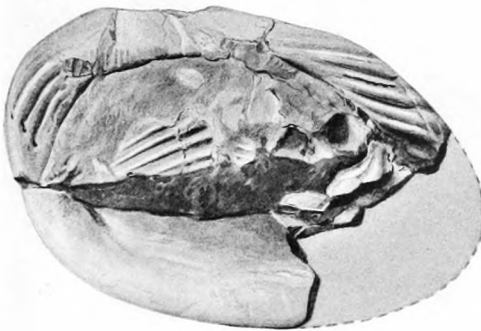
4b



5a



6a



5b



6b



7b



7a

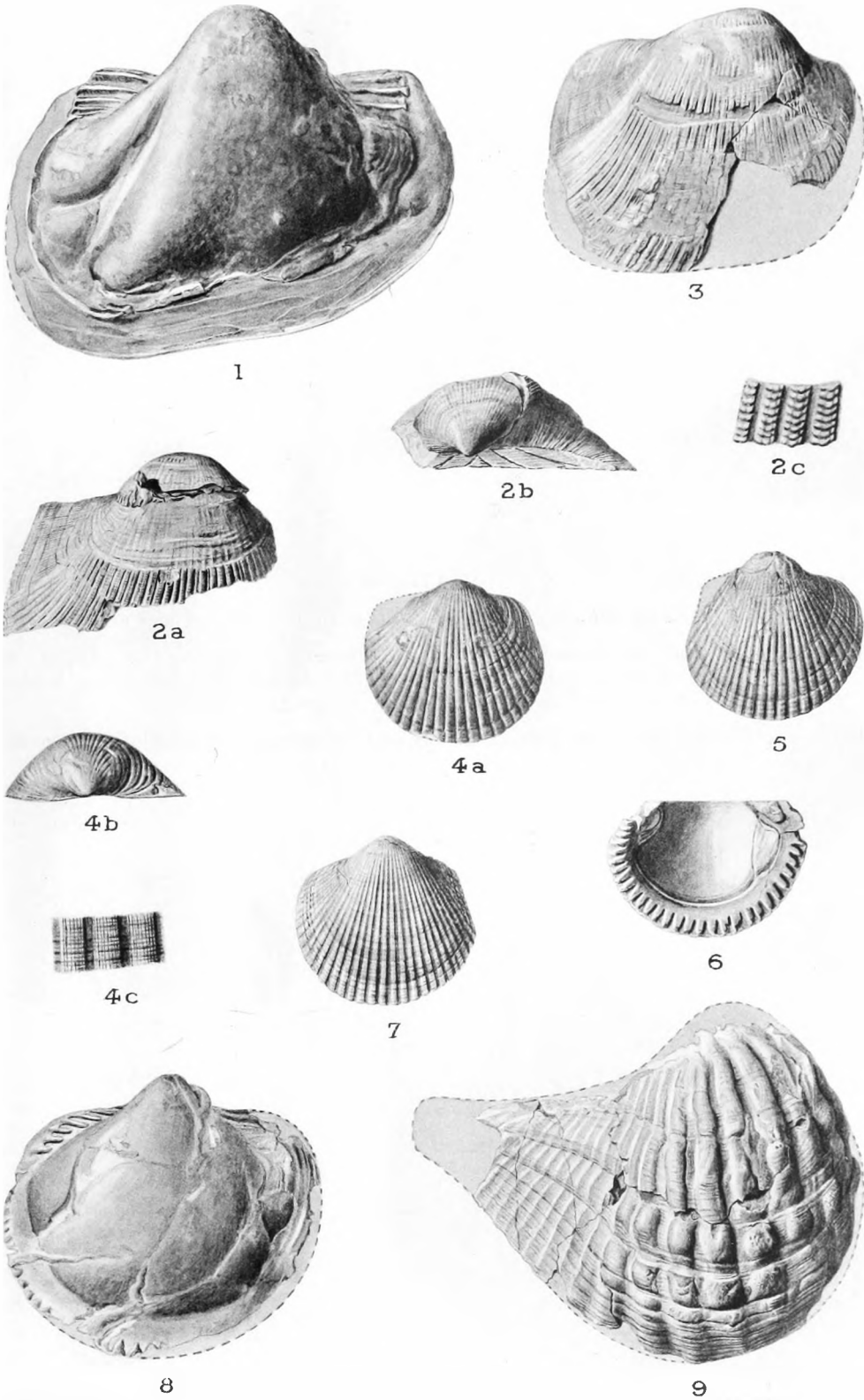
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London Stereoscopic Co. Ill.

PLATE VII.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Cucullæa zealandica* sp. nov. Calcareous conglomerate, Amuri Bluff. Internal cast of right valve. (Page 20.)
- Figs. 2, 3. *Cucullæa* sp. Calcareous conglomerate, Amuri Bluff. 2*b*, dorsal view of 2*a*; 2*c*, ornamentation of 2*a*, $\times 3$. (Page 20.)
- Figs. 4-7. *Pectunculus selwynensis* sp. nov. Selwyn Rapids beds, Selwyn River Rapids. 4*b*, dorsal view of 4*a*; 4*c*, ornamentation of 4*a*, $\times 5$; 6, interior of part of a left valve. (Page 20.)
- Fig. 8. *Pectunculus* sp. Calcareous conglomerate, Amuri Bluff. Internal cast. (Page 20.)
- Fig. 9. *Trigonia pseudocundata* Hector. Calcareous conglomerate, Amuri Bluff. (Page 21.)



