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Gastropods from the upper Early Jurassic/early Middle Jurassic of Kaiwara Valley, North Canterbury, New Zealand

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with 10 plates and 2 figures

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Abstract

An erratic block of limestone contained within volcanic tuffaceous rock of the Random Spur Melange within the Torlesse Group in Kaiwara valley to the north of Christchurch contained a rich fauna of gastropods of probably late early Jurassic age. The here described gastropods probably live in the environment of a submarine seamound that became integrated into the Random Spur melange during early Cretaceous subduction processes. The fauna consists of gastropods practically all of which are new to science. Here the subclass Archaeogastropoda is represented by the slit bearing Pleurotomariidae *Dictyotomaria gondwanaensis* n. sp., Scissurellidae *Maxwellella novozeelandica,* and Emarginulidae *Emarginula kaiwarensis* n.sp., *Emarginula* sp., *Loxotoma jurassica* n. sp., and *Austriacopsis ovalis* n. sp.. Members of the extinct Cirroidea are present with *Hamusina maxwelli.* Within the Trochoidea, and here Microdomatidae *Eucochlis costata* n. sp. was noted, while *Eucycloscala torulosa* n. sp. is a member of the Turbinidae to which also *Coelocentrus pacificus* n. sp. may be counted. The Liotiinae may be represented by *Klebyella minuta* n.sp., and the Crossostomatidae by *Crossostoma globulifera* n. sp. and *Crossostoma spirata* n. sp. Within the family Trochidae *Guidonia riedeli* n. sp. and *Tylotrochus keuppi* n. sp. can be seen while the somewhat problematic Pseudophoridae are represented by *Sallya calyptraeensis* n. sp. Among the subclass Neritimorpha and superfamily Neritoidea, the new family Pileolidae holds *Pileolus convexus* n. sp.. Members of the subclass Caenogastropoda are the most numerous with Cerithiimorpha represented by the Procerithiidae *Paracerithium spinosum* n. sp., *Paracerithium pacificum* n. sp., *Rhabdocolpus kowalkei* sp. n., and *Cryptaulax* sp. cf. *protortile.* A new family Maoraxidae is created to hold *Maoraxis kieli* n. sp. The taxonomic position of the Maoraxidae is questionable. *Canterburyella pacifica* n. sp. may represent a cerithioidean species or not and belongs to the new Canterburyellidae n. fam. A still unknown superfamily of the Caenogastropoda is represented by the Prisciophoridae n. fam. holding *Prisciophora schroederi* n. sp.. Pommerozygiidae like *Brevizygia spiralosulcata* n. sp. are considered to represent members of the order Littorinimorpha, while the Stromboidea are present with *Pietteia christchurchi* n. sp. The subclass Heterostropha is represented by the order Allogastropoda with the Mathildidae *Tricarilda cancellata* n. sp., Tofanellidae *Cristalloella parva* n. sp., *Camponaxis zardiniensis* n.sp., *Conusella*? *pacifica* n. sp. and Orbitestellidae *Kaiwarella beui* n. sp.. Members of the order Opisthobranchia, superfamily Cylindrobullinoidea are *Actaeonina novozealandica* n. sp. and of the superfamily Acteonoidea *Bullina (Sulcoactaeon) zealata* n. sp. Even though the species from New Zealand are distinct, most of them had close relatives that lived during the late Early Jurassic and early Middle Jurassic in the epicontinental sea of Europe.

Zusammenfassung

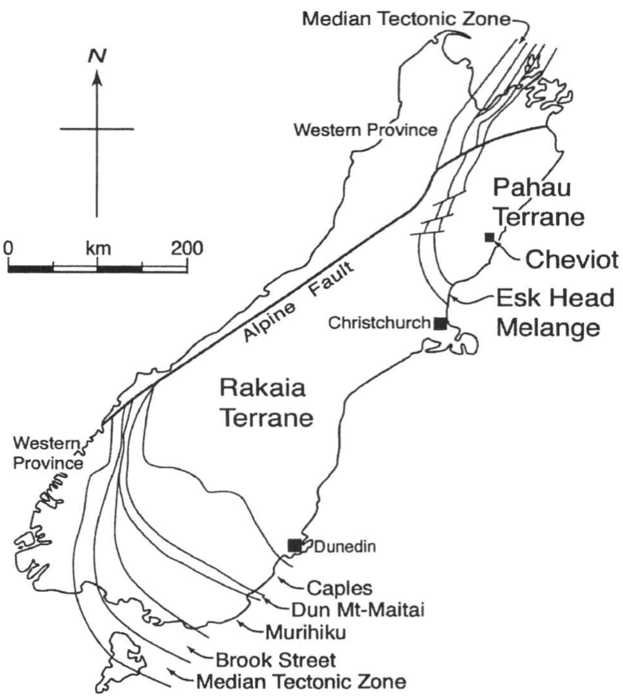
Ein einzelner Block fossilreichen Kalksteins in den Abfolgen der Random Spur Melange innerhalb der Torless Gruppe, deren Gesteine nördlich von Christchurch im südlichen Neuseeland anstehen, enthielt zahlreiche, meist kleine Fossilien, und darunter die beschriebenen Schnecken. Der Block ist wahrscheinlich spät-unterjurassischen Alters und wurde ursprünglich im Milieu eines untermeerischen Vulkans abgelagert, welcher dann später bei Subduktionsprozessen der Random Spur Melange zusammen mit Gesteinen triassischen bis unterkretazischen Alters eingegliedert wurde. Unter den Archaeogastropoden mit Schlitzband kommen die Pleurotomariide *Dictyotomaria gondwanaensis* n. sp., die Scissurellide *Maxwellella novozeelandica*, sowie die Emarginuliden *Emarginula kaiwarensis* n.sp., *Emarginula* sp., *Loxotoma jurassica* n. sp., und *Austriacopsis ovalis* n. sp. vor. Vertreter der ausgestorbenen Cirroidea sind mit *Hamusina maxwelli* vorhanden. Innerhalb der Trochoidea sind die Microdomatide *Eucochlis costata* n. sp., die Turbinide *Eucycloscala torulosa* n. sp. und *Coelocentrus pacificus* n. sp., die Liotiine *Klebyella minuta* n.sp. sowie die Crossostomatiden *Crossostoma globulifera* n. sp. und *Crossostoma spirata* n. sp. vertreten. Trochidae liegen mit *Guidonia riedeli* n. sp. und *Tylotrochus keuppi* n. sp. vor, während die etwas problematischen Pseudophoridae mit *Sallya calyptraeensis* vertreten sind. Innerhalb der Unterklasse Neritimorpha wird innnerhalb der Neritoidea die neue Familie Pileolidae ausgeschieden, welche die neue Art *Pileolus convexus* n. sp. enthält. Nach der Individuenzahl sind Vertreter der Unterklasse Caenogastropoda am häufigsten vertreten. Hier sind die Cerithiimorpha durch die Procerithiiden *Paracerithium spinosum* n. sp., *Paracerithium pacificum* n. sp., *Rhabdocolpus*? *kowalkei* n.sp. und *Cryptaulax* sp. cf. *protortile* vertreten. Die neue Familie Maoraxidae wird um *Maoraxis kieli* n. sp. definiert, ihre Stellung ist noch problematisch. *Canterburyella pacifica* n. sp. könnte mit den Cerithien oder den Cerithiopsiden verwandt sein und wird ebenfalls einer eigenen Familie Canterburyellidae n. fam. zugeordnet. In die Vorfahrenschaft der Latrogastropoda unter den Caenogastropoda könnten die Prisciophoridae n. fam. mit *Prisciophora schroederi* n. sp. gehören. *Brevizygia spiralosulcata* n. sp. gehört in die Littorinimorpha, und *Pietteia christchurchi* n. sp zu den Stromboidea. Zur Unterklasse der Heterostropha gehören die Allogastropoden *Tricarilda cancellata* n. sp., *Cristalloella parva* n. sp., *Camponaxis zardiniensis* n. sp., *Conusella*? *pacifica* n. sp. und die Orbitestellidae *Kaiwarella beui* n. sp., während den Opisthobranchia die beiden Arten *Actaeonina novozealandica* n.sp. und *Bullina (Sulcoactaeon) zealata* n. sp. zugerechnet werden. Obwohl alle hier beschriebenen Arten bisher nur von Neuseeland bekannt sind, besaßen die meisten von ihnen nahe Verwandte im europäischen Bereich, die hier während des frühen und mittleren Juras im Flachmeer lebten.

1 Introduction

Geological Setting

The gastropods described in this account come from the Kaiwara Valley, North Canterbury, about 75 km NNE of Christchurch (Figs. 1, 2). They were collected from a hillside outcrop of pillow lava, tuff and limestone on the east side of the valley north of the disused Random Spur Road, at the head of a small gully about 200 m south of a prominent exposure of volcanogenic rocks known locally as "Mount Sandford". The sequence exposes about 6 m of pillow basalts with brachiopod-rich tuffaceous limestone in interstices, overlain by 12 m of poorly fossiliferous dark green tuff with rare limestone lenses, succeeded by 20 cm of weathered highly calcareous fossiliferous tuff which represents GS 9510, and after one 1,8 m obcured section more than 1,5 m hard crystalline crinoid-rich limestone completes the section.

A special collecting technique had to be applied. Relatively few fossils at this locality are large or complete enough to be recognised as such in hand specimen. Most material was recovered by heating the dried rock with sodium thiosulphate (hypo) until the salt melted and soaked into the matrix, allowing the mixture to cool and solidify, and repeating the process (typically five or six times) until most of the rock had disaggregated. After thorough rinsing with hot water the sample was washed over a 60 mesh sieve, dried and the residue examined with a low-power binocular microscope. Identifiable fossils are rare, and the material discussed here was retrieved from about 20 kg of matrix. Besides gastropods the assemblage includes foraminifera, corals, brachiopods, bivalves, ammonoid fragments, ostracods, crinoids and other echinoderms (MAXWELL, 1987), and teeth of the Mesozoic shark *Hybodus* (R. GARDNER, pers. comm.).



When this site was discovered in 1964 it was assumed that the associated volcanic rocks and limestones formed an autochthonous sequence within the Torlesse "Group", a thick, areally extensive and complexly deformed sedimentary assemblage that forms much of the South Island and a substantial part of the North Island of New Zealand (see below). Large limestone blocks in streams to the north and south of the site were thought to have been derived from a coherent unit that extended for about 1.8 km along the east side of the Kaiwara Valley, a short distance east of the Kaiwara Fault (MAXWELL, 1964). However, it is now clear, the occurrence of such rocks near the fault is fortuitous, the limestone blocks probably range in age from Late Triassic to at least Late Jurassic, and the outcrop is just one of many unrelated blocks within an extensive melange.

Fig. 1. Tectonostratigraphic map of South Island, New Zealand based on LANDIS et al. (1999: fig. 1).

Evidence for the Torlesse rocks near Random Spur Road to represent part of a melange can be noted in the generally rounded topography, which is broken only by randomly distributed resistant blocks ("knocker" topography); the lack of an ordered relationship between the scattered outcrops; the almost complete lack of coherent bedding in outcrops (except within some of the included blocks); and the wide range in age shown by the fossils (Late Triassic to Early Cretaceous, about 85 myr, see below). By way of contrast, Torlesse rocks exposed in the Hurunui and Kaiwara Rivers a few kilometres to the west include some beds that can be traced for several hundred metres along the strike, are generally well-bedded, and span a much more restricted age range (Late Jurassic to Early Cretaceous, about 35 myr).

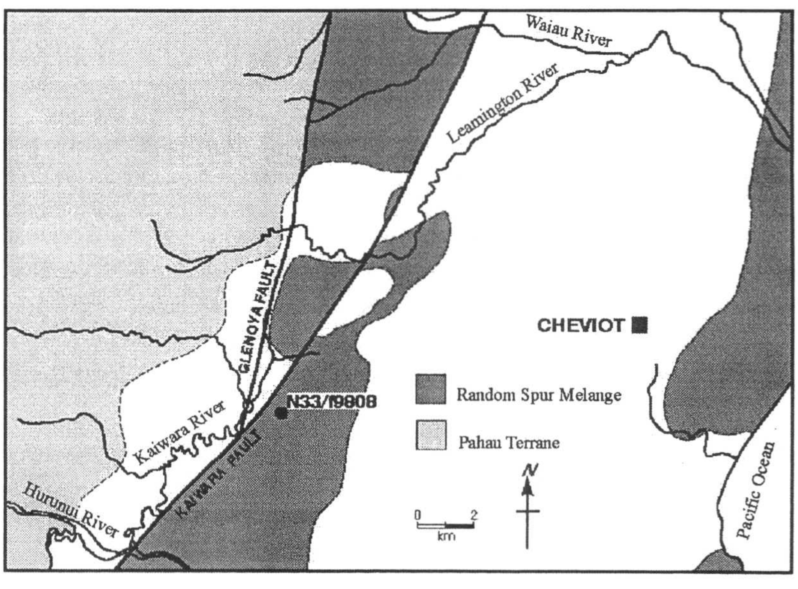


Fig. 2: Distribution of Torlesse assemblage rocks in Kaiwara - Cheviot area, North Canterbury, showing location of collection N33/f9808 (GS 9510). Late Cretaceous - Pleistocene covering sequence shown by unshaded area (boundaries approximate). Based partly on GREGG (1964).

In 1932 H.E. FYFE of the New Zealand Geological Survey collected a petrologic sample from one of the limestone blocks that litter the slope below GS 9510. This was subsequently shown to contain the bivalve *Monotis richmondiana* ZITTEL 1864, and the Torlesse rocks in this area were accordingly shown as Late Triassic by WELLMAN (1956: map 2) and GREGG (1964). No additional specimens of *Monotis* have been collected from the Random Spur Road area, and MAXWELL (1964) suggested FYFE's sample was incorrectly localised; on the other hand, he reported the discovery of several Late Jurassic fossils in float boulders in nearby streams, and others have been found since. They include *Anopaea* n.sp., *Australobuchia plicata* (ZITTEL, 1864), "*Buchia*" sp. aff. "*B.*" *subpallasi* (KRUMBECK, 1934), *Belemnopsis trechmanni* STEVENS, 1965 and *Hibolithes* sp., as well as the problematic microfossil *Stomiosphaera moluccana* WANNER 1940 (CAMPBELL & WARREN, 1965). MAXWELL (1964) assigned the limestone in the Random Spur Road area a Puaroan (Tithonian) age, but palynofloras associated with macrofossils collected nearby indicate one collection is Oxfordian and another (with "*Buchia*" sp. aff. "*B.*" *subpallasi*) Valanginian (WILSON & HELBY, 1987, 1988). CAMPBELL (1965) subsequently described two brachiopods, *Holcothyris* (?) *kaiwaraensis* and *Burmirhynchia Warreni* from one of the limestone blocks and concluded that they were also consistent with a Late Jurassic age. However, there was one anomalous occurrence - the Early Jurassic bivalve *Pseudaucella marshalli* (TRECHMANN, 1923) which was collected from float in a small stream near Mount Ellen (about 3 km NW of Random Spur Road) (SPEDEN, 1979), close to another float boulder with the Late Jurassic belemnite *Hibolithes arkelli* STEVENS, 1965. This is the only record from the South Island Torlesse of *P. marshalli*, which is the index fossil for the Ururoan Stage (Pliensbachian-Toarcian). [The presence of *Pseudaucella marshalli* and Oxfordian dinoflagellates in this area contradicts the claim made by CAMPBELL et al., (1993) - repeated by ADAMS et al. (1998: 237) - that Early and Middle Jurassic fossils are not known from the Torlesse.]

The Torlesse rocks east of the Kaiwara Fault are on the west limb of a major NNE-trending synclinal structure forming the Cheviot-Parnassus basin (GREGG, 1964). Similar rocks on the east limb form the low-lying Cheviot Hills between Cheviot and the coast. Much of the seaward side of the Cheviot Hills is badly slumped (FLEMING, 1958: 376), but there are good outcrops on the coast a few kilometres north of the Jed River. Torlesse rocks here consist of a chaotic assemblage of clasts of varied lithology - ranging in size from pebbles up to blocks of several hundred cubic metres - set in a fine-grained matrix. FLEMING (1958) recorded several molluscs that were taken to indicate a Late Jurassic (mostly Puraoan) age from nearby localities in the Cheviot Hills. They include *Retroceramus* spp., *Anopaea* n.sp., "*Buchia*" sp. aff. "*B.*" *subpallasi*, *Malayomaorica malayomaorica* (KRUMBECK, 1923) and *Hibolithes arkelli* STEVENS, 1965. FLEMING (1987:39) later described the trigoniid bivalve *Psilotrigonia zealandica* from volcanic agglomerate in a small tributary of Jed River and assumed it is also of Late Jurassic, probably Puaroan age. However, a concretion subsequently collected from the beach north of Jed River contains *Monotis richmondiana*, which not only supports the idea that the Torlesse rocks forming the Cheviot Hills are part of a melange, but also restores confidence that Fyfe's *Monotis* specimen from the Kaiwara Valley was correctly localised.

Although additional fieldwork and fossil collections would be desirable, the evidence for a widespread melange in north-eastern Canterbury is compelling. We consider this unit worth naming formally and propose for it the name "Random Spur Melange". (The term "melange" is used here in a non-genetic sense; the unit is probably an olistostrome, but a tectonic component cannot be ruled out.). The type locality is on the coast 2.5 km north of Jed River. Emplacement must have been after the Valanginian, but before the commencement of the Late Cretaceous (Santonian or Campanian)-Cenozoic transgression in this area. It probably took its place during the mid-Cretaceous. The area extent of the unit is uncertain, but it extends from at least the Waiau River in the north to the Hurunui River in the south, and eastwards to the coast. The Kaiwara Fault forms the western boundary over at least part of its length, possibly from near Scargill (18 km south-west of Random Spur Road) to just south of "Glenoya" homestead (c. 800 m south of Random Spur Road). At the latter locality, another major, but hitherto unrecognised fault, here named the Glenoya Fault, branches off the Kaiwara Fault with an approximately NNE strike. It passes west of Mount Ellen, and continues for at least 16 km to the Waiau River, where it seems to be responsible for an otherwise puzzling loop in the river north of "The Wart". Mount Ellen is interpreted as a block of Random Spur Melange, so the Glenoya Fault presumably forms the western boundary of the unit over at least part of its length. Given the tectonic complexity of North Canterbury, however, these boundaries should be regarded as provisional.

Age of GS 9510

The reinterpretation of Torlesse rocks in the Random Spur Road area as a melange means that the associated fossils cannot be used to date GS 9510, except within an unacceptably wide age range (at least Norian to Valanginian). Unfortunately, the Kaiwara faunule lacks the obvious molluscs that have been used to subdivide the New Zealand Jurassic: inoceramids, retroceramids, buchiids, belemnites and (except for fragments) ammonoids. In fact, the molluscan faunule bears little relationship at the generic level to anything else so far recorded from New Zealand, but the gastropods (this paper) have boreal and Tethyan affinities and are consistent with a late Early Jurassic age (Ururoan in the local stage classification). This is compatible with identification of small rhynchonellide brachiopods from the interstices of the pillow basalt about 15 m below GS 9510 as a species of the Early Jurassic genus *Furcirhynchia* (D. AGER, pers. comm. to H.J. CAMPBELL, IGNS).

The bivalve fauna, however, indicates a Middle or even Late Jurassic age. It includes a small oyster referred to *Nanogyra*, which has a stratigraphic range of Bajocian to Tithonian (STENZEL, 1971: N1121). The three species of astartids present in GS 9510 (GARDNER & CAMPBELL, in press) include the only New Zealand record of *Nicaniella*, which has a range of Middle Jurassic to Paleocene. The Kaiwara species has affinities with Bajocian, Oxfordian and Oxfordian to Kimmeridgian species from Europe (R. GARDNER, pers. comm.). The other astartids belong in a new genus, and are closely similar to Late Jurassic species from Japan (R. GARDNER, pers. comm.) A small trigoniid may be a juvenile specimen *of Psilotrigonia zealandica*, but even if it proves to be this species, it provides little information about the age of GS 9510, as the age of the type locality is uncertain (see above). [*Psilotrigonia* has a stratigraphic range of Late Liassic to Cretaceous (FLEMING, 1987: 16, 390).] Also in the faunule is a species of the arcticid *Antiquicyprina*; the type species is Bathonian and other New Zealand records of the genus are from the Temaikan (Aalenian-Callovian) and Heterian (Callovian-Oxfordian). Species of *Grammatodon* (s.str.), *Cingentolium* and *Spondylopecten* in GS 9510 are similar to some recorded from the Callovian to Oxfordian of western India (R. GARDNER, pers. comm.)

Depositional environment

MAXWELL (1964) suggested the limestone in the Random Spur Road area accumulated in shallow, clear waters on the wave-planed summit of a volcanic seamount. GARDNER & CAMPBELL (in press) also invoke deposition on a guyot, which they suggest formed in a low-latitude position and later became incorporated into Torlesse rocks. A warm-water environment for GS 9510 is indicated by the Tethyan affinities of some molluscs (particularly the bivalves), and the presence of colonial corals and a thecideide brachiopod.

Regional Significance

One of the most striking features of New Zealand geology is the marked contrast between the rocks making up most of the axial mountain ranges and foothills (Torlesse or Alpine assemblage), and the largely coeval sequences exposed in the Southland Syncline in southern South Island and their equivalents in Nelson and western North Island (Murihiku Terrane). The former are thick, highly deformed, predominantly quartzofelspathic with minor spilitic volcanics, cherts and limestones, and except for a few notable sites very poorly fossiliferous. Murihiku rocks in contrast, are substantially thinner (though with a total thickness measured in kilometres), structurally simple, largely derived from volcanic rocks but lacking cherts and having much more restricted limestones, and richly fossiliferous. For many years the Murihiku rocks were inferred to have accumulated in a miogeosyncline, the Torlesse in a more distal though contiguous eugeosyncline, but they are now interpreted as distinct tectonostratigraphic terranes (BISHOP et al., 1985; LANDIS et al., 1999). The Murihiku Terrane is thought to have been deposited in an arc-flanking basin on the margin of Gondwanaland, whereas the Torlesse originated as a series of accretionary prisms near a continental landmass. [This is a deliberately simplified account - the Murihiku Terrane is flanked by the Brook Street Terrane to the south-west, and the Dun Mountain-Maitai Terrane to the north-east, and there is another major unit, the Caples Terrane between them and the Torlesse (Fig. 1), (see LANDIS et al., 1999: fig. 4, for a concise summary of South Island terranes.) Recent work (ADAMS et al., 1998) indicates Torlesse rocks accumulated off the east Australian coast of Gondwanaland well to the north of its present position, and subsequently moved south subparallel to the continental margin. These authors suggested Murihiku Terrane is also allochthonous, but formed further south than the Torlesse; however, an exotic origin is difficult to reconcile with the relatively simple structure of this terrain.

The Torlesse assemblage is subdivided into the Rakaia (Carboniferous?, Permian-Triassic) and Pahau (Late Jurassic-Early Cretaceous) Terranes, separated by the Esk Head Melange (Fig. 1). LANDIS et al. (1999: fig. 1) and CAMPBELL & GRANT-MACKIE (2000: fig. 2) show all Torlesse rocks east of Esk Head Melange as undifferentiated Pahau Terrane.

Fossils are typically very rare and of low diversity in the Rakaia Terrane, but there are several rich localities (e.g. Mount Potts, Corbies Creek). Most species are also recorded from the Murihiku sequences, but "exotic" fossils without counterparts in the Murihiku Terrane include Carboniferous conodonts at Kakahu, South Canterbury (JENKINS & JENKINS, 1971) and Permian fusulinid Foraminifera at Benmore, South Canterbury and Glenfalloch Stream, mid-Canterbury (HORNIBROOK & SHU, 1965; LEVEN & CAMPBELL, 1998). The Kakahu and Benmore occurrences are in melange (HITCHING, 1979; HADA & LANDIS, 1995), and the only known block of limestone in Glenfalloch Stream was probably derived from nearby melange (LEVEN & CAMPBELL, 1998.)

Torlesse rocks in the Lowry Peaks block west of the Kaiwara and Glenoya Faults are assigned to the Pahau Terrain. Fossils (mostly in calcareous mudstone concretions) are more common than in most other areas of Torlesse, but diversity is low and there is nothing to compare with the rich Rakaia Terrane sites such as Mount Potts. Most of the molluscs are conspecific with, or have close relatives in Murihiku rocks: *Retroceramus galoi* (BOEHM, 1907), *Australobuchia plicata*, *Belemnopsis* ex gr. *aucklandica* (HOCHSTETTER, 1863), *Hibolithes* sp. aff. *H. arkelli* STEVENS, 1965 and *Idoceras speighti* (MARSHALL, 1924) (MAXWELL, 1964; CAMPBELL & WARREN, 1965). These species are Late Jurassic, but palynological evidence indicates the upper part of the Pahau Terrane in the Hurunui River is no older than late Valanginian (WILSON & HELBY, 1988: 38).

