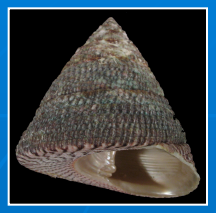
Evolution of the systematics of the Trochoidea Rafinesque, 1815

- Summary-

Claude Vilvens

2013



1. « Molecular » Systematics (1/3)

Sources :

Williams. S. T., Karube. S. & Ozawa. T. 2008. Molecular systematics of Vetigastropoda: Trochidae. Turbinidae and Trochoidea redefined. *Zoologica Scripta,* 37, 483–506.

Molecular systematics of Vetigastropoda: Trochidae, Turbinidae and Trochoidea redefined

SUZANNE T. WILLIAMS, SATOSHI KARUBE & TOMOWO OZAWA

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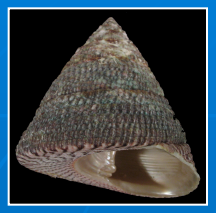
Williams, S. T., Karube, S. & Ozawa, T. (2008) Molecular systematics of Vetigastropoda: Trochidae, Turbinidae and Trochoidea redefined. — *Zoologica Scripta*, **, ***–***.

Trochoidea are a large superfamily of morphologically and ecologically diverse marine gastropods. We present here an appraisal of the composition and relationships among *trochoidean* families based on molecular data, with an especial focus on the family Trochidae. Bayesian analyses of sequences from three genes (18S rRNA, 28S rRNA and COI) including data from 162 vetigastropod species show that the gastropod family Trochidae (*sensu* Hickman & McLean (1990), *Natural History Museum Los Angeles County Science Series, 35*, 1–169) is not monophyletic. Recognition



1. « Molecular systematics (1/3)

Williams S.T., Donald K.M., Spencer H.G. & Nakano T. 2010. Molecular systematics of the marine gastropod families Trochidae and Calliostomatidae (Mollusca: Superfamily Trochoidea). *Molecular Phylogenetics and Evolution,* 54, 783–809.

Molecular systematics of the marine gastropod families Trochidae and Calliostomatidae (Mollusca: Superfamily Trochoidea)

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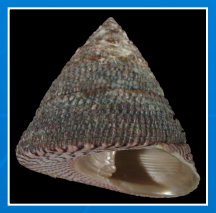
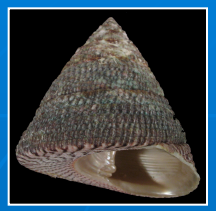
ABSTRACT

This study is the most extensive molecular study of the gastropod families Trochidae and Calliostomatidae published to date, in terms of both numbers of taxa and of gene sequences. As a result of Bayesian phylogenetic analyses of molecular sequence data from one nuclear gene and three mitochondrial genes, we propose dramatic changes to Trochidae family systematics, present the first molecular phylogeny for Calliostomatidae and include the first published sequence data for the enigmatic subfamily Thys-



1. « Molecular systematics (1/3)

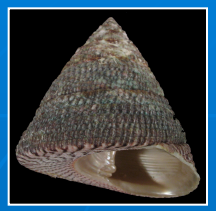
- **1. Seguenzioidea**
  - Calliotropidae
  - Cataegidae
  - Chilodontidae
  - n.cl. Bathymargarites
- **2. Trochoidea**
  - Calliostomatidae
  - Trochidae
  - Solariellidae
  - Trochoidea inc. sedis
  - Cyclostrematidae
  - Turbinidae
  - Liotiidae
  - Skeneidae
- **3. Phasianelloidea**
  - Phasianellidae
  - Colloniidae
- **4. Angarioidea**
  - Angariidae
  - Areneidae



2. Illustrated visit to the "NewTrochoidLand"

1.1 Seguenziidae Verril, 1884

- **Seguenziidae** Verrill, 1884
  - Seguenziinae
  - Asthelysinae
  - Davisianinae
  - Guttulinae



