

ART. XXVII.—*The Tertiary Molluscan Fauna of Pakaurangi Point.  
Kaipara Harbour.*

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Plates XVIII–XXII.

In a previous paper\* a list was given of the Mollusca that had been collected in this locality. Further collections have since been made which have added considerably to the number of the species. Descriptions and figures are given of all the new species. A discussion of the nature of the fauna will be given after the descriptions.

*Vaginella torpedo* n. sp. (Plate XXII, figs. 7, 8.)

Shell of moderate size, 18 mm. by 3.5 mm. Form cylindrical with a conical termination. Slightly compressed at the anterior end. Shell porcellaneous with a shining surface. With a low-power pocket-lens a series of fine longitudinal lines can just be made out.

Seven good specimens were obtained. Type in the Wanganui Museum.

*Calliostoma gracilis*. (Plate XVIII, figs. 1, 1a.)

Shell small: height, 7 mm.; breadth, 10 mm.: trochoidal. Spire short, of 3 whorls. Aperture oval. Columella slightly excavated. Protoconch consisting of 2 whorls. Outline of each whorl of the spire slightly concave. Three small spiral threads near the posterior suture of each whorl and a larger one near the anterior suture. Body-whorl with a large number of fine spiral threads in addition to those on the other whorls. Base with similar small spiral lines, with two large and prominent ones that divide the base into three approximately equal parts. Inner layer of the shell highly nacreous.

One specimen, in good condition. Type in the Wanganui Museum.

*Heliacus aucklandicus*. (Plate XVIII, figs. 2, 2a.)

Shell small: height, 3 mm.; breadth, 10 mm. Form obtusely conical. Spire short, consisting of 5 whorls each with a straight outline. Aperture regular. Umbilicus very large, with a strongly crenulated margin. Ornamentation: Each whorl with 4 beaded cinguli; the two most prominent of these border the anterior and posterior sutures closely. Base smooth except for irregular ribs radiating outward from the crenulated margin of the umbilicus.

One specimen only, in a good state of preservation. Type in the Wanganui Museum.

*Epitonium tricinctum* n. sp. (Plate XIX, figs. 8, 12.)

Shell small and slender: length, 8 mm.; breadth, 3 mm. Spire of 6 whorls, but it is not complete. Outline of whorls strongly convex. Suture deep. Aperture not preserved. Ornamentation: On each whorl 3 strong spiral lines. The uppermost of these is the most prominent: it is situated

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a little behind the middle of the whorl, and the other two lie between it and the suture in front. Each of the spiral lines is continuous over the radial lines, of which there are 18 in each whorl.

Only one specimen was found, and it is somewhat incomplete, but the ornamentation is quite distinct from that of any other New Zealand species. Type in the Wanganui Museum.

**Fusinus corrugatus** n. sp. (Plate XXII, figs. 9, 10.)

Shell of moderate size, fusiform, 21 mm. by 5 mm. Spire a little less than half the length of the shell, consisting of 6 whorls, each strongly convex. Aperture oval, and narrowing anteriorly into a moderately long canal. Protoconch of 3 whorls, smooth. Ornamentation: 7 rounded axial costae in each whorl, extending from suture to suture, but much higher on the keel than elsewhere. Spiral threads some 6 in number in each whorl but extremely unequal, the one that marks the keel being much more prominent than all the others, and the one anterior to it also much larger than the rest. The spiral lines are particularly strong on the costae, where they form prominent projections. Very small spiral threads between every pair of larger ones. Suture not pronounced, wavy. Body-whorl with similar ornamentation, the spiral lines being continued to the end of the beak, but they are much less prominent there.

Two specimens, one almost complete, the other without its beak. Type in the Wanganui Museum.

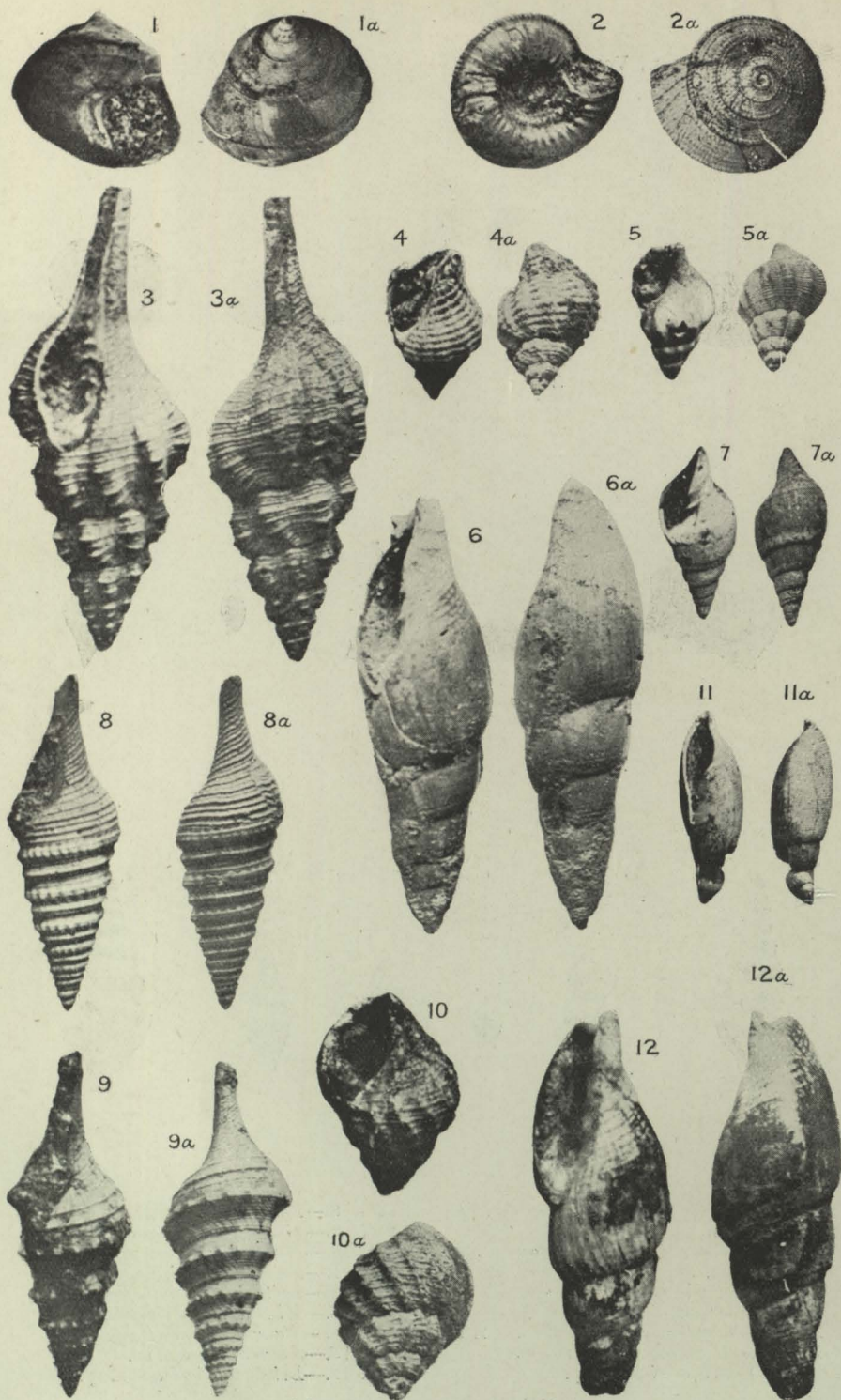
**Dolicholaturus (Pseudolaturus) ornatus** n. sp. (Plate XVIII, figs. 3, 3a.)