Esk Head Melange is one of the most important geological features in North Canterbury - a broadly arcuate belt that extends from the Wairau Fault in Marlborough south for about 200 km (BRADSHAW, 1973; SILBERLING et al., 1988). The unit includes large blocks of *Monotis* limestone which were long assumed to be autochthonous, as well as clasts with Late Jurassic belemnites. The conspicuous *Monotis* limestone distinguishes Esk Head Melange from the Random Spur Melange about 60 km to the east; it also differs in lacking Early Cretaceous fossils, and is assumed to be an older unit.

One important conclusion that can be drawn about the distribution of fossils within the Torlesse assemblage is that occurrences of exotic taxa (typically considered to be of low latitude origin) are largely, if not entirely in melanges, and typically associated with volcanogenic rocks. (Besides the examples given here the occurrence of Tethyan and non-Tethyan Mesozoic radiolarian assemblages in melanges near Auckland should also be mentioned [SPÖRLI et al., 1989]). These melanges were originally thought to be within Waipapa Terrane but are now assigned to Pahau Terrane (CAMPBELL & GRANT-MACKIE, 2000: 242)]. This implies Torlesse melanges result not simply from massive reworking and mixing of adjacent sequences, but also incorporate rocks that formed much further afield. HADA & LANDIS (1995: 357) ascribed the melange containing fusulinid limestone at Benmore to "collapse of a seamount as it entered a subduction zone", but seamounts may have had a more active role in Torlesse olistostrome formation. A giant late Pleistocene submarine avalanche off the east coast of the North Island is thought to be the result of collision of an obliquely subducted seamount with the continental slope (LEWIS & COLLOT, 2000; COLLOT et al., in press), and a similar mechanism may have formed some Torlesse melanges. However, the abundance of volcanogenic rocks in the Random Spur Melange suggests this was produced by collision with a volcanic chain rather than a single seamount.

Fossils from the Kaiwara-Cheviot area conform to this pattern - most of those from the largely coherent Pahau sequence west of the Kaiwara/Glenoya Faults are also recorded from the Murihiku Terrane, but the Random Spur Melange biota includes a number of taxa so far unknown from the Murihiku sequence: the molluscs "*Buchia*" aff. "*B.*" *subpallasi*, *Psilotrogonia* and most of the genera in GS 9510; the brachiopods *Burmirhynchia*, *Holcothyris* and the only Mesozoic thecideide recorded from New Zealand, and *Stomiosphaera moluccana*. In addition, volcanogenic rocks are much more common in the Random Spur Melange than in the Pahau sequence.

Stomiosphaera moluccana (a calcareous dinoflagellate?) is an especially useful biogeographic indicator with a very restricted stratigraphic range (Late Kimmeridgian to Early Tithonian) (BORZA, 1984). It was originally described from the Moluccas and is also recorded from Celebes and Timor (WANNER, 1940), as well as Greece, Italy, Switzerland, Poland, Turkey and the Carpathians (MAXWELL, 1964; BORZA, 1984), i.e. a typical Tethyan distribution. *S. moluccana* was first recorded from the New Zealand region by MAXWELL (1964) who identified it (and another calcisphere, *Cadosina* sp.) in limestone collected about 800 m north of GS 9510. CAMPBELL & HANDLER (1992: 43) (see also CAMPBELL et al., 1993: 21; CAMPBELL & SIMES, 1996: 35-36) recorded *S. moluccana* from Eketahuna and Mukamuka in southeast North Island and suggested it characterises a belt within the Torlesse assemblage to the east of, and subparallel to the Esk Head Melange. MORTIMER (1995) has differentiated the young Torlesse rocks making up much of the eastern North Island as a separate unit, Waioeka Terrane, and it is possible Random Spur Melange separates this from the older terranes to the west, but a considerable amount of fieldwork and paleontological and petrological studies will be required before this can be substantiated.

2 Systematic part

All types, figured specimens and the other gastropod material came from Kaiwara Valley, North Canterbury, about 75 km NNE Christchurch, boulder G 9510, from late Early Jurassic to early Middle Jurassic age. The whole material is deposited in the Institute of Geological & Nuclear Science, P.O. Box 30368, Lower Hutt, New Zealand.

Subclass: Archaeogastropoda THIELE, 1925

Diagnosis: These gastropods have no planktrotrophic larvae and an early ontogenetic deformation of a bilateral symmetric shell into a trochospiral shell.

Order: Vetigastropoda SALVINI-PLAWÉN, 1980

Diagnosis: These archaeogostropods have a rhipidoglossate radula.

Superfamily: Pleurotomarioidea SWAINSON, 1840

Diagnosis: They are vetigastropods with the nacreous shell bearing slit and selenizone.

Family: Pleurotomariidae SWAINSON, 1840

Diagnosis: These pleurotomarioideans have a shell and anatomy close to that of modern *Pleurotomaria*.

Genus: *Dictyotomaria* KNIGHT, 1945

Diagnosis: The trochospiral shell has rounded whorls and a selenizone in median position. The ornamentation consists of axial and spiral ribs which form a regular pattern with each other. There may or may not be an open umbilicus on the almost flattened base. The genotype is *Pleurotomaria scitula* MEEK & WORTHEN, 1861 from the Late Carboniferous of Texas.

Dictyotomaria gondwanaensis n. sp.
Plate 1/1-3

Derivatio nominis: Named according to its occurrence on ancient Gondwana continent.
Holotype: The specimen figured on pl. 1/3.
Material: Three shells of not fully grown individuals.

Description: The best preserved of the three individuals consists of 2,7 whorls which demonstrate the characteristics of the genus *Dictyotomaria* well. The shell is flat-trochspirally coiled. The 1,7 mm wide and 0,8 mm high shell has an about 0,3 mm wide embryonic shell which is succeeded by about one whorl of the teleoconch without slit and an ornament of evenly bend axial ribs. The slit makes its appearance on the middle of the whorl and remains in this position for the preserved further whorl. The selenizone consists of very regularly arranged well spaced lunulae and lies in a shallow concavity of the upper whorl. One, later two, spiral lirae appear between slit and apical suture. The greatest shell width lies in the spiral lira below the selenizone. On the base there are more spiral lirae (about four) of which one surround the wide umbilicus that is also lirated within. The sculpture of the shell consists of a regular pattern of rectangles formed by the weak axial ribs and the stronger spiral ribs that cross them.

Difference: The first whorl of *Dictyotomaria subcancellata* (D'ORBIGNY, 1849) from the Late Triassic St. Cassian Formation (BANDEL, 1991, pl. 1/1-6; pl. 2/3, 4, 8) closely resembles the juvenile shell from New Zealand. But *Dictyotomaria gondwanaensis* has a more narrow umbilicus and more spiral lirae on the apical whorl between selenizone and suture.

Remarks: BANDEL (1991) discussed the similarity that exists between members of the genera *Dictyotomaria*, *Zygites* and *Kokenella*. *Dictyotomaria gondwanaensis* from New Zealand can be included in this comparison and resembles the conical *Dictyotomaria* within this group of similarly ornamented small pleurotomarians.

Superfamily: Scissurelloidea GRAY, 1847

Diagnosis: These vetigastropods have usually a coiled shell, that is usually small, usually bears a slit and is composed predominantly of aragonitic crossed lamellar structure.

Family: Scissurellidae GRAY 1847

Diagnosis: These scissurelloideans conchologically and anatomically are close to *Scissurella.*

Genus: *Maxwellella* BANDEL, 1998

Diagnosis (according to BANDEL, 1998): The selenizone initiates in the second whorl of the teleoconch, and up to this point the shell is planispirally coiled in apical view. The position of the slit is on the upper edge of the whorl. With initiation of the slit the whorl diameter increases more rapidly than in the non-slit juvenile shell. The ornament of the teleoconch consists of very regular, strong axial ribs.

Difference: *Maxwellella* differs from *Scissurella* by having a planispiral juvenile shell, usually a later begin of the slit and also a later more rapid begin of increase in shell diameter. The genotype is *Scissurella annulata* RAVN, 1933 from the Paleocene of Faxe in Danmark.

Maxwellella novozeelandica BANDEL, 1998
Pl. 1/4-5

*1998 - *Maxwellella novozeelandica* n. sp. - BANDEL, p. 20, pl. 5, figs. 7-8, pl. 6, figs. 1-2

Material: 7 shells.

Description: According to BANDEL (1998) the shell fits into the generic diagnosis with flattened apex and 1,5 juvenile whorls succeeding the protoconch which are without slit. The shell consists of 3,5 whorls and is wider than high (1,5 x 1,2 mm). The protoconch measures 0,14 mm and is thickened at its margin. The juvenile shell with rounded whorls and without slit is ornamented by about 40 axial ribs and fine spiral lirae. With initiation of the slit the apical whorl side becomes flattened and the selenizone lies in a concavity and is bordered by keels. Ornament of this whorl consists of collabral ribs and spiral ribs which form tubercles with each other where they cross forming a network of rectangles. The umbilicus is widely open and surrounded by spiral ribs.

Remarks: *Maxwellella novozeelandica* resembles *Scissurella*? (*Scissurella*?) *szaboi* CONTI & MONARI, 1991 from the Early Jurassic of Turkey (CONTI & MONARI, 1991, figs. 14, 15) and differs from *M. gruendeli* BANDEL, 1998 from the mid-Jurassic beds of Poland by having a stronger ornament and a later appearance of the slit.

Superfamily: Fissurelloidea FLEMING, 1822

Diagnosis: The limpet-like shell in composition is like the Scissurelloidea and usually bears a slit or key-hole with characteristic genera like *Emarginula, Diodora* and *Fissurella.*

Family: Emarginulidae GRAY, 1834

Diagnosis: These fissurelloidean species have a shell with slit and usually selenizone on their anterior shell portion.

Genus: *Emarginula* LAMARCK, 1801

Diagnosis: The limpet-like shell has a slit on its anterior side, which inserts on the apex and is continuous to the shell margin. The protoconch is succeeded by a more or less extended and more or less dextrally twisted limpet-like shell without slit. There is no septum in the shell interior and the posterior slit is closed to form a selenizone. The genotype is *E. conica* LAMARCK, 1801 from the Atlantic Ocean of the Norwegian coast.

Remarks: *Emarginula* is well known from Late Triassic reef deposits of the St. Cassian Formation in northern Italy (MÜNSTER, 1841, Taf. 9, Fig. 15; PICTET, 1855, Taf. 68, Fig.,13; LAUBE, 1869, Taf. 35, Fig. 7; KITTL, 1891; ZARDINI, 1978, Taf. 1, Fig.4-6, Taf. 41, Fig. 15,16) and it has changed very little since that time (BANDEL, 1982, 1998).

Emarginula kaiwarensis n.sp.
Pl. 1/6, 8

Derivatio nominis: Named according to its place of origin in the Kaiwara valley.
Holotype: The specimen figured on pl. 1/6, 8.
Material: About 20 incomplete specimens.

Diagnosis: The cap-like shell of oval outline is high and has the highest point in its posterior third. The selenizone lies in a raised ribbon and it is accompanied by a rib on each side. The ornament consist of about 20 strong radial ribs initiating on the apex and weaker concentric ribs.

Description: The cap-like shell is of broadly oval outline with well rounded anterior and posterior margins and weakly convex sides. Seen from the side it is high and asymmetrically rounded with the highest point positioned in the posterior third. The anterior flank is steeply convex, while the posterior flank below the projecting apex is concave. The larger specimen is about 4 mm long and about 3 mm high. The protoconch is not preserved and lies in the top of the dextrally twisted apex
The selenizone begins after only a short distance from the protoconch margin and lies in a raised ribbon and is accompanied by a keel on each side. Its lunulae form straight lamellae. Major elements of the ornament consist of about 20-30 strong radial ribs which continue from the apex in weakly curving course to the apertural margin. In addition there are numerous weaker concentric ribs especially well developed between the radial ribs and forming weak ridges where they cross them. In the depressions formed by the ribs pores end, but are badly preserved.

Differences: A similar but much larger (about 30 mm long) and better preserved species has been described by DUBAR (1948, p. 138, pl. 11, figs. 14-15) as *Emarginula* cf. *orthogonia* TAUSCH from the Domerian of Morocco. Also the about 20 mm long *Emarginula nobilis* EUDES-DESLONGCHAMPS from the middle Early Jurassic of Normandy in France is similar (EUDES-DESLONGCHAMPS, 1863, p. 30, figs. 8a-c). *Emarginula kaiwarensis* differs from these by having fewer spiral ribs as ornament.

Emarginula sp.
Pl.1/9

Material: One specimen.

Description: The broad shell has a rounded anterior front and an almost straight posterior edge. The flanks are weakly convex. The shell measures 2,8 mm in length, 2,2 mm in width, and 1,3 mm in height. Seen from the side the shell is only moderately convex and the highest portion lies a little behind the frontal shell half. The shell apex lies in the posterior shell portion. The anterior side is weakly convex while the posterior side is weakly concave. The selenizone is positioned in a ridge and accompanied by a rib on either side. Its growth pattern is scaly. The main ornamental elements are 35 radial ribs that continue from the apex to the shell margins. They are separated from each other by shallow intermissions and are crossed by weak concentric growth lines.

Difference: *Emarginula* sp. differs from *E. kaiwarensis* by having a broader shell and less rounded anterior and posterior margins. Its shell is relatively lower and has more axial ribs as ornament. *E.* cf. *orthogonia* TAUSCH (according to DUBAR, 1948) is larger, has a higher shell and more numerous axial ribs in its ornament.

Genus: *Loxotoma* P. FISCHER, 1885

Diagnosis: The limpet-like shell has a slit on its anterior side that is distant from the apex and in a position to the right of the median line. The protoconch is succeeded by an extended and only in its top indistinctly dextrally twisted limpet-like shell without slit. There is no septum in the shell interior. The type is *E. neocomiensis* D'ORBIGNY, 1801 from Early Cretaceous of France (WENZ, 1938, fig. 281).

Difference: *Loxotoma* differs from *Emarginula* by having the slit distant from the apex and to the right of the median line, while in *Emarginula* the slit follows the median line and usually inserts only a little way anterior of the protoconch.

Loxotoma jurassica n. sp.
Pl. 1/7, 10

Drivatio nominis: This is a Jurassic *Loxotoma* and named accordingly.
Holotype: The specimen figured on pl. 1/7, 10.
Material: 2 specimens.

Diagnosis: This relatively low *Loxotoma* has an ornament of about 25 radial ribs.

Description: The broadly ovate limpet-shell has well rounded anterior and posterior margins. Seen from the side the shell is relatively low. The apex lies in the posterior part of the shell. The side in front of the apex is weakly convex while the posterior flank is concave in the upper portion and straight further downwards. Ornament consists of about 25 strong radiating ribs that originate from the apex and become broader on their way to shell margin, with furrows forming between them. There are also weak concentric ribs which form a network with the strong axial ribs surrounding deep depressions. It can not be decided whether these continue into shell pores. The slit lies to the right of the median line, is quite distant from the apex and open from begin to its end (without selenizone). The holotype is 3,0 mm long and about 1,6 mm high.

Differences: *Loxotoma jurassica* differs from *L. neocomiensis* only in regard to the more excentric and more twisted apex, otherwise has very similar ornament and position of the slit.

Genus: *Austriacopsis* HABER, 1932

Diagnosis: The conical limpet with the apex in about central position has a shell hole consisting of a posteriorly rounded and anteriorly narrow open slit that is continuous to the margin. The genotype is *Rimula austriaca* HOERNES, 1853 from the Early Jurassic of the northern Alps.

Austriacopsis ovalis n. sp.
Pl. 1/11-13

Derivatio nominis: This *Austriacopsis* has an oval shell outline (ovalis).
Holotype: The specimen figured on pl. 1/11-13.
Material: One individual.

Diagnosis: The patelliform shell has its apex in almost median position. The trema is of pyriform shape and lies midway between apex and anterior margin, tapering anteriorly to a narrow slit. Ornament consists of indistinct growth lines.

Description: The shell is relatively low, 2,5 mm long and 1,2 mm high. The apex lies a little in front of the centre of the shell and from it the flanks forwards and backwards are almost straight towards the apertural margin. The posterior margin is somewhat less rounded than the other portions of the apertural margin. The protoconch is not preserved. Ornament consists of fine concentric growth lines. The slit is narrow and long with rounded apical margin while it becomes narrow and pointed anteriorly.

Difference: *Austriacopsis ovalis* differs from the other known species of this genus by the absence of axial ornament and the lower shell shape.

Superfamily: Cirroidea COSSMANN, 1916

Diagnosis: According to BANDEL (1993) these sinistral trochomorph archaeogastropods have a nacreous inner shell layer, a flattened protoconch with dextral embryonic and juvenile whorl that changes into a planispiral whorl and later a sinistral teleoconch. The aperture may have an uninterrupted outer lip or a labial slit. Whether they were rhipidoglossate or not is unknown since they have become extinct by the end of the Cretaceous.

Family: Cirridae COSSMANN, 1916

Diagnosis: According to BANDEL (1993) the embryonic whorl of these cirroideans lies in a concavity formed by the dextral initial whorl of the teleoconch which only later changes into sinistral coiling mode. The shell is not slit-bearing. It is ornamented by a dense pattern of axial ribs.

Subfamily: Hesperocirrinae HAAS, 1953

Diagnosis: According to BANDEL (1993) these Cirridae have a conical shell with straight or weakly to convexly rounded sides. The base is gently rounded or flat, umbilicate or not, and connected to the flank by a more or less pronounced peripheral edge or keel. The periphery above the suture may bear nodules. Ornament consists of spiral lirae and spiral ribs crossed by oblique growth lines lirae or ribs often forming tubercles when crossing each other. The aperture is quadrangular.

Genus: *Hamusina* GEMMELLARO, 1879

Diagnosis (according to BANDEL, 1993): The high conical shell without open umbilicus has flattened whorl flanks with a basal angular peripheral carina as corner. The base is almost flat or weakly rounded. The ornament consists of nodes and spiral threads connected to oblique growth lines. The aperture is angular to rounded. The genotype is *Turbo berthelothi* D'ORBIGNY, 1850 from the Late Liassic of France.

Hamusina maxwelli BANDEL, 1993
Pl. 2/1-6

*1993 - *Hamusina maxwelli* n. sp. - BANDEL, p. 58, pl. 4, figs. 9-10, pl. 5, figs. 1, 3-5

Material: About 35 specimen.

Description (according to BANDEL, 1993): The shell is of conical outline with collabral ribs inclined and continuous across the sutures. With 5 whorls it measures 3 mm in height and 2,5 mm in width. The embryonic shell measures 0.15 mm in width and is embraced by a planispirally coiled, rounded first whorl of the teleoconch that is ornamented by a dense pattern of of axial ribs. Dextral coiling changes into sinistral coiling in the second whorl of the teleoconch and here sides of the whorls become flattened. Axial ribs decrease in number and are inclined toward the left base. They are continuous across the suture and across a ridge above the shallow suture. Ribs are transected by fine revolving striation. The base is flattened and the columella is massive. Outline of the aperture is subangular and its orientation is strongly oblique with inner lip reflexed.

Difference: In comparison to the European members of *Hamusina*, *H. maxwelli* is very small. Ribs are inclined and continuous across the sutures as is the case in *Sororcula costata* HAAS, 1953 from the Late Triassic of Peru, but the later has an open umbilicus.

Superfamily: Trochoidea RAFINESQUE, 1815

Diagnosis: According to HICKMAN & MCLEAN (1990) the trochoidean shell has no slit or trema and is of conospiral shape. The aperture is usually simple. Trochoideans usually have a rhipidoglossate radula and are living in the sea. Their shell may have nacre or crossed lamellar structure.

Family: Microdomatidae WENZ, 1938

Diagnosis: These trochoideans resemble the Carboniferous *Microdoma*.

Genus: *Eucochlis* KNIGHT, 1933

Diagnosis: The small conical-ovate, turbiniform shell has a narrow or closed umbilicus and rounded whorls. Apical whorls are smooth and form a low spiral that is followed by whorls ornamented with regular collabral cords first which later become more irregular. The aperture is simple and rounded with reflexed columellar lip and straight oblique outer lip. The genotype is *Eucochlis perminuta* KNIGHT, 1933 from the Late Carboniferous of Missouri, USA.

Eucochlis costata n. sp.
Pl. 2/7-10

Derivatio nominis: A member of *Eucochlis* with radial ribs (costae).
Holotype: The specimen figured on pl. 2/8-9.
Material: About 45 individuals

Diagnosis: The generic diagnosis applies. The embryonic shell is succeeded by a smooth shell of the teleoconch before the ornamental pattern of collabral ribs on the flanks and spiral ribs on the base make their appearance.

Description: The shell consists of 4,5 whorls with the protoconch composing the first three-quarter whorl measuring about 0,2 mm across and ending clearly set off from the following smooth whorl of the early juvenile shell. The following whorls beginning in the second whorl of the shell are ornamented with rounded collabral ribs that are well separated from each other. The first ornamented whorl has about 25 ribs while they decrease in number to about 20 on the last whorl. Axial ribs end on the margin to the rounded base which is sculptured by spiral ribs. The margin to the base is a little cornered and accompanied by the first spiral rib. The umbilicus is very narrow and almost closed by the raised wall of the inner lip. The aperture is rounded, simple and its orientation is oblique and inclined to the spindle axis. This inclination is reflected in the collabral ribs and does not change during ontogeny. The shell is about 2,2 mm high and 1,6 mm wide. The largest individual encountered measures 2,5 mm in height.

Differences: In contrast to the type of the genus the base of *E. costata* is covered by spiral lines and the umbilicus is closed.

Family: Turbinidae RAFINESQUE, 1815

Diagnosis: According to HICKMAN & MCLEAN (1990) the turbinids are usually larger than 5 mm in shell size. But Trochidae and Turbinidae have no real difference in characters of the shell. Both families may be distinguished by characters of the rhipidoglossate radula and the size of the growing edge of the operculum, both features that can not be recognised in fossil species.

Subfamily: Eucyclinae KOKEN, 1897

Diagnosis: The Eucyclinae are based on the Jurassic *Eucyclus* EUDES-DESLONGCHAMPS, 1860. According to HICKMAN & MCLEAN (1990) eucylinins consist only of fossil species.

Genus: *Eucycloscala* COSSMANN, 1895

Diagnosis: The turriform shell has an aragonitic nacreous inner shell layer. The axis of coiling of the first whorl with the planspirally coiled embryonic shell commonly deviates from the axis of the teleoconch. Ornamentation consists of simple axial costae crossed by more or less distinct spiral striae. The aperture is round and the base sculptured only by spiral sculpture. The genotype is *Trochus binodosus* MÜNSTER, 1841 from the Late Triassic St. Cassian Formation from the southern Alps.

Eucycloscala torulosa n. sp.
Pl. 2/11-13

Derivatio nominis: Latin *torus* - thickening, according to the axial ribs.
Holotype: The specimen figured on pl. 2/12
Material: About 50 incomplete specimens

Diagnosis: This *Eucycloscala* has a large protoconch, two convex, rounded teleoconch whorls and later whorls with one spiral rib that is tuberculated where is crosses the axial ribs. Of these 12-14 appear on the second whorl and become increasingly higher and more nodular. They are highest where they connect to the spiral rib, just above the suture and they end at the basal edge. The base is covered by 5-6 spiral ribs.

Description: The holotype measures with about 6 whorls about 3,4 mm in height and is moderately wide. The smooth embryonic shell is quite large (0,2 mm in diameter) and with the onset of the teleoconch appears a little raised from the actual shell apex. Axial costae make their appearance within the second whorl and their number per whorl remains about equal with 12-14 but increase in size with whorl dimension. As they increase in size with growth also the space between them increases and their course is straight and collabral, prosocline. In the fourth whorl the central high portion of the axial ribs connects in a spiral rib. Fine spiral striation occurs with first ribs and is present throughout. The whorl shape is rounded in the first three whorls, becomes cornered in the fourth whorl and appears angulated in later whorls. The weakly convex base is ornamented by spiral ribs. The aperture is round and the umbilicus closed.

Difference: *Eucycloscala supranodosa* (KLIPSTEIN, 1843) from the St Cassian Formation has rather similar ornament of axial ribs to which later a spiral rib is added, but differs by having a more rapid begin of the axial ribs and also less strong axial ornament in the later growth stages. *E. baltzeri* (KLIPSTEIN, 1889) is also similar but has fewer ribs on each whorl. But both of these among the five species of this genus from the Late Triassic of the Dolomites (BANDEL, 1993, pl. 10, figs.4-6,8, pl. 11, fig.1, 4, 5) are clearly close in shape to *E. torulosa* from the Jurassic of New Zealand.

Genus: *Coelocentrus* ZITTEL, 1882

Diagnosis: The shell has plane or low spire and a wide umbilicus. The outer edge of the apical whorls carries a keel with hollow spines. Growth lines between thorns are uninterrupted and the outer lip, therefore, was not slit between consecutive spines but was continuous. The embryonic whorl is that of an archaeogastropod (BANDEL, 1993). The shell has an inner nacreous layer. The genotype is *Cirrus polyphemus* LAUBE, 1868 from the Late Triassic St. Cassian Formation, Dolomites.