2. Illustrated visit to the "NewTrochoidLand"

1.1.1 Seguenziinae Verrill, 1884

1.1.1a Seguenziini Verrill, 1884

Seguenzia Jeffreys, 1876

Carenzia Quinn, 1983

Hadroconus Quinn, 1987

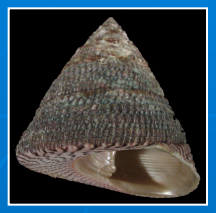
Halystes Marshall, 1988

Halystina Marshall, 1991

Quinnia Marshall, 1988

Rotellenzia Quinn, 1987

Seguenziopsis Marshall, 1983



2. Balade illustrée au "NewTrochoidLand"

1.1.1 Seguenziinae Verrill, 1884

1.1.1b Fluxinellini Marshall, 1991

Fluxinella Marshall, 1983

Ancistrobasis Dall, 1889

Basilissa Watson, 1879

Basilissopsis Dautzenberg & H. Fischer, 1897

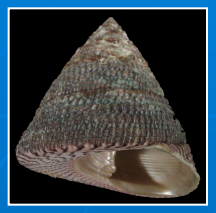
Calliobasis Marshall, 1983

Fluxinella Marshall, 1983

Thelyssa Bayer, 1971

Visayaseguenzia Poppe, Tagaro & Dekker, 2006

Fluxinella stirophora Marshall, 1991 - 3 mm



2. Balade illustrée au "NewTrochoidLand"

1.2 Calliotropidae Hickman & McLean, 1990

Bathybembix Crosse, 1893

Calliotropis L. Seguenza, 1903

Cidarina Dall, 1909

Convexia Noda, 1975

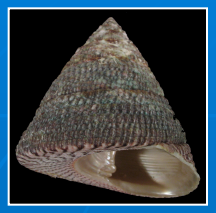
Echinogurges Quinn, 1979

Ginebis Taki & Otuka, 1942

Lischkeia P. Fischer, 1879

Putzeysia Sulliotti, 1889

Spinicalliotropis Poppe, Tagaro & Dekker, 2006

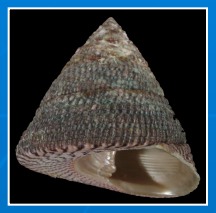


2. Balade illustrée au "NewTrochoidLand"

1.3 Chilodontidae Wenz, 1938

Chilodonta Etallon, 1859
Agathodonta Cossmann, 1918
Danilia Brusina, 1865
Dentistyla Dall, 1889
Euchelus Philippi, 1847
Granata Cotton, 1957
Herpetopoma Pilsbry, 1890
Hybochelus Pilsbry, 1890
Mirachelus Woodring, 1928
Perrinia H. Adams & A. Adams, 1854
Tibatrochus Nomura, 1940
Turcica H. Adams & A. Adams, 1854
Vaceuchelus Iredale, 1929

Chilodonta sp.



2. Balade illustrée au "NewTrochoidLand"

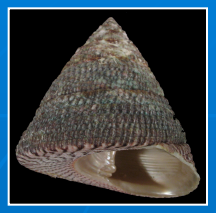
2.1 **Trochidae** Rafinesque, 1815

Trochidae Rafinesque, 1815

- Trochinae
- Monodontinae
- Chrysostomatinae
- Cantharidinae
- Stomatellinae
- Umboniinae
- Alcyninae
- Fossarininae
- Halistylinae
- genres non assignés

The Gibbulinae disappeared: absorbed by the Cantharidinae !

The Margaritinae and the Tegulinae have been transferred to the Turbinidae !



2. Illustrated visit to the "NewTrochoidLand"

2.1.1 **Trochinae** Rafinesque, 1815

Trochus Linnaeus, 1758

Clanculus Montfort, 1810

Coelotrochus P. Fischer, 1879

Eurytrochus P. Fischer, 1879

Infundibulops Pilsbry, 1889

Infundibulum Montfort, 1810

Notogibbula Iredale, 1924

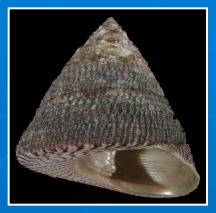
Pulchrastele Iredale, 1929

Rubritrochus L. Beck, 1995

syn : ***Thorista*** Iredale, 1915 et ***Thoristella*** Iredale, 1915 : unite species with a range from around New Zealand

Pseudotalopia moves to the Cantharidinidae !!!

Despite the fact that it is close to ***Trochus*** by radula, epipodium and operculum, ***Tectus*** is not included and becomes a member of the Turbinidae !!!