Shell of moderate size, 25 mm. by 10 mm. Shape fusiform. Spire of 6 whorls, protoconch of 2 whorls. Suture compressed wavy. Aperture pyriform, almost half the total length of the shell, and produced anteriorly into a long canal but somewhat truncated posteriorly. Outer lip thin, with 12 internal projections. Columella slightly bent inwards where the aperture narrows into the anterior siphon. Columella slightly callous, smooth but furnished with 5 small projections, 2 of which are the terminal points of columellar folds. At the base of the aperture 3 small projections. Ornamentation: 7 prominent radial costae on each whorl. The costae in successive whorls are not arranged in a straight line but form a spiral directed backwards. Each whorl with a large number of spiral threads. About every fourth thread is much larger and forms prominent elevations where they cross the costae. Strong lines of growth. On the body-whorl the costae extend to the beginning of the anterior canal.

Six specimens. Type in the Wanganui Museum.

**Siphonalia flexuosa** n. sp. (Plate XXII, figs. 11, 12.)

Shell of moderate size, of oval shape, 28 mm. by 17 mm. Spire of 6 whorls rapidly decreasing in size. Aperture rather less than half the length of the shell. Outer lip moderately thick and ornamented internally by several short spiral lines. Anterior canal bent sharply to the right and of moderate length. Ornamentation: 10 radial costae on each whorl: these extend to the anterior suture but barely reach the posterior one: they are more distinct in the upper whorls. Suture strongly margined anteriorly. Posterior portion of each whorl concave in outline. All parts of the whorls have spiral ribs, which are large and rounded. There is usually one small thread between each pair of ribs. Large spiral threads are less pronounced on the beak, and the interstitial threads are more numerous. Growth-lines are numerous and conspicuous on the body-whorl.



FIGS. 1, 1a.—*Calliostoma gracilis* n. sp.  
 FIGS. 2, 2a.—*Heliacus aucklandicus* n. sp.  
 FIGS. 3, 3a.—*Dolicholaturus* (*Pseudolaturus*) *ornatus*  
 n. sp.  
 FIGS. 4, 4a.—*Phos kaiparaensis* n. sp.  
 FIGS. 5, 5a.—*Phos spiralis* n. sp.  
 FIGS. 6, 6a.—*Cymbiola nitens* n. sp.

FIGS. 7, 7a.—*Cymbiola calcar* n. sp.  
 FIGS. 8, 8a.—*Turris ornatus* n. sp.  
 FIGS. 9, 9a.—*Turris kaiparaensis* n. sp.  
 FIGS. 10, 10a.—*Borsonia* (*Cordieria*) *ovalis* n. sp.  
 FIGS. 11, 11a.—*Crenilabium zelandicum* n. sp.  
 FIGS. 12, 12a.—*Cymbiola masefieldi* n. sp.

(All figs.  $\times 2\frac{1}{2}$ .)



FIG. 1.—*Tellina* (*Arcopagia*) *inconspicua* n. sp.  
 FIG. 2.—*Tellina* (*Arcopagia*) *inconspicua* n. sp. ( $\times 2$ ).  
 FIG. 3.—*Surcula nitens* n. sp.  
 FIG. 4.—*Corbula nitens* n. sp.  
 FIG. 5.—*Sarepta aucklandica* n. sp. ( $\times 2$ ).  
 FIG. 6.—*Sarepta aucklandica* n. sp.  
 FIG. 7.—*Corbula nitens* n. sp.

FIG. 8.—*Epitonium tricinctum* n. sp.  
 FIG. 9.—*Mitrella inconspicua* n. sp.  
 FIG. 10.—*Mangilia axialia* n. sp.  
 FIG. 11.—*Drillia tenuispiralis* n. sp.  
 FIG. 12.—*Epitonium tricinctum* n. sp.  
 FIG. 13.—*Mitrella inconspicua* n. sp.  
 FIG. 14.—*Mangilia axialia* n. sp.  
 FIG. 15.—*Surcula nitens* n. sp.  
 FIG. 16.—*Drillia tenuispiralis* n. sp.

(All figs. except 2 and 5  $\times 3$ .)



Several specimens, in good condition. Type in the Wanganui Museum.

This species most closely resembles *S. costata*, but the anterior canal is more bent and the costae less pronounced, though the spiral ribs are more distinct.

***Coptochetus zelandicus* n. sp. (Plate XXII, fig. 13.)**

Shell of moderate size, 24 mm. by 8 mm., of a fusiform shape, with a spire of 5 whorls. Whorls slightly convex in outline and gradually decreasing in size. Body-whorl somewhat incomplete. Aperture narrow and extended somewhat anteriorly into a moderately long canal. Columella smooth and almost straight. Ornamentation: Each whorl has 18 or 19 radial ribs. The ribs are rounded, continuous, and of equal height from suture to suture. The ribs are crossed by about 9 spiral threads of small size on each whorl. Suture with a sharp border on the anterior margin. Body-whorl with similar ornamentation to that of the spire. The radial ribs appear to extend to the end of the anterior canal, though the imperfect condition of the specimen does not show this clearly.

One specimen only, in an imperfect state. Type in the Wanganui Museum.

I am indebted to Mr. Suter for suggesting that the specimen should be referred to this genus, though he states that he is not certain that it is correct.

The genus *Coptochetus* appears to be restricted to the Oligocene and Eocene. It occurs in Europe and Australia.

***Phos kaiparaensis* n. sp. (Plate XVIII, figs. 4, 4a.)**

Shell small and oval, 7 mm. by 5 mm. Spire of 5 whorls, three of which are apparently the protoconch. Aperture less than half the length of the shell, broadly oval but narrowing anteriorly to a very short canal slightly bent backwards. Ornamentation: 10 radial costae on each whorl, broad and rounded but most prominent near the anterior suture. The whorls of the protoconch have no costae. There are a large number of spiral ridges on each whorl, well rounded, and continuous across the costae. On the protoconch the threads are relatively larger and less numerous. On the body-whorl the costae decrease in size anteriorly and end at about two-thirds of its length. The spiral ridges extend to the end of the short siphon. Suture impressed but not bordered.

One specimen only, in good condition. Mr. Suter thinks that it is not mature. Type in the Wanganui Museum.

***Phos spiralis* n. sp. (Plate XVIII, figs. 5, 5a.)**

Shell small, oval, 10 mm. by 6 mm. Spire consisting of 5 whorls rapidly decreasing: two of these are the protoconch. Aperture oval, rather less than half the length of the shell. The aperture narrows somewhat anteriorly and forms a short canal. There is a slight callosity on the columella, which is a little bent over to the left. Ornamentation: Axial costae 13 in number, broad and low, extending from suture to suture. They are crossed by a number of relatively large spiral ridges. There are 5 of these in the penultimate whorl, and they cross the costae without diminution. Protoconch smooth. Outline of whorls convex, suture impressed. The costae on the body-whorl become less prominent towards the anterior end, but the spiral threads are continuous.

One specimen only, in a good state of preservation. Mr. Suter thinks that it is not mature. Type in the Wanganui Museum.

