Thyasira planata n. sp. (Plate 75, figs. 10, 13.)

Shell small, suborbicular. Umbo at anterior third. Anterior end concave above, narrowly rounded below; posterior end winged; a strong furrow with convex anterior side proceeding from umbo to lower part of posterior margin, another with an angular anterior margin runs from umbo to upper part of posterior margin. Lunule large, sunken, lanceolate, well defined. Sculpture of obsolete irregular concentric ridges and folds, whole surface with regular, sharp, close, microscopic growth-lines. Interior not seen.

Height, 9 mm.; length, 10 mm.; diameter (one valve), 3·5 mm.

Locality.—1127, Waikiekie Stream.

Distinguished from *T. flexuosa* by well-defined lunule, sharper posterior ridges, and less inflation.

Leptomya simplex n. sp. (Plate 75, fig. 15.)

Shell small, ovate, thin. Umbo median, inconspicuous. Anterior end regularly convex; dorsal margin descending; posterior end tapering to obliquely and roundly truncated extremity. Sculpture of narrow distant concentric low lamellae, interspaces crowded with fine radial threads.

Height, 7 mm.; length, 9 mm.; thickness (one valve), 1·5 mm.

Locality.—1125, coast between Waikiekie and Mangapuketea Streams.

Distinguished from *L. perconfusa* Iredale by the greater height compared with length, and the absence of a posterior ventral sinus.

Geology of Upper Waitotara Valley, Taranaki.

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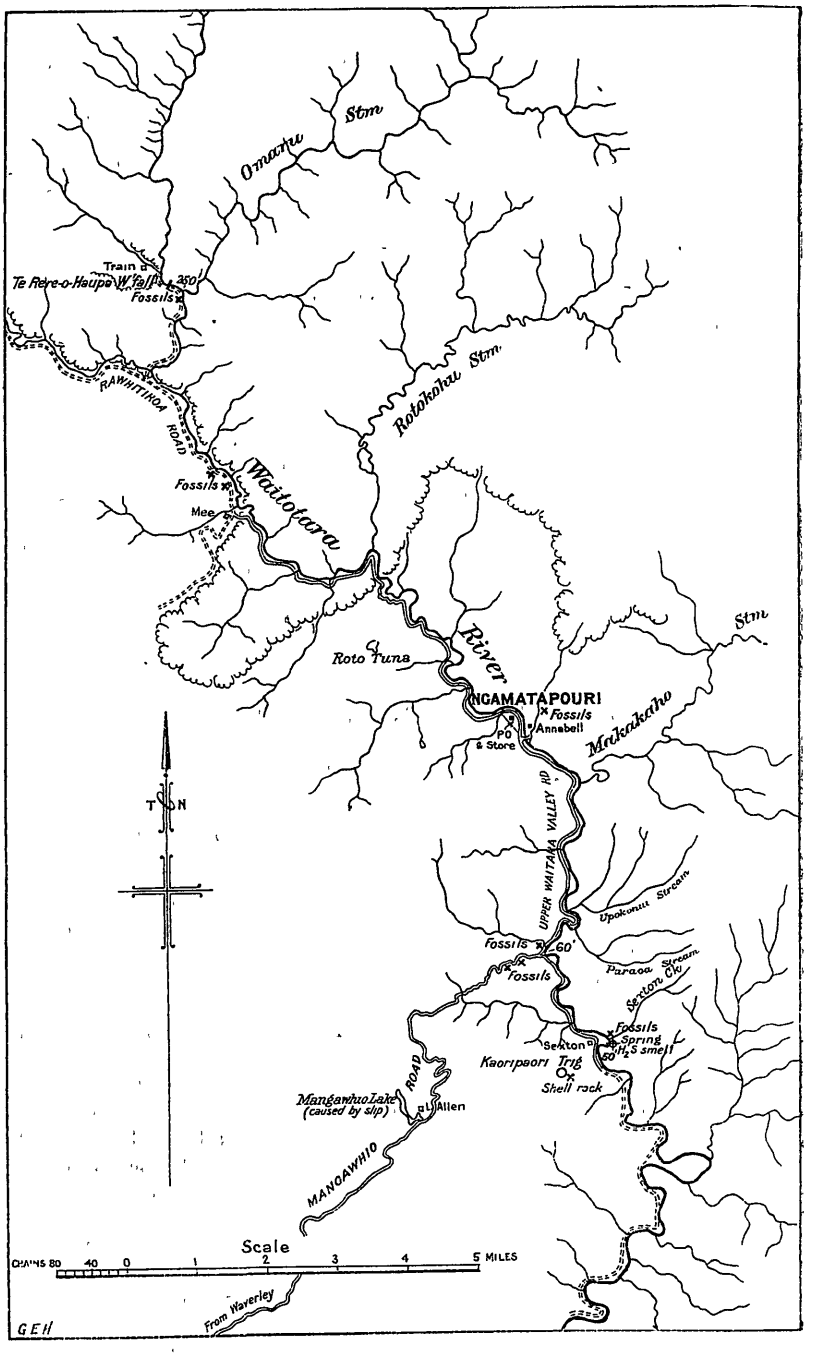
[*Read, by permission of the Director of the N.Z. Geological Survey, before the Wellington Philosophical Society, 8th July, 1924; received by Editor, 6th October, 1924; issued separately, 31st March, 1926.*]