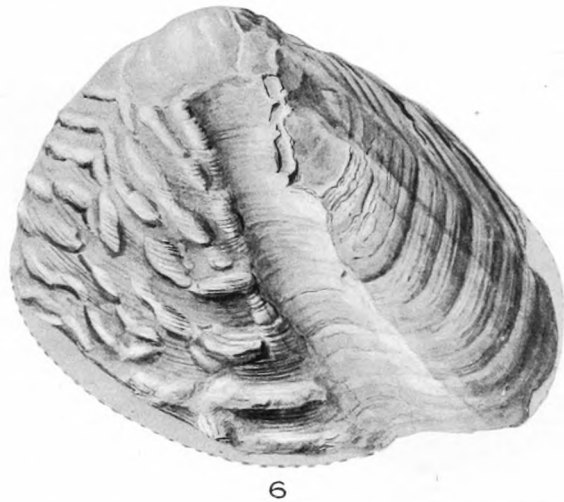
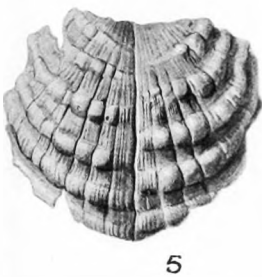
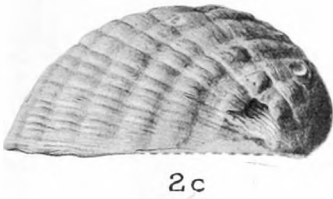
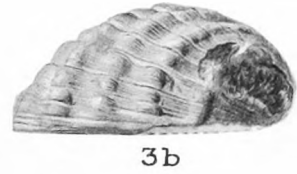
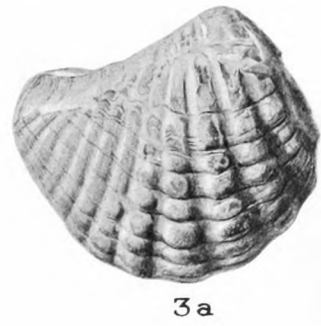
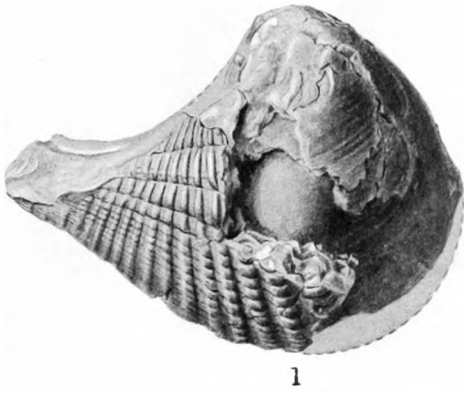
T. A. BROCK, DEL.

London: Printed and Sold by the British Museum, 1881.

PLATE VIII.

(The figures are of natural size, unless the amount of enlargement is stated).

- Figs. 1-5. *Trigonia pseudocundata* Hector. Calcareous conglomerate, Amuri Bluff.
2 *b, c*, dorsal and anterior views of *2a*; 3*b*, anterior view of *3a*; 5, anterior
view of part of two united valves. (Page 21.)
- Fig. 6. *Trigonia Hanetiana* d'Orb. Calcareous conglomerate, Amuri Bluff. (Page 22.)



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PLATE IX.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1-6. *Trigonia Hanciana* d'Orb. 1-5, calcareous conglomerate, Amuri Bluff; 1, 2, drawn from wax moulds of external casts; 6, *Ostrea* bed, Middle Waipara. (Page 22.)
- Fig. 7. *Modiola* sp. cf. *typica* Forb. Calcareous conglomerate, Amuri Bluff. (Page 23.)



