

**Notes on the systematics, morphology and biostratigraphy of fossil holoplanktonic Mollusca, 17<sup>1</sup>. On the status of some pteropods (Gastropoda, Euthecosomata) from the Miocene of New Zealand, referred to as species of *Vaginella***

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Type material of four pteropod species (Gastropoda, Euthecosomata) described from the Miocene of New Zealand, originally or subsequently assigned to the genus *Vaginella*, is revised: *Vaginella aucklandica* Clarke, 1905, is reassigned to the genus *Ireneia*; *Clio (Creseis) urenuiensis* Suter, 1917, and *V. inflata* Hayward, 1981, are considered to be junior subjective synonyms of *Ireneia calandrellii* (Michelotti, 1847) and *Vaginella depressa* Daudin, 1800, respectively. *Vaginella torpedo* Marshall, 1918, is transferred to *Cuvierina (Cuvierina)*, while additional samples identified as *Vaginella aucklandica* are shown to be assignable to *Ireneia calandrellii* and *I. nieulandei* Janssen, 1995.

The presence of several species of *Ireneia* in the New Zealand area during the Early Miocene supports the hypothesis that the genus *Cuvierina* developed from an *Ireneia*-root around the Oligocene/Miocene transition.

The transition from *Vaginella depressa* into *V. austriaca* Kittl, 1886, during the Late Burdigalian, took place exclusively in the Atlantic and Mediterranean realms. Closure of the Tethyan Seaway apparently prevented this in the Pacific Basin, where *V. depressa* ranges into the Serravallian.

Key words: Gastropoda, Euthecosomata, *Ireneia*, *Vaginella*, systematics, new combinations, Miocene, New Zealand.

## INTRODUCTION

Three euthecosomatous gastropods from the Miocene of New Zealand were originally assigned to the genus *Vaginella*, viz. *V. aucklandica* Clarke, 1905, *V. torpedo* Marshall, 1918, and *V. inflata* Hayward, 1981. A fourth species, first described as *Clio (Creseis) urenuiensis* Suter, 1917, was reassigned to *Vaginella* by Beu & Maxwell (1990: 424). A study of the type specimens and some additional material of these taxa has enabled a reconsideration of their actual status.

Local New Zealand chronostratigraphic units referred to in this paper are converted to global units, by means of R.A. Rohde's (2003-2005) GeoWhenDatabase-website (see Tab. 1). Another such correlation is given in Cooper (2004).

<sup>1</sup> For no. 16 in this series see *Basteria* 70: 67-70 (2006).

Abbreviations: AU, collection number AUGD; AUGD, Palaeontology Collection, Department of Geology, Auckland University, Auckland (New Zealand); G, gastropod specimen number in type collection AUGD; NZGS, Institute of Geological & Nuclear Sciences, Lower Hutt (New Zealand), formerly New Zealand Geological Survey; RGM, National Museum of Natural History, Naturalis, Palaeontology Department, Leiden (The Netherlands), formerly Rijksmuseum van Geologie en Mineralogie; Q08/f9687 (and similar), fossil locality registered in the archival New Zealand Fossil Record File, maintained jointly by the Geological Society of New Zealand and Institute of Geological & Nuclear Sciences, where f9687 is a unique locality in NZMS260 series 1:50,000 map sheet Q08; TM, specimen number, type Mollusca collection NZGS.

Table 1. New Zealand chronostratigraphical units correlated with global stages. Absolute ages are after Rohde (2003-2005).

| age<br>in Ma | global stages | New Zealand |        |               |          |    |
|--------------|---------------|-------------|--------|---------------|----------|----|
|              |               | series      | stages | symbol        |          |    |
| 5            | Zanclean      |             | 4.8    |               |          |    |
| 6            | Messinian     | Taranaki    | 6      | Kapitean      | Tk       |    |
| 7            |               |             |        |               |          |    |
| 8            |               |             |        |               |          |    |
| 9            | Tortonian     |             |        |               |          |    |
| 10           |               | Southland   | 10     |               |          |    |
| 11           |               |             |        | 11.5          | Waiauan  | Sw |
| 12           | Serravallian  |             |        |               |          |    |
| 13           |               |             |        |               |          |    |
| 14           |               |             |        |               |          |    |
| 15           | Langhian      |             | 15     |               |          |    |
| 16           |               | Pareora     | 16.5   | Cliffdenian   | Sc       |    |
| 17           |               |             |        | 17.5          | Altonian | Pl |
| 18           | Burdigalian   |             |        |               |          |    |
| 19           |               |             |        |               |          |    |
| 20           |               |             |        | 20            | Awamoan  | Pa |
| 21           |               |             | 21     | Hutchinsonian | Ph       |    |
| 22           | Aquitanian    |             |        |               |          |    |
| 23           |               |             |        |               |          |    |
| 23           |               |             | 23.3   | Otaian        | Po       |    |
| 24           | Chattian      |             |        |               |          |    |