**Cymbiola masefieldi** n. sp. (Plate XVIII, figs. 12, 12a.)

Shell of moderate size, 21 mm. by 8 mm. The type specimen, however, is not quite complete: if it were, the length would probably be 25 mm. Shape fusiform. Spire of 5 whorls separated by a deep suture. Each whorl with a convex outline rising steeply from the posterior suture but sloping gently anteriorly. Body-whorl about two-thirds of the total length. Aperture about one-third of the length of the shell, narrowly oval, extended anteriorly into a short canal. Columella without callosity but with two distinct plaits. Ornamentation slight. Two or three narrow spiral grooves on the posterior portion of each whorl. Base with about 12 spiral grooves filling all the space between the base of the aperture and the apex of the canal. Growth-lines are distinct on all the whorls.

Three specimens, in rather an imperfect condition. Type in the Wanganui Museum.

**Cymbiola nitens** n. sp. (Plate XVIII, figs. 6, 6a.)

Shell of moderate size, 26 mm. by 8 mm. Spire of moderate length, consisting of 5 or 6 whorls. Each whorl slightly convex, with a steep slope behind. Body-whorl about two-thirds the length of the shell, aperture about one-third. Aperture narrow, extended anteriorly into a short canal. Columella with no callus but with 2 strong folds of almost equal size. Ornamentation: Surface smooth and polished. A few spiral grooves in each whorl: these are deeper and more pronounced near the upper part of each whorl. Body-whorl with 2 of these grooves near its posterior end, with 13 grooves near its anterior end, where it is prolonged into a short canal. Growth-lines distinct.

This species is very closely related to *C. masefieldi*, but it has more numerous but less distinct spiral grooves, and the outline of the whorls is less convex.

Three specimens only, one of which is in good condition. Type in the Wanganui Museum.

**Cymbiola calcar** n. sp. (Plate XVIII, figs. 7, 7a.)

Shell small, 9 mm. by 4 mm. Shape ovate. Spire rather short, of 7 whorls, rapidly decreasing: three of these constitute the protoconch. Body-whorl distinctly longer than the rest of the shell. Aperture nearly one-half the length of the shell, ovate. Outer lip not preserved; columella without callosity, but with 2 sharp folds, the posterior of which is sharper than the anterior and more oblique than it. A well-developed but short anterior canal. Whorls slightly convex, steep on the posterior side but gently sloping on the anterior side. All the whorls have narrow spiral grooves. Body-whorl with 6 strong distant narrow ridges on the anterior part. Lines of growth distinct.

One specimen only, in good condition. Type in the Wanganui Museum.

**Mitrella inconspicua** n. sp. (Plate XIX, figs. 9, 13.)

Shell minute, 4 mm. by 1.5 mm., shortly fusiform. Spire of 6 whorls almost flat in profile. Aperture considerably less than one-half the length of the shell. Outer lip starting at a sharp angle, thick at first, but becoming thin towards the short anterior canal. Columella with 6 distinct spiral lines extending outward over the body-whorl. Protoconch of 3 smooth whorls. Ornamentation: Whorls almost smooth, though with obscure irregular radial lines. Suture impressed.

One specimen only, in good condition. Type in the Wanganui Museum.

Mr. Suter thinks that this species is closely related to *M. choava* Reeve, but is distinct from it.

*Ancilla spinigera* n. sp. (Plate XX, figs. 1, 1a.)

Shell of moderate size, 23 mm. by 14 mm., oval in shape, but the spire is extremely short, and is completely covered with a callus from which the protoconch projects as a small spine. Aperture three-quarters the length of the shell. The grooves in the columella are well marked, but towards the base of the columella it becomes extremely callous. Fasciole well marked. The body-whorl has distinct growth-marks, and on the callus there are some indistinct radial marks. The callus extends forward from the columella over the body-whorl for about one-third of its circumference, reaching as far as the fasciole. Three specimens, two of them in good condition. Type in the Wanganui Museum.

*Ancilla cincta* n. sp. (Plate XX, figs. 2, 2a.)

Shell of moderate size, 28 mm. by 13 mm.; form elliptical, the protoconch projecting as a sharp point. Spire short, and completely covered with callus. Aperture nearly two-thirds the length of the shell. Columella callous, and the callosity extends forward a short distance over the body-whorl. On the callosity which covers the spire a few spiral ridges are rather evident: these apparently indicate the whorls of the spire, which thus seems to consist of 4 whorls. Lines of growth are distinct over that part of the body-whorl that is not covered with callus.

One specimen only, in a fair state of preservation. Type in the Wanganui Museum.

*Surcula latiaxialis* n. sp. (Plate XX, figs. 3, 3a.)

Shell rather large, 34 mm. by 11 mm. Shape fusiform, with a long spire of 5 whorls, which are strongly convex. Aperture slightly longer than the spire, but oval in shape, though rather prolonged anteriorly. Columella distinctly bulging at the point where the aperture narrows to the anterior canal. Ornamentation: 7 prominent axial costae in each whorl; these extend to the anterior suture, which bends forward slightly at the points where the axials reach it. Posteriorly the axial sutures stop short of the suture; anteriorly the sutures are margined by a strong ridge, which is itself marked by extremely fine spiral lines. Whorls marked by numerous fine spiral lines, which traverse the axial costae as well as the other parts of the whorl. The spiral lines are finer and more numerous in the posterior part of the whorl, and are coarsest where they cross the axials. These are crossed by irregular lines of growth, the form of which indicate that the anal sinus was relatively shallow. The outer lip is not sufficiently well preserved to demonstrate that point.

This species is rather similar to *S. fusiformis* Hutton, from which it differs in the smaller number of its broad axial costae, which number 7 in place of 11; by the spiral striation of the posterior part of each whorl, and by the bordered and wavy suture.

Two specimens only, one of which is nearly complete. Type in the Wanganui Museum.

*Surcula nitens* n. sp. (Plate XIX, figs. 3, 15.)

Shell small, fusiform, 8 mm. by 2.5 mm. Spire of 5 convex tapering whorls, half as long again as the aperture. Suture slightly bordered

anteriorly. Aperture oval, anal notch rather shallow; anterior canal of moderate length. Ornamentation: 10 broad and rounded radial costae in each whorl. These costae extend to the anterior but not to the posterior suture. Surface of the shell quite smooth except at the end of the beak, which has 10 feeble spiral lines. Protoconch consists of 3 whorls.

The smoothness of the surface distinguishes this species.

Two specimens, in good condition. Type in the Wanganui Museum.

*Surcula ordinaria* n. sp. (Plate XX, figs. 4, 4a.)

Shell of rather large size, 32 mm. by 8 mm.; fusiform, with a tapering spire of 6 or 7 whorls. The narrow aperture is half the length of the shell, and is prolonged into a long anterior canal. The outer lip is thin, with a broad shallow anal notch near the suture but separated from it. Inner lip smooth. Protoconch smooth, of 4 whorls. Ornamentation is not conspicuous. In each whorl the posterior suture is margined with a broad spiral swelling. On this there are fine barely visible spiral striations, which are also to be distinguished on all the posterior part of the whorl as far as the keel. This is well marked, and has about 12 rounded tubercles on each whorl. Anterior to the keel there are about 9 spiral lines, more conspicuous than those posterior to it. Lines of growth numerous and well marked. Body-whorl with numerous spiral lines, about every fourth of which is larger than the others. Fifteen of these larger lines can be distinguished.