1



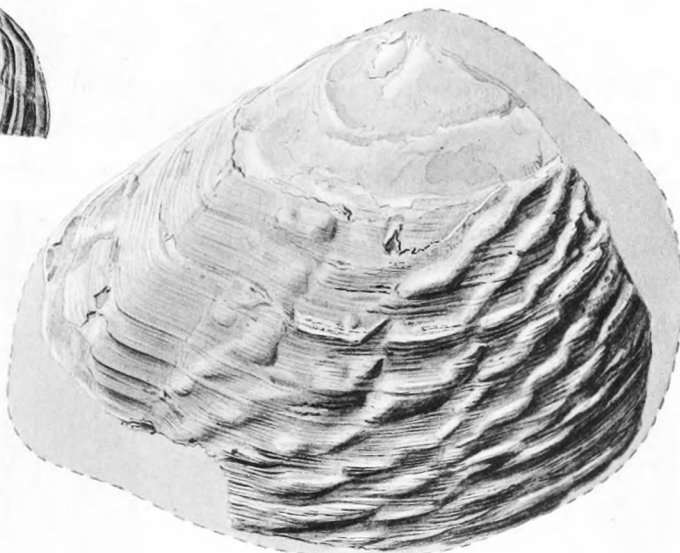
5



2



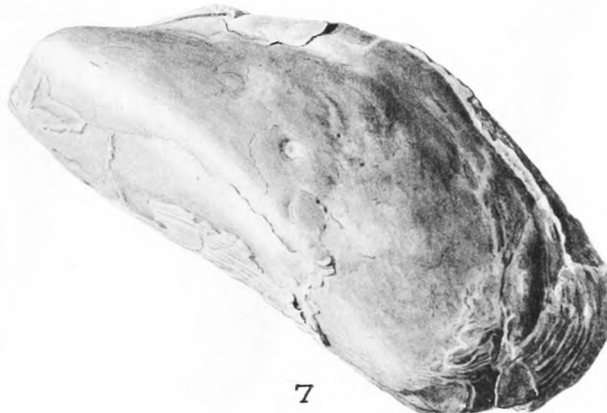
3



6



4



7

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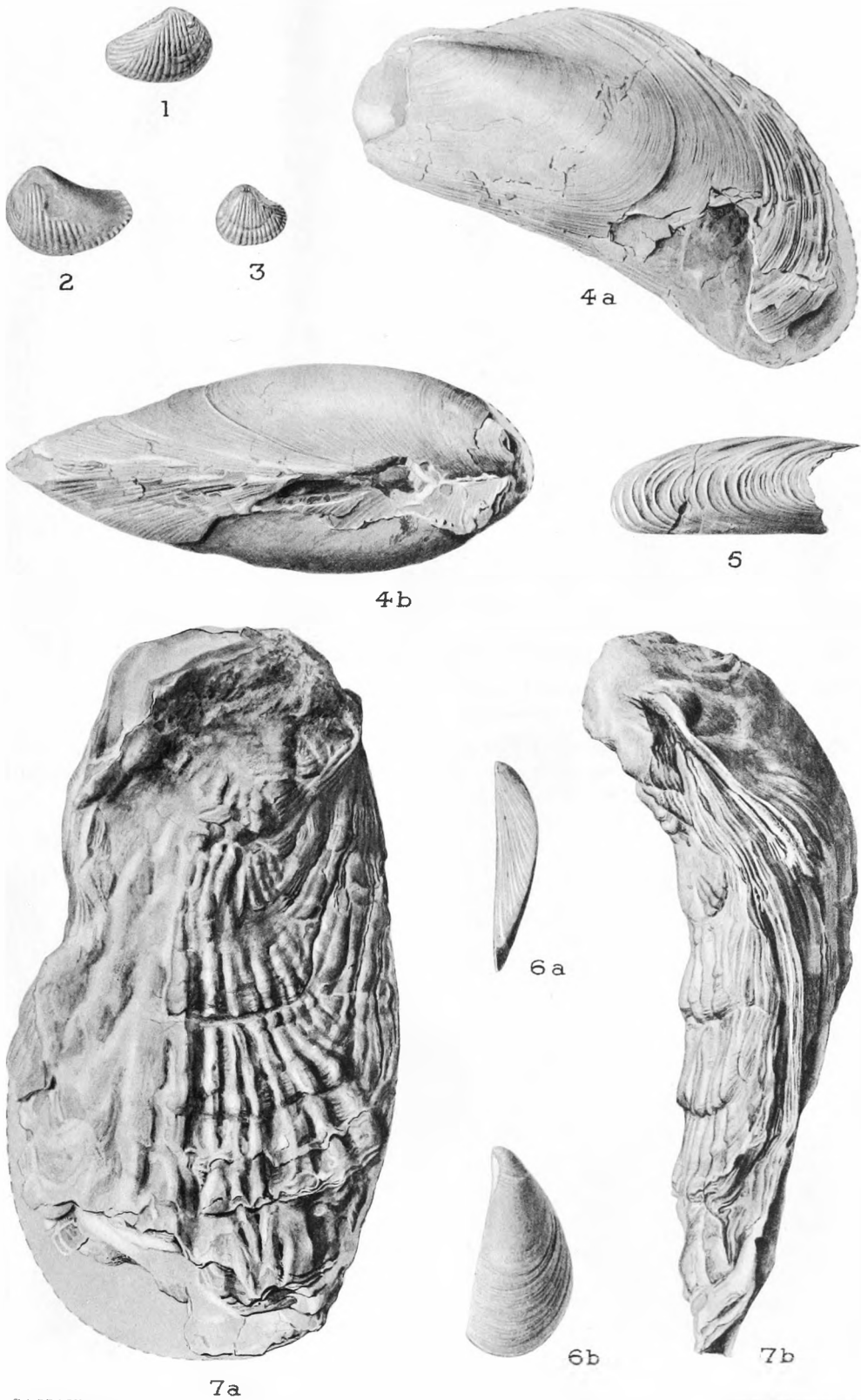
London Stereoscopic Co. Imp.

Cretaceous Fossils.

PLATE X.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1-3. *Trigonia waiparensis* sp. nov. Saurian beds, Middle Waipara. (Page 23.)
- Fig. 4. *Modiola* sp. cf. *typica* Forb. Calcareous conglomerate, Amuri Bluff. 4*b*, dorsal view of 4*a*. (Page 23.)
- Fig. 5. *Modiola flagellifera* Forb. Calcareous conglomerate, Amuri Bluff. (Page 24.)
- Fig. 6. *Dreissensia lanceolata* (Sow.). Calcareous conglomerate, Amuri Bluff. 6*a*, antero-ventral view of 6*b*. (Page 24.)
- Fig. 7. *Ostrea* sp. cf. *dichotoma* Bayle. *Ostrea* bed, Weka Creek. 7*b*, posterior view of 7*a*. (Page 24.)