SYSTEMATIC PART

Class Gastropoda Cuvier, 1797  
Subclass Orthogastropoda Ponder & Lindberg, 1996  
Superorder Heterobranchia Burmeister, 1837  
Order Euthyneura Spengel, 1881  
Suborder Thecosomata de Blainville, 1824  
Infraorder Euthecosomata Meisenheimer, 1905  
Superfamily Cavolinioidea Gray, 1850

Family Cuvierinidae Van der Spoel, 1967

Genus *Cuvierina* Boas, 1886

Type species: *Cuvierina columnella* (Rang, 1827), by monotypy (Recent).

Subgenus *Cuvierina* s. str.

*Cuvierina* (*Cuvierina*) *torpedo* (Marshall, 1918) (figs 1-4)

*Vaginella torpedo* Marshall, 1918: 263, pl. 22 figs 7, 8; Fleming, 1966: 84; Hayward, 1981: 118, figs 13, 14; Bernasconi & Robba, 1982: 215; Beu & Maxwell, 1990: 238, 424, pl. 26s-t; Janssen, 1995: 55.

? *Vaginella* cf. *torpedo* Marshall, 1918; Powell, 1935: 327, 329.

*Cuvierina* (*Cuvierina*) *torpedo* (Marshall, 1918); Janssen, 2005: 29, fig. 36.

Type material examined. – Lectotype (TM5419), designated by Hayward (1981), paralectotype (TM5420) and two syntypes (TM6679-80) in NZGS; one specimen (topotype) RGM 516.534, leg. C.R. Laws, donated to D. Curry, 1953, donated to RGM collections June 1987. All specimens from the type locality.

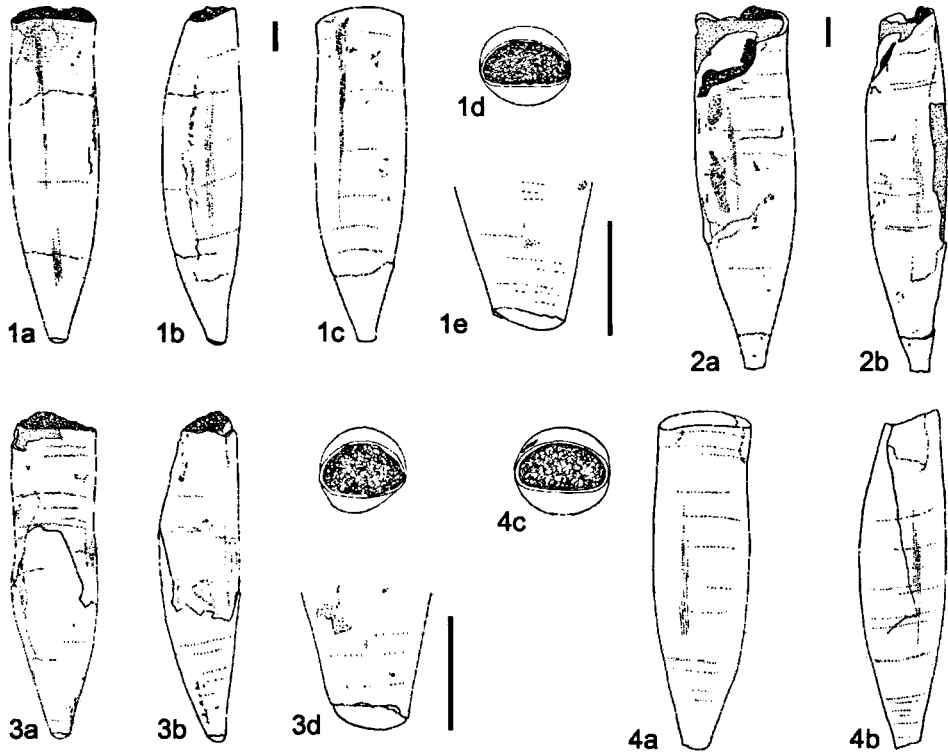
Type locality: Indicated as Pakaurangi Point, Kaipara Harbour, Northland, New Zealand (Q08/f9687), but Beu & Maxwell (1990: 239) had expressed doubts over this, and suggested “probably from the ‘pteropod bed’ in Waiteroa Member, Holland’s Bay, Otaian”.

Stratum typicum: Pakaurangi Formation (Late Otaian - Early Altonian, see Tab. 1)

Discussion. – Janssen (1995) studied the type material of ‘*Vaginella*’ *torpedo* and noted the longitudinal micro-ornament (the presence of which was denied by Hayward, 1981: 119) and the shape of the aperture, both features that clearly assign this taxon to the Cuvierinidae. Although closely resembling species of *Ireneia* in shape and other characteristics this species has to be assigned to *Cuvierina*, because the apical shell part is shed and an apical septum developed. New drawings (figs 1-4) of the lectotype, the paralectotype and a syntype illustrate these features.