Three specimens, two of which are in good condition. Type in the Wanganui Museum.

*Turris ornatus* n. sp. (Plate XVIII, figs. 8, 8a.)

Shell small, fusiform, 18 mm. by 6 mm. Spire of 6 whorls, each with a pronounced keel. Suture impressed. Body-whorl rather more than half the total length, but aperture rather less than half. Aperture oval in form and produced anteriorly into a long canal. Anal notch rather deep. Columella nearly straight and covered with a thin callus. Ornamentation: A broad keel with about 24 rounded tubercles on each whorl. A second smaller keel posterior to this, and a third near the posterior suture, but the last is quite small: both of these are slightly rough but have no well-defined tubercles. Two slender spiral lines in front of the keel and one on the posterior side. Abundant and prominent growth-lines. Body-whorl with a number of nearly equal spiral ridges in front of the keel, and these are crossed by numerous growth-lines.

Two good specimens and other fragments. Type in the Wanganui Museum.

*Turris kaiparaensis* n. sp. (Plate XVIII, figs. 9, 9a.)

Shell small, fusiform, 20 mm. by 7 mm. Spire of 7 whorls, strongly keeled. Body-whorl about half the length of the shell. Aperture about one-third, oval, rather obtuse posteriorly but anteriorly produced into a long canal. Columella nearly straight and very slightly callous. Anal notch deep. Ornamentation: A prominent keel with a slight median groove bearing 22 rounded tubercles in each whorl. Eleven thin spiral threads posterior to the keel, the one nearest to the suture being much the largest. Spiral threads crossed by many thin lines of growth. Body-whorl with 3 prominent rather diverging spiral lines anterior to the keel: the middle of these passes through the point where the outer lip joins the shell; the



anterior one passes into the aperture. There are many other spiral threads on the body-whorl, every alternate one being relatively small.

A very common species at Pakaurangi Point, no fewer than forty specimens being obtained. Type in the Wanganui Museum.

**Borsonia (Cordieria) ovalis** n. sp. (Plate XVIII, figs. 10, 10a.)

Shell small, oval, 13 mm. by 9 mm. Spire short, consisting of 4 rapidly diminishing whorls. Outline of whorls slightly convex. Aperture oval, rather less than half the length of the shell. Outer lip thick, inner lip not callous. The columella with 3 distinct folds. Aperture obtuse anteriorly. Ornamentation: Each whorl with about 15 radial costae slightly raised and continuous from suture to suture: these costae are turned slightly backward. A number of sharp spiral threads, which, however, are interrupted, on the costae. Suture impressed and not bordered. On the body-whorl the costae decrease anteriorly, and are not distinct on the base. Many of the spiral threads, however, continue into the aperture.

One specimen only, in a good state of preservation. I am indebted to Mr. Suter for placing this specimen generically. Type in the Wanganui Museum.

**Drillia tenuispiralis** n. sp. (Plate XIX, figs. 11, 16.)

Shell small, turreted, 12 mm. by 4 mm.; fusiform in shape, with a tapering spire consisting of 7 whorls. Outline of each whorl strongly convex. Aperture rather more than one-quarter the length of the shell, with a short anterior canal and a deep anal slit. Each whorl with 6 prominent radial costae, which extend from the anterior suture for two-thirds of the breadth of the whorl. At this point they terminate abruptly, and leave the posterior portion of the whorl almost smooth. The anterior part of each whorl is marked with numerous extremely fine spiral lines. On the body-whorl the radial costae are far less prominent, and towards the outer lip they are replaced by prominent lines of growth. Spiral threads are continued to the end of the anterior canal. A slight callosity on the columella.

Mr. Suter remarks that this species comes nearest to *D. costifer* Suter.

A single specimen, but in excellent condition. Type in the Wanganui Museum.

**Mangilia axialis** n. sp. (Plate XIX, figs. 10, 14.)

Shell small, fusiform, 6 mm. by 2.5 mm. Spire consisting of 5 strongly convex whorls. Aperture oval, more than one-third but less than one-half the length of the shell. A very short anterior canal. Outer lip thick. Columella smooth. Ornamentation: Strong axial ribs to the number of 12 on each whorl: they are rounded and extend from suture to suture, and are bent slightly forward in the lower part, though broader in the middle than elsewhere. A large number of fine spiral lines, which are more prominent in the interstices than on the ribs. Body-whorl with the same ornamentation, the axial ribs extending almost to the end of the short canal. Protoconch of 3 perfectly smooth whorls.

Rather similar to *M. tenuispiralis*, but the spiral lines of *M. axialis* are finer, the axial ribs less pronounced, the body-whorl ribbed, and the form is more slender than in *M. tenuispiralis*.

Three specimens, one in very good condition. Type in the Wanganui Museum.

**Conus (Leptoconus) lyratus** n. sp. (Plate XX, figs. 5, 5a.)

Shell of moderate size, 28 mm. by 10 mm. Spire short, about one-fifth the length of the body-whorl. Five whorls, each slightly convex in outline. Each whorl rising by a decided step from the anterior suture. Aperture narrow but expanding slightly anteriorly. Ornamentation: Whorls smooth except for numerous distinct lines of growth which extend completely across them. Body-whorl with distinct spiral lirae over its whole surface, though they are more distinct in the anterior than in the posterior portion. Lines of growth on the body-whorl are not numerous and not distinct.

A single specimen, in good condition. Type in the Wanganui Museum.

**Conus convexus** n. sp. (Plate XX, figs. 6, 6a.)

Shell of moderate size, 27 mm. by 13 mm. Spire conical, about one-sixth the length of the shell, and consisting of 5 whorls. Outline of each whorl convex. Aperture linear, narrow. Ornamentation: Whorls of the spire lyrate with about 10 lirae, which are more pronounced on the anterior than on the posterior part of the whorl. Lines of growth not distinct. Body-whorl has fairly well-marked lines of growth, but it is otherwise smooth except for some 10 spiral lirae near the anterior end.

A single specimen, in good condition. Type in the Wanganui Museum.

**Conus (Lithoconus) abruptus** n. sp. (Plate XX, figs. 7, 7a.)

Shell of moderate size, conical, 20 mm. by 11 mm. Spire of 5 whorls, almost flat, and from it the protoconch of 3 whorls projects sharply. Aperture narrow. Columella with a spiral groove near its anterior end. Ornamentation: The whorls of the spire each with about 5 spiral lirae crossed by numerous growth-lines. Suture moderately deep. Body-whorl with numerous but indistinct growth-lines. Eleven distinct spiral lirae near the anterior end. Otherwise the surface is quite smooth.

One specimen, in good condition. This subgenus has not previously been recorded from New Zealand. Type in the Wanganui Museum.

**Crenilabium zelandicum** n. sp. (Plate XVIII, figs. 11, 11a.)

Shell small, 10 mm. by 3 mm., tapering. Spire evidently short, but only one whorl remains. Aperture more than half the length of the shell, narrow below but rapidly widening in the middle. A short anterior canal. Outline of whorl almost flat. Ornamentation: A series of rounded spiral lines which extend to the anterior end of the shell. Columella with a thin fold.

One specimen only, somewhat imperfect. It is, however, certainly rightly placed in this genus, which has not previously been recorded from New Zealand. Type in the Wanganui Museum.