Coelocentrus pacificus n. sp.
Pl. 3/1-4

Derivatio nominis: This *Coelocentrus* in contrast to the other so far known species comes from the region of the southern Pacific.

Holotype: The specimen figured on pl. 3/2-4.
Material: 11 shells.

Diagnosis: This *Coelocentrus* has two keels, a spinous one forms the apical margin and a smooth one features the basal margin.
Description: The largest specimen with more than three whorls is 2,9 mm wide. The embryonic whorl measures about 0,13 mm in diameter. The teleoconch is low trochispiral with flat or slightly concave apex, flattened sides, and deep and wide umbilical side. The lateral margins are inclined and bordered on both corners by a keel. Both keels are separated by the concave shell side. The apical keel is the stronger one, and it projects from the peripheral edge. It is featured by gutter-like spines and nodes which insert in the first whorl of the teleoconch. Projections of the keel are numerous at first and later decrease in number to 12 or 13 on the last whorl noted on the largest specimen. The lower keel around the margin of the base is smooth. In section whorls appear somewhat unsymmetrical trapezoidal in shape. The wide base bears an open umbilicus that has weakly convex to straight sides.

Difference: *Coelocentrus pacificus* differs from *Coelocentrus polyphemus*, *C. pichleri* (LAUBE, 1869), *C. tubifer* KITTL, 1891 by having a basal keel on its lateral flanks, from *C. pentangularis* (KLIPSTEIN, 1843) by having a straight side and smooth basal keel (BANDEL, 1993, pls.15-16).

Remarks: Members of the taxon Turbininae RAFINESQUE, 1815 have been traced only to the Late Cretaceous by HICKMAN & MCLEAN (1990) with the genus *Turbo* LINNEUS, 1758. But they suggested that perhaps the Chinese *Gizhouia* YIN & YOCHELSON, 1983 from the Triassic represents a relative of modern *Astraea* RÖDING, 1798. If that is so *Coelocentrus* could also be included here, but also the Silurian *Spinicharybdis* ROHR & PACKARD, 1982 which resembles modern *Guildfordia* GRAY, 1850.

Subfamily: Liotiinae ADAMS & ADAMS, 1854

Diagnosis: The liotiinid shell usually has a rounded aperture with an uninterrupted margin and lamella-like axial ribs on the teleoconch (HICKMAN & MCLEAN, 1990). Recent species have nearly world-wide distribution.

Genus: *Klebyella* GRÜNDEL, 1998

Diagnosis (according to GRÜNDEL, 1998, pl.1, figs.4-7): The small shell is almost planispirally and dextrally coiled with plane apical side and concave umbilical side. The whorls are rounded and touch only little so that the aperture is round. Ornament consists of fine spiral lirae and fine rib-like growth lines crossing each other. The genotype is *Klebyella striatocostata* GRÜNDEL, 1998 from the mid-Jurassic of northern Poland.

Klebyella minuta n.sp.
Pl. 3/5-9

Derivatio nominis: This species is very small (*minuta*).
Holotype: The illustrated specimen is the holotype.
Material: Only the holotype is known.

Diagnosis: This *Klebyella* has evenly curving axial ribs forming a dense pattern. Spiral lirae are lacking. The protoconch measures about 0,3 mm and the aperture is half-moon-shaped.

Description: The planispirally coiled shell with three whorls of the teleoconch measures 1,8 mm in width and 0,86 mm in height. The inner whorl lies a little lower than the following whorl so that the apical side of the shell is slightly concave. The umbilical side has a wide and more strongly concave shape. Whorls meet only little and are well rounded. The protoconch measures about 0,3 mm in width and consists of almost one whorl. The whorls of the teleoconch are ornamented with numerous thin and densely arranged axial and collabral ribs. Spiral lirae are lacking. The aperture has an evenly rounded outer lip and a thin callus on the former whorl forming most of the inner lip, with only a short, well rounded columellar portion.

Difference: *Klebyella striatocostata* from Poland is even less tightly coiled so that apertural shape is more that of a full moon than that of a half moon as is the case in *Klebyella minuta* from New Zealand. Also the ornament in the later consists only on axial ribs. The protoconch of *K. minuta* is larger than that of the genotype, where it measures about 0,2 mm.

Family: Crossostomatidae COX, 1960

Diagnosis: According to KNIGHT et al. (1960) crossostomatid shell is rotelliform to low-turbiniform, thick and usually smooth. The strongly convex whorls end in a circular aperture with an uninterrupted margin formed by a thickened lip. The family is based on the genus *Crossostoma.*

Genus: *Crossostoma* MORRIS & LYCETT, 1851

Diagnosis: The thick, turbinate depressed shell has a deep umbilicus closed by a thickened glaze of the inner lip. There are only few whorls which in the adult are smooth. The fully grown shell has a thickened apertural margin. The aperture is round. The genotype is *Crossostoma prattii* MORRIS & LYCETT, 1851 from the Middle Jurassic Inferior Oolithe of England (WENZ, 1938, fig.512), while KNIGHT et al. (1960) preferred *C. reflexilabrum* (D'ORBIGNY) from the same age, which may be the same species or not.

Crossostoma globulifera n. sp.
Pl. 3/10-13

Derivatio nominis: According to the Latin *globulus* which means small and rounded according to the shell shape of this species.
Holotype: The specimen figured on pl. 3/12-13.
Material: Numerous individuals.

Diagnosis: The thick, turbinate depressed shell has a deep umbilicus that is closed by a thickened glaze of the inner lip. There are only 3,5 whorls which in the adult are smooth. Juvenile shells are ornamented by a variable number of spiral grooves on their base, and very small shells show a widely open umbilicus. The fully grown shell has a thickened apertural margin and round apertural shape.

Description: The low rounded, lenticular shell is up to 3 mm wide and 2 mm high with up to 3,5 smoothly rounded whorls. The base is rounded and is ornamented by several spiral grooves in the juvenile shell and is smooth when fully grown. The columella is solid. The round, almost vertically oriented aperture shows a thickened inner lip and covers the straight columella. This thickened lip is also present in juvenile growth stages of the teleoconch, but it successively covers more of the umbilical region, which in shells of only one to two whorls is open. The embryonic shell demonstrates the characteristics of archaeogastropods and measures 0,13 mm across. The apical flanks of each whorl are smooth and shiny and spiral lines on the base become fewer with continued growth of the shell until they are absent in fully grown specimen. It is here also that the aperture expands and forms a final thickened rounded varix.

Difference: *Crossostoma globulifera* differs from *C. prattii* by the more spherical shell outline and smaller size, since, according to HUDLESTON (1892), *C. pratti* measures 10 to 15 mm across.

Discussion: *Crossostoma globulifera* demonstrates a change from juvenile more lenticular shape to adult more spherical shape that goes along with a closure and disappearance of the umbilicus as well a continuous disappearance and covering of spiral lines present on the base. The adult stage is reached as soon as the apertural swelling of the outer lip is accompanied by a thick callus of the inner lip. A similar change of the base is noted in the Anomphalidae, a group of thick shelled, smooth lenticular archaeogastropods which occur continuously from the Paleozoic into the Triassic (BANDEL, 1993) and from there on to modern tropical seas. But according to its small size *C. globulifera* also resembles modern Skeneidae living among coral rubble in the modern reefs of the Indopacific. These modern forms are of similar small size. SZABÓ & CONTI (1993) connect *Crossostoma* with the more turbiniform smooth rounded members of the genus *Ataphrus* GABB, 1869 and its relation.

Crossostoma spirata n. sp.
Pl. 3/14-16

Derivatio nominis: According to the spiral ornament.
Holotype: The specimen figured on pl. 3/14-16.
Material: Only the holotype is known.
Diagnosis: The shell shape is like that of *Crossostoma globulifera*, but the ornament of spiral grooves is also present on the apical whorl sides.

Description: The shell consists only of about 2,5 whorls and measures 1,1 mm in diameter. The protoconch is of the characteristic archaeogastopod type and measures about 0,24 mm in width without recognisable ornament. The apical side of the shell is almost planispiral while the basal side is clearly convex. Teleoconch whorls are rounded and are separated from each other by distinct sutures. Ornament consists of spiral grooves that cover the whole surface and are separated from each other by broad spaces. The apical whorls show at first about 10 grooves and their number increases rapidly. Growth lines are prosocline in the early whorl and change into almost straight course in the later one. The shape of the base and the aperture is not preserved.

Remarks: The described shell obviously belongs to a juvenile and with base and aperture unknown. The generic position may thus change, when the fully grown individuals of this species do not correspond to the definition of the genus *Crossostoma*.

Family: Trochidae RAFINESQUE, 1815

Diagnosis: According to HICKMAN & MCLEAN (1990) trochids have a shell without slit or foramen with usually conospiral shape and diameter of whorls increasing slowly. An umbilicus is present or not and the aperture is commonly of rounded shape with free anterior margin and usually has an inclined position in regard to the shell axis. The operculum is organic or calcified. Other features characterising this taxon regard the ctenidium, appendages to the foot, sensory cilia of the head tentacles and the rhipidoglossate radula.

Gattung: *Guidonia* DE STEFANI, 1880

Diagnosis: The small, turbinate shell consists of up to eight volutions, and is mostly wider than high. The staircase profil shows a comparatively large body whorl and a low or depressed spire with planispiral embryonic whorl. The convex base bears a funnel shaped umbilicus that is encircled by a ridge. The apical and lateral bands of the whorl are more or less concave. The aperture is subpentagonal in outline with the inner lip thickened and reflexed over the umbilicus. Main elements of ornamentation are two revolving keels bordering the lateral whorl face. Transverse ornamentation consists of growth striae that run obliquely backward. The genotype is *Trochus rotulus* STOLICZKA, 1861 from the Early Jurassic of the Northern Alps (as defined by HAAS, 1953).

Guidonia riedeli n. sp.
Pl. 4/1-3, 5

Derivatio nominis: Named for Frank Riedel (Berlin), a distinguished gastropod researcher.
Holotype: The specimen figured on pl. 4/2, 5.
Material: Its one of the most commonly preserved shells in the Kaiwara fauna with about 100 individuals present.

Diagnosis: The spire is very low, with the first two whorls planispirally coiled. Whorls have two strong keels and both lateral and apical bands of the whorl are gently concave. The base has a large and wide umbilicus. The whole whorls is covered by fine spiral lirae, while axial ornament consists of growth lines and ribs at the base.

Description: The shell of almost 2 mm diameter is 1,3 mm high and consists of 3,7 whorls. The shell profile is depressed. Both lateral and apical bands of the whorl are gently concave. The apical band in the first two whorls is plane, in the third whorl it slopes, and the lateral band is vertical. The nucleus is depressed, and the first two whorls appear planispirally coiled. The embryonic shell measures about 0,13 mm in diameter and demonstrates well the characteristic fold of its apical portion, that is typical for archaeogastropods. Its sculpture was very delicate and differs strongly from the fine lamellation of growth lirae which are present on the teleoconch. The shoulder appears after 1,7 whorls and develops into a keel. Approaching the aperture the body whorl slopes markedly below the keel. The base with a large and wide funnel-shaped umbilicus has a circumumbilical ridge with a concave umbilical flank and a convex lateral flank ending in the lower keel. Fine revolving liration of about 8 lirae on each side of the ridge in addition to axial fine ribs on the umbilical side and regular more widely spaced folds on the outer side produce a characteristic ornament of the base. The subsutural keel is the larger of the two keels and is developed into tubercules where the regular growth lirae cross. The apical band and the shell between the keels are also covered with spiral lirae.

Difference: The five species of *Guidonia* described by HAAS (1953) from the Late Triassic of Peru are quite similar to *G. riedeli* but they all differ in details of the sculpture or/and the width of the umbilicus. *G. peruviana* is smooth, *P. planetecta* has a narrower umbilicus, *P. intermedia* is higher and more angular, *P. parvula* is rather similar regarding the scuptural pattern but has a higher shell and narrower umbilicus, which is also true in the case of *G. bifasciata*.

Discussion: HAAS (1953) discussed the complicated taxonomy of *Guidonia* and his conclusions have been accepted by BANDEL (1994). Of his 5 species from the Late Triassic of Peru *Guidonia intermedia* HAAS, 1953 is most similar to *G. riedeli* from New Zealand. HAAS recognised a similarity to *Trochonema* from Ordovician time and suggested placement of *Guidonia* within the Trochonematoidea. The shell is that of an archaeogastropod, so that it is suggested to place it within Trochoidea instead (BANDEL, 1994).

Genus: *Tylotrochus* KOKEN, 1896

Diagnosis: In the conical shell whorls are rounded initially and later are flattened. They are separated by distinct sutures that form an angulation towards the base which is flattened and without umbilicus. The aperture is strongly inclined. Whorl diameter increases very slowly. Ornament is predominated by spiral lirae, which are crossed by finer growth increments reflecting the strongly oblique apertural margin. The embryonic shell is of the archaeogastropod type and is included in a weakly trochospiral first whorl of the teleoconch, so that the apex has a rounded outline. The genotype is *Trochus konincki* HOERNES, 1856 from the Karnian of the Northern Alps.

Tylotrochus keuppi n. sp.
Pl. 4/4, 6-9

Derivatio nominis: Named for Helmut Keupp (Berlin), a distinguished researcher of molluscs.
Holotype: The specimen figured on pl. 4/6, 9.
Material: About 60 individuals were studied.

Diagnosis: The generic diagnosis applies to this species. Ornament of spiral ribs and inclined growth lines combine on the flanks to a granulated pattern, while on the base the spiral pattern dominates. The corner between flank and base is angular. The base is almost flat in juvenile shells and rounded in the adult. The embryonic shell is succeeded by one smooth whorl of the teleoconch before characteristic ornament begins. Sutures are well marked and the aperture is oblique.

Description: The holotype has about 4 whorls and is 2,4 mm high and 2,5 mm wide. Spiral cords of the shell ornament increase in number from 4 to 6 to 8 in the second, third and fourth whorl. The base bears additional 10 lines. The aperture is inclined with an angle of about 45° formed by the outer lip and shell axis, resulting in oblique and simple growth lines. The protoconch measures 0,3 mm across with three quarters of a whorl and has a well rounded apex. The following first whorl of the teleoconch is initially smooth and rounded while two spiral lirae form later. After 1,5 whorls spiral lirae increase in number and collabral axial ribs appear. Ornament is finely granulated by collabral lines crossing spiral ribs. The suture is only little depressed and whorl flanks are weakly convex. At the periphery a spiral rib is more prominent and forms an angle with the base. The aperture is almost as wide as high, rounded below and angular at the suture. The inner lip is weakly concave.

Difference: *Tylotrochus kaiwarensis* differs from *Ozodochilus cossmanni* KASE, 1984 from the Early Cretaceous of Japan by a more angular periphery, deeper sutures and from *Trochus davoustanus* D'ORBIGNY, 1852 from the Bajocian of France by deeper sutures in combination to a more strongly convex outline and more numerous axial ornamental elements. Very similar is *Pleurotomaria clathrata* GOLDFUSS as described and figured by MORRIS & LYCETT (1850) from the Middle Jurassic of England, but this species is larger and broader, its basis is less convex and the axial ornament almost straight. The Triassic species of *Tylotrochus* described by BANDEL (1993) have quite different ornament of their shell and do not resemble *T. keuppi*.

Family: Pseudophoridae S.A. MILLER, 1889

Diagnosis: The shell is conical and the base flat or concave with a surrounding marginal frill, lamella or sharp corner. The family is based on the genus *Pseudophorus* MEEK, 1973 from the Devonian of eastern North America.

Genus: *Sallya* YOCHELSON, 1956

Diagnosis: The conical shell has a concave base and a surrounding narrow frill formed by the extension of the upper whorl. The base has no open umbilicus and is ornamented with spiral lirae while the ornament on the side is by discontinuous ripple-like, spirally arranged elements and oblique growth increments. Whorl diameter increases strongly during growth, and the aperture is inclined having rhomboedric outline. The genotype is *Sallya linsa* YOCHELSON, 1956 from the Middle Permian of the USA.

Sallya calyptraeensis n. sp.
Pl. 4/10-13

Derivatio nominis: The species resembles *Calytraea* in shell shape.
Holotype: The specimen figured on pl. 4/10-11.
Material: 6 specimen.

Diagnosis: This *Sallya* has a shell with the outer, apical side of whorls weakly convex and continuous into a frill forming the edge of the shell. The whorl is flat on the base and forms a shallow cone. Sculpture of the flanks consists of spiral rows of low rounded tubercules.

Description: A 2,7 mm wide and a little more than 1 mm high shell consists of 2,3 whorls with a rapid extension of their diameter during growth. The flat to slightly convex base of the body whorl forms a shallow concavity below the frill similarly as is the case in modern *Calyptraea*. The steeply conical umbilicus is totally filled by shell material forming a helical structure derived from the thickened inner lip. The ornament of the apical surface of the limpet is formed by revolving ribs (almost 20 on body whorl) consisting of low rounded tubercules arranged to rows. The flat base of the body whorl is sculptured by broad revolving ribs separated from each other by narrow furrows.

Differences: The ornament of rows of tubercles on the flanks and spiral lines on the base differs from the sculpture of growth lines present in the type *Pseudophorus antiquus* (KNIGHT, 1941, pl. 59, fig. 1). *Sallya linsa* differs from *S. calyptraeensis* by having a higher shell and more elongate tubercules in its ornament, but otherwise is very similar. Members of *Calyptraea* do not have the convex and spirally ornamented base and a filled umbilicus.

Remarks: The protoconch of *S. calyptraeensis* is not preserved well enough to decide whether it resembles that of an archaeogastropod, neritimorph or caenogastropod. The frilled *Jurassiphorus* COSSMANN, 1915 appears to have a protoconch of an archaeogastropod (GRÜNDEL, 1997, pl. 4, figs. 9, 10) but the teleoconch is more flattened, consists of more whorls as is the case in *Sallya*, and it is ornamented by axial ribs. *Sallya calyptraeensis* can, thus, be placed with the problematic Pseudophoridae S. A. MILLER, 1889 (KNIGHT et al., 1960) or the Paraturbinidae COSSMANN, 1916 (WENZ, 1938-41). The protoconch is not preserved, but the whorl that should represent it is smaller than would be the protoconch of *Xenophora* (BANDEL, 1993, pl. 12, fig. 1) that measures more than 1 mm in diameter and consists of several whorls. Even though, from a functional point of view, *S. calyptraeensis* represents a gastropod with cap-like shell as is found in the modern *Calyptraea* or

Sigapatella that lived attached and had no operculum (BANDEL & RIEDEL, 1994), a relation with the Jurassic *Jurassiphorus* is more likely. It and the new species may have lived in a similar way.

Subclass: Neritimorpha GOLIKOV & STAROBOGATOV, 1975

Diagnosis: The shell has different shapes but is generally low and consists of few whorls. Commonly the outer shell layer is calcitic while the inner layer consists predominantly of aragonitic crossed lamellar structure. The anatomy regarding kidney plumbing, feather-like ctenidium, and special type of rhipidoglossate radula among others differs from that of the other gastropod subclasses.

Superorder: Cycloneritimorpha BANDEL & FRÝDA, 1999

Diagnosis: Here neritimorphs with dextrally and closely coiled protoconch are united. This taxon includes the order Neritoina RAFINESQUE, 1815.

Superfamily: Neritoidea RAFINESQUE, 1815

Diagnosis: In these cycloneritimorphs the internal shell walls are resorbed.

Family: Pileolidae n. fam.

Diagnosis: Neritoidea of the *Pileolus*-relation with limpet shape which developed during the Jurassic time from *Nerita*-like ancestors in fully marine environment. The family, as suggested by BANDEL (2000), is based on the genus *Pileolus*,.

Genus: *Pileolus* G. B. SOWERBY, 1823

Diagnosis: The shell is patelliform to capuliform and either smooth suface or it is covered with radial ribs. The outer lip is closed around the margin of the concave base. The inner lip protrudes as a broad septum with a smooth to dentate margin and reduces the aperture to a lunate slit. The outer shell layer is calcitic, the inner one consists of an aragonite crossed lamellar structure (MUSTAFA & BANDEL, 1992). The genotype is *Pileolus plicatus* G. B. SOWERBY, 1823 from the Bathonian of England.

Pileolus convexus n. sp.
Pl. 5/1-4, 6

Derivatio nominis: The septum forming the inner lip is rounded, Latin *convexus*.
Holotye: The specimen figured on pl. 5/3, 6.
Material: 9 individuals (including the holotype).

Diagnosis: The full grown shell with almost circular outline measures about 4 mm in diameter. The protoconch is of spherical shape and large. The teleoconch is smooth with only lines of growth present as ornament. The aperture is of crescentic shape with evenly rounded outer lip and almost straight inner lip that extends in a strongly convex callus pad.

Description: This *Pileolus* has a rather small sized capuliform shell of only 1,5 mm in height. The largest shell measures about 4 mm in diameter and is of oval to circular shape with the apex in the centre or slightly displaced from it to the back. The concave base has a broad margin formed by the circular outer lip. Ornamentation consists of growth lines which are concentrically arranged around the large protoconch that measures 0,7 mm. It represents a typical rounded neritimorph larval shell with internal walls dissolved. Coiling of the larval shell is dextral but the number of whorls was not preserved. The teleoconch is smooth, and its slower side is concave with the inner lip protruded as a broad convex septum with simple smooth margin of the inner lip. The lunate aperture has a straight base and rounded outer lip and is wider anteriorly and narrower posteriorly. The inner lip extends onto the rounded callus pad that forms the centre of the base.

Differences: *P. convexus* is lentil-like and not ribbed as many species of *Pileolus* in the Jurassic of Europe or the Cretaceous of Jordan and elsewhere (MUSTAFA & BANDEL, 1992). *Pileolus laevis* SOWERBY, 1823 from the Middle Jurassic of England differs regarding the outline of the aperture which is regularly lunate and has a less thickened callus pad but otherwise is closely similar to *P. convexus* (MORRIS & LYCETT, 1850, HUDLESTON, 1894). DUBAR (1948, pl. 11, figs. 8-10) described a *Pileolus laevis* from the Domerium of Morocco which apparently is much closer to *P. convexus* and may have to be transferred to this species. The Moroccan individuals of this species have lived at about the same age as its representatives from New Zealand.

Discussion : The inner wall within the large protoconch appear to have been totally resorbed, so *P. convexus* displays this character of the Neritioidea which all dissolve the inner walls of their shell including those of the larval shell (BANDEL, 1991, 1992).

Subclass: Caenogastropoda COX, 1959

Diagnosis: The ontogeny of these gastropods may include a planktrotrophic stage during which a dextrally coiled trochospiral protoconch is formed consisting of embryonic and larval shell that usually differs from the teleoconch formed after metamorphosis from larval to benthic life.

Order: Cerithiimorpha GOLIKOV & STAROBOGATOV, 1975

Diagnosis: Here shells are commonly turriform, commonly strongly ornamented and usually have a siphonal notch at their aperture. But a number of members of this taxon have different shell shape and cerithiimorphs are better recognised by anatomical feature, like having no penis, having distinct sperm morphology etc. (HOUBRICK, 1988).

Superfamily: Cerithioidea FLEMING, 1823

Diagnosis: The protoconch of these Cerithiimorpha in species with planktotrophic larvae is commonly multiwhorled, connected to a small first embryonic whorl and provided with an anterior projection of the outer lip of the larval shell. The protoconch usually differs in shape and ornament from the teleoconch.

Family: Procerithiidae COSSMANN, 1906

Diagnosis: The turriform teleoconch is usually ornamented by strong axial ribs crossed by weaker spiral ribs and is connected to a conical cerithioidean protoconch with dominant ornament of one to several spiral ribs. The family is based on the genus *Procerithium* COSSMANN, 1902 with Jurassic type.

Genus: *Paracerithium* COSSMANN, 1902

Diagnosis: In this procerithiid the aperture has a well developed siphonal notch. The conical shell is usually moderately wide and ornamented with one or two strong spiral ribs in position of about median whorl height or a little above it. Whorls have, thus, a keeled appearance. Smaller spiral lirae cover the whorl flanks as well as the base. The few widely spaced axial ribs continue from the suture to the spiral keels on the median whorl, forming nodules with them where they cross. The aperture is of oval shape with strongly convex outer lip, weakly pointed apical margin and short anterior siphonal channel. The genotype is *Paracerithium acanthocolpum* COSSMANN, 1902 from the Early Jurassic of France.

Remarks: The protoconch of the type species of *Paracerithium* is not known. The two species described here to belong to the *Paracerithium* regarding teleoconch shape closely resembles that of the genotype, especially so in case of *P. spinosum*. Here the protoconch is preserved and differs somewhat from that of the other Procerithiidae (GRÜNDEL, 1999).

Paracerithium spinosum n. sp.
Pl. 5/5; pl. 7/1-2, 4

Derivatio nominis: The Latin *spinosus* means thorny, according to the thorn-like tubercules present on the whorl edge.
Holotype: The specimen figured on pl. 5/5 and pl. 7/4.
Material: About 30 specimens.