DURING September, 1923, the writer spent a week at Ngamatapouri and Kapara, in the Waitotara Valley, and partly explored the geologically unknown area lying between the coastal strip west of Wanganui examined by Marshall and Murdoch (1920 and 1921) and the Tongaporutu–Ohura Subdivision (see *N.Z. Geol. Surv. 17th Ann. Rep.*, Parl. Paper C.–2c, pp. 3, 7–8, 1923). Ngamatapouri Township, in the centre of the district, is about twenty-two miles north-east of Patea.

The writer is indebted to the Geological Survey for the determination of the fossils he collected, and also for permission to examine Professor James Park's collection from the Wanganui River, made in 1887. He also wishes to acknowledge the assistance given by Messrs. J. R. Annabell and G. H. Sexton, of Ngamatapouri, and Mr. G. Mee, of Kapara. Mr. G. E. Harris kindly drew the accompanying sketch-map.

Most observers in Taranaki have noted the accordant heights of the ridges. Up-stream from Ngamatapouri the main ridges range between 1,400 ft. and 1,700 ft. above sea-level. They are probably the inter-stream upland spaces of a mature surface, into which the drainage-channels have entrenched deeply. At the junction of Mangawhio Road with Waitotara Valley Road the river is approximately 60 ft. above sea-level, and at Te Rere-o-Haupa Waterfall, some twelve miles farther up the valley,



WAITOTARA VALLEY NORTH AND SOUTH OF NGAMATAPOURI.

about 250 ft. This dissection has been due to rejuvenation of the streams by uplift. Of the lakes that occur in the branch streams the writer had an opportunity of observing only the Mangawhio Lake. This has been formed by a portion of the hillside damming the valley by breaking away and sliding forward across the stream-bed.

Excepting alluvial deposits, the only beds outcropping in this area are Tertiary rocks consisting of sandstones, arenaceous mudstones, shelly limestones, and conglomerates. From Waitotara Township almost to the northern end of Mangawhio Road the beds are sandstones with no appreciable dip. At the end of the Mangawhio Road mudstone appears under the sandstone a little above road-level. Owing to a dip of about 2° to the south-west, the line of contact rises up-stream at least as far as the mouth of Rotokohu Stream. Up-stream from this point most of the land is covered with bush; the few outcrops that were observed indicate that the beds are sandy and lie fairly flat. Shelly limestone outcrops at many points about road-level between the mouth of Rotokohu Stream and Te Rere-o-Haupa Waterfall, at a few chains east of Kaoripaori Trig., and near the mouth of the branch of the Waitotara entering from the east opposite Mr. Sexton's house. Shelly conglomerate, about 20 chains north-east of Mr. Annabell's house, contains small pebbles of argillite and greywacke.

Fossils collected from several localities have been identified by Dr. J. Marwick. They appear to be of Waitotaran (Lower Pliocene) age. The following Mollusca were obtained from sandstone and shelly conglomerate near the mouth of the branch of the Waitotara entering from the east opposite Mr. Sexton's house. This stream has a local name which should not be adopted, and the writer proposes to call it Sexton Creek.

†*Alcithoe morgani* (Marsh. & Murd.)
* *Anomia trigonopsis* Hutt.
**Atrina zelandica* (Gray).
Barnea n. sp.
Cardium spatiosum Hutt.
Crepidula incurva Zitt.
Dentalium solidum Hutt.
**Divaricella cumingi* Ad. & Ang.
Dosinia n. sp.
Drillia n. sp.
†*Glycymeris manaiaensis* Marwick
†*Miltha neozelanica* Marsh. & Murd.
Olivella neozelanica Hutt.
†*Ostrea ingens* Zitt.
†*Pecten triphooki* Zitt.
†*Polinices ovuloides* Marwick
Tellina n. sp.
**Turritella rosea* Q. & G.
**Verconella mandarina* (Duclos)
Xymene olweri Marwick

In the above and following lists an asterisk indicates that the species is still living; a dagger that it is elsewhere found only on the Waipipi beds, which are considered to extend along the coast from Waipipi Beach to Hawera.