**Anomia poculifera** n. sp. (Plate XXI, figs. 1, 1a.)

Shell of small size: height, 25 mm.; length, 18 mm. Shape rather obtusely oval. Shell thin and inequilateral, with a nacreous interior. Right valve strongly convex. Anterior end somewhat truncated, posterior end somewhat longer. Foramen moderate, the processes united. Sculpture: 7 large rounded radiating ribs, somewhat bent, and extending from the umbo to the ventral margin. Surface covered with small semilunar cups just in contact with one another and with the convex side nearest the umbo. Muscular impression large.

A single specimen of the right valve, in good condition. Type in the Wanganui Museum.



FIGS. 1, 1a.—*Ancilla spiniyera* n. sp.  
 FIGS. 2, 2a.—*Ancilla cincta* n. sp.  
 FIGS. 3, 3a.—*Surcula latiaxialis* n. sp.  
 FIGS. 4, 4a.—*Surcula ordinaria* n. sp.

FIGS. 5, 5a.—*Conus (Leptoconus) lyratus* n. sp.  
 FIGS. 6, 6a.—*Conus convexus* n. sp.  
 FIGS. 7, 7a.—*Conus (Lithoconus) abruptus* n. sp.

(All figs.  $\times 2$ .)





FIGS. 1, 1a.—*Anomia poculifera* n. sp.  
 FIGS. 2, 2a.—*Spondylus aucklandicus* n. sp.  
 FIGS. 3, 3a.—*Mytilus torquatus* n. sp.  
 FIGS. 4, 4a.—*Dosinia tumida* n. sp.

FIGS. 5, 5a.—*Cardium (Glans) kaiparaensis*  
 n. sp. ( $\times 1\frac{1}{2}$ .)

FIGS. 6, 6a.—*Macrocallista sculpturata* n. sp.

(All figs. except 5 and 5a  $\times 2$ .)

*Sarepta aucklandica* n. sp. (Plate XIX, figs. 5, 6.)

Shell small and thin: height, 9 mm.; length, 6 mm. Shape semi-orbicular. Umbo fairly prominent, almost in the middle of the dorsal margin. Ventral margin circular. Dorsal margin descending slowly behind but gently rounded in front. Surface of the shell smooth and almost polished, though faint concentric lines can be distinguished. About 9 small teeth can be distinguished on either side of the umbo, but they commence rather more closely to it on the posterior than on the anterior side. Ligament-pit triangular and directed forward.

Not very common. Only two good valves (both left) were found. I am indebted to Mr. Suter for information as to the correct place of this species in classification. Type in the Wanganui Museum.

*Mytilus torquatus* n. sp. (Plate XXI, figs. 3, 3a.)

Shell small, elongated, inflated: height, 22 mm.; length, 14 mm.; thickness, 9 mm. Inflated anteriorly, compressed posteriorly. Slightly winged about the middle. Beak acute, strongly curved anteriorly. Dorsal margin ascending for a short distance, then bent quickly through an angle of 70°, forming a straight line along the anterior margin. Ventral margin gradually rounded, returning with a gradual sweep to the dorsal margin. Surface finely striated. The striae ramify repeatedly along the central line, then extend without further branching to the margin. Striae rounded, very fine on the anterior slope, about as wide as the interstices. They are crossed by very wide concentric undulations and by small cross-threads.

Two specimens only, both right valves, in good condition. Closely related to *M. huttoni* Cossmann = *M. striatus* Hutton.

*Spondylus aucklandicus* n. sp. (Plate XXI, figs. 2, 2a.)

Shell of moderate size, only 20 mm. high and 30 mm. long. Strongly inequilateral with a considerable posterior expansion. Hinge-line straight with a typical provinculum. On the left valve the area is small and almost linear. Umbo not prominent. Crural teeth very large and with 2 or 3 crenulations on the dorsal side. Ligament-pit distinct, with a well-marked ridge on either side. Ornamentation: One or two broad concentric undulations crossed by a number of scaly but not spiny radiating ridges of extremely unequal size. Generally 3 or 4 smaller ribs between the larger ones. The ribs are somewhat irregularly curved, and are continued to the margin, near which they are discernible also on the inner side. On the inner surface, however, they only extend as far as the pallial line.

Two specimens only, one of which is in a very good state of preservation. Type in the Wanganui Museum.

No species of this genus has previously been recorded from the Tertiary deposits of New Zealand, but Professor Woods has lately recorded a specimen, too imperfect for description, from the Cretaceous rocks of North Canterbury. There is also a very large specimen of *Spondylus* in the Auckland Museum which is labelled as coming from Hawke's Bay.

*Dosinia tumida* n. sp. (Plate XXI, figs. 4, 4a.)

Shell small, ovato-orbicular: height, 17 mm.; length, 20 mm.; thickness, 7 mm. Dorsal margin sloping gently posteriorly and developing gradually into the almost circular curve of the ventral margin. Inner surface of the margin delicately crenulated. Umbo fairly prominent and distinctly bent anteriorly. Sculpture a fine concentric striation with strongly incised concentric grooves at intervals. Hinge-plate rather small.

Posterior cardinal tooth in the left valve less markedly bifid than in *D. greyi* Zittel, but well separated from the posterior cardinal tooth. Anterior lateral tooth small, but the posterior lateral large, long, and sharp.

A single left valve, in good condition. Type in the Wanganui Museum.

This species is closely related to *D. greyi* Zittel.

**Cardium (Glans) kaiparaensis** n. sp. (Plate XXI, figs. 5, 5a.)

Shell small, nearly orbicular: height, 30 mm.; length, 35 mm.: somewhat inequilateral and ventricose. Umbo pointed well forward and strongly incurved. Anterior end the shorter and regularly rounded. Dorsal margin gently sloping and ventral margin broadly rounded. Sculpture: The surface is coarsely ribbed, some 35 ribs being present. The ribs are narrower than the interstices, sharp and strongly nodulose. Interstices crossed by numerous fine concentric threads, which do not cross the ribs. Margin sharply dentate. Hinge-plate bow-shaped. Left valve with 1 large cardinal tooth, 1 large and long posterior lateral, and 1 short anterior lateral. Right valve: cardinal tooth long and slender; posterior lateral long, and anterior lateral small.

A common species at Pakaurangi Point, but the shells vary greatly in size. Type in the Wanganui Museum.

**Tellina (Arcopagia) inconspicua** n. sp. (Plate XIX, figs. 1, 2.)

Shell small, very thin, broadly oval: length, 14 mm.; height, 8 mm.; thickness, 4 mm.: slightly compressed, somewhat inequilateral. Beaks rather produced, situated a little behind the middle. Dorsal edge straight, ventral margin strongly rounded. Valves equally convex. Sculpture consisting of numerous fine rather irregular concentric rounded ridges. A large rounded radiating rib on the posterior portion of the right valve. In the right valve the two cardinal teeth are of equal size. The anterior lateral tooth is much nearer to the cardinals and is much larger than the posterior tooth.

Not uncommon, but the thin and fragile nature of the shell makes it difficult to obtain good specimens. Type in the Wanganui Museum.