Diagnosis: The protoconch is ornamented with spiral ribs of which two are strong, with the apical one becoming weaker close to the aperture. On the last larval whorl of the protoconch collabral ribs are present and reflect the apertural projection of the anterior portion of the outer lip, and even though largely covered still preserved just above the suture to the first teleoconch whorl. Ornament of the teleoconch differs from that of the protoconch. A flattened apical ramp ends in a spinous edge forming a keel. The axial ribs initially form nodes, later thorns with this keel. Below the keel the whorl side bears three, later five spiral ribs which cross the about 11 axial ribs forming tubercules with them. The aperture ends anteriorly in an oblique and twisted short canal.

Description: During the first five whorls of the teleoconch the shell increases in size regularly, later the whorls remain the same width, and in the fully grown shell with about 10 to 12 whorls (including the protoconch) even decreases in whorl width. The adult shell may be about 7 mm high. The protoconch consists of more than three whorls and is about 0,8 mm high. The larval shell has initially two, later three spiral ribs. The apical ones becomes weaker close to the aperture. The anterior one becomes keel-like on the last whorl and continues onto the upper margin of the larval hook of the outer lip of the fully grown larval shell. Collabral axial ribs appear on the last larval whorl and twist forwards strongly before they meet the keel-like anterior spiral rib and end there. The projection of the aperture of the larval shell is almost totally covered by the first whorl of the teleoconch. Transition to the teleoconch ornament is abrupt.
Ornament of the teleoconch consists of strong, high and slightly convex axial ribs of which about 10 are found on the first whorl and 11 on later whorls. They are crossed by several weak spiral lirae. Within the first whorl an apical ramp makes its appearance and remains a characteristic element of the teleoconch becoming more prominent with later whorls. This peripheral edge develops a keel which forms nodes, later dull thorns with the axial ribs. These continue from suture to suture. On the apical ramp there is one spiral rib, while on the side there are three, later five spiral ribs that crenulate the axial ribs where they cross them. The corner to the convex base is formed by a spiral rib. On the base there are additional 2-3 continuously weaker spiral ribs. In the largest individuals the last whorls no longer increase in width and the very last one is a little narrower than those before. Here the base is strongly convex, bears six spiral lirae and grades well rounded into the side forming no edge as is the case in earlier whorls. The oval aperture has an oblique and twisted anterior channel.

Difference: *P. acanthocolpum* COSSMANN, 1902 from the Hettangian of Europe has a broader shell, fewer axial ribs, more spirals on the ramp. Otherwise it closely resembles *Paracerithium spinosum* but its protoconch is still unknown.

Paracerithium pacificum n. sp.
Pl. 6/1-3, 7

Derivatio nominis: Named for its occurrence close to the Pacific Ocean.
Holotype: The specimen figured on pl. 6/1-2.
Material: About 75 individuals.

Diagnosis: This *Paracerithium* has a widely conical shell. Whorls are ornamented with eight to nine strong axial ribs present only on the flanks but not on the base and spiral lirae all over which increase in number with consecutive whorls. Two spiral ribs in central position dominate and form keels. The protoconch is ornamented by three spiral ribs.

Description: The shell is of conical shape and whorls are concave and ornamented with nine strong and high axial ribs which cover only the flanks but do not continue onto the base. Axial ribs are crossed by fine spiral lirae which also cover the base. Spiral elements increase in number with whorls size and the two in central position on the flanks become dominant and acquire keel-like appearance. Where ribs and revolving ridges cross each other tubercles form. The base is flattened and covered by spiral ridges.
The protoconch is ornamented by three spiral ribs. It consists of 3,3 rounded whorls, is about 0,35 mm high and 0,3 mm wide. The embryonic whorl measures about 0,1 mm across and appears to be smooth. The pleural angle of the larval shell is smaller (about 50°) than that of the teleoconch (about 60°) and its sculpture ends and changes abruptly with the onset of the teleoconch due to the appearance of axial ribs.

Difference: The two strong spirals about in the middle part of the whorls of the teleoconch characterise *Paracerithium pacificum* and distinguish it from the other species of this genus.

Remarks: *Paracerithium pacificum* represents an unusual member of the Procerithiidae since it has three spiral ribs on its protoconch, while there are usually only one or two present in genera like *Procerithium* and *Rhabdocolpus* (SCHRÖDER, 1995; GRÜNDEL, 1999). In case of *P. spinosum* only the older portion of the larval shell has three ribs, while there are two on the early portion. A protoconch with three spirals may also be present in *Rhynchocerithium* COSSMANN 1906 (GRÜNDEL, 1999, pl.5, figs.1-2).

Genus: *Rhabdocolpus* COSSMANN, 1906

Diagnosis (according to GRÜNDEL, 1999): The shell is slender turriform with more or less distinctly cornered whorls. The protoconch consisting of 3-5 whorls has two spiral ribs on its larval whorls and there may also be an ornament of spirally arranged tubercules. The whorls of the teleoconch initially have three, later five or more spiral ribs. The numerous axial ribs are straight at first and later curve with their anterior end that does not reach the base. The spiral lirae form tubercules where they cross axial ribs. The apical row of tubercules just next to the suture usually increases in magnitude during shell growth. The base is convex, continuous with the sides and is ornamented by 5-7 spiral lirae. The aperture has an indistinct anterior notch and the outer lip forms a low rounded anterior projection. The genotype is *Melania scalariformis* DESHAYES, 1830-32 from the Middle Jurassic of western France.

Rhabdocolpus? *kowalkei* sp. n.
Pl. 6/4-6, 8, 10

Derivatio nominis: Named after our colleague Thorsten Kowalke (Hamburg) who worked extensively with cerithioidean protoconchs.
Holotype: The in pl. 6/4-6 illustrated specimen.
Material: 30 further specimens.

Diagnosis: The apical angle increases during growth to at least the seventh teleoconch whorl. Whorls are ornamented by 7-8 high axial ribs that form a tubercule next to the suture and end before reaching the base. They are crossed by initially three and later 7-8 spiral ribs which have about equal distance to each other. The protoconch has rounded whorls and spiral ribs.

Description: An individual with six whorls of the teleoconch is 3,8 mm high and 1,7 mm wide. The protoconch consists of about four whorls and is about 0,4 mm high. The ornament of two spiral ribs is seen, but there may have originally been more ornamental pattern in existence, since protoconch whorls are somewhat corroded. The teleoconch is slender trochospiral with slow, and later a little more rapid increase in whorl diameter. The sutures are impressed and there is only a rather indistinct posterior ramp formed by the axial ribs. Ornament consists of 7-8 narrow, high, axial ribs on each whorl. Since their number does not increase with growth their distance to each other increases. Ribs are highest next to the apical suture and they decrease in height on the whorl sides until they disappear on the base. These ribs are oriented in such a way that they form a screw-like pattern on succeeding whorls. The whorls of the spire have initially three spiral lirae, later there are continuously more, up to eight spiral lirae. They cross the axial ribs in equal distance to each other crenulating them on their way. The base is weakly convex and connected to the whorl sides by a rounded margin that carries a spiral lira. About six spiral lirae cover the base.

Remarks: *Rhabdocolpus*? *kowalkei* is distinguished from the genotype of *Rhabdocolpus* by the continued increase in apical angle during growth of the shell, the weak whorl ramp only on the first teleoconch whorls, and the few spirally arranged axial ribs. *Exselissa* contrasts to our species by not decreasing in shell width in the last whorl and by lowering the suture here.

Genus: *Cryptaulax* TATE, 1869

Diagnosis: The shell is slender. The protoconch consists of several rounded whorls in which the larval shell is ornamented by two, often tuberculated spiral ribs. The teleoconch is ornamented by axial ribs which are arranged in an alternating screw-like pattern. They are crossed by two primary spiral ribs. There may be more spiral lirae which form tubercules where they cross axial ribs. In the juvenile shell the base forms an angle with the sides and it is rounded in the adult shell. Three spiral ribs ornament the base. The aperture has only an indistinct anterior notch. The genotype is *Cerithium tortile* HÉBERT & EUDES-DESLONGCHAMPS, 1860 (= *Procerithium* (*Xystrella*) *protortile* COX, 1969 nom. nov. = *Cerithium bellayenis* GRÜNDEL, 1999 nom. nov., secondary homonym) from the Middle Jurassic of France and Germany.

Cryptaulax sp. cf. *protortile* (COX, 1969)
Pl. 6/9, 11-13

Material: 30 specimens.

Description: The slender turriform shell has an apical angle of about 50°, and there is no change in the transition from the larval shell to the teleoconch except for more rounded whorls in the former. The embryonic shell appears smooth and measures about 0,12 mm in diameter. The larval shell consists of 3,2 whorls which are ornamented by two revolving keels which are covered with tubercles. Two further rows of tubercles are developed anteriorly. The larval shell has a median larval hook, that is a projection of the outer lip. Growth lines of the larval shell are sinuate in contrast to the straight growth lines of the teleoconch. The sculpture of the first two whorls of teleoconch consists of three spiral ridges which represent more or less a continuation of the spiral keels of the larval shell. Later fine spiral lirae appear between the spiral ridges and between these and the sutures. These revolving elements are crossed by 7-8 straight axial costae which may form continuous ridges which cross the sutures and may continue over large parts of the shell. The base forms an angle with the flank and is ornamented by only few spiral ribs. Since all shells studied represent juveniles, the adult base is not preserved. The aperture is angled above, about as wide as high and channelled next to the straight columella.

Differences: The protoconch of *Cryptaulax* sp. cf. *protortile* has an apertural projection which lies unusually high in comparison to that of other procerithiid protoconches known.

Remarks: The shape of the base that is angulated marginally and ornamented by a only few spiral ribs in the juvenile shell places this species from New Zealand into the genus *Cryptaulax*. From central Europe it is well known that in many species of the Procerithiidae the juvenile shell strongly differs in ornament and shape from the last whorls of the adult shell (GRÜNDEL, 1974, 1999) and therefore the adult whorls of *Cryptaulax* sp. cf. *protortile* may be quite different from the juvenile ones as well.

Family: Maoraxidae n.fam.

Diagnosis: The teleoconch is procerithid in shape with few and strong axial ribs transected by spiral lirae and with angular whorls. The protoconch is high conical with rounded whorls and ornamented by a pattern of axial ribs with forward twisted base and more or less well developed spiral lirae crossing them. The family is based on the genus *Maoraxis*.

Remarks: Regarding the shape and ornament of the teleoconch the genus *Cryptoptyxis* COSSMANN, 1906 is very similar to *Maoraxis kieli* in also having 4-5 axial ribs on each whorl. But according to COSSMANN (1906) *Cryptoptyxis* has columellar folds and the last whorl of the shell is more narrow than former ones; both features are absent in *Maoraxis*.

The protoconch of *Maoraxis* (illustrated as *Cryptoptyxis* sp. by BANDEL, 1993, pl.7, fig.3) resembles in shape and ornamental pattern of a network formed by sinuous axial ribs and finer straight spiral lirae larval shells that have been discovered among so different Cerithioidea and their fossil counterparts in the late Cretaceous and Paleogene as the Dendropominae BANDEL & KOWALKE, 1997 (BANDEL & KOWALKE, 1997, pl. 2, fig. 2; KOWALKE, 1998, pl .8, fig. 9; BANDEL & KIEL, 2000), Planaxidae GAY, 1850 (HOUBRICK, 1987; BANDEL, 1993; BANDEL & KOWALKE, 1997, pl. 1, figs. 4-6; KOWALKE, 1998, pl. 5, fig. 9), Thiaridae (BANDEL et al., 1997, fig. 5C, D; BANDEL & RIEDEL, 1998, fig. 6E), Litiopidae GRAY, 1847 (HOUBRICK, 1987; BANDEL et al., 1997, fig. 1 F,G;) and Provannidae (WARÉN & PONDER, 1991, fig. 44; BANDEL & KIEL, 2000).
BANDEL & KIEL (2000) suggested that Provannidae, Dendropominae, and Litiopidae represent a group of gastropods which are not yet well known, and only few species of each taxon have been studied to date. Based on the similarities which are recognisable among the protoconch sculpture and the radulae of these groups they considered them to be related taxa within the Cerithioidea with the Campanian members *Desbruyeresia antigua* BANDEL & KIEL, 2000 and *Litiopella schoeningi* BANDEL & KIEL, 2000 which were already present in the Late Cretaceous. Perhaps this group of cerithioids with the cancellated larval shell morphology also had *Maoraxis* in its stem group which lived already in the Early Jurassic.

Great similarities of the protoconch of *Maoraxis* also exist with that of some Cerithiopsoidea such as members of the Eumetulidae (*Vatopsis* GRÜNDEL, 1980, *Thereitis* LE RENARD = nom. nov. for *Tembrockia* GRÜNDEL, 1980; GRÜNDEL, 1980, NÜTZEL, 1998). Quite similar are also the protoconchs of very early representatives of the Cerithiopsoidea (*Cerithiopsidella* sp. after GRÜNDEL, 1977, p. 189, fig. 3 and GRÜNDEL, 1980, p. 218, Fig. 1; "Prot. sp. 1" after SCHRÖDER, 1995, p. 16, pl. 2, figs. 1-7). Thus there is the possibility that *Maoraxis* may not belong to the Cerithioidea but to the Cerithiopsoidea.

Genus: *Maoraxis* n. gen.

Derivatio nominis: A free combination of a gastropod from the country of the Maoris with a protoconch resembling that of *Planaxis*.

Diagnosis: The slender teleoconch with angular whorls carries a protoconch with several whorls with ornament of numerous collabral axial ribs crossed by more or less distinct spiral lirae. The ornament of the teleoconch consists of about 5 axial ribs crossed by spiral lirae. The genotype is *Maoraxis kieli.*

Difference: The modern genus *Ataxocerithium* TATE, 1894 with the genotype *Cerithium serotinum* A. ADAMS, 1855 resembles *Maoraxis* in general shape but in contrast the Recent species have a tubular siphonal canal. The genus *Maoraxis* may also include *Cerithiopsidella* sp. as described by GRÜNDEL (1977, 1980) from the Bathonian of Germany. The protoconchs described by SCHRÖDER (1995, pl. 2, figs. 1-7) from the Valanginian of Poland have a similar ornament of the larval shell as found in *Maoraxis,* but axial ribs are more prominent and they join a larval apertural projection higher up on the whorl. Also these protoconchs are more elongate in shape, while that of *Maoraxis* is more conical. So it may well be that SCHRÖDER's assignment to the Protorculidae or some other ctenoglossate species is a more likely one than to cerithioideans, as is suggested here in case of *Maoraxis* (but see under "Remerks" by the genus). NÜTZEL (1998) suggested to place "Prot. sp. 1" of SCHRÖDER (1995) into the stem group representatives of the Janthinoidea and noted its similarity to *Vatopsis* GRÜNDEL, 1980 regarding the features of the protoconch, which resembles *Maoraxis* also in shape of the teleoconch whorls.

Maoraxis kieli n. sp.
Pl. 7/5-11

Derivatio nominis: Named after Steffen Kiel (Hamburg) who found the possible Cretaceous relative to *Maoraxis.*
Holotype: The specimen figured on pl. 7/5-6.
Material: About 20 individuals.

Diagnosis: The generic diagnosis applies to this species. The protoconch consists of a little more than four whorls. The projection of the aperture of the larval shell of the protoconch is partly hidden by the first teleoconch whorl. 6 strong axial ribs on the first teleoconch whorl and later 5 or rarely 4 ornament each whorl, and they are transacted by initially 3-4, later many low and broad spiral ribs. While the first teleoconch whorls have a rounded side, later whorls are flattened and develop an edge next to the suture.

Description: The moderately wide shell carries a slender conical protoconch with more than 4 whorls and 0,7-0,8 mm height. The initial whorl is rounded and measures less than 0,1 mm in diameter. The larval shell is ornamented by 26-30 axial ribs which are crossed by 2 to 3 larger spiral lirae of about equal width and there may be more smaller lirae. Axial ribs of collabral arrangement reflect in their course the lower projection of the outer lip. The first teleoconch whorl has 6, the second only 5 axial ribs.These end near the sutures, are highest in the centre of each whorl and doe not enter the basis. Three to four revolving low and broad ribs crenulate the axial costae where crossing them and of these the rib just below the suture is the most prominent. Whorls are about twice as wide as high.
From the second whorl of the teleoconch onward the ornament consists of 5, seldom of 4 strong axial ribs which are continuous from one whorl to the next, forming a weakly screw-like pattern of rib-ridges. In early teleoconch whorls ribs are strongly incised towards the apical suture and in later whorls they remain in equal height from whorl to whorl. The visible whorl sides are also ornamented by more than 10 spiral lirae of which initially two are more strongly developed and form an angulation and later all are of equal size and the sides are straight. The base is flattened, forms an angular corner with the sides that is pronounced by a strong bordering spiral lira, and is covered by many spiral lirae. The shape of the aperture is not preserved.

Differences: *Cryptaulax pentagonum* D'ARCHIAC from the Bathonian has a more slender shell and is larger. Its ornament has fewer and more faint spiral lirae. The protoconch of *Cryptaulax* differs considerably and resembles that of *Procerithium* und *Rhabdocolpus* (GRÜNDEL, 1999). The protoconch of *Cryptaulax pentagonum* is not known though.

Family: Canterburyellidae n. fam.

Diagnosis: The rissoiniform teleoconch with aperture having an anterior notch is connected to a protoconch in which the larval shell is ornamented with axial ribs. The family is based on *Canterburyella pacifica* n. sp. from the Jurassic of New Zealand, in which the typical teleoconch is preserved together with the ornamented protoconch.

Remarks: *Rissocerithium* CONTI & FISCHER, 1981 and *Zebinostoma* CONTI & FISCHER, 1983 have a teleoconch that is very similar to that of *Canterburyella* but their protoconch is still unknown. Possibly they also belong to the Canterburyellidae.

Genus: *Canterburyella* n. gen.

Derivatio nominis: According to the occurrence of the genotype in North Canterbury, New Zealand.

Diagnosis: The shell is slender and turriform with many convex whorls which are wider than high. The protoconch consists of more than three whorls of which the first is almost planispirally coiled. The ornament of the larval shell consists of numerous axial ribs and the transition to the teleoconch is abrupt and connected to a apertural thickening. Ornament of the teleoconch is dominated by axial costae which are crossed by numerous revolving lines. The aperture is D-shaped with suboval shape and bears an anterior notch with a short canal. The outer lip of the adult shell is thickened. The genotype is *Canterburyella pacifica* n. sp. from the Kaiwara Valley, southern New Zealand (Early/Middle Jurassic).

Canterburyella pacifica n. sp.
Pl. 7/12-16; pl. 8/1, 4

Derivatio nominis: Named according to its place of location near the Pacific Ocean.
Holotype: The specimen illustrated in pl. 8/1, 4.
Material: More than 50 shells, several of which have the protoconch preserved.

Diagnosis: The generic diagnosis applies. The very slender shell is ornamented by broad axial ribs which in the juvenile teleoconch end at the edge to the rounded margin to the base, in the adult are continuous across the rounded conical base. Adult shell forms a final varix of growth. The protoconch is conical with convex flanks, fine axial ribs and a rounded apertural projection of the lower outer lip.

Description: The very slender shell with about 8 whorls of the teleoconch is abou 5 mm high and has a D-shaped aperture with slightly flaring outer lip and thickened inner lip forming the final varix of the fully grown shell. Ornament consist of about 8 axial ribs with indistinct incised spiral lines crossing. The rounded ribs are straight or of curving course, commonly bend toward the aperture. They do not cross the edge to the base except in the very last whorl of the fully grown teleoconch, where they are continuous across the base up to the short siphonal notch. In the juvenile teleoconch the base is ornamented only by fine spiral striae, and it is of weakly convex shape.
The protoconch is slender, about 0,5 mm high and consists of 3,5 whorls. The embryonic shell measures about 0,12 mm across and is rounded. The following larval shell is ornamented by numerous axial ribs (about 40 per whorl) that form a lobe in the lower portion of each whorl that projects from the aperture of the fully grown pediveliger shell. Axial ribs are strongest in the apical portion of the larval whorls and near the aperture these rib are bend forwards anteriorly.

Differences: *Canterburyella pacifica* differs from *Rissocerithium nicosiai* by having a shorter siphonal notch but otherwise is quite similar also in size. The type of *Rissocerithium* represents a 4,5 mm large shell of which the protoconch is unknown. *Zebinostoma* CONTI & FISCHER, 1983 has a less axially ribbed ornament, spiral lirae are lacking and its protoconch is also unknown. Modern representative of the Rissoidae with larval shell usually have no axial larval ornament and the aperture of the larval shell is connected to a strongly projecting hook. *Palaeorissoina* GRÜNDEL, 1999 has a predominantly smooth protoconch with curving axial ribs present only on the last half whorl in addition to fine spiral lirae and a graditional transition into the teleoconch. The type of *Palaeorissoina* from the mid-Jurassic of northern Germany has a shorter shell than is present in *Canterburyella pacifica*, but *Palaeorissoina acuminata* (SOWERBY, 1818) from the Middle Jurassic of northern Germany is close in teleoconch shape to the species from New Zealand, but has sinuous ribs on the larval shell and a more rounded aperture (GRÜNDEL, 1999, pl. 4, figs. 12-16).

Remarks: CONTI & FISCHER (1981, 1983) consider *Rissocerithium* and the similar *Zebinostoma* to be related to the modern genus *Rissoina* D'ORBIGNY, 1840 (see also BANDEL, 1993). *Rissocerithium* differs from *Zebinostoma* mainly by a dominance of axial ribs in shell ornament. GRÜNDEL (1999) placed the similar *Palaeorissoina* in the Rissoidae, Rissoininae, but he excluded *Zebinostoma* and *Rissocerithium* from the Rissoidae. Comparison of teleoconchs of *Canterburyella* from New Zealand with tropical representatives of *Rissoina* from the Indopacific and the Caribbean Sea show similarities, but their protoconchs are different (own unpublished data BANDEL). *Rissoina* and relatives have a short, rounded larval shell with a strong apertural projection, and its ornament is by spiral lines and rows of tubercules. The protoconch of *Canterburyella*, in contrast, is slender and ornamented by sinuous axial ribs. Shell morphology of *Rissocerithium* and *Zebinostoma* is also close to that of the modern representatives of the genus *Colina* H. & A. ADAMS, 1854 as well, which represent Cerithiidae (HOUBRICK, 1990). Protoconch morphology and sculpture of the types of *Rissocerithium* and *Zebinastoma* are still unknown. An exact systematic placement of *Canterburyella* and, thus the Canterburyellidae within the caenogastropods is momentarily not possible.

Unknown superfamily of the Caenogastropoda

Family: Prisciophoridae n. fam.

Diagnosis: The family consists of species with procerithid-like teleoconch and a characteristic protoconch that is large and consists of more than four whorls with characteristic ornament. The first whorl succeeding the smooth embryonic shell with around 0,1 mm in diameter is also smooth. In the following larval shell an ornament of many (around 20) axial ribs appears. Later also spiral lirae occur and the axial ribs twist into apertural direction low on the whorl, so this feature is almost completely covered by later whorls. The larval shell has a strong apertural projection in very low position of the outer lip. The following teleoconch is ornamented by strong, straight axial ribs and fine spiral striae. The aperture is elongate and provided with an anterior siphonal canal. The family is based on the genus *Prisciophora* SCHRÖDER, 1995 from Aptian-Albian beds of northern Germany.

Remarks: The best protoconch connected to a teleoconch was documented by SCHRÖDER (1985, pl. 2, figs. 15-18) from *Prisciophora beyschlagi* (WOLLEMANN, 1903). Here the protoconch consists of 5 whorls and is almost 1 mm high (BANDEL, 1993, p l. 3, fig. 3). An even larger shell, called *Trochoturbella* COSSMANN, 1921 and restudied by GRÜNDEL (1997, pl. 6, figs. 13-14, pl. 7, fig. 1) from the Bajocian of France is 2,8 mm high and consists of about 5 whorls. Here axial ribs appear first on the second whorl, change from dense arrangement to wider spacing in the third whorl, while later spiral elements appear, perhaps indicating the presence of one whorl of the teleoconch. Very similar to the protoconch of the mid-Cretaceous *P. beyschlagi* is that of an *Prisciophora* sp. from the mid-Jurassic of Poland documented by GRÜNDEL (1998, pl. 9, figs. 3-8). Here the embryonic shell of a little less than one whorl is well recognisable by the initiation of first growth line and measures less than 0,1 mm in width. Axial ribs initiate after about 1,5 whorls and a little later than the appearance of a first spiral lira. The illustrated shell is less than 0,8 mm high and consists of 4,5 whorls. Here the characteristic twist of the axial ribs into the apertural projection is seen well. The documented individual has probably just metamorphosed to benthic life as is documented by a thin but well developed calcareous shell.
Brachytrema buvignieri MORRIS & LYCETT, 1850 from the Middle Jurassic of NW France as documented by WENZ (1938, fig. 2096) in general outline resembles *Prisciophora schroederi*, but is much larger. The relations of the family Brachytrematidae COSSMANN are still undetermined as was indicated by WENZ (1938). MORRIS & LYCETT (1850) did not select a genotype to their genus *Brachytrema,* but noted that they knew seven described species and described two new species of which *B. buvignieri* was considered to represent the type of the genus *Brachytrema* by COSSMANN (1900, p. 555). WENZ (1938) characterised the genotype as having an extended and convex outer lip of the aperture. This feature is not noted in the new species and also varieties are not present.