Janssen (2005: 29) considered *C. torpedo* to be the first species of *Cuvierina* to have split off from the *Ireneia* branch around the Oligocene-Miocene boundary. The assumed predecessor, *I. tenuistriata* (Semper, 1861), however, was only known from Europe. Below it is demonstrated that species of that genus did indeed occur in New Zealand, viz. *Ireneia aucklandica* and *I. nieulandei* (during the Otaian), succeeded by *I. calandrellii* (during the Otaian or Altonian).

Concerning the age of *C. torpedo*, Dr Phil Maxwell (in litt., 2005) made the following

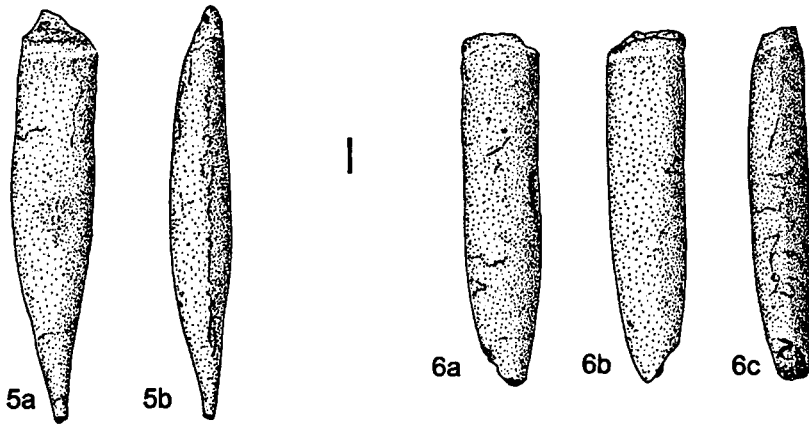


Figs 1-4. *Cuvierina (Cuvierina) torpedo* (Marshall, 1918), type specimens. **1**, lectotype designated by Hayward, 1981: 118), NZGS TM5419; a, ventral; b, left lateral; c, dorsal; d, apertural views, e: base of shell in left lateral view, showing septum; **2**, paralectotype, NZGS TM5420; a, ventral, b: left lateral view (septum present, but invisible in frontal or lateral views); **3**, syntype, NZGS TM6679, a: ventral, b: left lateral, c: apertural views, d: base of shell in left lateral view, showing septum; **4**, syntype, NZGS TM 6678, a: ventral, b: left lateral, c: apertural views. All specimens labeled Pakaurangi Point, Kaipara Harbour, Northland, New Zealand (Q08/t9687). Miocene (Late Otaian-Early Altonian), Pakaurangi Formation. Bar length is 1 mm.

additional remarks: 'Now the type horizon of *Cuvierina torpedo* is not precisely known. "Pakaurangi Point" is a very broadly defined locality, with units ranging in age from Otaian to Altonian. I have collected *C. torpedo* from the Waiteroa Member of the Pakaurangi Formation (Late Otaian) at Hollands Point (c 1 km NW of Pakaurangi Pt), but I understand it is also in the Pakaurangi Member (Early Altonian) at Pakaurangi Pt itself.'

#### Genus *Ireneia* A.W. Janssen, 1995

Type species: *I. tenuistriata* (Semper, 1861), by original diagnosis (Oligocene, Chattian).



Figs 5-6. *Ireneia aucklandica* (Clarke, 1905), lectotype and paralectotype. 5, lectotype designated by Hayward, 1981: 118, AUGD G5960; a: ventral, b: left lateral views; 6, paralectotype, AUGD G5961a; a: dorsal, b: ventral, c: left lateral view. Both specimens from Orakei, Hobson Bay, Auckland, New Zealand (R11/f7027). Miocene (Otaian), Orakei Greensand. Bar length is 1 mm.

*Ireneia aucklandica* (Clarke, 1905) (figs 5, 6)

? Belemniten ähnliche Körper, vermuthlich Steinkerne von Pteropoden – Von Zittel, 1864, pl. 9 fig. 1.

? *Vaginella tenuistriata*; Kittl, 1886: 54, footnote.

*Vaginella aucklandica* Clarke, 1905: 419, pl. 32 fig. 5; Fleming, 1966: 84; Hayward, 1981: 118, figs 11, 12 (partim; includes *Ireneia calandrellii* and *I. nieulandei*); Bernasconi & Robba, 1982: 215; Beu & Maxwell, 1990: 424.

Type material examined. – Lectotype (G5960), designated by Hayward (1981), and four paralectotypes (G5961a-d) in AUGD from the type locality.