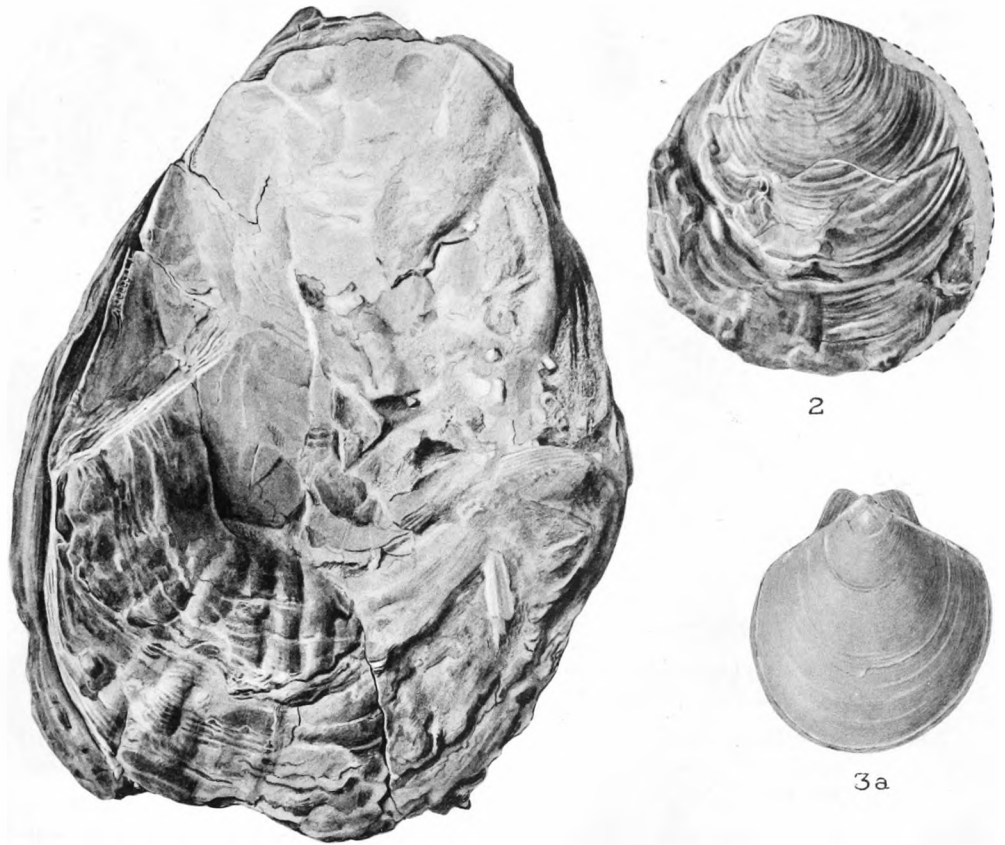


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PLATE XI.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Ostrea* sp. cf. *dichotoma* Bayle. *Ostrea* bed, Weka Creek. (Page 24.)
- Fig. 2. *Ostrea* sp. Calcareous conglomerate, Amuri Bluff. (Page 25.)
- Figs. 3-5. *Pecten* (*Syncyclonema*) *membranaceus* Nilss. Amuri Group (black grit), Amuri Bluff. 3*b*, ornamentation of 3*a*, $\times 5$. (Page 25.)
- Figs. 6-9. *Pecten* (*Camptonectes*) *Hectori* sp. nov. 6, 7, *Ostrea* bed, Selwyn River. 8, 9, Calcareous conglomerate, Amuri Bluff; internal casts. 7*b*, ornamentation of 7*a*, $\times 6$. (Page 26.)



1

2



3a



3b



4



5



6



8



7a



7b



9

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PLATE XII.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Pecten (Camptonectes) Hectori* sp. nov. Calcareous conglomerate, Amuri Bluff. Internal cast. (Page 26.)
- Figs. 2-9. *Pecten (Æquiptecten) amuriensis* sp. nov. Calcareous conglomerate, Amuri Bluff. 3b, posterior ear of 3a, $\times 4$; 4-7, $\times 1\frac{1}{2}$; 8, ornamentation of left valve, $\times 8$. (Page 26.)
- Figs. 10, 11. Probably a form of *P. (Æquiptecten) amuriensis* with more numerous ribs than usual. Calcareous conglomerate, Amuri Bluff. 10, $\times 1\frac{1}{2}$; 11, ornamentation of left valve, $\times 8$. (Page 26.)
- Figs. 12-16. *Lima (Limatula) Huttoni* sp. nov. Calcareous conglomerate, Amuri Bluff. 12a, $\times 1\frac{1}{2}$; 12b, ornamentation of 12a, $\times 8$; 13, $\times 1\frac{1}{2}$; 14, anterior view of left valve, $\times 1\frac{1}{2}$; 15, internal cast, $\times 1\frac{1}{2}$; 16, ornamentation, $\times 8$. (Page 27.)
- Figs. 17-19. *Inoceramus australis* sp. nov. Calcareous conglomerate, Amuri Bluff. 17b, anterior view of 17a. (Page 27.)