Genus: *Prisciophora* SCHRÖDER, 1995

Diagnosis: The genus has the same characteristic as the family Prisciophoridae.

Prisciophora schroederi n. sp.
Pl. 8/2, 3, 5-9

Derivatio nominis: This species of *Prisciophora* is named in honor of Michael Schröder (Hamburg) who discovered the unusual protoconch of this gastropod.
Holotype: The specimen figured in pl. 8/2.
Material: 23 individuals, including the holotype.

Diagnosis: The generic diagnosis applies to this species. The first two whorls form a smooth protoconch with rounded whorls and broadly conical shape. The next whorl is ornamented by about 25 axial ribs which turn forwards near to the suture. In the fourth whorl a median spiral carina is added to the ornament and axial ribs decrease in number to about 15. The pattern of a spiral median rib crossing axial ribs continues onto the first whorl of the teleoconch, but axial ribs no longer turn forwards at their base but end on the edge of the base. The base in the juvenile shell is conical, extends into the twisted siphonal canal and is ornamented by spiral lirae.

Description: The holotype with 3,1 mm in height consists of 6,5 whorls with a gradual change in sculptural pattern of the protoconch and the first whorl of the teleoconch. The embryonic shell is smooth and measures about 0,1 mm in diameter. There is almost a whole whorl without ornament succeeding the embryonic shell. The first ornamented whorl carries about 25 axial ribs. On the next whorl there are only 16 of these and a median keel makes its appearance. The first three whorls of the protoconch have a rounded profile. On the following still larval whorl an inclined slope develops from the median keel towards the apex and a vertical face is present anteriorly of it. Here axial ribs are more distant to each other and have a distinct forward twist at their base. Below the spiral median keel up to three more spiral make their appearance. Axial ribs number about 15 in the fifth whorl of protoconch which also has the onset of the teleoconch.
On the teleoconch about 10 axial ribs are present and they no longer twist into apertural direction as in the last larval whorls of the protoconch but end at the corner to the base. In this last whorl that could be studied the axial ribs have become broadened and raised in the area where they cross the median keel forming a nodulated carina with it. The whorls are covered with about 15 spiral lirae. The base is set off from the flanks by an edge and ornamented by fine spiral lirae. The aperture is extended into a distinct anterior siphon.

Differences: *Prisciophora schroederi* resembles *Brachytrema turbiniformis* MORRIS & LYCETT, 1850 from the Middle Jurassic of England and *B. wrighti* (COTTEAU) as figured by COSSMANN from France, but is more slender than both these species and much smaller. Of similar shape is also *B. filosum* (BUV.) from the Late Jurassic (Rauracien) of France as figured by COSSMANN (1913, pl. 1, figs. 31-34, 43-47) but again this species is much larger (20 mm). *Prisciophora beyschlagi* is more slender and the teleoconch ornament has fewer spiral lirae but it fits in size with *P. schroederi*.

Order: Littorinimorpha GOLIKOV & STAROBOGATOV, 1975

Diagnosis: Littorinimorpha have a short rounded conical protoconch that might be smooth or ornamented in variable ways. Teleoconchs commonly are ovoid or conical. Modern Rissooidea and Littorinoidea can be regarded as representatives.

Family: Pommerozygiidae GRÜNDEL, 1999

Diagnosis: The short shell consists of 3 to 4 whorls of the teleoconch. The rounded barrel-shaped protoconch consists of several whorls, of which the first are flatly coiled. The whorls of the larval shell have an ornament of short ribs that start just below the suture. The teleoconch whorls are rounded and may be smooth, may be spirally lirated, and may have low axial ribs as well. The aperture is of drop shape with short anterior siphonal notch. The family is based on the genus *Pommerozygia* GRÜNDEL, 1998 from the Middle Jurassic of northern Germany.

Difference: Members of the family Settsassiidae BANDEL, 1992 resemble Pommerozygidae in shape of the teleoconch as well as regarding the rounded protoconch with its flat first whorl. In case of *Lacunina bronni* (MÜNSTER, 1841) from the Late Triassic of the southern Alps there is even a subsutural row of nodes present on the larval whorls, but they do not extend into short ribs as is the case in the larval shell of *Brevizygia spiralosulcata*.

Genus: *Brevizygia* GRÜNDEL, 1999

Diagnosis: The shortly ovoid and rounded shell consists of few whorls. The protoconch consists of a few whorls and has an evenly rounded apex since the initial whorls are almost flat. The shell of the larval part of the protoconch is ornamented with a subsutural row of nodes or short axial ribs. Teleoconch whorls are smooth with indistinctly curving growth lines on the whorl face and forward bend ones on the base. The aperture is of simple ovoid shape. The genotype is *Zygopleura*? *jurassica* GRÜNDEL, 1998 from the Middle Jurassic of northern Germany and Poland.

Brevizygia spiralosulcata n. sp.
Pl. 8/10-14

Derivatio nominis: The name indicates the presence of a subsutural furrow.
Holotyp: The specimen figured on pl. 8/10.
Material: More than 100 individuals.

Diagnosis: The generic diagnosis applies to this species and there is a subsutural spiral groove and the last whorl deviated a little from former regular coiling.

Description: The subglobular-fusiform shell with 5 whorls measures 2,5 mm in height and 1,7 mm in width. The embryonic first whorl measures about 0,1 mm in diameter and is almost planspirally coiled. The following two whorls are well rounded and show indistinct growth lines reflecting a lobe of the outer lip that is largely covered by the following whorls of the shell. Just below the suture the larval shell shows fine ribs arranged in collabral orientation, but ending on the smooth flanks. The larval shell is of naticoid shape, about 0,6 mm high and wide and connected to a projecting larval hook on the outer lip. With the onset of the teleoconch a subsutural groove makes its appearance while the remainder of the shell is smooth outside. Straight fine growth lines can be recognised as well as a rather indistinct fine spiral liration. The aperture is ovoid with narrow apical end and

short anterior siphonal notch. The last whorl deviates a little from former regular coiling and, thus, the suture of the last whorl is more inclined than sutures of the former whorls of the spire.
Differences: All other species of the genus *Brevizygia* that are known have no subsutural furrow on their teleoconch. *Costazygia* GRÜNDEL, 1999 in contrast to *Brevizygia* including *B. spiralosulcata* has sigmoidally curving growth lines. *Oonia pennina* (PARONA, 1892) as described by SZABO (1983) from the Pliensbachian of Hungary is much larger with a shell reaching 30 mm in height. Also the shape of its teleoconch diffes by having a concavity on the side that accompanies the subsutural spiral groove. Also the spiral ornament is more distinctly developed.

Order: "Meta-Mesogastropoda" BANDEL, 1994

Superfamily: Stromboidea RAFINESQUE, 1815

Diagnosis: The shell is more or less trochospiral in shape and the aperture usually has an elongate anterior canal. The outer lip of fully grown specimen is mostly widened to wing-like shape and often has finger-like extensions.

Family: Aporrhaiidae PHILIPPI, 1836

Diagnosis: These stromboids commonly have an ornament of spiral ribs and/or axial ribs and the outer lip of the aperture of fully grown specimen has mostly one or more finger-like extensions. The family is based on modern *Aporrhais*.

Genus: *Pietteia* COSSMANN, 1904

Diagnosis: The teleoconch whorls are ornamented by a keel, axial ribs and fine spiral ribs. On the last whorl only a keel and spiral ribs are present. The aperture is provided with a long and nearly straight anterior canal. The outer lip of adults has a long and narrow horizontal wing which is bent in apical direction. The type species is *Rostellaria hamus* EUDES-DESLONGCHAMPS, 1842 from the Bajocian of France.

Pietteia christchurchi n. sp.
Pl. 5/7-14

Derivatio nominis: According to its occurrence not far from the town of Christchurch, New Zealand.
Holotype: The specimen figured on pl. 5/11, 12, 14.
Material: 6 shells and fragments (the holotype inclusive).

Diagnosis: The shell measures only 3-4 mm in height. The teleoconch whorls are ornamented by a keel below the middle of the flanks and coarse axial ribs and finer spiral ribs. The last whorl has a reduced sculpture. The convex base is rounded.

Description: A specimen with about 6 whorls (without protoconch) is 2,6 mm high. The protoconch consist of several whorls. The teleoconch whorls have a keel below the middle of the flanks. Axial ribs of the ornament are straight and strongest on the keel forming 10-12 nodules with it. Between the keel and the anterior suture axial ribs are only weakly developed. Between the apical suture and the keel at first there are 1-2, later 4-5 spiral ribs without nodules. One or two spiral ribs lie between the keel and the anterior suture. On the last whorl ornament is subdued and only the keel and the spiral ribs are distinctly developed while the suture is coming down. The strongly convex base bears about 10 spiral ribs. There is no accentuated spiral rib that borders the flank. The aperture is broadly oval in shape.

Differences: Similar species to *Pietteia christchurchi* are known from the mid-Jurassic of Europe, as for example *Pietteia hamus* (EUDES-DESLONGCHAMPS, 1842), *Alaria unicarinata* HUDLESTON, 1882-85, *Alaria hamoides* HUDLESTON, 1887-96. But they are much larger in size measuring about 20-25 mm in height, their keel lies nearer to the apical suture, and the base is separated from the flank by a strong and accentuated spiral rib.

Subclass: Heterostropha FISCHER, 1885

Diagnosis: The subclass represents all those gastropods that have a sinistral larval shell (protoconch) and a dextral teleoconch with a change in coiling at metamorphosis or during larval life, or such species that had ancestors with such ontogeny. In rare cases this tendency left to right coiling is reversed.

Order: Allogastropoda HASZPRUNAR, 1985

Diagnosis: The order includes shell bearing Heterostropha like the Streptacidoidea, Pyramidelloidea, Mathildoidea, Architectonicoidea, Nerineoidea and Valvatoidea which are not Euthyneura.

Superfamily: Mathildoidea DALL, 1889

Diagnosis: Here species with elongated shell with many whorls that are usually ornamented with spiral and axial elements are included. The protoconch has a sinistral embryonic shell and twists into dextral coiling at the end or still within the course of the larval shell.

Family: Mathildidae DALL, 1889

Diagnosis: The elongated shell with many whorls is sculptured by spiral carinae that may be crossed by collabral costae or growth lines. The aperture is subcircular. The protoconch is sinistral and rests on the dextral teleoconch at a right angle or an angle smaller than 90° between the axis of the larval shell and the axis of the adult shell. This larval shell is low conical with rounded whorls that may show some axial folds on the apical and umbilical sides. Just before the onset of the teleoconch the shell twists into the planispiral coil before the dextral coiling of the teleoconch begins. The onset of the teleoconch is always abrupt and connected with a change in sculpture. The family is based on the genus *Mathilda* with a type species living in the Mediterranean Sea.

Genus: *Tricarilda* GRÜNDEL, 1973

Diagnosis: The heterostrophic protoconch is large and smooth to axially wrinkled. The shell is high-turriform with teleoconch ornament with three spiral ribs and numerous collabral axial ribs forming a reticulated pattern with each other. Where ribs cross a tubercule is formed. There may be additional minor spirals and whorls are rounded. The aperture is rounded with the inner lip covering the columella. The genotype is *Mathilda (Tricarilda) plana* GRÜNDEL, 1973 and from the Middle Jurassic of northern Germany and Poland.

Tricarilda cancellata n.sp.
Pl. 9/11-3

Derivatio nominis: From Latin *cancelli* -cancellate pattern.
Holotype: The specimen figured on pl. 9/1-2.
Material: 6 individuals (inclusive of the holotype).

Diagnosis: The generic diagnosis applies to the species. The protoconch consists of about 1,7 trochoform sinistral whorls with coiling axis forming an angle of about 45° with the coiling axis of the dextral teleoconch. The whorls of the teleoconch are sculptured by 3 spiral ribs which lie next to each other of which the uppermost is separated from the suture by a broad, inclined whorl portion. About 18 axial ribs are present on each whorl and they are stronger than the spiral ribs.

Description: The protoconch measures 0,45 mm across and consists of 1,7 whorls. Its last whorl was formed by a planktotrophic larva that thickened its final aperture. Its ornament consist of axial folds present on the umbilical side and disappearing on the flanks. Change from sinistral to dextral coiling occurs in the transition from the protoconch to the teleoconch so that the teleoconch is dextral from first secretion onward.

Only three whorls of the teleoconch are preserved on a 2 mm high shell. Ornament is that of 3 spiral ribs of equal size close to each other which are transsected by about 18 axial ribs. The upper flank of the whorl is flattened and forms an edge with the upper of the three spiral ribs. The base is rounded and not umbilicate. It shows a spiral rib at its margin which is usually covered by the succeeding whorl and a weaker spiral on its proper. No adult individuals are known.

Difference: *Tricarilda cancellata* differs from the similar Jurassic *T. angulata* GRÜNDEL, 1997 by having a larger protoconch, fewer and stronger axial ribs and three spiral ribs which lie next to each other on the teleoconch and fewer spiral ribs on the base.

Family: Tofanellidae BANDEL, 1995

Diagnosis: The small, slender, turritelliform shell has spiral and collabral ornament with spiral ribs or keels dominating. Whorl flanks are angular or convexly flattened. The aperture is angular or rounded and provided with a short, shallow anterior canal. The distinctive feature of this family is the protoconch. The embryonic shell is sinistral and immersed in the apex of the larval shell. The rounded whorls of the larval shell gradually change from sinistral coiling to planispiral and finally to dextral coiling. The pediveliger shell is, thus, dextral. Apertural margin of the protoconch is usually thickened, and a hook-like projection of the outer lip may or may not be present. The larval shell is smooth or indistinctly ornamented by growth lines of straight outline and axial or spiral lirae. The Tofanellidae are based on *Tofanella* from the St. Cassian Formation.

Subfamily: Tofanellinae BANDEL, 1995

Diagnosis: The protoconch has a larval hook. The whorls of the teleoconch have a keel, and their flanks are usually angular. The ornament consists of axial ribs and fine spiral ribs.

Genus: *Cristalloella* BANDEL, 1995

Diagnosis: The shell is slender, small and multiwhorled with keeled flank and fine axial ribs crossed by spiral striae. The aperture is angular with a short siphonal fold. The smooth or wrinkled larval shell has a sinistral first whorl immersed in the apex that grades into a dextral final whorl, which has a thickened margin. The genotype is *Cristalloella cassiana* BANDEL, 1995 from the Late Triassic of the southern Alps.

Cristalloella parva n. sp.
Pl. 9/4-8

Derivatio nominis: Named after having a small, Latin *parvus*, shell.
Holotype: The figured specimen on pl. 9/5-8.
Material: 4 specimen.

Diagnosis: The diagnosis of the genus applies to the species. The tofanellid protoconch has wrinkles, consists of 1,5 whorls and has a thickened simple margin. The base of the teleoconch forms a sharp edge.

Description: With six whorls the shell measures about 1 mm in height. The toffanellid protoconch consists of 1,5 whorls, has wrinkles in its larval portion and a thickened simple margin. It measures 0,22 mm in diameter. The teleoconch whorls have a characteristic triangular outline produced by the median keel. Numerous fine collabral striae reflecting the oblique course of the outer lip and cross the keel. They are continuous across the suture which is indistinct and with the third whorl of the teleoconch accompanied by a subsutural spiral rib. Ornament of the base consists of growth lines.

Difference: *Wonwalica spiralocostata* GRÜNDEL, 1998 from the Callovian of northern Germany has a hooked apertural margin of the protoconchs and the teleoconch whorls have fewer axial ribs and more prominent spiral ornament than *Cristalloella parva*. The later differs from *Wonwalica minuta* SCHRÖDER, 1995 from the Early

Cretaceous of Poland by not having an apertural hook of the protoconch margin. *C. parva* has a teleoconch that is extremely similar in shape and ornament to that of *Cristalloella cassiana* BANDEL, 1995 from Late Triassic St. Cassian Formation and differs from it only by the protoconch that has only 1,5 whorls and not two whorls.

Subfamily: Usedomellinae GRÜNDEL, 1998

Diagnosis (according to GRÜNDEL, 1998): The protoconch has no larval hook and whorls of the teleoconch have no keel and are well rounded. Ornament may consists of axial ribs, fine spiral ribs or only axial ribs or may be absent. The typical genus is *Usedomella* GRÜNDEL, 1998 from the Middle Jurassic of northern Germany with smooth teleoconch.

Genus: *Camponaxis* BANDEL, 1995.

Description: The teleoconch is ornamented by axial ribs that may or may not be crossed by spiral lirae of smaller size than the ribs. The protoconch is of tofanellid type with a sinistral embryonic shell and twists into dextral coiling well within the larval shell. The genus is based on *Camponaxis lateplicatum* (KLIPSTEIN, 1843) from the Late Triassic St. Cassian Formation in the Alps.

Remarks: Similar shells in size and shape nowadays commonly occur in the Pyramidelloidea GRAY, 1840, family Pyramidellidae GRAY, 1840. Here the teleoconch has an aperture that is elongate to ovate, with or without columellar folds. Their heterostrophic protoconch is smooth and oriented 90-150° to the teleoconch. Transition from sinistral protoconch to dextral teleoconch occurs where they meet with each other. This can be regarded as the major difference to the Jurassic Usedomellinae which have a tofanellid protoconch in which only the embryonic shell is sinistral while during the growth of the larval shell dextral coiling is acquired and the transition into the teleoconch is from dextral larval whorl to dextral whorl of the benthic snail. The Jurassic *Urlocella* GRÜNDEL, 1998 has a high-trochospirally and conically coiled shell with convex whorls relatively wide in relation to their height and a sculpture which is reduced during the ontogeny. Otherwise it closely resembles *Camponaxis*.

Camponaxis zardiniensis n.sp.
Pl. 9/9-13

Derivatio nominis: Named in honour of Rinaldo Zardini from Cortina d'Ampezzo who described and collected many of the gastropods from the St Cassian Formation also in the locality Campo, from here this genus received its name.
Holotype: The specimen figured on pl. 9/9-10.
Material: With the holotype 19 individuals.

Diagnosis: The slender shell is ornamented by rounded axial ribs that end at the edge to the base. The aperture is simple and the apex crowned by a tofanellid protoconch in which the sinistral early whorl twists into the dextral larval shell long before the pediveliger shell is completed. The larval shell is sculptured with incompletely developed axial ribs.

Description: The 2 mm long shell with about 8 whorls is of slender turriform, conical shape with the rounded knob-like apex formed by the tofanellid protoconch that is more than 0,2 mm wide. It is almost as high and consists of 1,8 whorls. The embryonic shell is distinctly sinistrally coiled and less than 0,1 mm in diameter. The larval shell has rounded axial folds on its apical side which end on the sides and become weaker on the last portion of the larval shell. The transition to the teleoconch is well visible and simple without larval hook present. Ornament of the teleoconch consists of costae separated by broader intervening spaces and flexuous on the basal whorl where they end. 10-12 axial ribs are found on the first whorl of the teleoconch and their number increases to more than 15 in the fifth whorl. The aperture is small and as wide as high with simple inner and outer lips. The base is smooth and not pierced by an umbilicus.

Remarks: The teleoconch closely resembles that found among members of the modern genus *Turbonilla* RISSO, 1826. But in connection to the protoconch *Camponaxis zardiniensis* closely resembles *Camponaxis lateplicata* from the Late Triassic, which is perhaps a little more slender and has a smaller protoconch. The protoconch of *C. subcompressa* (KITTL, 1894) is practically identical to that of the species from New Zealand (BANDEL, 1995, pl. 14). *Stuorilda* BANDEL, 1995 from the Late Triassic St. Cassian Formation has a rather similar teleoconch shape but a more strongly ornamented protoconch of the ampezzanildid type (BANDEL, 1995, pl. 19).

Genus: *Conusella* GRÜNDEL, 1998

Diagnosis: The tofanellid protoconch is narrower than the first teleoconch whorl and has no distinct larval hook. The small slender teleoconch has whorls with nearly straight flanks and indistinct sutures. The whorls are broad in relation to their high. The genotype is *Conusella conica* GRÜNDEL, 1999 from the Pliensbachian of northern Germany.

Difference: Within the similar *Usedomella* GRÜNDEL, 1998 the protoconch is broader than the first teleoconch whorl, while the teleoconch whorls are rounded and separated from each other by deep sutures, and are mostly high in relation to their width.

Conusella? *pacifica* n.sp.
Pl. 10/1-3

Derivatio nominis: Named for its occurrence in the Pacific region.
Holotype: The specimen figured on pl. 10/2-3.
Material: 10 individuals inclusive the holotype.
Diagnosis: The slender, smooth shell carries a blunt protoconch with intucked embryonic whorl. The protoconch is a little wider than the first whorl of the teleoconch. Teleoconch whorls are wider than high, their ornament may bear very fine spiral striae, and flanks are nearly straight and sutures are shallow.

Description: The protoconch consists of about two whorls with tofanellid type of coiling and measures more than 0,2 mm in width and about 0,2 mm in height. The axis of coiling is the same as that of the teleoconch and the round whorls are smooth. The onset of the teleoconch is without transition with somewhat inclined apertural margin. The teleoconch is conical with smooth nd only weak convex whorls and not very distinct sutures. A shell with about 5 whorls is 1,6 mm high and 0,6 mm wide. Whorls are gently convex or almost flat in profile and ornament consists only of simple growth lines. There is a small subsutural shelf. The aperture is oval, the inner lip is straight and the outer lip evenly convex. The last whorl occupies about half of shell height. The base is weakly convex with an indistinct umbilicus. Growth lines are almost straight and the aperture is broadly ovate. The smooth inner lip is a little detached in the columellar and umbilical region.

Differences: From *Usedomella* differs *C.*? *pacifica* by its protoconch which is broader than the first teleoconch whorls and by the lower teleoconch whorls with nearly straight flanks. *Conusella* GRÜNDEL, 1999 has a similarly smooth shell, but differs by having the protoconch not as broad and not wider than the first whorl of the teleoconch as is the case in *Conusella*? *pacifica*. The broad tofanellid protoconch distinguishes this species from modern pyramidellids. The taxonomic position of *C.*? *pacifica* is therefore uncertain. The Early Jurassic ?*Chevallieria* sp. from Germany described by SCHRÖDER (1995) (= *Usedomella schroederi* GRÜNDEL, 1998) has a smooth shell which is more slender and has more rounded whorls.

Superfamily: Valvatoidea GRAY, 1840

Diagnosis: The lowly conical, small, valvatiform teleoconch has a simple aperture and is connected to a sinistrally coiled protoconch in this group of marine and fresh water species of Heterostropha. The sinistral protoconch is smooth, consists of embryonic and in marine species commonly also larval shell and is coiled along the same axis as the dextral teleoconch.

Family: Orbitestellidae IREDALE, 1917

Diagnosis: The almost planispiral, teleoconch is of small size and usually has spiral keels. The species of the family are marine and based on the genus *Orbitestella* with the type *Cyclostrema bastowi* GATLIFT, 1906 living in the Indopacific Ocean.

Genus: *Kaiwarella* n. gen.

Derivatio nominis: This small shell is named for its type locality in Kaiwara valley.

Diagnosis: The *Orbitestella*-like, flatly coiled shell has an apical ridge and ornament of axial ribs that reach a marginal keel that is present on the lower whorl side. The base is concave with wide umbilicus. The angular aperture has a notched outer lip forming the lateral keel. The genotype is *Kaiwarella beui.*

Kaiwarella beui n. sp.
Pl. 10/4-7

Derivatio nominis: Named for the palaeontologist and gastropod worker A.G. Beu (Lower Hutt, New Zealand).
Holotype: The specimen figured on pl. 10/4, 6.
Material: Three specimen.

Diagnosis: The diagnosis of the genus applies. The shell has a broad keel situated just below half its height. On the apical whorl face there is an edge with a vertical outer side and an inclined inner side. Ornament consists of numerous axial ribs which reach the marginal keel. The base has a wide open umbilicus, near the keel a spiral rib and coarse growth increments. The smooth protoconch has planispiral shape with rounded whorls.

Description: The shell consists of about three whorls, is 1,2 mm wide and planispirally coiled. The protoconch consists of about one and half whorl and measures about 0,2 mm across. With begin of the teleoconch an edge is formed on the apical side of the whorl from which there is an almost vertical drop off to the side and a strong keel that forms the greatest shell width and the edge to the base. Sutures are grooved. This keel on the side is covered by the succeeding whorl. The base has well developed growth lines and a deep groove that accompanies the keel and a spiral keel bordering it. On the apical side the ornament consists of strong and straight axial ribs which are contiñuous from the suture to the lateral keel. They are a little narrower than the depressions separating them. On the last whorls there are 30-35 axial ribs. They are prosocline on the lateral keel and weakly prosocyrte on the flanks. The base has low axial ribs but much better developed growth lines. The aperture is of subrectangular shape, and it is notched where the keel has its origin in the outer lip.