In a block cutting about 20 chains north of the junction of Mangawhio and Upper Waitotara Valley roads †*Pecten crawfordi* Hutt. and †*P. triphooki* Zitt. were collected.

The shelly conglomerate north-east of Mr. Annabell's house yielded—

Aethocola n. sp.
†*Aethocola* sp. (spire same as Patea specimen)
**Amphidesma subtriangulatum* (Wood)
Ancilla cf. *australis* (Sowb.)
**Ancilla novae-zelandiae* E. A. Smith
†*Ancilla* n. sp. cf. *hebera* (Hutt.)
Ataxocerithium n. sp.
Barnea n. sp.
Callanaitis n. sp. cf. *speighti* (Sut.) ?
**Calyptraea tenuis* (Gray)
Cerithidea n. sp.
**Chione stutchburyi* (Gray)
**Comnella lurida* (Phil.)
Crepidula incurva Zitt.
Dosinia sp.
†*Glycymeris manaiaensis* Marwick

**Mactra discors* (Gray)
**Mactra ordinaria* E. A. Smith
Monodonta sp.
Olivella neozelanica Hutt.
†Ostrea ingens Zitt.
†Polinices ovuloides Marwick
**Spisula* cf. *aequilateralis* Desh.
Struthiolaria n. sp. cf. *spinosa* Hector
Terebra n. sp. ? (not Recent)
Turbo postulatus Bart.
Umbonium n. sp. cf. *anguliferum* (Phil.) (same as at Waipipi Beach)
Xymene expansus (Hutt.)
**Zenatia acinaces* (Q. & G.)

Turris n. sp. cf. *kaiparaensis* Marsh. was found in a road-cutting 20 chains west from the store at Ngamatapouri.

The following Mollusca were obtained from outcrops of shelly limestone on the road for two miles north of Mr. Mee's house at Kapara :—

†Ancilla n. sp. cf. *hebera*
**Anomia trigonopsis* Hutt.
Crepidula incurva Zitt. (very large)
**Glycymeris laticostata* (Q. & G.) (inflated)
**Mactra ordinaria* E. A. Smith
Mydora sp. (inside of left valve)
Mytilus sp.
Paphia (*Ruditapes*) n. sp. (longer than *intermedia*)
Turritella n. sp. (four spirals)
**Venericardia purpurata* (Desh.)
**Zenatia acinaces* Q. & G.

The fossils listed below are from shelly limestone outcropping on the Upper Waitotara Valley Road, between Rawhitiroa Road and the waterfall :—

Atrina sp.
**Calliostoma selectum* (Chemn.)
**Calyptraea tenuis* (Gray) (very large)
Cardium spatiosum Hutt.
Chione cf. *subsulcata* Sut.
Crepidula incurva Zitt.
Dosinia sp.
**Glycymeris laticostata* (Q. & G.)
†Glycymeris manaiaensis Marwick
Glycymeris n. sp. (like *manaiaensis* but very inflated)
Lucinida dispar Hutt. ?
**Mactra ordinaria* E. A. Smith
Marcia cf. *sulcata* (Hutt.)
Modiolus sp.
†Ostrea ingens Zitt. ?
Paphia (*Ruditapes*) n. sp. (longer than *intermedia* (Q. & G.))
†Pecten triphooki Zitt.
**Protocardia pulchella* (Gray)
Turritella n. sp. cf. *fulminata* Hutt.
**Venericardia purpurata* (Desh.)
**Zenatia acinaces* (Q. & G.)

The reference of the beds containing these fossils to their position in the classification appended below of Tertiary strata in Taranaki and west Wellington presents no difficulties.

Beds in Taranaki and West Wellington	Stage Name.	Group Name.
Castlecliff beds	Castlecliffian‡.. ..	Wanganuian.‡
Nukumaru beds.. .	Nukumaruan§ ..	
Waipipi beds	Waitotaran‡	
Onairo beds	Taranakian	Taranakian.‖
Tongaporutu beds .. .		
Mokau and Mohakatino beds ..	Awamoan‡	Oamaruian.‡

‡ Thomson's stage and group names. See *Trans. N.Z. Inst*, vol. 48, pp. 28–40, 1916. It is stated in *N.Z. Geol. Surv Pal. Bull No. 10*, p 43, that the Waitotaran stage may be divided into the Nukumaruan and Waipipian ; but this cannot be done, for Thomson in the paper cited above does not include the Nukumaru beds in the Waitotaran

§ See J. MARWICK, *Trans N Z. Inst*, vol 55, p 191, 1924

‖ The reasons for making the Tongaporutu and the Onairo series (as employed in *N Z. Geol Surv. 17th Ann. Rep.*, p. 7) a new group are detailed in the bulletin on the Tongaporutu–Ohura Subdivision, now in preparation.