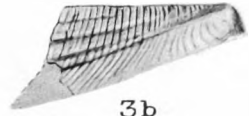
1



2



3a



3b



4



5



6



7



8



9



10



11



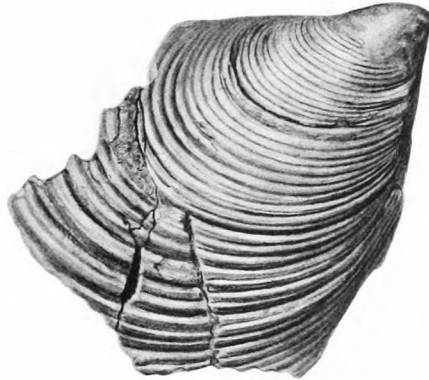
12a



12b



13



17a



17b



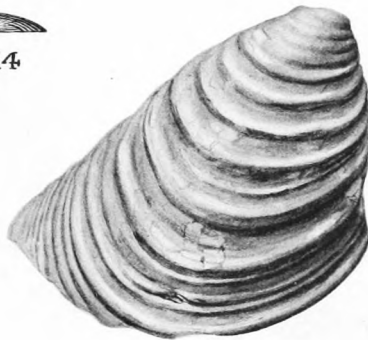
15



14



16



18



19

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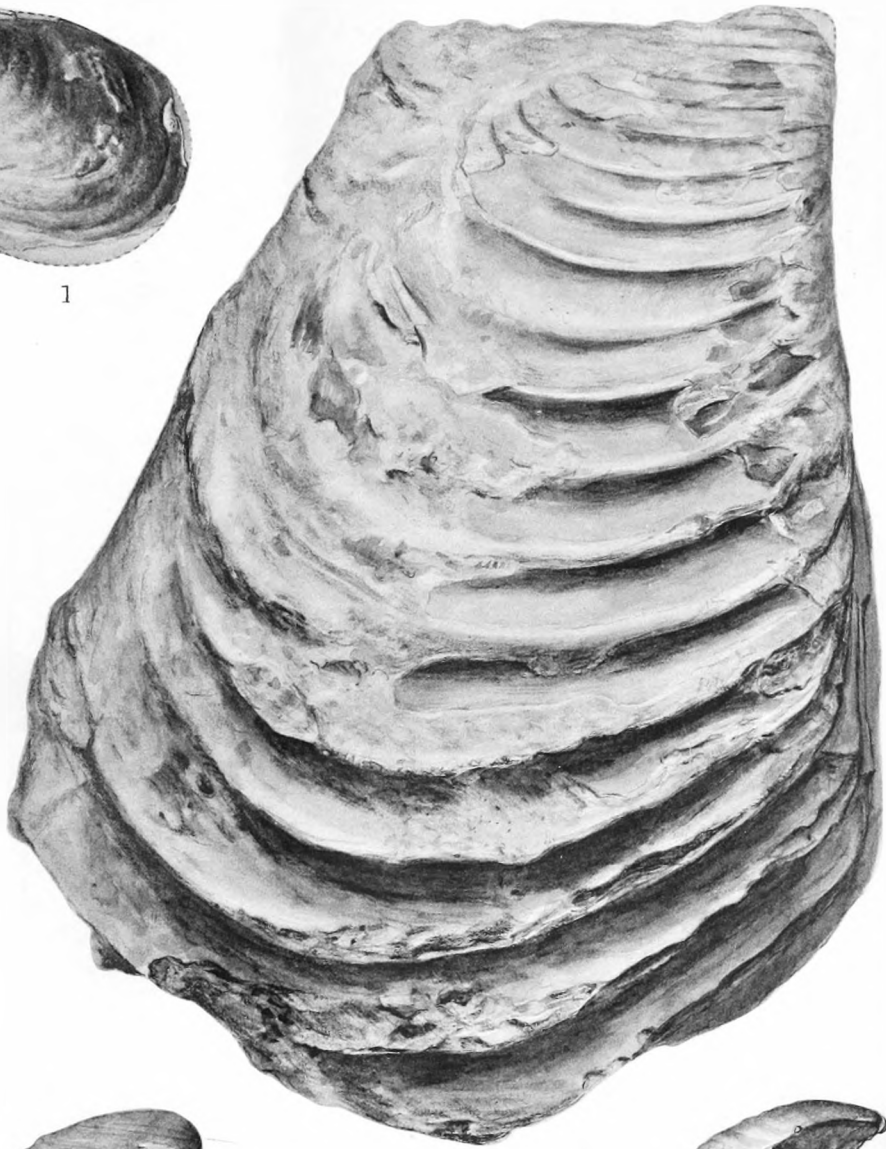
PLATE XIII.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1-3. *Inoceramus australis* sp. nov. Calcareous conglomerate, Amuri Bluff. 2a, dorsal part of the right valve shown in 2b; 2c, anterior view of 2b. (Page 27.)



1



3



2b



2a



2c

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Cretaceous Fossils.

PLATE XIV.

(The figures are of natural size, unless the amount of enlargement is stated.)

Figs. 1, 2. *Inoceramus pacificus* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 28.)

Figs. 3, 4. *Inoceramus* sp. Calcareous conglomerate, Amuri Bluff. 3*b*, anterior view of 3*a*.
(Page 28.)