Difference: Of the Jurassic Orbitestellidae only *Praeorbitestella keuppi* is known from the Callovian of Germany (GRÜNDEL, 1998). It differs by having no keel and no axial ribs. Modern species of *Orbitestella* have a less well developed lateral keel and the strong edge on the apical side as found in *K. beui* is usually lacking.

Order: Opisthobranchia MILNE-EDWARDS, 1848

Superfamily: Cylindrobullinoidea WENZ, 1947

Diagnosis: The shell is egg-shaped in outline with a conical or step-like spire and growth lines as the major sculptural elements. The aperture is elongate and oval and the spindle is thickened but bears no folds. The larval shell is sinistral and twists into the teleoconch at the very end of its whorls. Its axis forms an angle from 90 degrees to less than about 45 degrees with that of the teleoconch.

Family: Cylindrobullinidae WENZ, 1947

Diagnosis (according to WENZ & ZILCH, 1960): As in the superfamily, with elongate and oval aperture and spindle that bears no folds. The larval shell is sinistral and twists into the teleoconch at the very end of its whorls. The taxon is based on the genus *Cylindrobullina* AMMON, 1878.

Genus: *Actaeonina* D'ORBIGNY, 1847

Diagnosis: The slender shell is egg-shaped to elongate conical and whorls are moderately convex with more or less distinct narrow ramp between suture and whorl side. A spiral incision accompanies the ramp anteriorly on the whorl side. Growth lines are the major elements of sculpture. The aperture is elongate oval. The inner and columellar lip are simple, may be thickened and raised to cover the umbilical slit. The spindle bears no folds. The sinistral protoconch forms an angle of 90° or smaller with the dextral teleoconch. The genotype is *Actaeonina acuta* D'ORBIGNY, 1847 from the Oxfordian of France.

Differences: The shell of *Actaeonina* resembles that of *Cylindrobullina* in general shape, the type of protoconch and simple ornament consisting of growth lines. *Actaeonina* differs by its ovoid shape and slender spindle-like outline in contrast to the stair-like and more cylindrical shape of *Cylindrobullina* where the subsutural ramp is always well developed.

Actaeonina novozealandica n. sp.
Pl. 10/8-10, 12

Derivatio nominis: An *Actaeonina* from New Zealand.
Holotype: The specimen figured on pl. 10/9, 12.
Material: 5 individuals.

Diagnosis: The shell is slender with rounded sutural ramp that grades into the spiral groove. The protoconch measures about 0,3 mm in diameter and is coiled with such angle of to the coiling axis of the teleoconch that its inner (embryonic) whorls are partly displayed.

Description: The 1,8 mm large egg-shaped shell consists of 4 whorls of the teleoconch with last whorl slightly smaller than the spire. The whorls have a rounded angular corner and below it a spiral narrow groove. The aperture is pear-shaped. The lines of growth form a shallow forward pointing lobe. Other sculpture is lacking. The early ontogenetic shell is sinistral, consists of 1,5 whorls of almost 0,3 mm in diameter and rounded outline and bears a wide umbilicus. It twists into the dextral adult shell at the very end of the larval whorl. Its axis forms an angle of about 50° with the axis of the teleoconch and its inner whorl is only partly covered by the first whorl of the teleoconch.

Difference: Several similar species are known from the Early Jurassic of Germany. *A domeria* GRÜNDEL & NÜTZEL, 1998 has a larger protoconch, a broader and more inclined ramp that forms a sharp edge with the anterior groove. *A. obliquata* GRÜNDEL & NÜTZEL, 1998 is larger measuring 1,5 mm with only two whorls of the teleoconch and has the whorls of the protoconch more immersed and sutures more inclined. *Sinuarbullina procera* GRÜNDEL, 1999 differs by a more exposed protoconch and the sinuate course of its growth lines. *Actaeonina pralongiana* (BANDEL, 1994) from the Late Triassic St. Cassian Formation is also very similar, but its inner lip is formed by a callus that shows a plica at the anterior end, which is not present in *Actaeonina novozealandica*.

Discussion: Members of the Cerithellidae like *Ceritella* from the Late Jurassic show some similarity in general shell shape with *Actaeonina*, but the spire is more slender, sutures are less pronounced and the aperture is shorter (HUCKRIEDE, 1967, pl. 18, 19). *Actaeonina*/ *Cylindrobullina* can be traced into the Triassic time (BANDEL, 1994) and is common in the Jurassic of Europe (GRÜNDEL, 1997; GRÜNDEL & NÜTZEL, 1998; SCHRÖDER, 1995).

Superfamily: Acteonoidea ORBIGNY, 1842

Diagnosis: Acteonidae with *Acteon*- like shell shapes have as characteristic features an ornament of spiral furrows with pitted appearance. The modern Acteonoidea hold the family Acteonidae and Bullinidae with solid shells and the Hydatinidae with thin and reduced shell (THOMPSON, 1976; BURN & THOMPSON, 1998).

Remarks: Acteonoidea with the name giving genus *Acteon* can be traced from the Middle Jurassic (COSSMANN, 1895; SCHRÖDER, 1995; GRÜNDEL, 1997) in a continuous line to the modern species. They do not appear first during the Cretaceous of Europe as stated by ZILCH (1960) and repeated by GOSLINER (1981). Acteonoidea differ from Cylindrobullinoidea by having spiral ornament. They differ from Actaeonelloidea by the same feature but may have columellar folds like these. Hydatinoidea have a thinner and more reduced shell. Ringiculoidea have a thickened apertural margin.

Family: Bullinidae RUDMAN, 1972

Diagnosis: The *Acteon*-like shell has a smooth columellar edge. The shell is spindle-like or broadly oval in shape with the sinistral protoconch forming an angle with the teleoconch that may reach 90°. The spira may form a more or less distinct ramp with the last whorl. Ornament consists of spiral furrows or incisions that may be transected by fine collabral axial lirae. The aperture is of drop-like shape with indistinct anterior notch and inner lip callus that may cover the umbilical region.

Remarks: The Bullinidae differ from the Cylindrobullinidae by the submerged protoconch and the spiral furrow as ornament on the teleoconch. From the Ringiculidae they are distinguished by the simple aperture, while the protoconch of both families is similar. Bullinidae differ from Acteonidae by the absence of columellar folds. The oldest representatives of the acteonelloids where included in an own family Sulcoactaeonidae GRÜNDEL, 1997 which in all essential features resembles Bullinidae as are still living. Sulcoactaeonidae differ from Acteonidae by the absence of columellar folds, but a difference to the Bullinidae as described by RUDMAN (1972) based on modern *Bullina* can not be stated. The same can be said in regard to the *Nonacteonina* (STEPHENSON, 1941) relation placed in the Nonacteoninidae by BANDEL (1994), which, therefore, would also represent a synonym to the Bullinidae.

Genus: *Bullina* FÉRUSSAC, 1822

Diagnosis: The shell of acteonid shape with short spire and ornament of punctuate grooves has no columellar fold, open and narrow umbilicus, is rounded, and its protoconch is inclined. The genotype is *B. scabra* (GMELIN, 1791). *Bullina* shells are illustrated by BURN & THOMPSON (1998) from the Australian waters of the Pacific Ocean.

Subgenus: *Sulcoactaeon* COSSMANN, 1895

Diagnosis: The egg-shaped shell has a short spire and a large body whorl and is sculptured by spirally arranged grooves and ridges. Axial ribs are missing. Whorls are well rounded and separated by a deep suture or a narrow ramp. The umbilical slit is almost closed by callus of the inner lip and the spindle is short. The genotype is *Actaeon striatosulcatus* ZITTEL & GOUBERT from the Late Jurassic of France.

Bullina (Sulcoactaeon) zealata n. sp.
Pl. 10/11, 13-15

Derivatio nominis: Free combination of "Zea" from New Zealand with the Latin *latus* meaning broad.
Holotype: The specimen figured on pl. 10/14-15.
Material: 9 individuals.

Diagnosis: The generic and subgeneric diagnosis applies. The protoconch lies strongly inclined in the apex of the teleoconch with about 55° formed by both axes of coiling. The ornament is formed by strong, about equally wide spiral ribs which are separated from each other by narrower grooves.

Description: The shell with 3,5 whorls of the teleoconch measures 2,2 mm in height and 1,4 mm in width. 14 broad, rounded ribs separated by more narrow, rounded grooves ornament the body whorl which makes up two thirds of the shell height. The spiral ornament is crossed by fine, axially arranged growth striae, best visible within the grooves and here producing a regularly pitted appearance. The inner lip of the aperture is thickened by callus and raised to cover a slit-like umbilicus. There are no folds or plicae present on the columellar lip.

The protoconch consists of almost two whorls and is 0,25 mm wide and high. The smooth whorls are sinistrally coiled and of naticoid shape with a wide umbilicus. In the very last portion of the larval shell the twist from the sinistral into the dextral coil is apparent and the larval shell is well set off from the teleoconch by an increment in growth as well as the begin of spiral sculpture. The axis of coiling of the protoconch is at angle with the spindle axis of the teleoconch.

Difference: *Bullina (Sulcoactaeon) zealata* differs from most *B. (Sulcoactaeon)* species known from the Jurassic of Europe (COSSMANN, 1895; GRÜNDEL, 1997) by the regular ornamental pattern. Most other species have a more pronounced apical ramp. A similar ornament is found in the Late Jurassic type species of the subgenus *Sulcoactaeon*, but here the grooves are narrower and the shell is wider. *Parvulactaeon* GRÜNDEL, 1997 has a similar ornament but shells are smaller consisting maximally of two whorls of the teleoconch and there is a distinct ramp. *Sulcoactaeon pullus* (KOCH & DUNKER, 1837) as described by SCHRÖDER (1995, pl. 11, figs. 11-15) from the Late Jurassic of north Germany differs only in the details of ornament, which consists of 20 instead of 14 spiral grooves and ribs on the last whorl. In neither the Andean nor the Alpine fauna of the Late Triassic a similar form is found (BANDEL, 1994).

3 Conclusions and comparison with European faunas

Archaeogastropods had no planktrotrophic larvae and should, thus, have a more local appearance than such gastropods in which planktotrophic larvae occur, as is the case in the Neritimorpha, Heterostropha and Caenogastropoda. Among the archaeogastropods of Kaiwara we only recognised members of the Vetigastropoda, while members of the Docoglossa were not encountered. Among the slit bearing (Selenimorpha) gastropods only one species of the genus *Dictyotomaria* may be placed in the nacreous Pleurotomarioidea even though it differs from modern *Pleurotomaria* both in size and shape of the shell. *Dictyotomaria gondwanaensis* n. sp. is not close to modern forms of this family but to more ancient ones like *Dictyotomaria subcancellata* from the Late Triassic of the southern Alps. The latter closely resembles the Carboniferous species from the USA on which the genus is based.

The other selenimorph species belong to groups characterised by a shell with crossed lamellar structure. Here the Scissurelloidea are represented by *Maxwellella novozeelandica* which is not distant from other Jurassic representatives of this genus like *M. gruendeli* from Poland but also resembles modern species of the Scissurellidae. The limpet-like Fissurelloidea are represented by Emarginulidae of quite different character. The two species of the genus *Emarginula* resembles Triassic species as well as modern ones. *E. kaiwarensis* and *E.* sp. are similar to *Emarginula* cf. *orthogonia* from the Jurassic of Morocco and *Emarginula nobilis* from western France. Their shells have the slit on their anterior side and it inserts near the apex while the slit in the shell of *Loxotoma* is a little displaced to the right and it inserts distant from the apex. *Loxotoma jurassica* from New Zealand is very similar to *Loxotoma neocomiensis* from the Early Cretaceous of France. In the genera *Loxotoma* as well as *Austriacopsis* no recent representatives are known. The later is present with *Austriacopsis ovalis* that differs from *A. austriaca* from the Early Jurassic of the northern Alps by having a smooth shell. The special shape of the slit of *Austriacopsis* which is pyriform, lies midway between apex and anterior margin, and tapers anteriorly into a narrow slit is unknown in modern species of the fissurelloids.

In case of the Cirroidea the taxon can be traced back in time to the Silurian (FRÝDA, 1999) but its last representatives lived near the end of the Cretaceous. In the Cirridae the dextral embryonic and juvenile whorl changes into a sinistral teleoconch. *Hamusina maxwelli* closely resembles European members of the genus but is quite a bit smaller, in this regard being closer to *Sororcula costata* from the Triassic of Peru, but the later has an open umbilicus.

A number of archaeogastropods can be placed into the Trochoidea. But here taxa are difficult to recognise with any certainty by the shape of their shell, which has no slit, is of conospiral shape, and usually has a simple rounded shape of the aperture. But by comparison *Eucochlis costata* can be placed with the Microdomatidae based on Carboniferous *Microdoma* with *Eucochlis perminuta* from the Late Carboniferous of North America (Missouri) having a very similar shell shape. Whether *Eucycloscala torulosa* belongs to the Turbinidae is difficult to prove since Trochidae and Turbinidae have no real difference in the general characters of their shell. The same can be said about the place of *E. torulosa* in the Eucyclinae which are based on Jurassic *Eucyclus* which probably is an archaeogastropod and may be closely related to *Eucycloscala*. *E. torulosa* from Kaiwara closely resembles *Eucycloscala supranodosa* and *E. baltzeri* from the Late Triassic of the Dolomites. Also regarding the genus *Coelocentrus* it is unknown whether is has relatives among modern trochoideans. But

Coelocentrus pacificus resembles *Coelocentrus polyphemus*, *C. pichleri* and *C. tubifer* from the Late Triassic of the Dolomites.

Klebyella minuta may be a member of the Liotiinae which usually have a rounded aperture, a small-sized shell, and lamella-like axial ribs on the teleoconch. It is close to *Klebyella striatocostata* from the mid-Jurassic of Poland and also resembles *Fredericella* BANDEL, 1993 from the Jurassic and Late Triassic (GRÜNDEL, 1998). Modern representatives of Skeneidae may look rather similar to species placed in the family Crossostomatidae of the Jurassic. *Crossostoma globulifera* and the similar *Crossostoma spirata* have spiral ornament but otherwise are close to *Crossostoma prattii* from the Middle Jurassic of England and France. Representatives of the genus *Guidonia* resemble more modern members the Trochidae. Here *Guidonia riedeli* is similar to the five species of *Guidonia* known from the Late Triassic of Peru, but they all differ from each other in details of the sculpture and of the umbilicus. *Tylotrochus keuppi* resembles *T. clathrata* from the Middle Jurassic of England but is smaller, and it is also similar to *Ozodochilus cossmanni* from the Early Cretaceous of Japan and *Trochus davoustanus* from the Middle Jurassic of France.

The shells of the basically Paleozoic Pseudophoridae are characterised by conical shape and concave base within a surrounding marginal frill. *Sallya calyptraeensis* in shape and ornament of low spirally arranged tubercules closely resembles the Permian *Sallya linsa* from the USA. The most likely relation is that to the frilled *Jurassiphorus* which appears to have an archaeogastropod typed protoconch. So *Sallya calyptraeensis* could be the lone survivor of a Permian genus only known from North America with no relation to European species of the time.

In summary the slit bearing archaeogastropods from Kaiwara with *Dictyotomaria gondwanensis* connect to older European species, with *Maxwellella novozeelandica, Emarginula kaiwarensis* and *Emarginula* sp. to species of the same age in the tropical and boreal European Jurassic as well as to modern species, and with *Loxotoma jurassica* and *Austriacopsis ovalis* to European fossil relatives that lived perhaps up to mid-Cretaceous time. Regarding the extinct Cirroidea *Hamusina maxwelli* seems to be in the continuation of Late Triassic species from Peru. Among the trochomorph archaeogastropods *Eucochlis costata* resembles a North American Carboniferous species, while *Eucycloscala torulosa* seems closely related to Late Triassic species of the southern Alps, that is from the tropical Tethys. The same is the case for *Coelocentrus pacificus*. *Klebyella minuta* appears to be a relative of a European group of small-sized species that existed from the Late Triassic and the Jurassic. *Crossostoma globulifera* and *C. spirata* have relatives in the shore living fauna of the European Jurassic, while *Guidonia riedeli* appears related to species from the Later Triassic of Peru. *Tylotrochus keuppi* can be related to European species of the same age and Japanese ones from the Early Cretaceous. *Sallya calyptraeensis* would be a similar case as *Eucochlis costata* with relations to older species that lived in North America.

Neritimorpha are presented by *Pileolus convexus* representing one of the earliest known members of the genus *Pileolus*. It is similar in shape to species that lived in coastal environment in the Middle Jurassic of England as well as on the other side of the Tethys in Morocco. The genus is derived from *Nerita*-like ancestors (BANDEL, 2000), but the Pileolidae have apparently not survived the Late Cretaceous.

Among the Caenogastropoda the Procerithiidae are represented in the fauna of Kaiwara by three genera, but not by *Procerithium* with the probably most basic ornament of the teleoconch consisting only of axial ribs (GRÜNDEL, 1997, 1999). All procerithiid species encountered in New Zealand have the characteristic protoconch of the group with two or three spiral ribs present on the larval shell, and the teleoconch ornament consists of spiral and axial elements. *Paracerithium* with *Paracerithium spinosum* resembles *P. acanthocolpum* from the Hettangian of Europe of which the protoconch is still unknown. *Paracerithium pacificum* has three spiral ribs on its protoconch, while there are usually only one or two present in genera like *Procerithium* and *Rhabdocolpus*. Of the later genus *Rhabdocolpus*? *kowalkei* is distinguished from the European genotype of *Rhabdocolpus* by the steady increase in apical angle during growth of the shell, the weak whorl ramp, and the few spirally arranged axial ribs. *Cryptaulax* sp. cf. *protortile* with the typical protoconch ornamented by two tuberculated spiral ribs has an unusual apertural projection of the larval shell that lies quite high up on the outer lip.

A new group of the Cerithioidea or Cerithiopsoidea of Jurassic times is recognised with the new family Maoraxidae in which a procerithiid teleoconch is connected to a protoconch with an ornament of axial ribs. The protoconch of *Maoraxis* resembles that of Cerithioidea like Dendropominae, Planaxidae, Thiaridae, Litiopidae and Provannidae, but also that of some cerithiopsoidean genera like *Vatopsis*, *Thereites* (= *Tembrockia*), and *Eumetula*. *Vatopsis* also resembles *Maoraxis* regarding the shape of the teleoconch whorls. On the other side, *Maoraxis kieli* resembles *Cryptaulax pentagonum* with unknown protoconch from Europe. The protoconch of some other species of *Cryptaulax* differs from that of *Maoraxis* and resemble those of *Procerithium* and *Rhabdocolpus* (GRÜNDEL, 1999) so that the position of *C. pentagonum* with the Maoraxidae or the Procerithiidae remains to be determined.

CONTI & FISCHER (1981, 1984) considered *Rissocerithium* and *Zebinostoma* as members of the Rissooidea but emphasised some similarities to the Cerithioidea. The genotype *Rissocerithium nicosia* from "Ammonitico Rosso" of Italy has a similar teleoconch to *Canterburyella pacifica*, but its protoconch is unknown. The protoconch of the latter species that represents the type species to the new family Canterburyellidae is conical with convex flanks, fine axial ribs and a rounded apertural projection of the lower outer lip and, thus, differs considerably from protoconchs of true rissoid genera. The teleoconch has great similarity to the teleoconch of *Palaeorissoina* GRÜNDEL 1999. *Canterburyella pacifica* differs from *Rissocerithium nicosiai* by having a shorter siphonal notch, but otherwise is quite similar also in size. *Palaeorissoina* has a predominantly smooth protoconch with curving axial ribs present only on the last half whorl. *P. acuminata* from the Middle Jurassic of northern Germany in the shape of its teleoconch is quite close to the species from New Zealand, but has a palaeorissoid protoconch. The Canterburyellidae resembles several groups of Caenogastropoda (Cerithioidea, Cerithiopsoidea, Rissooidea) and their taxonomic position is questionable.
The order Littorinimorpha is represented by the Jurassic family Pommerozygiidae with *Brevizygia spiralosulcata*, representing the oldest species of this taxonomic unit with a number of members in the Middle and Late Jurassic of Europe. Stromboidea are recognised in *Pietteia christchurchi* with similar, but larger species known from the Middle Jurassic of Europe. The newly introduced family Prisciophoridae with characteristically large and ornamented protoconch is based on the genus *Prisciophora* from Aptian-Albian beds of northern Germany. *Prisciophora schroederi* is the oldest known species of this group with exceptional protoconch that appears very large and of "modern" type as later found in the Latrogastropoda of the type defined by RIEDEL (2000) which do not appear before the mid-Cretaceous.
Within the subclass Heterostropha order Allogastropoda a member of the superfamily Mathildoidea, family Mathildidae is represented by *Tricarilda cancellata* that is rather similar to mid-European species of this Jurassic genus that is rather close to the modern *Mathilda.* The more Mesozoic representatives of the family Tofanellidae are recognised with *Cristalloella parva* that resembles *Wonwalica spiralocostata* from the Callovian of northern Germany as well as *Cristalloella cassiana* from Late Triassic of the Alps. The subfamily Usedomellinae is represented by *Camponaxis zardiniensis* that resembles the Late Triassic *Camponaxis lateplicatum* from the Alps and *Conusella*? *pacifica* that is in shape of the protoconch like *Usedomella* from the Jurassic of mid Europe and in shape of the teleoconch resembles *Conusella conica* that differs by having a narrower protoconch. The new genus *Kaiwarella* can be placed in the superfamily Valvatoidea family Orbitestellidae, and here *Kaiwarella beui* resembles modern species of *Orbitestella.*
The order Opisthobranchia with its most basic superfamily Cylindrobullinoidea family Cylindrobullinidae is represented by *Actaeonina novozealandica* which has similar species in the European Jurassic and Triassic. The members of the more modern superfamily Acteonoidea D'ORBIGNY, 1842 are represented by *Bullina (Sulcoactaeon) zealata* that closely resembles *B. (Sulcoactaeon) pullus* from the late Jurassic of north Germany. There is no indication so far that any member of the acteonoids had occurred prior to the begin of the Jurassic.
Jurassic gastropods have been described from Europe during the last two centuries beginning with J. SOWERBY's publications of 1812-1823. Main regions of research have been Great Britain, France, Germany, and Switzerland and the fossils described were mainly large shells coming from coastal environments. Here archaeogastropods have been dominating. Only much later the small sized fauna of soft substrates from more off-shore environments was considered (BANDEL & HEMLEBEN, 1987; GRÜNDEL, 1974 a,b, 1975 a, b, 1977, 1997 a,b, 1998 a,b, 1999; GRÜNDEL & NÜTZEL, 1998; NÜTZEL & KIESSLING, 1997; SCHRÖDER, 1995; WALTHER, 1951). Here most species are small sized and only few show relations with those of the near shore environment. Archaeogastropods are, thus, more rarely present and Caenogastropoda and Heterostropha form the bulk of the encountered species.
A comparison can also be carried out with the Jurassic gastropods of the Bakony Mountains (Hungary) from Tethyan environment (SZABÓ, 1979, 1980, 1981, 1982, 1983). The fauna from the Bakony Mountains originated off-shore in the tropical Tethys Ocean and usually lived on hard surfaces. It is richer in the number of species than are recognised in the fauna from Germany and Poland that lived on the shelf of an epicontinental sea. In the Tethyan fauna Archaeogastropoda dominate forming 86 % of the species of the "Ammonitico Rosso" facies in Hungary and among them members of the Pleurotomaroidea are specially common. In the north German locality Grimmen and the south German locality Kalchreuth archaeogastropod species make up only about 20 % of the faunal composition. The fauna of Kaiwara in New Zealand in its composition is intermediate with archaeogastropods composing about 40 % of the encountered species.
Regarding the age of the Kaiwara fauna it is obviously of late Early Jurassic or early Middle Jurassic when the gastopods are consulted.

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Plate 1

Fig. 1-2	*Dictyotomaria gondwanensis* n. sp., paratype. 1 = Protoconch, 0,35 mm in diameter; 2 = shell in dorsal view, width 1,6 mm.
Fig. 3	*Dictyotomaria gondwanensis* n. sp., holotype. Shell in ventral view, width 1,5 mm.
Fig. 4	*Maxwellella novozeelandica* BANDEL, 1998; holotype. Shell in side view, width 1,7 mm.
Fig. 5	*Maxwellella novozeelandica* BANDEL, 1998; paratype. Shell in side view, width 1,6 mm.
Fig. 6, 8	*Emarginula kaiwarensis* n. sp., holotype. Shell in side and dorsal view, length 3,5 mm.
Fig. 7, 10	*Loxotoma jurassica* n. sp., holotype. Shell in side and dorsal view, length 3,0 mm.
Fig. 9	*Emarginula* sp. Shell in side view, length 2,8 mm.
Fig. 11-13	*Austriacopsis ovalis* n. sp., holotype. 11 = trema (height of the section 0, 6 mm); 12-13 = shell in dorsal and side view, length 2,5 mm.