On field evidence the beds from Sexton Creek, close to the junction of Mangawhio and Upper Waitotara Valley Roads, near Mr. Annabell's, and near Ngamatapouri, belong to one horizon. The common shells at this horizon—*Alcithoe morgani, Cardium spatiosum, Glycymeris manaiaensis, Miltha neozelanica, Olivella neozelanica, Ostrea ingens, Pecten crawfordi, P. triphooki,* and *Polinices ovuloides*—are also common in the Waipipi beds* and are not found in the younger beds; also, eight species have hitherto been found only in the Waipipi beds. Of the remainder, fourteen are new species; and, of the other twenty-eight, those that are not new species occur also in younger beds—Castlecliffian or Recent. The above evidence indicates that the beds are Waitotaran. In the field the stratigraphic position of the strata near Kapara and the waterfall in relation to those down-stream is uncertain. Since the beds at these two localities contain forms which are either new species or occur in the Waitotaran, they also can be correlated with the fossiliferous beds of the Waitotaran. On the other hand, the above conclusions do not agree with that obtained by the percentage method of correlating. The total fauna from this district contains fifty-three species, of which seventeen, or 32 per cent., are still living, whereas 48 per cent. of the fossils in the Waitotaran in the coastal section are Recent. This difference may be due to the smaller fauna from Waitotara Valley, for, since the extinct species, as it happens, are the common shells, further collecting may increase the percentage of Recent ones.

Since the bed of the river from Te Rere-o-Haupa Waterfall rises fairly rapidly to its headwaters, it is unlikely that beds lower than the Waitotaran occur farther up the Waitotara Valley than the part examined by the writer.

A collection made by Park (1887) from the limestone caves near Mangaic (fifteen miles north-east of Ngamatopouri), on the Wanganui River, about four miles above Pipiriki, is probably from the Waitotaran. The fossils, identified by Dr. Marwick, are:—

**Calyptraea tenuis* (Gray) (large)
**Dosinia subrosea* (Gray)
Glycymeris cf. *manaiaensis* Marwick
**Mactra ordinaria* E. A. Smith
Olivella sp.
**Protocardia pulchella* (Gray)
**Solariella egena* (Gould)
**Solariella* n. sp. near *egena* (Gould)

All these except the *Solariella* are abundant in the Waitotaran. *Solariella egena* is not found on the coast below the Castlecliff beds. Thus the area occupied by Wanganuian strata in south Taranaki and west Wellington can be extended from the coast-line in a northerly direction roughly to a line stretching from Hawera to the headwaters of the Waitotara, and across to the Wanganui River a few miles above Pipiriki.

The nearest point where the writer has collected fossils from the Onairo series to the fossil localities near the head of the Waitotara is in the Whangamomona Stream, below Whangamomona Township, distant sixteen miles due north. It would be interesting to explore the unmapped area between the head of the Waitotara and the Whangamomona in order to ascertain the relation of the two groups of strata. Unfortunately, this area is rugged, and for the most part covered by bush.

There is a cold spring about 2 chains from the mouth of Sexton Creek; it is about 9 ft. away from and about 3 ft. above the bank. The spring

* Many of the facts concerning the Waipipi beds were supplied by Dr. J. Marwick.

has a flow of a few gallons per minute, and smells strongly of sulphuretted hydrogen. The water was analysed by the Dominion Analyst, with the following result:—

	Parts per 100,000.
Silica (SiO_2)	2·00
Aluminium (Al)	0·60
Iron (Fe)	0·07
Calcium (Ca)	4·30
Magnesium (Mg)	1·30
Sodium (Na)	3·05
Chlorine (Cl)	4·25
Sulphuric-acid ion (SO_4)	10·10
Carbonic-acid ion (HCO_3)	11·50
Total solids	37·17
Ionic sulphur (S)	0·019
Ionic hydrogen (H)	0·001

These may be combined as follows:—

Sodium silicate ($Na_2O.4SiO_2$)	2·5
Aluminium sulphate ($Al_2(SO_4)_3$)	4·0
Iron bicarbonate ($FeH_2(CO_3)_2$)	0·2
Calcium sulphate ($CaSO_4$)	9·5
Calcium bicarbonate ($CaH_2(CO_3)_2$)	6·0
Magnesium bicarbonate ($MgH_2(CO_3)_2$)	8·0
Sodium chloride (NaCl)	7·0
	37·2
Hydrogen sulphide	0·02

Sulphuretted hydrogen is not uncommon in springs of meteoric origin, and where rising through marine sedimentary rocks is most probably formed by the action of acid waters on iron sulphide (Clarke, 1920). Cunningham Craig (1914) points out that in many oilfields it is formed by the action of water upon sulphur compounds in the petroleum. As an isolated occurrence it has no value as an oil-indication.

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