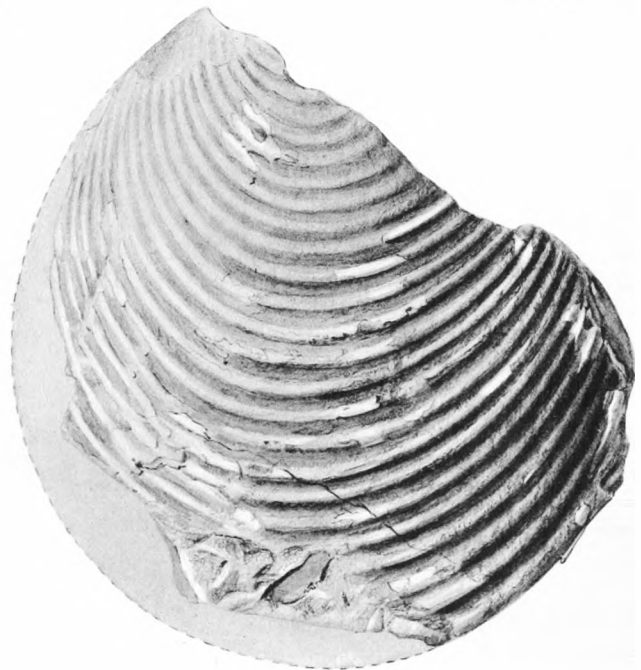
2



3a



3b



1



4

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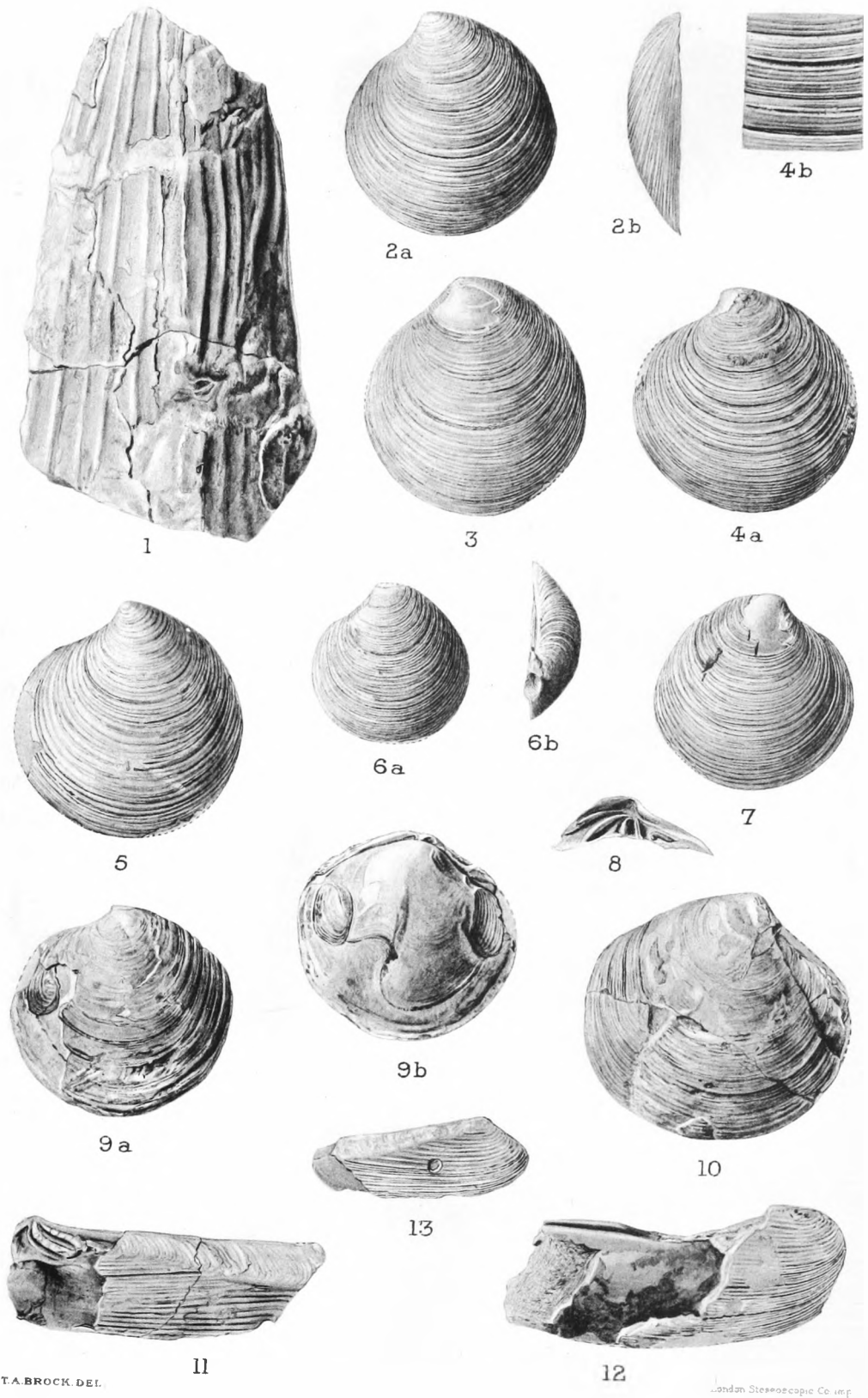
Landon Stereoscopic Co. Imp.

Cretaceous Fossils.

PLATE XV.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Pinna* sp. Calcareous conglomerate, Amuri Bluff. (Page 28.)
- Figs. 2-7. *Astarte (Eriphyla) meridiana* sp. nov. Calcareous conglomerate, Amuri Bluff, 2*b*, posterior view of 2*a*; 4*b*, ornamentation of 4*a*, $\times 3$; 6*b*, dorsal view of 6*a*. (Page 28.)
- Fig. 8. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff. Hinge of left valve. (Page 31.)
- Figs. 9, 10. *Astarte (Eriphyla) lenticularis* (Goldf.). Selwyn Rapids beds, Selwyn Rapids. 9*b*, cast of right valve of 9*a*. (Page 29.)
- Figs. 11-13. *Anthonya elongata* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 29.)



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PLATE XVI.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1-3. *Anthonya elongata* sp. nov. Calcareous conglomerate, Amuri Bluff. 1, internal cast of right valve; 2, 3, hinge and interior of parts of right valves. (Page 29.)
- Figs. 4, 5. *Lucina canterburiensis* sp. nov. Selwyn Rapids beds, Selwyn River (4), and Selwyn Rapids (5). 5b, dorsal view of 5a; 5c, ornamentation of 5a, $\times 4$. (Page 30.)
- Fig. 6. *Tellina* sp. cf. *Largillierii* (d'Orb.). Selwyn Rapids beds, Selwyn River. (Page 30.)
- Fig. 7. *Tellina* sp. Selwyn Rapids beds, Selwyn River. (Page 30.)
- Fig. 8. *Maetra?* sp. Saurian beds, Middle Waipara. 8b, dorsal view of 8a. (Page 30.)
- Fig. 9. *Cultellus cretaceus* sp. nov. Calcareous conglomerate, Amuri Bluff. (Page 31.)
- Figs. 10, 11. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff. 10b, dorsal view of 10a. (Page 31.)