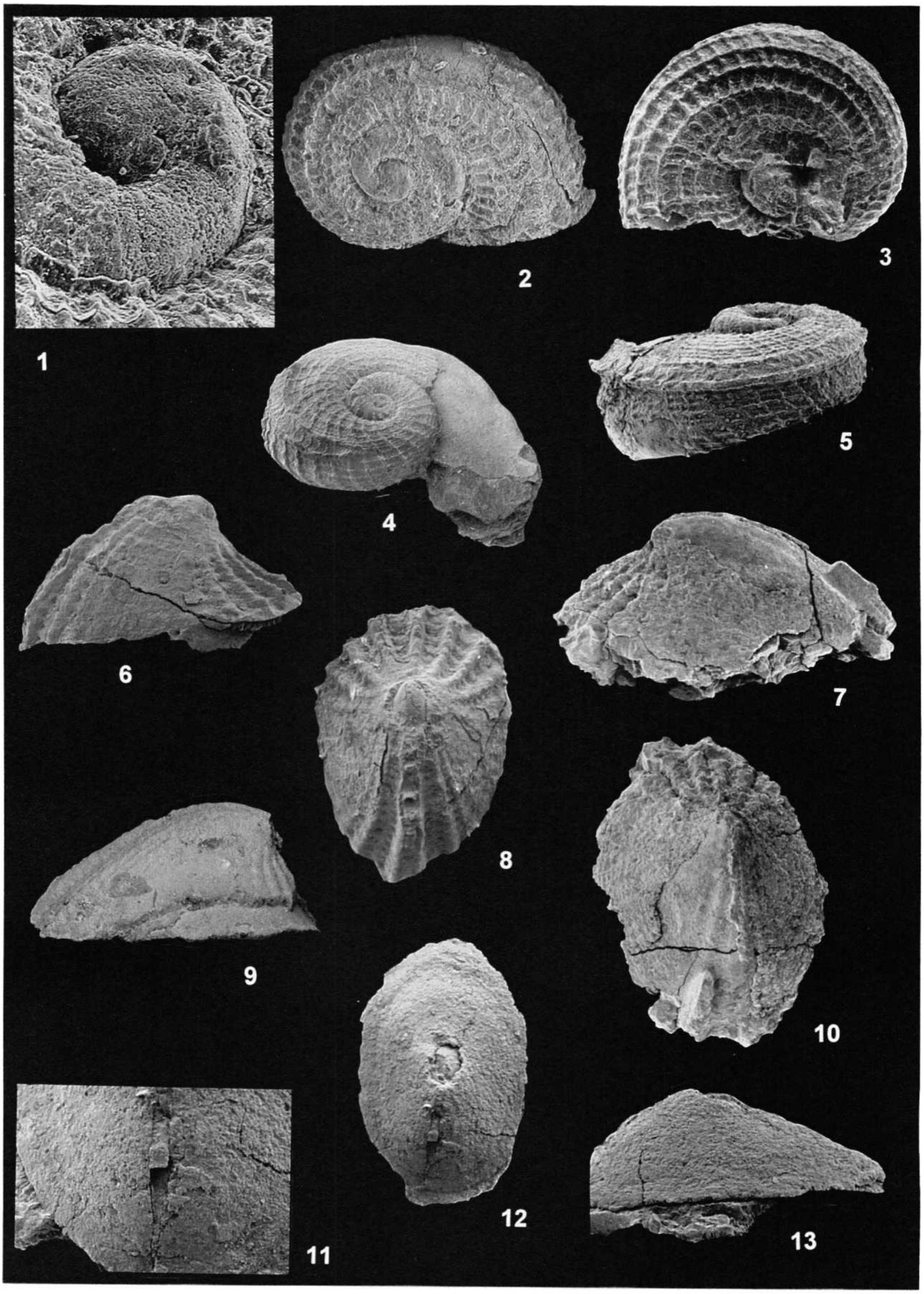
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Plate 2

Fig. 1	*Hamusina maxwelli* BANDEL, 1993; paratype. Protoconch and the first teleoconch whorl, height of the section 0,3 mm.
Fig. 2	*Hamusina maxwelli* BANDEL, 1993; paratype. Shell in side view, height 1,3 mm.
Fig. 3	*Hamusina maxwelli* BANDEL, 1993; paratype. Shell in side view, height 1,5 mm.
Fig. 4	*Hamusina maxwelli* BANDEL, 1993; holotype. Shell in side view, height 2,0 mm.
Fig. 5	*Hamusina maxwelli* BANDEL, 1993; paratype. Shell in dorsal view, width 1,2 mm.
Fig. 6	*Hamusina maxwelli* BANDEL, 1993; paratype. Shell in dorsal view, width 1,2 mm.
Fig. 7	*Eucochlis costata* n. sp., paratype. Shell in side view, width 1,7 mm.
Fig. 8-9	*Eucochlis costata* n.sp., holotype. Shell in side and basal view, width 1,6 mm.
Fig. 10	*Eucochlis costata* n. sp., paratype. Top of a shell in side view, height of the section 0,35 mm.
Fig. 11, 13	*Eucycloscala torulosa* n. sp., paratype. 11 = top of the shell in dorsal view, height of the section 0,45 mm; 13 = shell in side view, height 1,6 mm.
Fig. 12	*Eucycloscala torulosa* n. sp., holotype. Shell in side view, height 3,4 mm.

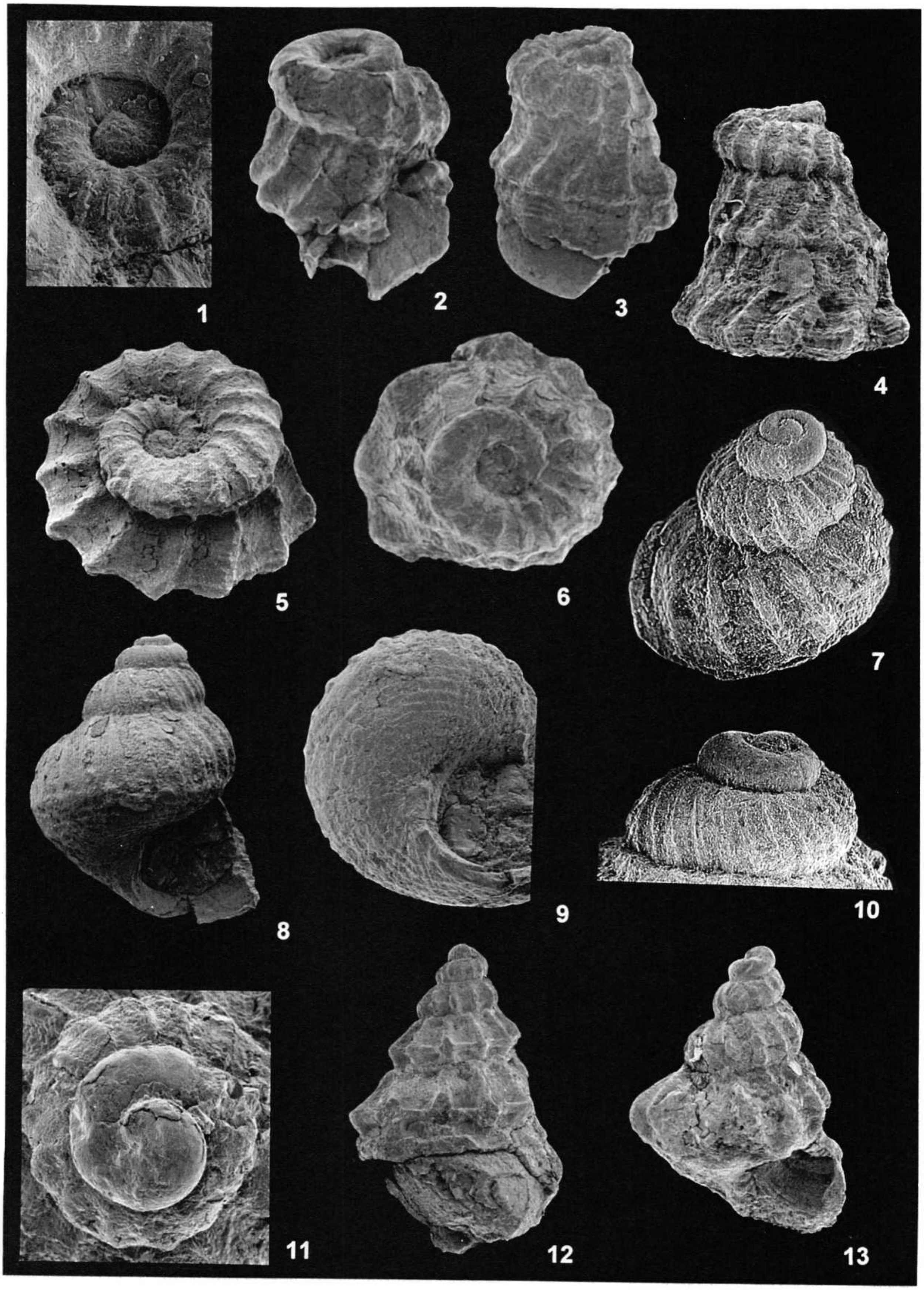
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Plate 3

Fig. 1	*Coelocentrus pacificus* n. sp., paratype. Shell in dorsal view, width about 2,8 mm (specimen is lost).
Fig. 2-4	*Coelocentrus pacificus* n. sp., holotype. Shell in two side views and in ventral view, width 2,9 mm.
Fig. 5-9	*Klebyella minuta* n. sp., holotype. 5, 8 = two sculpture details, dorsal side of the shell, width of the sections 0,65 mm and 0,6 mm; 6, 7, 9 = shell in dorsal, ventral and side view, width 1,8 mm.
Fig. 10-11	?*Crossostoma globulifera* n. sp., paratype. 10 = shell in side view, height 1,2 mm; 11 = protoconch and the first teleoconch whorl from dorsal, width of the section about 1mm.
Fig. 12-13	*Crossostoma globulifera* n. sp., holotype. Shell in side and basal view, width 2,5 mm.
Fig. 14-19	*Crossostoma spirata* n. sp., holotype. 14 = protoconch and the first teleoconch whorl in dorsal view, width 0,7 mm; 15-16 = shell in side and dorsal view, width 1,1 mm.

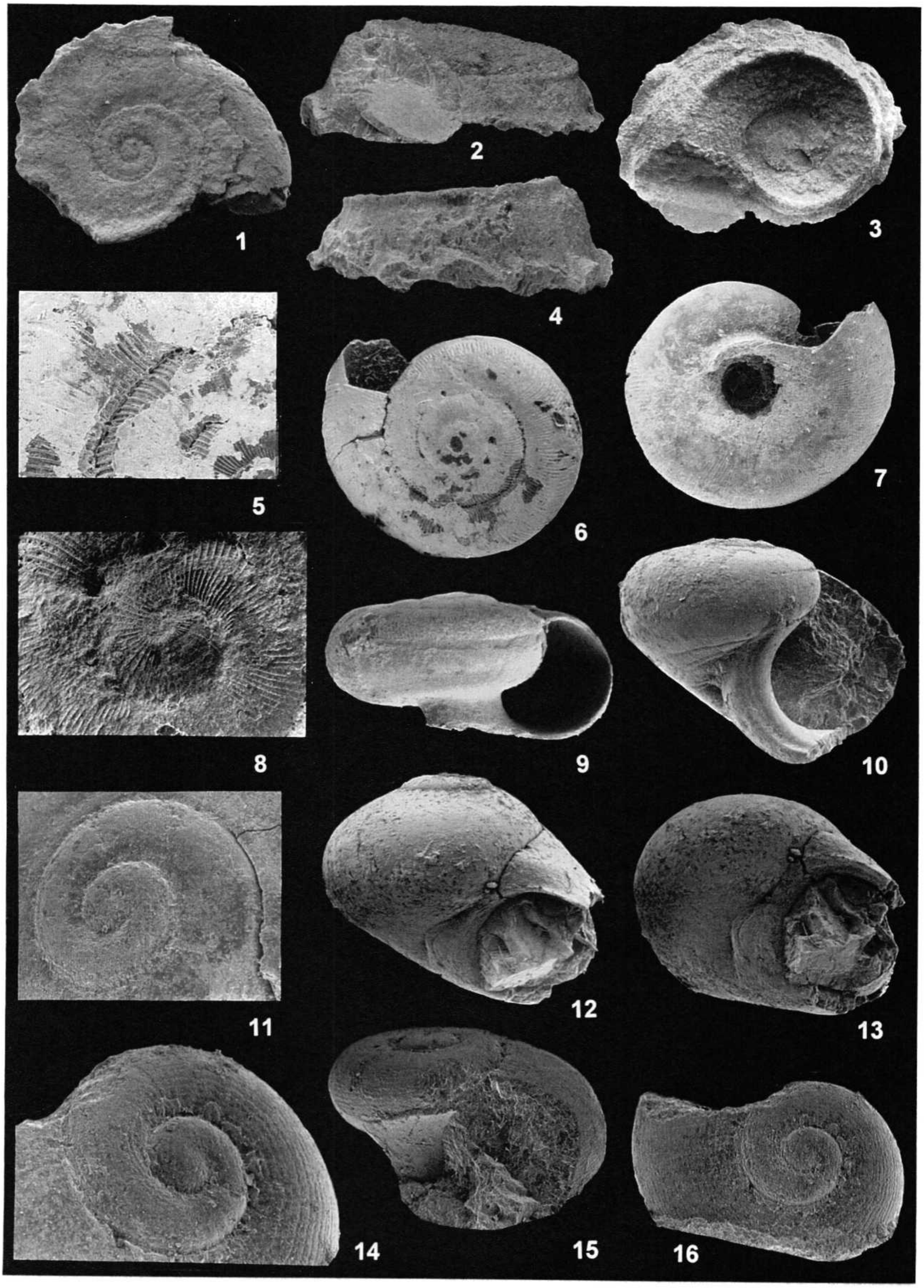
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Plate 4

Fig. 1	*Guidonia riedeli* n. sp., paratype. Protoconch and the first teleoconch whorl in dorsal view, width of the section about 0,6 mm.
Fig. 2, 5	*Guidonia riedeli* n. sp., holotype. Shell in side and dorsal view, width 1,9 mm.
Fig. 3	*Guidonia riedeli* n. sp., paratype. Shell in ventral view, width 1,5 mm.
Fig. 4	*Tylotrochus keuppi* n. sp., paratype. Shell in side view, height 1,4 mm.
Fig. 6, 9	*Tylotrochus keuppi* n. sp., holotype. Shell in side and ventral view, width 2,5 mm.
Fig. 7	*Tylotrochus keuppi* n. sp., paratype. Protoconch and the first teleoconch whorl, width 0,7 mm.
Fig. 8	*Tylotrochus keuppi* n. sp., paratype. Shell in side view, height 1,4 mm.
Fig. 10-11	*Sallya calyptraeensis* n. sp., holotype. Shell in side and ventral view, width 2,5 mm.
Fig. 12-13	*Sallya calyptraeensis* n. sp., paratype. Shell in side and dorsal view, width 1,7 mm.

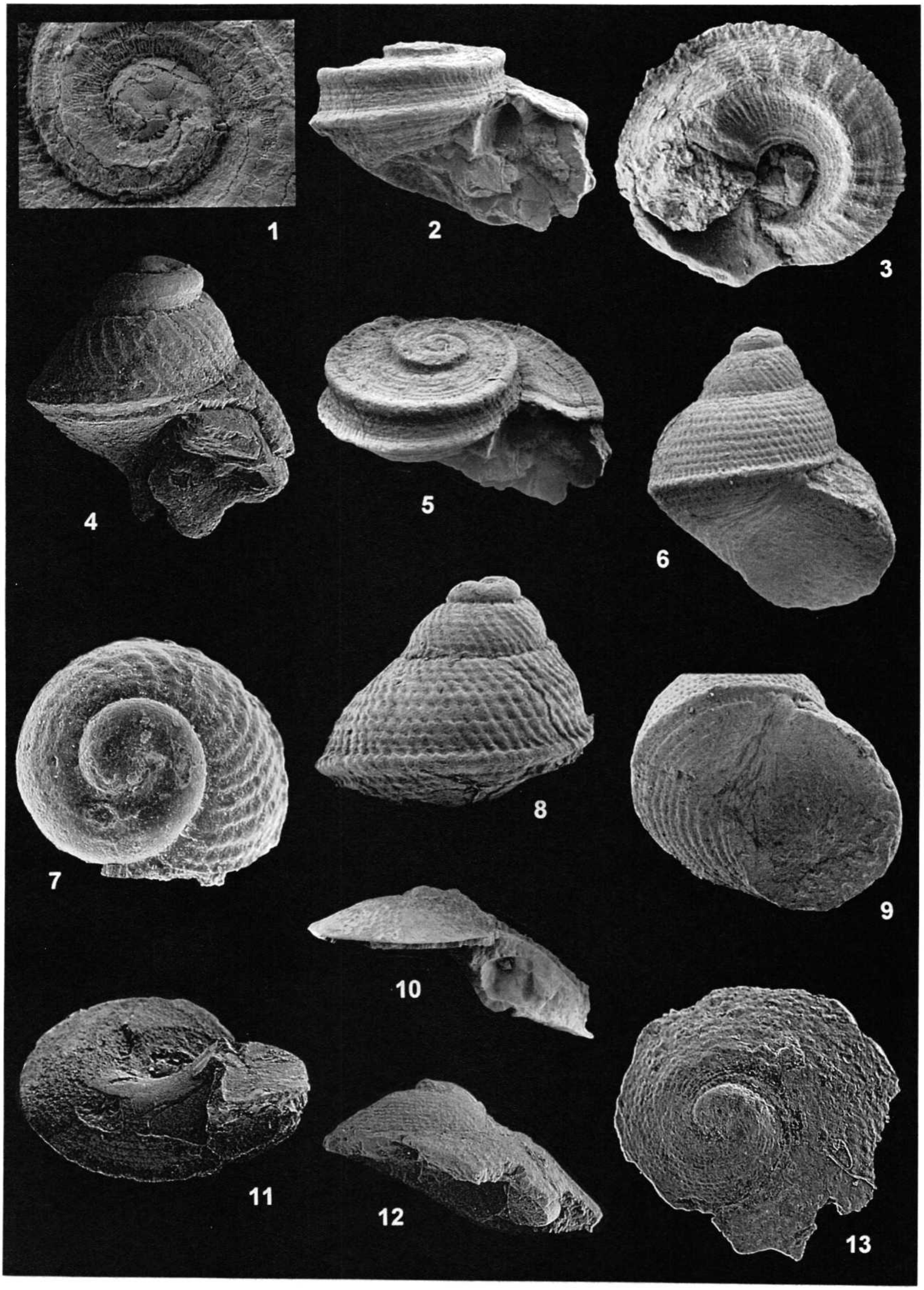
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Plate 5

Fig. 1 *Pileolus convexus* n. sp., paratype. Protoconch in side view, width 0,7 mm (the biconvex inner part) and 1,3 mm.

Fig. 2, 4 *Pileolus convexus* n. sp., paratype. 2 = aperture enlarged, height of the section 1,1 mm; 4 = shell in ventral view, largest width 2,9 mm.

Fig. 3, 6 *Pileolus convexus* n. sp., holotype. Shell in ventral and dorsal view, largest width 2,5 mm.

Fig. 5 *Paracerithium spinosum* n. sp., holotype. Top of the shell in side view, height of the section 1,0 mm.

Fig. 7, 9 *Pietteia christchurchi* n. sp., paratype. 7 = transition between protoconch and teleoconch, height of the section 0,45 mm; 9 = shell in side view, height 1,2 mm.

Fig. 8 *Pietteia christchurchi* n. sp., paratype. Shell in side view, height 1,3 mm.

Fig. 10, 13 *Pietteia christchurchi* n. sp., paratype. 10 = shell in side view, height 1,8 mm; 13 = top of the shell in side view, width of the broadest whorl 1,0 mm

Fig. 11, 12, 14 *Pietteia christchurchi* n. sp., holotype. 11 = shell in ventral view, width 1,4 mm; 12 = shell in side view, height 2,6 mm; 14 = top of the shell in side view, width of the section 1,1 mm.

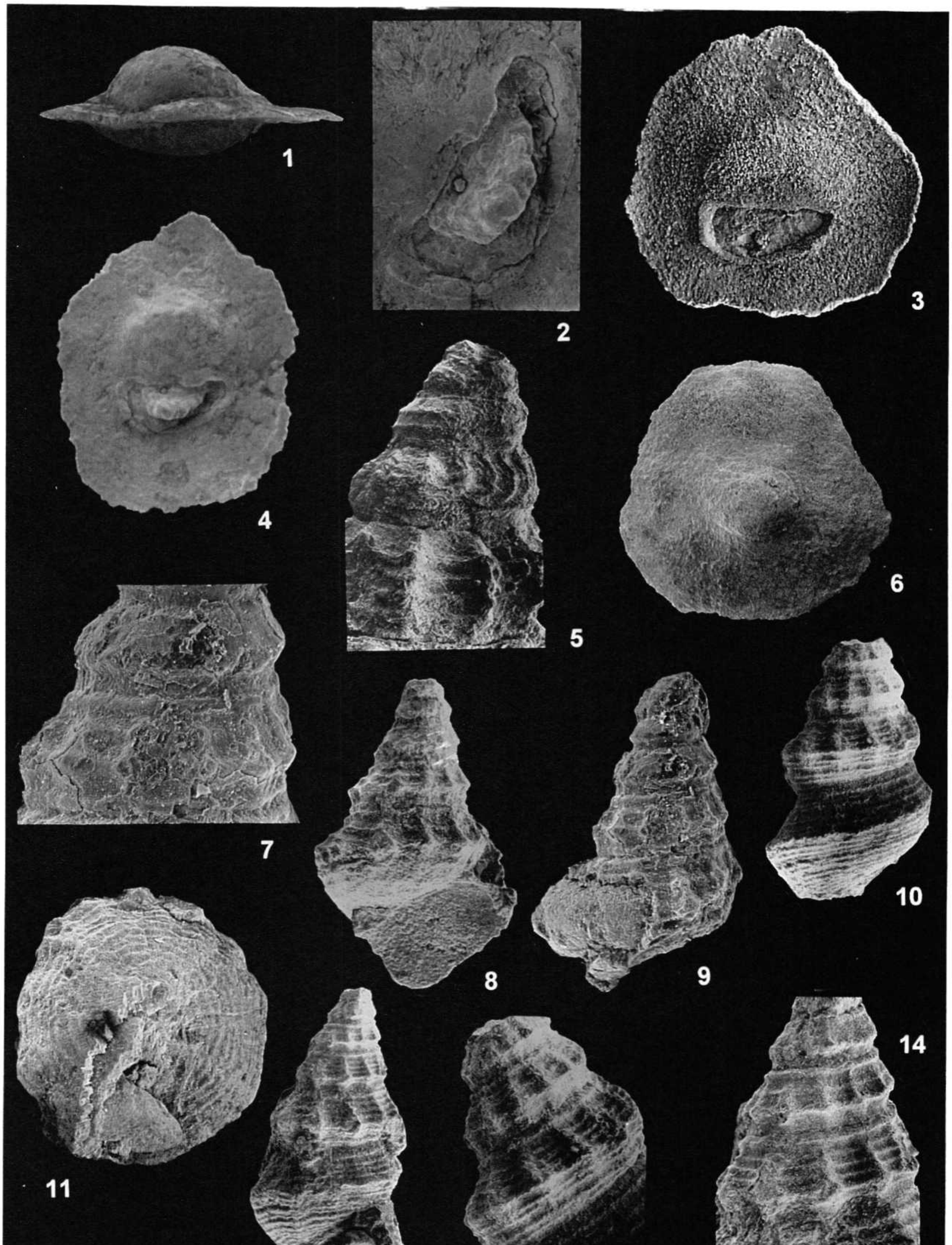
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Plate 6

Fig. 1-2 *Paracerithium pacificum* n. sp., holotype. Shell in side and dorsal view, width 1,8 mm.

Fig. 3 *Paracerithium pacificum* n. sp., paratype. Oblique view from dorsal, width of the last complete whorl 0,5 mm.

Fig. 4-6 *Rhabdocolpus*? *kowalkei* n. sp., holotype. 4 = shell in side view, height 3,8 mm; 5 = protoconch in side view, height of the section 0,45 mm; 6 = shell in dorsal view, width 1,7 mm.

Fig. 7 *Paracerithium pacificum* n. sp., paratype. Shell in side view, height 1,4 mm.

Fig. 8 *Rhabdocolpus*? *kowalkei* n. sp., paratype. Shell in ventral view, width 1,6 mm.

Fig. 9, 11, 13 *Cryptaulax* sp., cf. *protortile* (COX, 1969). 9 = protoconch in side view, height of the section 0,4 mm; 11 = shell in side view, height 1,4 mm; 13 = top of the shell in side view, height of the section 0,8 mm.