**Macrocallista sculpturata** n. sp. (Plate XXI, figs. 6, 6a.)

Shell small, broadly ovate: height, 20 mm.; width, 25 mm. Dorsal margin arched. Anterior margin at first straight, then arched and rounded. Ventral and posterior margins well rounded. The 3 cardinal teeth are well marked and large. The first anterior lateral is small and obtuse. The second anterior lateral is long and reaches to the margin. The 2 posterior lateral teeth are sharp. Sculpture: A fine general concentric striation is nearly obsolete. On the posterior portion a series of fine wavy striations nearly parallel to the margin. On the anterior portion an angular or V-shaped sculpture can be seen over a portion of the surface.

A single right valve in a good state of preservation. Type in the Wanganui Museum.

**Corbula nitens** n. sp. (Plate XIX, figs. 4, 7.)

Shell very small: height, 4 mm.; length, 7 mm.: subtrigonal. Valves not greatly unequal in size, but the right valve is considerably more convex than the left. Umbones of the two valves equal and incurved. Dorsal margin sloping. Anterior end distinctly the shorter, and rounded; posterior end rather the longer, and rostrate. Ventral margin gently rounded. Sculpture: Both valves with a rounded ridge extending from





FIG. 1.—*Pecten costato-striatus* n. sp.  
 FIG. 2.—*Pecten costato-striatus* n. sp.  
 FIG. 3.—*Pecten costato-striatus* n. sp.  
 FIG. 4.—*Pecten subconvexus* n. sp.  
 FIG. 5.—*Pecten subconvexus* n. sp.  
 FIG. 6.—*Pecten subconvexus* n. sp.  
 FIG. 7.—*Vaginella torpedo* n. sp.

FIG. 8.—*Vaginella torpedo* n. sp.  
 FIG. 9.—*Fusinus corrugatus* n. sp.  
 FIG. 10.—*Fusinus corrugatus* n. sp.  
 FIG. 11.—*Siphonalia flexuosa* n. sp.  
 FIG. 12.—*Siphonalia flexuosa* n. sp.  
 FIG. 13.—*Coptochetus zelandicus* n. sp.

(All figs.  $\times 2$ .)



the umbo to the posterior truncation: this is much sharper in the left valve than in the right. Near the umbo the right valve is smooth or has very small concentric striae. The concentric lines become more and more pronounced as the ventral margin is approached. The sculpture of the left valve is similar but somewhat less pronounced than that of the right. The outer coating of the shell is frequently absent, and then leaves a perfectly smooth and polished inner layer.

A common species at Pakaurangi Point. Type in the Wanganui Museum.

*Pecten costato-striatus* n. sp. (Plate XXII, figs. 1, 2, 3.)

Shell small, slightly inequilateral, fan-shaped: height, 17 mm.; breadth, 18 mm. Ears very unequal. Anterior ear large, nearly triangular, but with the outer margin rounded. It bears 7 radiating ribs crossed by a number of transverse bars which are almost spiny. The radiating ribs which are near the hinge-line are much stronger than the others. Posterior ear much stronger, smaller, with 5 ribs less strongly crossed by transverse bars. Right valve with about 40 rounded radiating ribs, many of which subdivide into 3 each near the ventral margin. Each rib is crossed by a large number of transverse striations: these are so deep as to almost make the ribs appear to be composed of a large number of overlapping plates. Towards the ventral margin these may develop into small spiny processes. Interstices about as wide as the ribs, and crossed by a large number of fine transverse lines.

I am much indebted to Mr. Suter for examining this species, which he rightly remarks is closely related to *P. burnetti* Zittel. This species is perhaps the most abundant of the pectens at Pakaurangi Point. Type in the Wanganui Museum.

*Pecten subconvexus* n. sp. (Plate XXII, figs. 4, 5, 6.)

Shell small, fan-shaped: height, 16 mm.; breadth, 16 mm.: slightly inequilateral. Ventral margin nearly circular. Ears unequal, the anterior distinctly the larger with 6 radiating scaly ribs; posterior ear relatively small but with the same number of ribs, though they are less scaly and less prominent than those of the anterior rib. The shell has a large number of rounded radiating ribs. Intervening grooves usually much narrower than the ribs, and both the grooves and the ribs are marked by a large number of fine cross-lines. In some valves some 5 large radiating undulations can be distinguished.

Mr. Suter, who kindly examined these specimens for me, remarks that the species is near to *P. convexus* Q. & G. This species is fairly abundant at Pakaurangi Point. Type in the Wanganui Museum.

Including the species described above, the following is now the complete list of the species that I have found at Pakaurangi Point. Those marked \* are Recent species.

*Vaginella torpedo* n. sp.  
\**Emarginula striatula* Q. & G.  
*Solariella stoliczkai* Zittel.  
*Calliostoma gracilis* n. sp.  
*Astraea subfimbriata* Suter.  
*Turritella semiconcava* Suter.  
*Struthiolaria cincta* Hutton.  
*Cerithiella fidicula* Suter.  
*Crepidula gregaria* Sowerby.

\**Calyptrea maculata* Linn.  
*Turbo etheridgei* Ten.-Woods (?).  
\**Natica zelandica* Q. & G.  
*Polynices gibbosus* Hutton.  
*Ampullina suturalis* Hutton.  
\**Trivia avellanioides* McCoy.  
*Cymatium minimum* Hutton.  
*Epitonium browni* Zittel.  
*Epitonium trilineatum* n. sp.