Type locality. – Orakei (R11/f7027), Hobson Bay, Auckland, New Zealand.

Stratum typicum. – Orakei Greensand (Early Miocene, Otaian, compare Tab. 1).

Discussion. – The type lot specified above is in internal mould preservation, and to a certain extent, all five specimens are dorso-ventrally compressed. The lectotype is the most complete specimen, but lacks the apex with protoconch. A septum is absent. In the other specimens, larger portions of the shell's base are missing. In all specimens the reinforcement of the inner apertural margin (seen as a groove on the internal moulds) is more or less clearly visible. In spite of the compression it can be observed that the shell had no lateral carinae. Also the shape of the shell, with a slightly more convex ventral side, as well as the reinforcements along the apertural margin, characterise this species as a typical *Ireneia*.

Recently, when describing *Ireneia gracilis* from the Italian Miocene (Janssen, 2005: 38), I overlooked the present New Zealand taxon as a related species of *Ireneia*. Now, with the types before me, it can be seen that, although similar, they do indeed represent two distinct taxa. The still considerably more slender *I. gracilis* was described from Late Burdigalian sediments and consequently is clearly younger than the New Zealand taxon.

Kittl (1886: 54, footnote) referred to specimens in the collection of the 'k.k. naturhistorischen Hofmuseums' (now Naturhistorisches Museum), Vienna, Austria, collected by F. von Hochstetter at Orakei-Bay, Auckland, New Zealand and illustrated earlier in von Zittel (1864). Kittl considered these specimens (all on a single slab of sediment) to be identical with '*Vaginella tenuistriata*' (now *Ireneia tenuistriata*), but remarked that most specimens showed discontinuous lateral carinae. I did not find these specimens when I studied the Vienna pteropod collection, back in 1982, but most probably they belong to the present species, *Ireneia aucklandica*. The 'discontinuous lateral carinae' may be the result of compression, as is the case in the type lot. Unfortunately, according to Dr Ortwin Schultz (in litt., 2005), the slab containing the specimens cannot be traced at present in the Vienna collections.

Additional material, referred to by Hayward (1981), was also made available to me. Sample AU2068 contains two specimens (on two slabs of sediment), labelled 'On E slope of 500' hill before coast on Mitimiti Rd (O05/f9644), Waitemata Group (Altonian), leg. E Milligan, 1958'. They are too poorly preserved to be recognised with certainty. They are clearly less slender than *I. aucklandica*, and therefore agree better with *I. calandrellii*.

Sample AU2435 comprises seven fragmentary specimens, labelled 'cutting on farm road, 2.25 km upstream from Waimamaku River mouth (O06/f9623)', of Altonian age, leg. B. Hayward, 1972. Most of these specimens have at least portions of shell preserved, but the longitudinal micro-ornament is no longer visible because of corrosion. I consider these specimens to belong to *I. calandrellii* as well.

Finally, a single shell from Orongo Point, Okahukura Peninsula, Kaipara Harbour (referred to by Hayward, 1981 as 'Okahukura Peninsula, Kaipara' (Q09/f9573), of Otaian age (Pakaurangi Formation), registration numbers AU3044-G5938, clearly differs from both *Ireneia aucklandica* and *I. calandrellii* by its size, which is in excess of 20 mm. It cannot be distinguished from *I. nieulandei* A.W. Janssen, 1995 (see below).

### *Ireneia calandrellii* (Michelotti, 1847) (figs 7-9)

New Zealand records:

*Clio* (*Creseis*) *urenuensis* Suter, 1917: 1, pl. 1 fig. 1 (mala); Janssen, 1995: 55.

*Creseis urenuensis* (Suter, 1917); Fleming, 1966: 84; Bernasconi & Robba, 1982: 217.

? *Vaginella aucklandica* Clarke, 1905; Hayward, 1981: 118 (partim, ? non Clarke, specimens from Mitimiti and Waimamaku only).

*Vaginella urenuensis* (Suter, 1917); Beu & Maxwell, 1990: 238, 424.