2. Illustrated visit to the "NewTrochoidLand"

2.1.2 Monodontinae Gray, 1857

syn : ***Melagraphia*** Gray, 1847

Austrocochlea P. Fischer, 1885

Diloma Philippi, 1845

Monodonta Lamarck, 1799

3 genera (with a general regrouping (almost) of the genera related to ***Diloma***)

The genera ***Osilinus*** and ***Oxystele*** have not been retained and become members of the Cantharidinae !!!

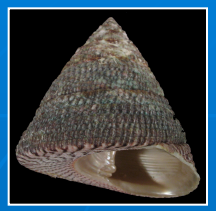
Diloma in it's usual sense is not monophyletic: The subgenus ***Pictodiloma*** (with *D. suavis*) becomes a genus in the Cantharidinae ! And two *Diloma* become *Austrocochlea*.

Chrysostoma and ***Chlorodiloma*** become a new subfamily!

Cittarium does not stay here but becomes a member of the Turbinidae !!!

Margarella has not been considered: incertae sedis !

Fossarina becomes the base for a new subfamily.



2. Illustrated visit to the "NewTrochoidLand"

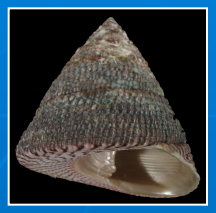
2.1.3 Chrysostomatinae Williams, Donald, Spencer & Nakano, 2010

Chrysostoma Swainson, 1840

Chlorodiloma Pilsbry, 1889

??? autres ???

Monophyletic group



2. Illustrated visit to the "NewTrochoidLand"

2.1.4 Cantharidinae Gray, 1857

Cantharidus Montfort, 1810

Agagus Jousseaume, 1894

Calliotrochus P. Fischer, 1879

Calthalotia Iredale, 1929

Cantharidella Pilsbry, 1889

Clelandella Winckworth, 1932

Gibbula Risso, 1826

Jujubinus Monterosato, 1884

Kanekotrochus Habe, 1958

Komaitrochus Kuroda & Taki, 1958

Nanula Thiele, 1924

Odontotrochus P. Fischer, 1880

Osilinus Philippi, 1847

Oxystele Philippi, 1847

Phasianotrochus P.Fischer, 1885

Phorcus Risso, 1826

Pictodiloma Habe, 1946

Priotrochus P.Fischer, 1879

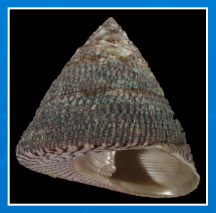
Prothalotia Thiele, 1930

Pseudotalopia Habe, 1961

Thalotia Gray, 1847

Tosatrochus MacNeil, 1961

Trochinella Iredale, 1937



2.1.5 Umboniinae H. Adams & A. Adams, 1854 (1840)

Monophyletic group

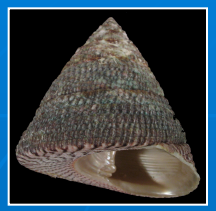
The *Lirularia* and *Archiminolia* (?) are integrated in the Umboniinae

There is no molecular indication which pleads in favor for the maintaining of the tribes Umboniini, Talopini, etc.

Ethminolia [*stearnsi*] and ***Conotalopia*** are not monophyletic.

Talopena ?

Umbonium Link, 1807
Antisolarium Finlay, 1926
?***Archiminolia*** Iredale, 1929
Bankivia Krauss, 1848
Camitia H. Adams & A. Adams, 1854
Conotalopia Iredale, 1929
Ethalia H. Adams & A. Adams, 1854
Ethaliella Pilsbry, 1905
Ethminolia Iredale, 1924
Inkaba Herbert, 1992
Isanda H. Adams & A. Adams, 1854
Leiopyrga H. Adams & A. Adams, 1863
Lirularia Dall, 1909
Monilea Swainson, 1840
Parminolia Iredale, 1929
Pseudominolia Herbert, 1992
Rossiteria Brazier, 1895
Rotella Lamarck, 1822
Sericominolia Kuroda & Habe, 1954
Vanitrochus Iredale, 1929
Zethalia Finlay, 1926