- \**Crossea labiata* Suter.  
 \**Phalium achatinum pyrum* Lamk.  
*Galeodea senex* Hutton.  
*Galeodea muricata* Hector.  
*Galeodea sulcata* Hutton.  
*Architectonica* n. sp. (?).  
*Heliacus aucklandicus* n. sp.  
*Fusinus kaiparaensis* Suter.  
*Fusinus morgani* Suter.  
*Fusinus corrugatus* n. sp.  
*Dolicholaturus (Pseudolaturus) ornatus* n. sp.  
*Ptychatractus pukeuriensis* Suter.  
*Ptychatractus tenuiliratus* Suter.  
 \**Siphonalia dilatata* Q. & G.  
*Siphonalia flexuosa* n. sp.  
*Coptochetus zelandicus* n. sp.  
*Cominella carinata* Hutton.  
*Phos kaiparaensis* n. sp.  
*Phos spiralis* n. sp.  
*Alectrion socialis* Hutton.  
 \**Murex angasi* Crosse.  
 \**Murex zelandicus* Q. & G.  
*Murex zelandicus komiticus* Suter.  
*Cymbiola corrugata* Hutton.  
*Cymbiola nitens* n. sp.  
*Cymbiola masefieldi* n. sp.  
*Cymbiola calcar* n. sp.  
 \**Ancilla australis* Sowerby.  
*Ancilla papillata* Tate.  
*Ancilla spinigera* n. sp.  
*Ancilla cincta* n. sp.  
*Marginella conica* Harris.  
*Marginella harrisi* Cossmann.  
*Surcula climacota* Suter.  
*Surcula fusiformis* Hutton.  
*Surcula latiaxialis* n. sp.  
*Surcula nitens* n. sp.  
*Surcula ordinaria* n. sp.  
*Leucosyrinx alta transennus* Suter.  
*Turris ornatus* n. sp.  
*Turris kaiparaensis* n. sp.  
*Drillia awamoensis* Hutton.  
*Drillia imperfecta* Suter.  
*Drillia tenuispiralis* n. sp.  
*Borsonia (Cordieria) ovalis* n. sp.  
*Bathytoma haasti* Hutton.  
*Bathytoma sulcata excavata* Suter.  
 \**Mangilia dictyota* Hutton.  
*Mangilia axialis* n. sp.  
*Conus armoricus* Suter.  
*Conus (Leptoconus) lyratus* n. sp.  
*Conus convexus* n. sp.  
*Conus (Lithoconus) abruptus* n. sp.  
*Terebra orycta* Suter.  
*Acteon ovalis* Hutton.  
 \**Acteon craticulatus* Murdoch and Suter.  
*Crenilabrum zelandicum* n. sp.  
*Cylichnella enysi* Hutton.  
 \**Dentalium ecostatum* T. W. Kirk.  
*Dentalium pareorense* Ihering.  
*Dentalium solidum* Hutton.  
 \**Cadulus delicatulus* Suter.  
*Leda semiteres* Hutton.  
 \**Leda fastidiosa* A. Adams.  
*Sarepta aucklandica* n. sp.  
*Anomia poculifera* n. sp.  
 \**Arca novae-zelandiae* Smith.  
*Arca subvelata* Suter.  
*Glycymeris subglobosus* Suter.  
*Cucullaea alta* Sowerby.  
*Cucullaea australis* Hutton.  
*Mytilus torquatus* n. sp.  
*Pecten beekhami* Hutton.  
*Pecten huttoni* Park.  
*Pecten burnetti* Zittel.  
*Pecten aldingensis* Tate.  
*Pecten costato-striatus* n. sp.  
*Pecten subconvexus* n. sp.  
*Spondylus aucklandicus* n. sp.  
*Lima colorata* Hutton.  
*Ostraea wuellerstorfi* Zittel.  
*Ostraea nelsoniana* Zittel.  
*Ostraea tatei* Suter.  
 \**Cardita calyculata* Linn.  
*Venericardia subintermedia* Suter.  
 \**Thyasira flexuosa* Montague.  
 \**Tellina eugenia* Suter.  
 \**Tellina glabrella* Deshayes.  
*Tellina (Areopagia) inconspicua* n. sp.  
*Crassatellites attenuatus* Hutton.  
 \**Dosinia greyi* Zittel.  
*Dosinia tumida* n. sp.  
*Macrocallista sculpturata* n. sp.  
*Macrocallista assimilis* Hutton.  
*Macrocallista pareoraensis* Suter.  
*Cytherea chariessa* Suter.  
 \**Chione meridionalis* Sowerby.  
*Paphia curta* Hutton.  
*Cardita (Glans) kaiparaensis* n. sp.  
 \**Cardium pulchellum* Gray.  
*Chama huttoni* Hector.  
*Corbula canaliculata* Hutton.  
*Corbula kaiparaensis* Suter.  
 \**Corbula macilenta* Hutton.  
*Corbula nitens* n. sp.  
 \**Panope zelandica* Q. & G.

This collection from Pakaurangi Point is of rather more than usual interest, as it is the first time that any attempt has been made to identify or describe a Tertiary fauna of such an extensive nature from any northern locality in New Zealand.

In the first place, there are several genera that have not previously been recorded from any locality in New Zealand. These are *Dolicholaturus*, *Coptochetus*, *Crenilabium*, *Spondylus*, *Sarepta*, and the subgenus *Cordieria* of *Borsonia*. On the other hand, *Acteon craticulatus*, *Cadulus delicatulus*, and *Crossea labiata*, all members of the Recent molluscan fauna of New Zealand, have not previously been found in the fossil state. The genera *Cymbiola* and *Surcula* are represented by more species than is usual in New Zealand fossil collections from Tertiary localities. The four species of *Conus* that have been collected give this genus a prominence that it fails to attain in any other collections from New Zealand localities.

A more general survey shows that in this collection of 124 species there are as many as forty-five, or 36.3 per cent., which have not been found elsewhere, while 20.3 per cent. are Recent species. Generically and specifically, therefore, this fauna is sufficiently distinct from any other that has been recorded. There are, however, no specially archaic types, while there are very many species identical with those that have been found in Tertiary localities in Canterbury and North Otago in those places where full collections have been made. This consideration, and the further fact that nearly 21 per cent. of the species are of Recent occurrence, shows that the age of the Pakaurangi beds is much the same as that of the beds at the North Otago localities of Wharekuri and Otiake—or, in other words, of the Oamaru limestone. In these localities the percentage of Recent species was found by Marshall to be 23.3 and 24 respectively, but in each case only some sixty species were collected.

In my previous papers insistence has been laid on the fallacy of relying too implicitly on the criterion of the percentage of the Recent species for the determination of the relative age of the Tertiary strata. The personal equation in connection with the identification of the species, the varying depth of the water, the geographical peculiarities of the station, are all matters that have to be taken into consideration before any comparison of real value can be instituted. In the present case, however, Mr. Suter has been good enough to examine and classify the species from both the Otago localities and from Pakaurangi Point: in consequence the personal equation in this comparison is of little importance. Similarly, the depth of the water in which deposition of the strata took place appears to have been of the same order of magnitude in both cases. Probably it was off-shore water in both cases approaching a depth of 100 fathoms.

The geographical features of the different localities may, however, have an important bearing on the question. The localities are nine degrees of latitude apart, and it is obvious that the species in the more northern locality should suggest a warmer climate than those in a locality more than six hundred miles farther south, in water relatively so shallow.

There is also a general belief that has been expressed by various authors that the climate of the New Zealand area has become relatively cooler since the early and middle Tertiary times. This opinion is based on the nature of the Tertiary Mollusca as compared with the Recent fauna, on the relatively large size of many of the Tertiary species, and of the greater variety of the species. Similar features have been noticed in regard to other animal groups. It is, of course, obvious that a general reduction of the temperature

within the New Zealand region would be more fatal to the northern species, which, owing to the limited extent of the land, would have no warmer littoral waters to which to migrate, than to the southern species, which would have a large extent of northern coast-line to which they could retire as the climate became cooler. This consideration supports the belief that the small percentage of Recent species in the Pakaurangi beds does not indicate a greater geological age than that of the beds at Wharekuri and of Otiake in North Otago. Actually, as explained in an earlier paper, these Pakaurangi beds succeed the white mudstones conformably, and these mudstones merge into the hydraulic limestones in their lower members. The hydraulic limestone is believed to rest conformably on the greensands, which in certain neighbouring localities contain an Upper Senonian fauna. This fauna includes the ammonoid genera *Kossmaticeras*, *Phylloceras*, *Lytoceras*, and *Baculites*, as well as the gasteropods *Amberleya*, *Cinulids*, and the lamellibranchs *Malletia*, *Panope*, and *Inoceramus*, amongst several others. It is hoped that this fauna, which has been found at Batley and at Bull's Point, both within a few miles of Pakaurangi Point, may be fully described in the next volume of the *Transactions*.

There are at Pahi, some five miles distant, some greensands lying beneath the "hydraulic limestones." In these sediments there are a large number of species of fossil Mollusca, but the shells are in a very poor state of preservation, and no attempt has been made of recent years to classify them. It is, however, the case that the species are mainly, if not entirely, of Cainozoic types, and the horizon is certainly lower than that of the Pakaurangi Point beds. Thus stratigraphically there is not any definite indication of the age of the Pakaurangi beds. There are certainly Upper Senonian beds at about 1,000 ft. below them, and the intervening strata are partly extremely fine mudstones and *Globigerina* oozes with much diatomaceous and radiolarian matter.