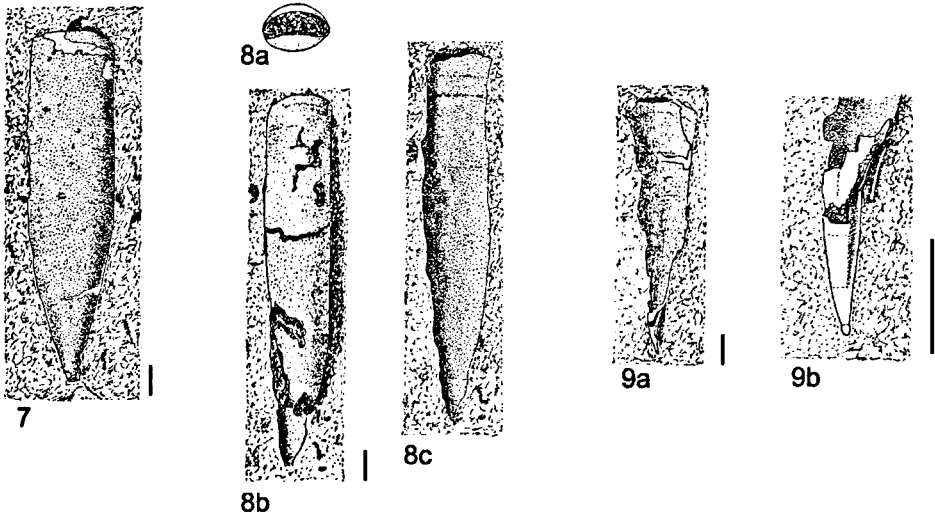
*Ireneia urenuensis* (Suter, 1917); Janssen, 2005: 29.

Type material examined. – Holotype and five paratypes of *Clio* (*Creseis*) *urenuensis* in NZGS (TM6684).

Type locality of *C. urenuensis*. – Indicated as White Cliffs, North of Urenui, Taranaki (Q19/f6485), New Zealand, but Beu & Maxwell (1990: 238) corrected this (on the authority of Dr F.J. Brook) as 'almost certainly from the Waitemata Group near Auckland'.

Stratum typicum. – Indicated as Miocene (Tongaporutuan), but corrected to 'Otaian or Altonian' in Beu & Maxwell (1990: 238), see tab. 1.

Discussion. – Janssen (1995: 55; 2005: 29) suggested '*Clio urenuensis*' to be a synonym of *Ireneia calandrellii* (Michelotti, 1847), described from the Italian Miocene (Late Burdigalian-Serravallian). All specimens in the type lot of '*Clio*' *urenuensis* are preserved as internal moulds with very little of the actual shell remaining on some of them. The general shell form is visible only in the holotype (fig. 7), which has an outline closely resem-



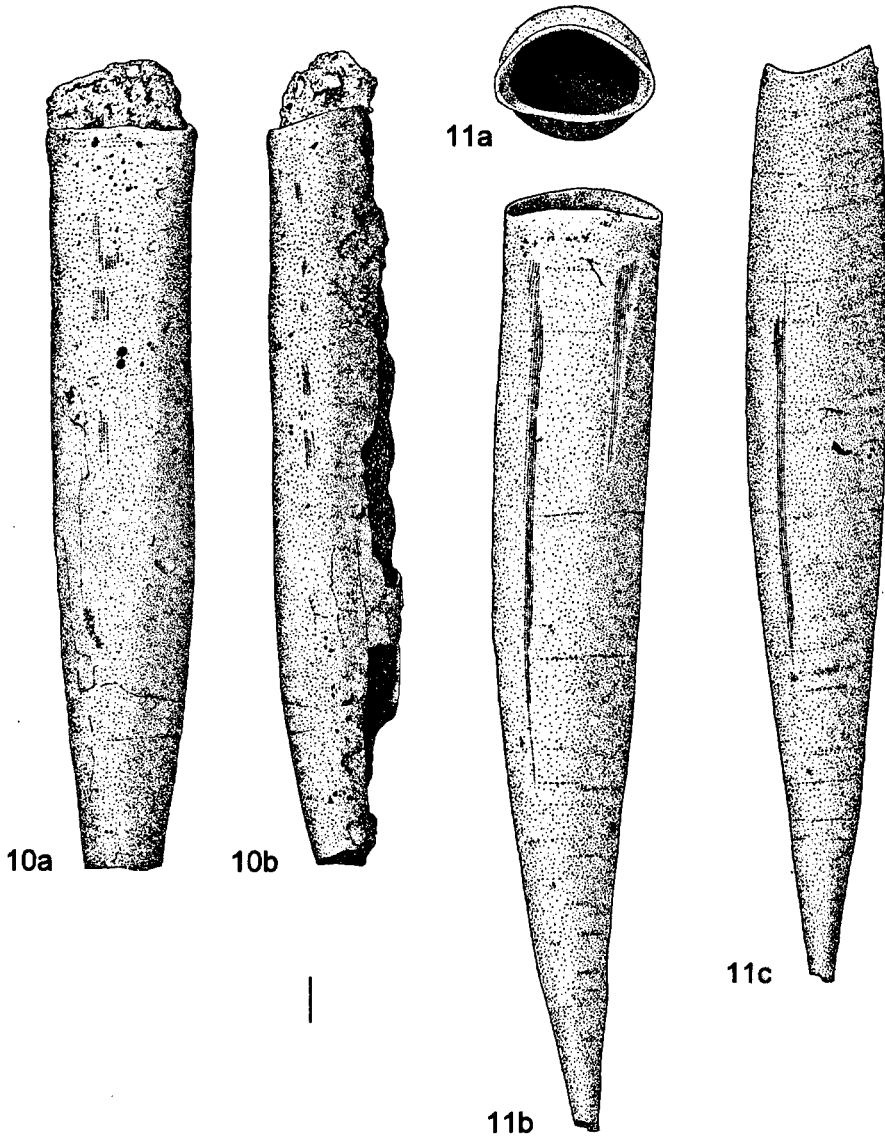
Figs 7-9. *Ireneia calandrellii* (Michelotti, 1847), holotype and paratypes of *Clio* (*Creseis*) *urenuensis* Suter, 1917. 7, holotype, internal mould in matrix, dorsal (?) view; 8, paratype 1, a: apertural view of internal mould, b: internal mould in matrix, dorsal view, c: external mould in matrix, ventral view; 9, paratype 5, a: external mould in matrix, retaining apical shell part, b: apical shell part with protoconch. NZGS TM6684, labeled White Cliffs, North of Urenui, Taranaki, New Zealand (Q19/f6485). Miocene (Tongaporutuan, but see remarks on age correction in the text). Bar length is 1 mm.