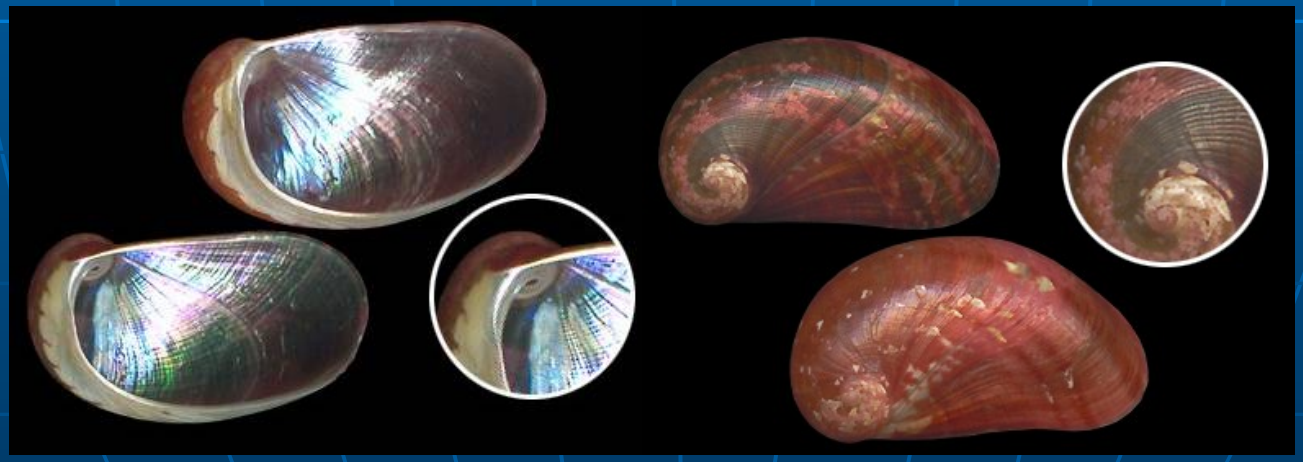
2. Illustrated visit to the "NewTrochoidLand"

2.1.6 Stomatellinae
Gray, 1840

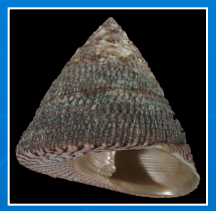
Monophyletic group

Stomatella Bowdich, 1822
Gena Gray, 1840
Microtis H. Adams & A. Adams, 1850
Pseudostomatella Thiele, 1924
Stomatia Helbling, 1779
Stomatolina Iredale, 1937

Stomatella Bowdich, 1822



Stomatella impertusa (Burrow, 1815)



2. Illustrated visit to the "NewTrochoidLand"

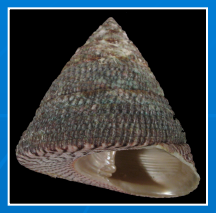
2.1.7 **Alcyninae** Williams, Donald, Spencer & Nakano, 2010

Alcyna A.Adams, 1860

Ex-Cantharidini

Shell without mother of pearl

Alcyna ocellata
A.Adams, 1860



2. Illustrated visit to the "NewTrochoidLand"

2.1.8 **Fossarininae** Bandel, 2009

Fossarina A. Adams & Angas, 1864

Broderipia Gray, 1847

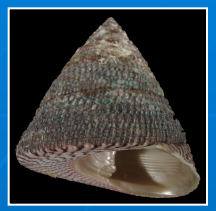
Clydonochilus P. Fischer, 1890

Minopa Iredale, 1924

Synaptocochlea Pilsbry, 1890

Synaptocochlea moved from the Stomatellinae to the Chilodontini and finally joins ***Fossarina***.

Broderipia moves directly into Stomatellinae to the ***Fossarininae***



2. Illustrated visit to the "NewTrochoidLand"

2.1.9 **Halistylinae** Keen, 1958

Not yet tested group - remains in Trochidae for the moment.