Palaeontologically also the exact age of the Pakaurangi beds is not precisely indicated. The percentage of Recent species does not give a satisfactory basis for a comparison with European horizons. The isolation of New Zealand and the relatively rare arrival of species from outside the New Zealand area make it probable that species would survive for a much longer time here than on coast-lines where there was more competition from newly arrived species. It is probable that a fauna in New Zealand with 20 per cent. of Recent species would have a much greater antiquity than a fauna with a similar percentage of Recent species in Europe or America.

The actual genera that have been collected do not appear to indicate any precise Tertiary age. *Exilia*, *Gilbertia*, and other genera from the lowest Tertiary beds of the South Island have not been collected here. *Fulgoraria* has not been found, and *Chione* is poorly represented. But such facts appear to depend upon station rather than age. Relative stratigraphical position with respect to beds deposited in water of similar depth in other parts of New Zealand would suggest an age rather younger than that of Wharekuri and Otiake, and such a position would generally agree with the palaeontological evidence. On the whole, I am inclined to correlate the beds with those of All Day Bay—that is, next above the Oamaru limestone.

As the work of collecting, classifying, and describing the Tertiary Mollusca gradually proceeds the number of species becomes much larger, and the fact emerges that there have been very few generic additions to



our fauna during Tertiary times. On the other hand, it is clear that many genera have become extinct. It is also the case that many of the genera that were in earlier times well represented have but few species in the present fauna. Those that have become extinct include *Cymbiola*, *Niso*, *Cypraea*, *Trivia*, *Conus*, *Latirus*, *Erato*, *Cerithium*, *Cardium*, *Exilia*, *Cucullaea*. More generally it may be said that of the 205 genera mentioned in Mr. Suter's *Hand-list of New Zealand Tertiary Mollusca* (1915) some forty-eight are now extinct. This statement, however, does not give a complete idea of the magnitude of the change that has taken place. Many of the genera that in Tertiary times contained a large number of species are now reduced to a very small number. Of these, *Epitonium*, *Surcula*, *Turris*, *Siphonalia*, *Struthiolaria*, *Mangilia*, *Pecten*, and *Polinices* are the most prominent examples.

In this comparison the purely littoral fauna cannot be properly considered, as remains of such organisms are so seldom preserved. No one Tertiary horizon which has had its Mollusca properly collected and described shows any notable introduction of species or genera which are absent from lower horizons. Such facts go far to support the idea of a continuous isolation of New Zealand throughout Tertiary times—a contention that has been previously urged by the author on purely stratigraphical grounds. This position has lately been supported by Thomson and Morgan, though stated in a different manner: "Each Tertiary fauna seems to merge gradually into the succeeding one."\* Mr. Suter also has written to me as follows: "There is no doubt that our molluscan fauna has greatly decreased, and also that the Tertiary forms gradually merge into one another." These statements appear to me to afford the strongest support from the palaeontological standpoint to the view so frequently urged by me that there is no important break in the succession of Tertiary sediments in New Zealand. In the absence of satisfactory palaeontological material in the past this view has been based on stratigraphical material, and it is satisfactory to note that as the palaeontological material gradually accumulates its verity is placed practically beyond doubt.

It is to be hoped that a complete comparison may be possible ere long between our Tertiary faunas and those of Australia, South America, and North America. In the meantime one can only emphasize the well-known fact that our Tertiary fauna closely resembles that of South America, where the species of *Turritella*, *Malletia*, *Struthiolaria*, *Epitonium*, and *Polinices* are evidently extremely closely related to ours. Again, the occurrence of the genera *Perissolax* and *Heteroterma* in the Wangaloa beds shows a rather unexpected relationship between our earliest Tertiary beds and those of the Tejon and Martinez districts in California.

In New Zealand I have frequently stated that there does not appear to be any stratigraphical discordance between the Upper Cretaceous (Senonian) and the Tertiary horizons. In all known cases, however, deep-sea beds of *Globigerina* or diatomaceous or radiolarian ooze intervene between the Senonian and Tertiary horizons. In South America Wilckens, as previously pointed out, has insisted on an important break between the Senonian and the Miocene. Other authorities on the South American stratigraphy hold very different opinions. The latest that I have seen is that of von Ihering, who maintains emphatically that there is no break between the Cretaceous and Tertiary: "Überblicken wir die von uns

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\* Preface to *Palaeontological Bulletin No. 5*, 1917.

gewonnenen Ergebnisse, so muss jede unbefangene Diskussion die Tatsache anerkennen: dass die marinen Ablagerungen der oberen Kreide von Patagonien eine starke, successive Abnahme von mesozoischen Charakterformen aufweisen, dass aber andererseits diese letzteren sich zum Teil erhalten, dass mithin die Elemente der Kreidefauna teils unverändert, teils modifiziert in die patagonische Formation übertreten und dass keine Discordanz zwischen der Kreide und den Ablagerungen der patagonischen Formation besteht.”\*

So far as New Zealand is concerned, then, it appears to be probable that at the close of Cretaceous times a great movement of epirogenic depression took place. The land area was reduced to the dimensions of a few small islands. Over much of the present land area deep-sea oozes were deposited for a great lapse of time. Marginal deposits were restricted and small. When elevation again commenced the Upper Cretaceous fauna had been replaced by one of Tertiary characteristics.

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ART. XXVIII. — *Notes on the Geology of the Tubuai Islands and of Pitcairn.*

By P. MARSHALL, M.A., D.Sc.

[Read before the Wanganui Philosophical Society, 19th December, 1917; received by Editors, 31st December, 1917; issued separately, 24th June, 1918.]

THE scattered islands which constitute the Tubuai Group are situated near 23° south latitude and 150° west longitude. Little geological information has been published about them except in regard to their general configuration and the nature of the coral reefs by which they are encircled.

A visit has lately been made to the group by Professor J. Macmillan Brown in connection with his anthropological studies, and he has been good enough to give me chips from implements that he obtained from Tubuai and Rapa. In addition, the Chief Magistrate of Pitcairn sent me several specimens from that island. I have previously published a note on rock-specimens from Rurutu Island, another member of the Tubuai Group.†

*Stone Axe, Tubuai Island.*—A dense black rock in hand-specimens. In section the structure is dominated by an abundance of small laths of feldspar with the extinction angle of labradorite. There are a few large crystals of olivine much serpentinized. There is also a little olivine in the groundmass. Augite is very plentiful in the groundmass in small colourless grains. Magnetite very abundant. The rock must be classed as a dense, rather acid basalt.

*Stone Axe, Rapa Island.*—In hand-specimens a dark fine-grained rock without any crystals that can be distinguished macroscopically. In section fine laths of feldspar are very abundant. They appear to be an acid labradorite or andesine. Augite is very plentiful, but the grains seldom have any crystalline outline, and they are quite colourless. A little olivine is present in very irregular-shaped grains. Magnetite is very plentiful in crystals up to 0.2 cm. in diameter. A little apatite can be distinguished. This rock is also an acid feldspathic basalt, and, like the specimen from Tubuai, it has an unusual quantity of magnetite.

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\* VON IHERING, *Revista do Museu Paulista*, vol. 1, Fasc. 3, p. 130 Sao Paulo, 1914.

† *Trans. N.Z. Inst.*, vol. 46, p. 283, 1914.