bling that of *I. calandrellii* (compare Janssen, 1995, figs 4-6). The reniform shape of the aperture is visible in paratype 1 (fig. 8a) and this is also identical to *I. calandrellii*. In paratype 5, the apical part is present in shell preservation, showing a globular protoconch with a rounded tip, separated from the later shell parts by a distinct constriction (fig. 9a, b). The same specimen seems to have a faint vertical furrow just above the protoconch (might very well be caused by compression), which is reminiscent of *Johnjagtia* Janssen, 2005, but in that genus the much more strongly developed furrow is situated higher, at mid-height of the adult shell.

Additional material of this species (apart from the type lot of '*Clio*' *urenuensis*) seems to be present from the localities Mitimiti (O05/f9644, AU2068) and Waimamaku River mouth (O06/f9623, AU2435), as discussed above under *Ireneia aucklandica*. These two occurrences are both of Altonian age and therefore substantiate the age correction which Beu & Maxwell (1990) preferred.

A further specimen in the AUGD collection that might belong to *I. calandrellii* is an incomplete shell (G6955) from Waimamaku, lacking further data, but probably of Otaian or Altonian age. This specimen is relatively larger than the other *I. calandrellii* specimens and therefore I cannot exclude that it in fact represents *I. nieulandei* (see below).

The fact that *Ireneia calandrellii* was originally described from Italy, far from the '*Clio*' *urenuensis* type locality, does not present problems in considering them to be specifically identical. There are more than a few examples of such remote fossil pteropod occurrences to date, and the same holds true for several extant taxa.



Figs 10-11. *Ireneia nieulandei* A.W. Janssen, 1995. 10, Orongo Point, Kaipara Harbour [referred to by Hayward (1981) as 'Okahukura Peninsula, Kaipara' (Q09/19573)], Miocene, Otaian (Pakaurangi Formation), leg. J. McCarthy, 1973, AUGD registration numbers AU3044, G5938; a: ventral, b: left lateral views. 11, holotype, Saucats, La Coquillière, co-ordinates  $x = 367.5$ ,  $y = 265.5$ , France (Landes), Miocene, Burdigalian, Falun de Pont Pourquet, level A1 (see Janssen, 1985b), leg. F.A.D. van Nieulande, July 1981, don. 1994, RGM 393.138; a: apertural, b: ventral, c: left lateral views. Bar length is 1 mm.



*Ireneia nieulandei* A.W. Janssen, 1995 (figs 10, 11)

*Vaginella aucklandica* Clarke, Hayward, 1981: 118 (pars, non Clarke, only the specimen numbered G5938).  
*Ireneia nieulandei* Janssen, 1995: 170, pl. 14 figs 4, 5.

Material examined. – A single specimen (G5938, AU3044) among additional samples recorded under the name of '*Vaginella aucklandica*' by Hayward (1981: 118), from Orongo Point (referred to by Hayward as 'Okahukura Peninsula, Kaipara' (Q09/f9573), of Otaian age (Pakaurangi Formation), leg. J. McCarthy, 1973.

Discussion. – This shell reaches almost double the size (when complete) of *Ireneia aucklandica*. It agrees in this respect with *I. nieulandei*, described from the Burdigalian of SW France, and also known from Patagonia. A drawing of the holotype of *I. nieulandei* (fig. 11a-c) is given here for comparison. The New Zealand specimen clearly shows (remnants of) longitudinal micro-ornament.

Furthermore, I cannot exclude the possibility that a specimen (G6955) from Waimamaku in the AUGD collection also belongs to this species. It is an incomplete shell, probably of Otaian or Altonian age, that alternatively might represent a relatively large specimen of *I. calandrellii* (see above). Longitudinal micro-ornament is present in this specimen.