Halistylus Dall, 1890
Botelloides Strand, 1928
Charisma Hedley, 1915

Halistylus Dall, 1890

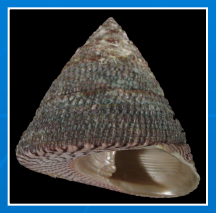
Halistylus columna (Dall, 1890)

Botelloides Strand, 1928

Botelloides bassianus (Hedley, 1911)

Charisma Hedley, 1915

Charisma compacta Hedley, 1915



2. Illustrated visit to the "NewTrochoidLand"

2.1.10 Not assigned genera

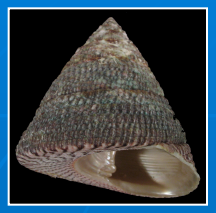
Callumbonella Thiele, 1924
Enida A. Adams, 1860
Margarella Thiele, 1893
Intortia Egorova, 1972
Labio Gray, 1850
Umbonella A. Adams, 1863

Enida A. Adams, 1860

Enida japonica A.Adams, 1860

Callumbonella Thiele, 1924

Callumbonella suturale (Philippi, 1836)

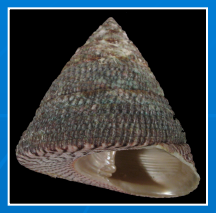


2. Illustrated visit to the "NewTrochoidLand"

2.2 Calliostomatidae Thiele, 1924

- **Calliostomatidae**
  - Calliostomatinae
  - Thysanodontinae
  - genre non assigné

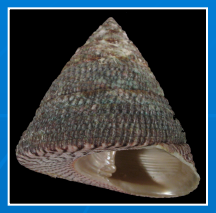
Venustatrochus Powell, 1951



2. Balade illustrée au "NewTrochoidLand"

2.2.1 **Calliostomatinae** Thiele, 1924

Calliostoma Swainson, 1840
Akoya Habe, 1961
Alertalex Dell, 1956
Ampullotrochus Monterosato, 1890
Astele Swainson, 1855
Astelena Iredale, 1924
Bathyfautor Marshall, 1995
Benthastelena Iredale, 1936
Carinator Ikebe, 1942
Coralastele Iredale, 1930
Dactylastele Marshall, 1995
Dymares Schwengel, 1942
Elmerlinia Clench & Turner, 1960
Eucasta Dall, 1889
Falsimargarita Powell, 1951
Fautor Iredale, 1924
Fautrix Marshall, 1995
Fluxina Dall, 1881
Kombologion Clench & Turner, 1960
Laetifautor Iredale, 1929
Leiotrochus Conrad, 1862
Maurea Oliver, 1926
Neocalliostoma Castellanos & Fernandez, 1976
Omphalotukaia Yoshida, 1948
Otukaia Ikebe, 1942
Photinastoma Powell, 1951
Photinula H.Adams & A.Adams, 1854
Selastele Marshall, 1995
Sinutor Cotton & Godfrey, 1935
Tropidotrochus Parodiz, 1977
Venustas Allan, 1926
Ziziphinus Gray, 1842



2. Balade illustrée au "NewTrochoidLand"

2.2.2 **Thysanodontinae** Marshall, 1988

Thysanodonta Marshall, 1988
Carinastele Marshall, 1988
Herbertina Marshall, 1988

Carinastele kristelleae is a sister species of *Margarella antartica* !

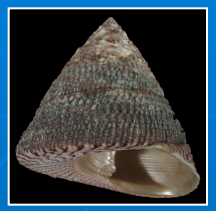
Carinastele Marshall, 1988

Carinastele kristelleae
Marshall, 1988

Thysanodonta Marshall, 1988

Thysanodonta boucheti Marshall, 1988

Thysanodonta cassis
Vilvens & Maetrati, 2006



2. Balade illustrée au "NewTrochoidLand"

2.3 Solariellidae Powell, 1951

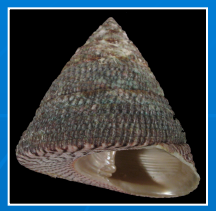
Solariella S. Wood, 1842
Archiminolia Iredale, 1929
Bathymophila Dall, 1881
Ilanga Hebert, 1987
Lamellitrochus Quinn, 1991
Microgaza Dall, 1881
Minolia A. Adams, 1860
Spectamen Iredale, 1924
Zetela Finlay, 1927

Solariella S. Wood, 1842

Solariella mutabilis Schepman, 1908

Solariella euteia Vilvens, 2009

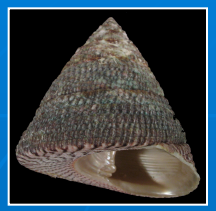
Solariella nyssona Dall, 1919



2. Balade illustrée au "NewTrochoidLand"

2.4 **Turbinidae** Rafinesque, 1815

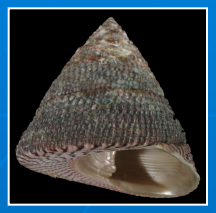
- **Turbinidae**
  - Turbininae
  - Margaritinae
  - Tegulinae
  - Prisogasterinae
  - Moellerinae
  - Skeneinae
  - genres non assignés