1



3



2



4



6



5a



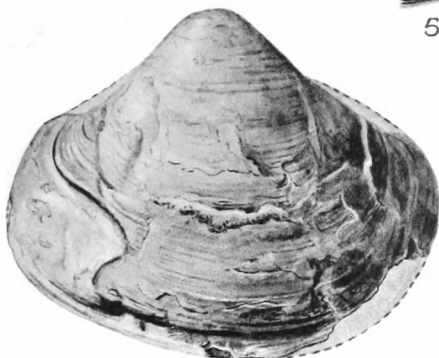
5b



5c



7



8a



8b



9



10a



10b



11

T.A. BROCK DEL

W. & A. G. GREEN, Lith. & Print.

PLATE XVII.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Figs. 1-3. *Callista (Callistina) Wilckensi* sp. nov. Calcareous conglomerate, Amuri Bluff.
1*b*, dorsal view of 1*a*; 2*b*, anterior view of 2*a*; 2*c*, ornamentation near the middle of 2*a*, $\times 3$; 2*d*, ornamentation near the ventral margin of 2*a*, $\times 3$; 3, internal cast of right valve. (Page 31.)
- Figs. 4-6. *Callista (Callistina) Thomsoni* sp. nov. Selwyn Rapids beds, Selwyn Rapids.
5*b*, dorsal view of 5*a*. (Page 32.)
- Fig. 7. *Callista* sp. Selwyn Rapids beds, Selwyn Rapids. (Page 32.)



1a



1b



2a



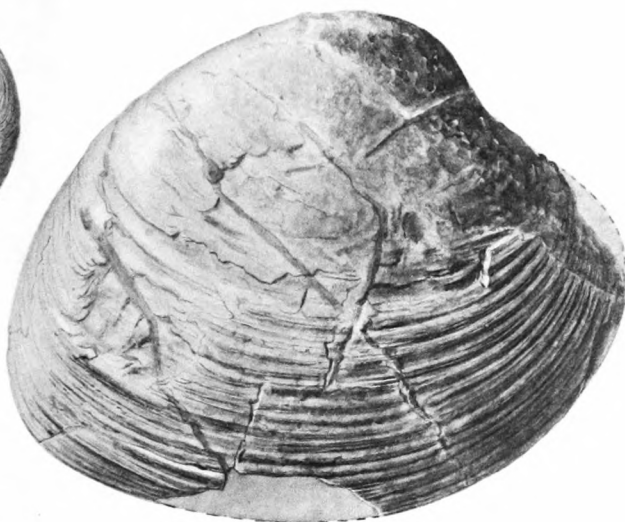
2b



2c



2d



4



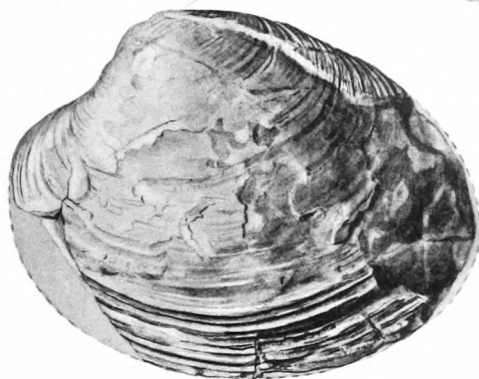
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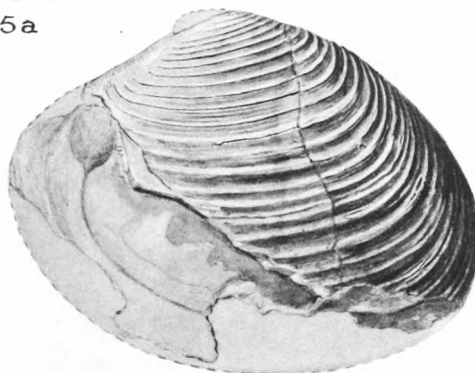
5a



5b



6



7

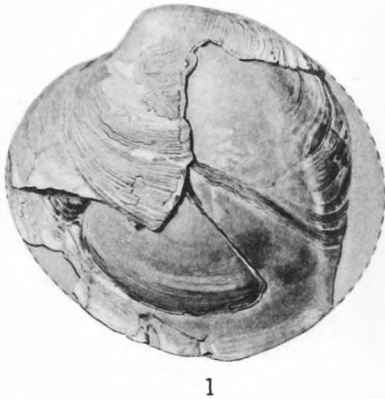
T. A. BROCK DEL.

London: Greenough, Col. Imp.

PLATE XVIII.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Dosinia* sp. Selwyn Rapids beds, Selwyn River. (Page 32.)
- Fig. 2. *Dosinia* sp. Same locality and horizon. (Page 32.)
- Fig. 3. *Cardium* sp. Calcareous conglomerate, Amuri Bluff. Internal cast. 3*b*, posterior view of 3*a*. (Page 33.)
- Figs. 4, 5. *Cardium* sp. Selwyn Rapids beds, Selwyn Rapids. 4, $\times 1\frac{1}{2}$; 5, imperfectly preserved ornamentation, $\times 6$. (Page 33.)
- Figs. 6, 7. *Panopea clausa* Wilck. Calcareous conglomerate, Amuri Bluff. 6*b*, *c*, dorsal and anterior views of 6*a*. (Page 33.)
- Figs. 8, 9. *Panopea malvernensis* sp. nov. Selwyn Rapids beds, Selwyn Rapids. 8*b*, dorsal view of 8*a*. (Page 33.)