## Family Cavoliniidae Gray, 1850

Genus *Vaginella* Daudin, 1800

Type species: *Vaginella depressa* Daudin, 1800, by monotypy (Miocene, Burdigalian).

*Vaginella depressa* Daudin, 1800 (figs 12-34)

## New Zealand records:

*Vaginella inflata* Hayward, 1981: 119, figs 15-17; Shibata, 1983: 79; Beu & Maxwell, 1990: 424; Janssen, 1990: 51, 57; 1995: 147.

Type material examined. – Holotype (G5962) and twenty-six paratypes (G5963a-l, G5964a-g, G5965, G5966, G5967a-d, G5968) of *Vaginella inflata*, as designated by Hayward (1981).

Type locality of *V. inflata*. – North Tirikohua Point (Q11/f7574), Waitakere Coast, West Auckland, New Zealand.

Stratum typicum of *V. inflata*. – Miocene (mid Altonian, see tab. 1), Tirikohua Formation, Tirikohua Member.

Discussion. – The name *Vaginella inflata* has been used previously as a manuscript name, and was subsequently cited as a synonym [e.g. Bellardi, 1873: 37, sub *Cuvieria inflata* (Bonelli)]. Bonelli's manuscript, however, was never published, and thus the name *Vaginella inflata* Hayward, 1981 is not preoccupied by *Vaginella inflata* Bonelli, in Bellardi, 1873 (ICZN Art. 11.6).

Shibata (1983: 79) already noted that *Vaginella inflata* 'seems to be synonymous' with *V. depressa*. Janssen (1990, 1995) did indeed synonymise these taxa, but that decision was merely based on Hayward's illustrations. A study of the type lots now substantiates that view.

Hayward did compare his taxon with *V. depressa*, but decided that it differs 'in having its greatest inflation dimensions two-thirds of the distance from the aperture, rather than to the middle of the shell, and also in its less acute apical angle'. Such differences, however, are easily misinterpreted in case incomplete material is available, and may apply if only few specimens for comparison are at hand. In a large sample of the quite variable *V. depressa* these points cannot be substantiated. Figs 12-18 illustrate a random sample of *V. depressa* from the type area (Léognan, SW France; Miocene, Burdigalian), showing the range of variation. Figs 19 and 20-34 are outline drawings of the holotype and some of the paratypes, respectively, of *V. inflata*. The only more or less constant difference is that the New Zealand specimens reach slightly larger dimensions, which cannot be a reason for specific separation.

In *Vaginella* especially the apical angle is difficult to measure, first of all because the basal sidelines in most of the species are curved, not straight lines, and therefore the value obtained for such measurements depends strongly on definition, and because *Vaginella* specimens usually are incomplete, lacking their larval shells, inclusive of a smaller or greater portion of the adult shell (as well as portions of the apertural margin), as is also the case in the otherwise well-preserved specimens illustrated in figs 12-18 (for an exceptionally well-preserved specimen see Janssen, 1985a, fig. 13a-d). Certainly in the case of specimens in a rather poor state of preservation (as is the case in '*Vaginella inflata*') such measurements are hardly useful.

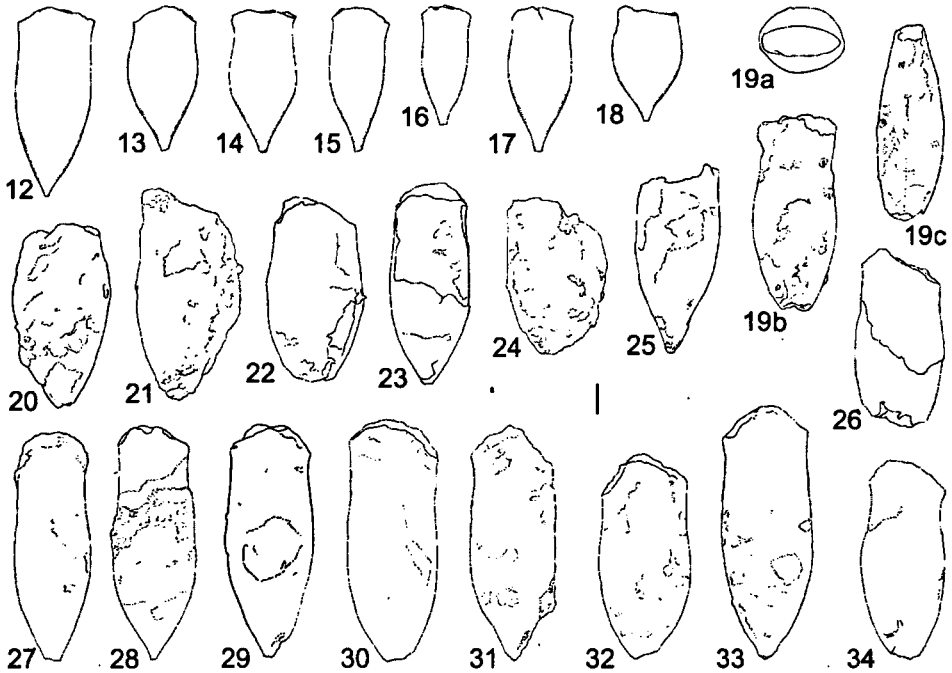
The occurrence of *Vaginella depressa* in the New Zealand Miocene (of mid Altonian age, see Tab. 1) once more documents the presence of this species in the Indo-Pacific Basin. Additional records are from Japan (Shibata, 1983 and earlier papers referred to therein) and southern Australia (Janssen, 1990).