2. Illustrated visit to the "NewTrochoidLand"

2.4.1 Turbininae Rafinesque, 1815

Turbo Linnaeus, 1758
Astraea Röding, 1798
Astralium Link, 1807
Bellastraea Iredale, 1924
Bolma Risso, 1826
Cookia Lesson, 1832
Guildfordia Gray, 1850
Lithopoma Gray, 1850
Lunella Röding, 1798
Megastraea J. H. McLean, 1970
Micrastraea Cotton, 1939
Modelia Gray, 1850
Pomaulax Gray, 1850



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2.4.2 Margaritinae Thiele, 1924

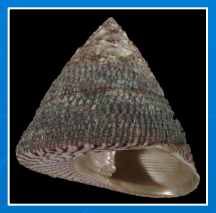
Margarites Gray, 1847
Antimargarita Powell, 1951
Callogaza Dall, 1881
Gaza Watson, 1879
Kaiparathina Laws, 1941

The type genus *Margarites* is not a Trochidae, but a Turbinidae !!!

This is not a monophyletic group.

Gaza remains close to *Margarites*

No molecular information yet on Kaiparathini



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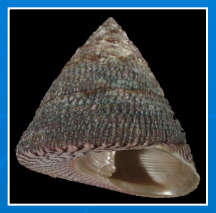
2.4.3 Tegulinae Kuroda, Habe & Oyama, 1971

Chlorostoma Swainson, 1840
Cittarium Philippi, 1847
Norrisia Bayle, 1880
Omphalius Philippi, 1847
Tectus Montfort, 1810
Tegula Lesson, 1832

The genus *Tegula* and related genera are no longer associated with the Trochidae, but are now with the Turbinidae !!!

This is a monophyletic group with *Tectus* et *Cittarium* included as sister group. With the transfer of Cittarium, there are no longer Monodontinae in the western Atlantic.



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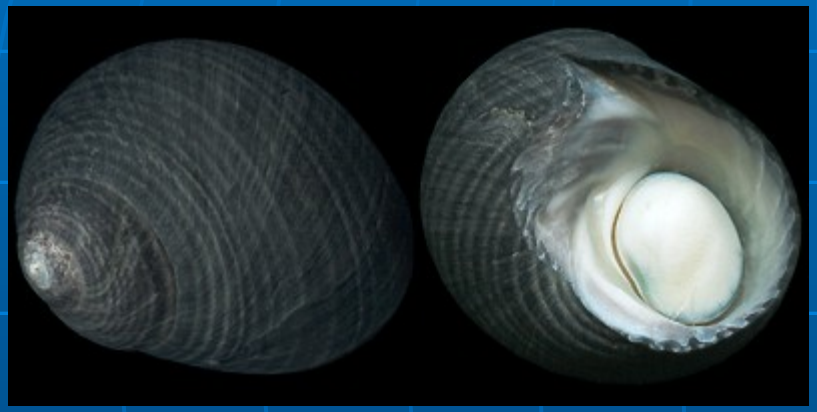
2.4.4 **Prisogasterinae** Hickman & McLean, 1990

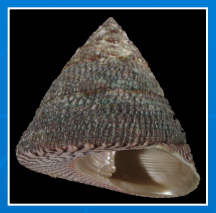
Prisogaster Mörch, 1850



Prisogaster niger
(Wood, 1828)

The subfamilies Turbininae et Prisogasterinae are the only ones that have a calcareous operculum.

One single genus (Peruvian zone) **and a single species!** But this species presents a unique combination of primitive caracteristics which are derived from, among others, the Tegulinae and the Turbininae, even from the Phasianellidae : nacreous interior, multispiral operculum at the start, but paucispiral later, …



2. Balade illustrée au "NewTrochoidLand"

2.4.5 **Moellerinae** Hickman & McLean, 1990

Moelleria Jeffreys, 1865
Spiromoelleria Baxter & McLean, 1984

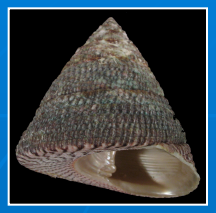
Moelleria Jeffreys, 1865

Moelleria costulata (Møller, 1842)

A very thin shell with a fine layer of mother of pearl in the interior.