Fig. 10 *Rhabdocolpus*? *kowalkei* n. sp., paratype. Shell in side view, height 1,9 mm.

Fig. 12 *Cryptaulax* sp., cf. *protortile* (COX 1969). Shell in side view, height 1,4 mm.

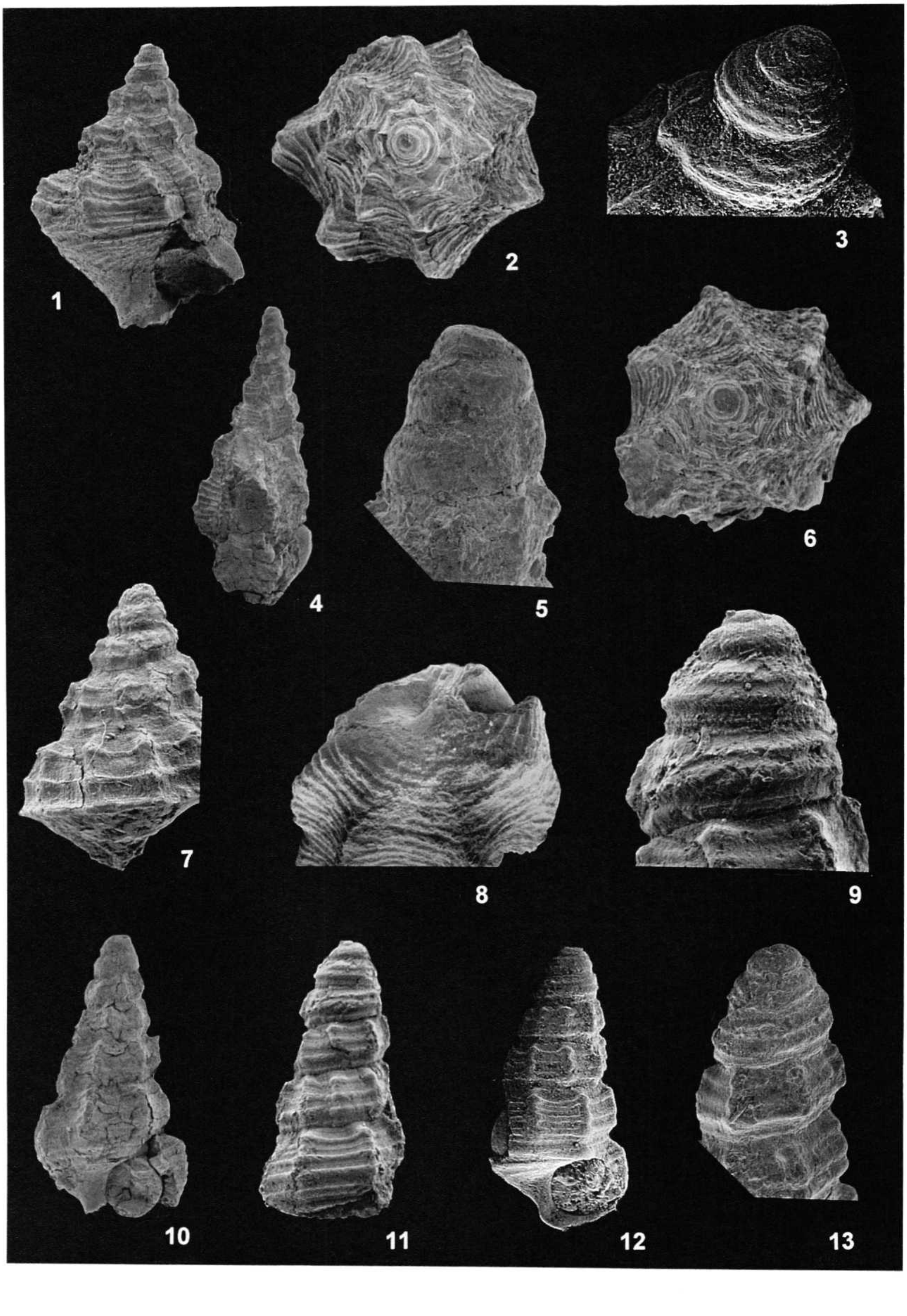
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Plate 7

Fig. 1	*Paracerithium spinosum* n. sp., paratype. Shell in side view, height 4,5 mm.
Fig. 2	*Paracerithium spinosum* n. sp., paratype. Shell in side view, height 6,5 mm.
Fig. 3	*Paracerithium spinosum* n. sp.?. Shell in side view.
Fig. 4	*Paracerithium spinosum* n. sp., holotype. Top of the shell in side view, height of the section 0,95 mm.
Fig. 5-6	*Maoraxis kieli* n. sp., holotype. 5 = protoconch with transition to the teleoconch, height of the section 0,9 mm; 6 = shell in side view, height 1,9 mm.
Fig. 7	*Maoraxis kieli* n. sp., paratype. Shell in side view, height 1,2 mm.
Fig. 8	*Maoraxis kieli* n. sp., paratype. Shell in side view, height 3,6 mm.
Fig. 9	*Maoraxis kieli* n. sp., paratype. Shell in dorsal view.
Fig. 10-11	*Maoraxis kieli* n. sp., paratype (variety with only 4 axial ribs). Shell in dorsal an side view.
Fig. 12-13	*Canterburyella pacifica* n. sp., paratype. Shell in two side views, height 4,9 mm.
Fig. 14	*Canterburyella pacifica* n. sp., paratype. Shell in dorsal view.
Fig. 15-16	*Canterburyella pacifica* n. sp., paratype. 15 = shell in side view, height 1,6 mm; 16 = part of the protoconch in side view, height of the section 0,55 mm.

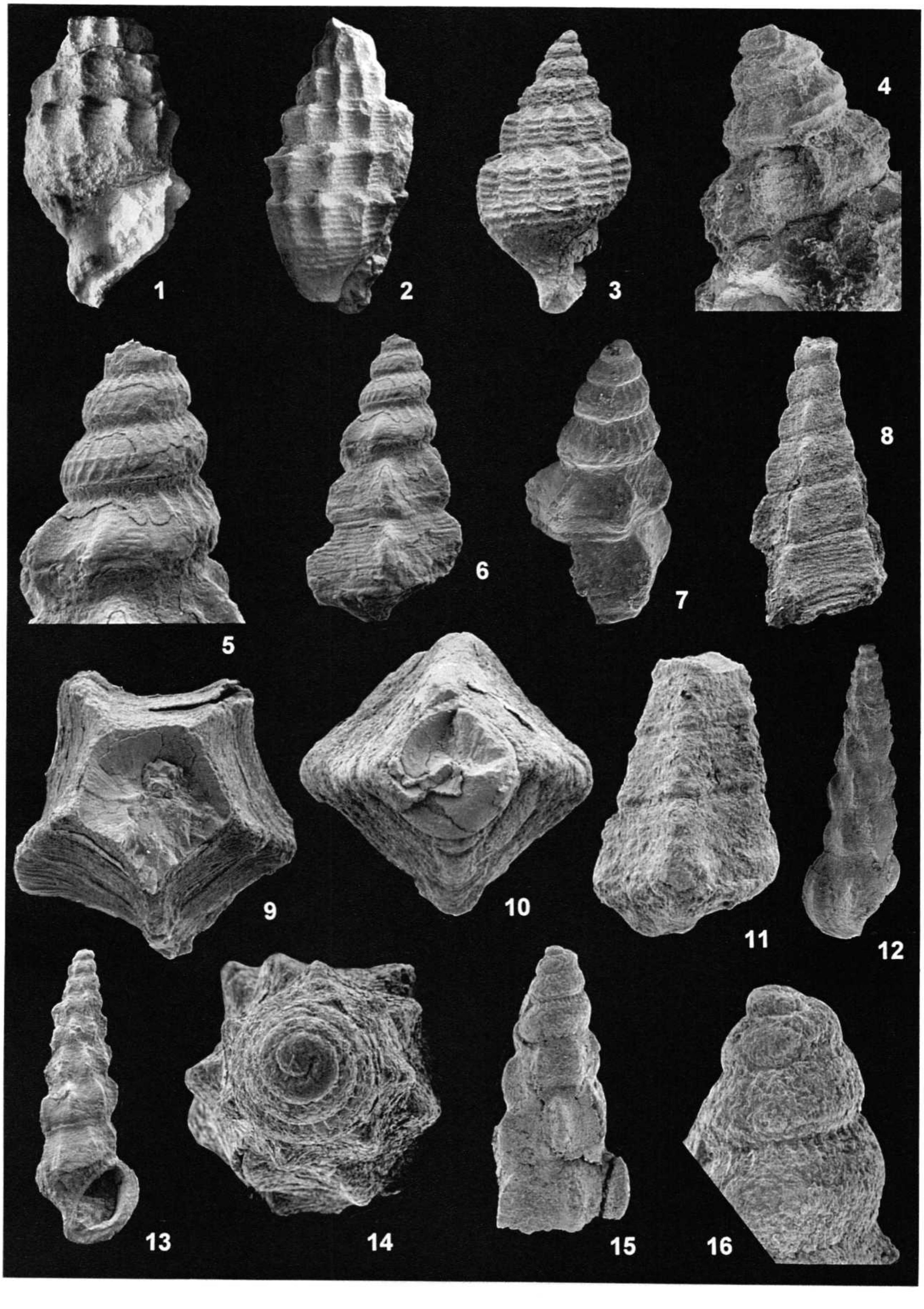
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Plate 8

Fig. 1, 4	*Canterburyella pacifica* n. sp., holotype. 1 = detail from the sculpture, width of the section about 0,4 mm; 4 = top of the shell in side view, height of the section 1,0 mm.
Fig. 2	*Prisciophora schroederi* n. sp., holotype. Shell in side view, height 3,1 mm 6,5 mm.
Fig. 3, 5, 7	*Prisciophora schroederi* n. sp., paratype. 3 = top of the shell in dorsal view, width of the section 0,4 mm; 5, 7 = shell in side and dorsal view, width 1,0 mm.
Fig. 6, 9	*Prisciophora schroederi* n. sp., paratype. 6 = top of the shell in side view, height of the section 0,5 mm; 9 = shell in side view, height 1,9 mm.
Fig. 8	*Prisciophora schroederi* n. sp., paratype. Top of the shell in side view, height of the section 1,3 mm.
Fig. 10	*Brevizygia spiralosulcata* n. sp., holotype. Shell in side view, height 2,0 mm.
Fig. 11	*Brevizygia spiralosulcata* n. sp., paratype. Shell in side view, height 2,0 mm.
Fig. 12	*Brevizygia spiralosulcata* n. sp., paratype. Shell in side view, height 1,1 mm.
Fig. 13	*Brevizygia spiralosulcata* n. sp., paratype. Top of the shell in side view, height of the section about 0,8 mm.
Fig. 14	*Brevizygia spiralosulcata* n. sp., paratype. Shell in side view, height 1,7 mm.

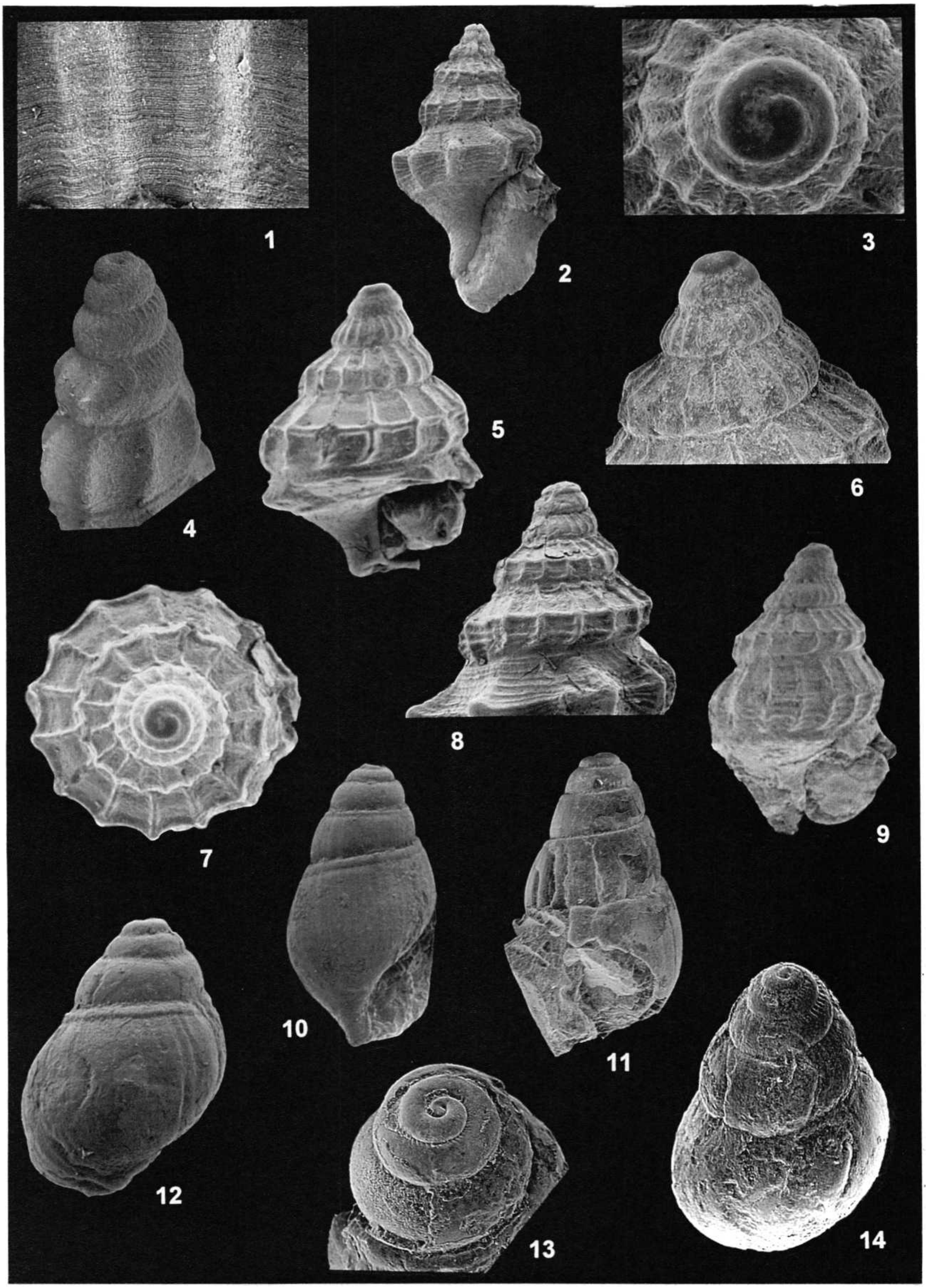
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Plate 9

Fig. 1-2	*Tricarilda cancellata* n. sp., holotype. 1 = Top of the shell with protoconch, oblique view from dorsal, height of the section 0,5 mm; 2 = shell in side view, height 1,2 mm.
Fig. 3	*Tricarilda cancellata* n. sp., paratype. Shell in side view, height 2,1 mm.
Fig. 4	*Cristalloella parva* n. sp., paratype. Shell in side view, height about 0,7 mm.
Fig. 5-8	*Cristalloella parva* n. sp., holotype. 5 = shell in dorsal view, width 0,7 mm; 6 = shell in side view, height 0,9 mm; 7 = teleoconch whorl with sculptur, width of the whorl 0,7 mm; 8 = top of the shell with protoconch in side view, height of the section 0,2 mm.
Fig. 8	*Prisciophora schroederi* n. sp., paratype. Top of the shell in side view, height of the section 1,3 mm.
Fig. 9-10	*Camponaxis zardiniensis* n. sp., holotype. 9 = protoconch in dorsal view, height of the section 0,3 mm; 10 = shell in side view, height 1,1 mm.
Fig. 11	*Camponaxis zardiniensis* n. sp., paratype. Protoconch in side view, height of the section about 0,3 mm.
Fig. 12	*Camponaxis zardiniensis* n. sp., paratype. Shell in side view, height 1,4 mm.
Fig. 13	*Camponaxis zardiniensis* n. sp., paratype. Shell in side view, height 1,6 mm.

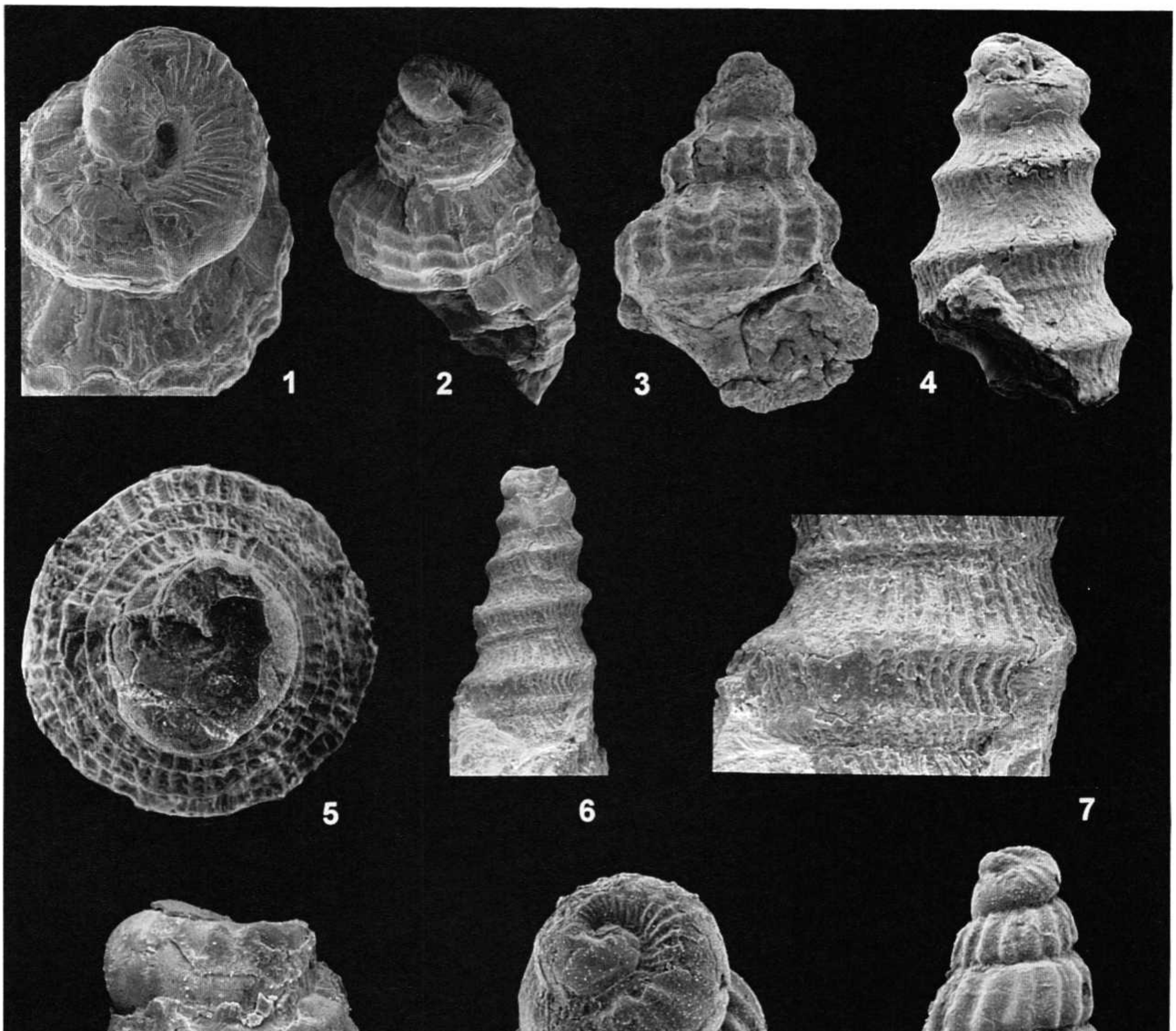
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Plate 10

Fig. 1 *Conusella? pacifica* n. sp., paratype. Shell in side view, height 1,6 mm.

Fig. 2-3 *Conusella? pacifica* n. sp., holotype. 2 = shell in side view, height 1,5 mm; 3 = protoconch in side view, height 0,2 mm.

Fig. 4, 6 *Kaiwarella beui* n. sp., holotype. Shell in dorsal and side view, width 1,0 mm.

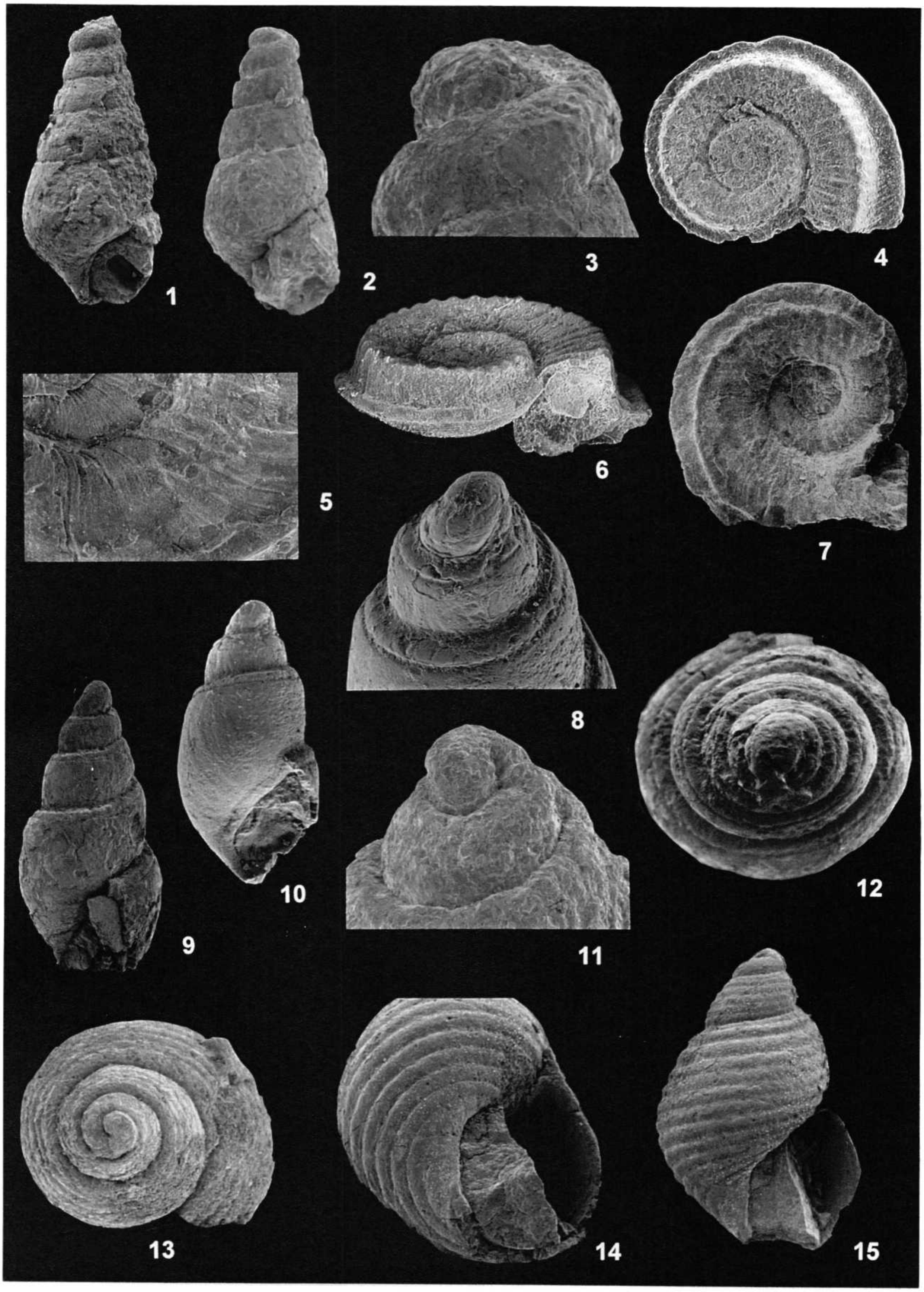
Fig. 5, 7 *Kaiwarella beui* n. sp., paratype. 5 = detail from the ventral view with growth lines, width of the section 0,5 mm; 7 = shell in ventral view, width 1,2 mm.

Fig. 8, 10 *Actaeonina novozealandica* n. sp., paratype. 8 = top of the shell in side view, height of the section 0,5 mm; 10 = shell in side view, height 1,2 mm.

Fig. 9, 12 *Actaeonina novozealandica* n. sp., holotype. Shell in side view (height 1,8 mm) and in dorsal view (width 0,8 mm).

Fig. 11, 13 *Bullina (Sulcoactaeon) zealata* n. sp., paratype. 11 = top of the shell in side view, height of the section 0,45 mm; 13 = shell in dorsal view, width 1,6 mm.

Fig. 14, 15 *Bullina (Sulcoactaeon) zealata* n. sp., holotype. 14 = shell in ventral view, width 1,4 mm; 15 = shell in side view, height 2,2 mm.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