Interesting, however, are the age differences of such populations, compared to the European ones. In Europe, *V. depressa* occurs during the Aquitanian and Early Burdigalian, and it is replaced by *V. austriaca* Kittl, 1886 during the Late Burdigalian, which species continues through the Langhian, until the Early Serravallian. The Japanese records of *V. depressa* are of Langhian age (Blow Zones N8 and N9; Shibata, 1983) and the southern Australian specimens cover a range from Balcombian to and including the Bairnsdalian (= Langhian-Serravallian; Janssen, 1990). The species *V. austriaca*, however, has not been recorded from the Indo-Pacific, which might indicate that the development from *V. depressa* to *V. austriaca* took only place in the Atlantic and Mediterranean realm, separated from the Indo-Pacific as a result of severed connections through the Tethyan Seaway (Harzhauser et al., 2002, fig. 3).

*Vaginella sannicola* A.W. Janssen (1990: 69, pl. 9 figs 7-9) was introduced from Langhian deposits in Italy, but elsewhere in the Mediterranean (e.g. Maltese Archipelago) it is also found in older Miocene sediments. The differences with *V. depressa* are small, and it might turn out that *V. sannicola* is better interpreted as a Mediterranean 'race', or maybe subspecies, of *V. depressa*. This needs to be checked by additional comparisons. At any rate, typical *V. depressa* is also known from the Mediterranean Basin, where it has a quite restricted vertical range. This situation will be discussed in more detail in a forthcoming paper.

#### SUMMARY OF CONCLUSIONS

Type material of the four euthecosomatous pteropods from the Miocene of New Zealand, originally or subsequently referred to the genus *Vaginella*, was studied, resulting in the following nomenclatural changes:



Figs 12-34. *Vaginella depressa* Daudin, 1800. 12-18, Léognan (France, Gironde), RGM 396.082, dorsal or ventral views, random sample demonstrating range of variation. Miocene (Burdigalian), Falun de Saucats; 19, holotype of *Vaginella inflata* Hayward, 1981, a: apical, b: ventral, c: right lateral views, AUGD G5962, North Tirikohua Point cliffs (Q11/f7574), Waitakere Coast, West Auckland, New Zealand. Miocene (Altonian), Tirikohua Formation, Tirikohua Member; 20-26, 7 paratypes of *V. inflata*, AUGD G5964a-g, same locality and stratigraphy as Fig. 17 (Q11/f7571), dorsal or ventral views; 27-34, 8 paratypes of *V. inflata* (all illustrated in Hayward, 1981, fig. 17), AUGD G5963a-h, same locality and stratigraphy as Fig. 17 (Q11/f7574), dorsal or ventral views. Bar length is 1 mm.

## Original name

## Revised name

*Clio (Creseis) urenuiensis* Suter, 1917  
*Vaginella aucklandica* Clarke, 1905  
*Vaginella inflata* Hayward, 1981  
*Vaginella torpedo* Marshall, 1918

*Ireneia calandrellii* (Michelotti, 1847)  
*Ireneia aucklandica* (Clarke, 1905)  
*Vaginella depressa* Daudin, 1800  
*Cuvierina (Cuvierina) torpedo* (Marshall, 1918)

In addition, *Ireneia nieulandei* A.W. Janssen, 1995, was recognised among additional samples identified as *Vaginella aucklandica*, from the Early Miocene (Otaian) of Orongo Point, Northland, New Zealand. Some additional samples identified as *I. aucklandica* are now also referred to *I. calandrellii*.

The presence of several species of *Ireneia* in the New Zealand area during the Early Miocene supports the hypothesis (Janssen, 2005: 28) that the genus *Cuvierina* developed from an *Ireneia* root around the Oligocene/ Miocene transition.

*Vaginella depressa* evolved into *V. austriaca* during the Late Burdigalian in the Atlantic and Mediterranean realms. Apparently as a result of the closure of the Tethyan Seaway this development did not take place in the Pacific, where *V. depressa* continues until the Serravallian.

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