Particular operculum: interior horny and multispiral, exterior calcareous.

In this stage not yet any molecular information.

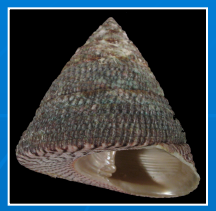


2.4.6 **Skeneinae** Clark, 1851

Skenea Fleming, 1825
Akritogyra Warén, 1992
Anekes Bouchet & Warén, 1979
Bruceiella Warén & Bouchet, 1993
Callomphala A. Adams & Angas, 1864
Cirsonella Angas, 1877
Dasyskenea Fasulo & Cretella, 2003
Didianema Woodring, 1928
Dikoleps Hoisaeter, 1968
Dillwynella Dall, 1889
Eudaronia Cotton, 1945
Fucaria Warén & Bouchet, 1993
Ganesa Jeffreys, 1883
Granigyra Dall, 1889
Haplocochlias Carpenter, 1864
Iheyaspira Okutani, Sasaki & Tsuchida, 2000
Leucorhynchia Crosse, 1867
Lissomphalia Warén, 1992
Lissospira Bush, 1897
Lissotesta Iredale, 1915
Lodderena Iredale, 1924
Lopheliella Hoffman, van Heugten & Lavaleye, 2008
Mikro Warén, 1996
Moelleriopsis Bush, 1897
Notosetia Iredale, 1915
Palazzia Warén, 1991
Parviturbo Pilsbry & McGinty, 1945
Protolira Warén & Bouchet, 1993
Pseudorbis Monterosato, 1884
Retigyra Warén, 1989
Skeneoides Warén, 1992
Tharsis Jeffreys, 1883
Trenchia Knudsen, 1964
Xyloskenea Marshall, 1988

Sister group of the Margaritinae.

We here find monophyletic groups with *Dillwynella*.



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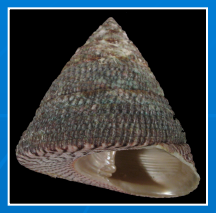
2.4.? Not yet assigned genera

Lodderia Tate, 1899
Submargarita Strebel, 1908
Tropidomarga Powell, 1951

Submargarita Strebel, 1908

Submargarita macknighti Dell, 1990



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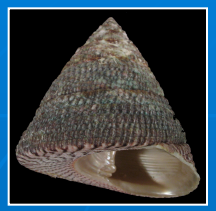
2.5 **Cyclostrematidae** Fischer, 1885

Cyclostrema Marryat, 1818
Abyssogyra A.H. Clarke, 1961
Brookula Iredale, 1912
Cithna A. Adams, 1863
Liotella Iredale, 1915
Liotina Munier-Chalmas, 1885

Cyclostrema Marryat, 1818

Cyclostrema cancellatum Marryat, 1818



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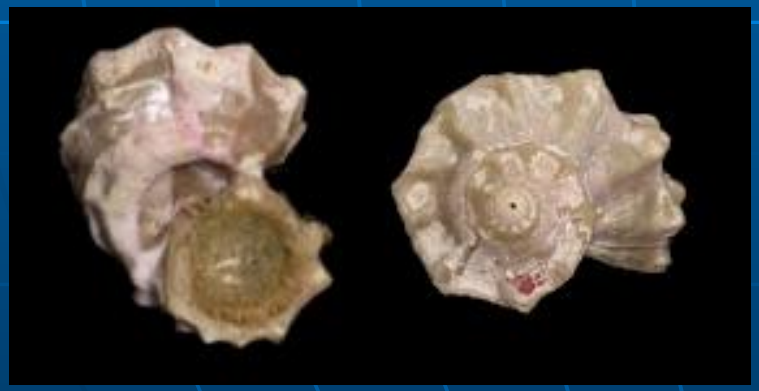
2.6 **Liotiidae** Gray, 1850

Liotia Gray, 1842
Dentarene Iredale, 1929
Liotina Munier-Chalmas, 1885
Macrarene Hertlein & Strong, 1951
Munditia Finlay, 1926
Wanganella Laseron, 1954

This is possibly a sister group of the Calliostomatidae !