1



2



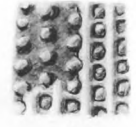
3a



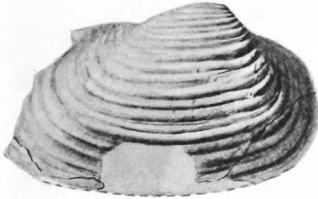
3b



4



5



6a



6c



7



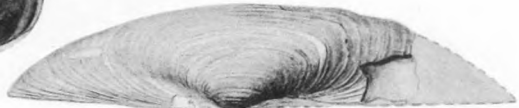
6b



8a



9



8b

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Cretaceous Fossils.

PLATE XIX.

(The figures are of natural size, unless the amount of enlargement is stated.)

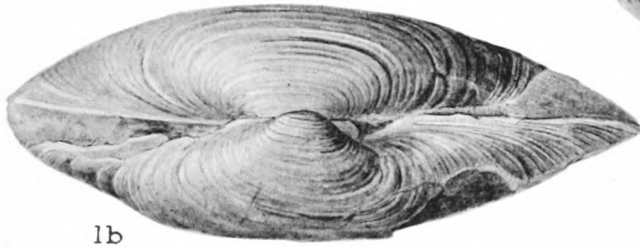
- Figs. 1, 2. *Panopea malvernensis* sp. nov. Selwyn Rapids beds, Selwyn Rapids. 1*b*, dorsal view of 1*a*, the left valve displaced ; 2, internal cast of right valve. (Page 33.)
- Fig. 3. *Thracia Haasti* sp. nov. Calcareous conglomerate, Amuri Bluff. 3*a*, right valve with part of the shell preserved ; 3*b*, cast of left valve of the same specimen ; 3*c*, dorsal view of 3*a*, *b*. (Page 34.)
- Fig. 4. *Thracia* sp. Saurian beds, Middle Waipara. 4*b*, dorsal view of 4*a*. (Page 34.)
- Fig. 5. *Kossmaticeras (Madrasites) haumuriensis* (Hector). Calcareous conglomerate, Amuri Bluff. 5*c*, part of suture of 5*a*, $\times 4$. (Page 34.)



1a



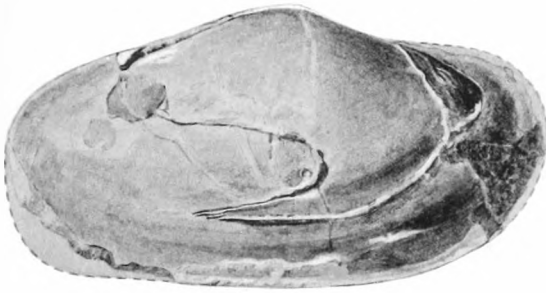
3c



1b



3a



2



3b



4b



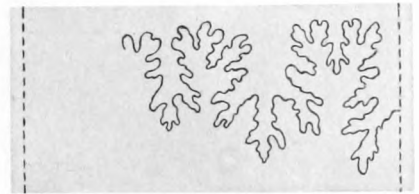
5b



4a



5a



5c

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Cretaceous Fossils.

PLATE XX.

(The figures are of natural size, unless the amount of enlargement is stated.)

- Fig. 1. *Kosmaticeras (Madrasites) haumuriensis* (Hector). Calcareous conglomerate, Amuri Bluff. (Page 34.)
- Fig. 2. *Gandryceras* sp. (aff. *Jukesi* Whiteaves). Calcareous conglomerate, Amuri Bluff. (Page 35.)
- Figs. 3, 4. *Hamites (Anisoceras?)* sp. Calcareous conglomerate, Amuri Bluff. 3*b*, external margin of 3*a*; 3*c*, section of 3*a*; 4, internal margin of straight part. (Page 35.)
- Fig. 5. *Baculites* sp. cf. *vagina* Forb. Calcareous conglomerate, Amuri Bluff. 5*b*, suture, $\times 2$; 5*c*, *d*, sections of the ends of 5*a*. (Page 36.)
- Figs. 6-11. *Belemnites Lindsayi* Hector. Calcareous conglomerate, Amuri Bluff. 6*a*, *b*, dorsal and lateral surfaces; 7 *a*, *b*, ventral and lateral; 8 *a-c*, ventral, lateral, and dorsal; 9, alveolar end; 10 *a*, *b*, ventral and lateral; 11, phragmocone. (Page 36.)



1



2



3a



3c



3b



4



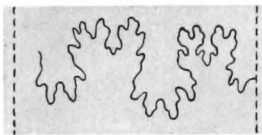
5a



5c



5d



5b



6a



6b



7a



7b



8a



8b



8c



10a



10b



9



11

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(Previous Bulletins.)

PALÆONTOLOGICAL BULLETIN No. 2.

Page 37, line 1: *For* " Plate V, fig. 4a, b," *read* " Plate III, figs. 5a, 5b."

Plate II, middle figure from bottom: *For* " 8 " *read* " 12 " (*Turris altus*).

PALÆONTOLOGICAL BULLETIN No. 3.

Page 64, line 16 from bottom: *Read* " Fig. 14. *Mangilia (Clathurella) rudis*."

Page 64, line 18 from bottom: *Read* " Fig. 13. *Mangilia (Clathurella) cincta*."