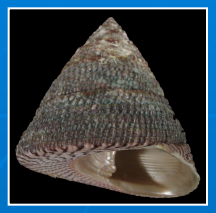
Macrarene Hertlein & Strong, 1951



Macrarene cookeana (Dall, 1918)

Munditia Finlay, 1926

Munditia australis Kiener, 1839



2. Illustrated visit to the "NewTrochoidLand"

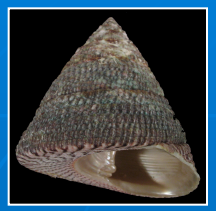
3.1 **Phasianellidae** Swainson, 1840

Eulithidium Pilsbry, 1898
Gabrielona Iredale, 1917 **OR** subfamily Gabrieloninae
Phasianella Lamarck, 1804 **OR** subfamily Phasianellinae
Tricolia Risso, 1826 **OR** subfamily Tricoliinae

Monophyletic group – it was already an informal group for Hickman & McLean.

No mother of pearl inside, smooth surface with color patterns.

Radula with the rachidian reduced or even absent, replaced by the interior laterals which are more or less fused.

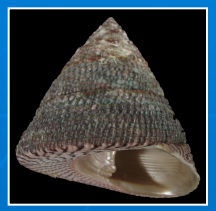


2. Illustrated visit to the "NewTrochoidLand"

3.2 **Colloniidae** Cossmann, 1917

- **Colloniidae**
  - Colloniinae
  - Petropomatinae

Groupe monophylétique, in fact quite distant from the Turbinidae.



2. Balade illustrée au "NewTrochoidLand"

3.2.1 **Colloniinae** Cossmann, 1917

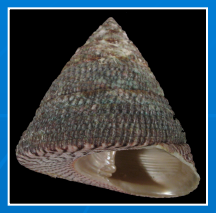
Collonia Gray, 1850
Anadema H. & A. Adams, 1854
Argalista Iredale, 1915
Bothropoma Thiele, 1924
Cantrainea Jeffreys, 1883
Collonista Iredale, 1918
Emiliotia Faber, 2006
Homalopoma Carpenter, 1864
Leptocollonia Powell, 1951
Leptothyra Pease, 1869

Collonista Iredale, 1918

Collonista costulosa
(Sowerby II, 1886)

3.2.2 ***Petropomatinae*** Cox, 1960

Liotipoma McLean & Kiel, 2007

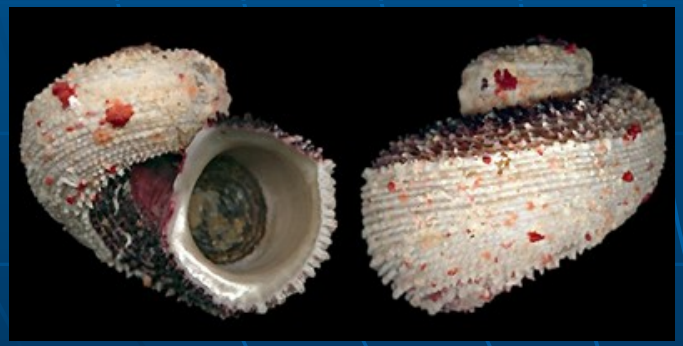


4.1 **Angariidae** Gray, 1857

Angaria Röding, 1798

Groupe monotypique.

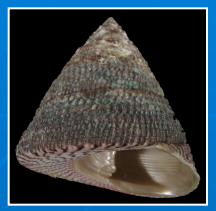
Angaria delphinus
(Linnaeus, 1758)



Angaria tyria
(Reeve, 1842)

Angaria vicdani Kosuge, 1980

Angaria sphaerula (Kiener, 1873)



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4.2 Areneidae Adams, 1854

Arene H. Adams & A. Adams, 1854
Cinysca Kilburn, 1970

A group which is definitely distinct from the Liotiidae.

Arene H. Adams & A. Adams, 1854

Arene cruentata (Mühlfeld, 1824)

Cinysca Kilburn, 1970

Cinysca alvesi Rubio & Rolán, 2002

Arene briareus (Dall, 1881)