

Chapter I

IDENTIFICATION OF MARINE WOOD-BORING MOLLUSCS

by

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When inspecting a piece of wood in the field or prior to laboratory examination, it is usually possible to judge by the size of the holes whether the borers within belong to the Teredinidae or the Pholadidae. Those of teredinids are usually very small, 1 to 2 mm in diameter, and the calcareous lining of the tube is often visible ; the aperture of a mature pholad burrow is usually 2 to 3 times that size and does not have a calcareous lining.

It is generally impossible to distinguish between newly settled pholads and teredinids but once they have entered the wood, though the apertures of the burrows are similar, the calcareous lining of the teredinid burrow is usually apparent. In addition, the pallets of the teredinid, which are produced within a very few days, are visible inside the burrow.

Wood-boring pholads (except one genus found in very deep water and not included here) make burrows only about 3 to 8 times the length of the shell. Teredinids usually continue to burrow as long as they live and make long worm-like tunnels, the animal extending its entire length. A teredinid does not stop lengthening its burrow and seal off the anterior end with a calcareous lining until there is no further space available in the wood.

This paper is divided into four sections. The first part, on the identification of the Pholadidae, discusses the problems involved in determining species and contains a glossary of terms used in describing pholads as well as a list of the wood boring species with their ranges. The second part, on the Teredinidae, includes in addition to data similar to those given for the Pholadidae a list of synonyms for the recognized species. The third part is a key to the identification of the wood boring bivalves of the world and part four, a bibliography of the more general studies of value in determining species in different parts of the world.

I. IDENTIFICATION OF PHOLADIDAE

In addition to the two calcareous valves characteristic of the Bivalvia, members of the Pholadidae have at least one and some have as many as 4 accessory calcareous plates. The generic classification of the Pholadidae is based on the arrangement of these plates, the presence or absence of a callum in the adult and on the presence or absence of apophyses. Species identification is based on the shape of the valves, the accessory plates and the characters of the siphons (Turner, 1954, 1955). In the subfamilies, Pholadinae and Xylophaginae, both having wood borers, there is no basic change in the shell with growth from young to adult. Xylophaga differ from all other wood borers in lacking apophyses, the pedal retractor muscles being attached to the valves in the normal position anterior to the posterior adductor muscle. In another subfamily, the Martesiinae, however, the young and adults present two distinct forms ; the young shell is beaked and widely gaping anteriorly while in the adult, the anterior gape is closed by a calcareous deposit, the callum. At the time the callum is deposited the mesoplax becomes fully developed and the metaplax and hypoplax are produced.

Since many specialised terms are used in describing pholads, the following glossary and diagrams are included as an aid in using the key.

Accessory plates - three dorsal plates and one ventral plate which cover the areas between the valves and are attached to the valves by periostrical folds.

Dorsal plates - accessory plates on the dorsal surface, comprising the protoplax, mesoplax and metaplax.

Ventral plate - an accessory plate called the hypoplax on the ventral surface.

Protoplax - a simple, nearly flat, elongate dorsal plate which rests on top of the anterior adductor muscle but does not enclose it. It may be calcareous or periostracal, in one piece or divided longitudinally.

Mesoplax - a transverse plate, usually wider than long, which straddles the valves at the umbos and partially or completely covers the posterior end of the anterior adductor muscle. It may be composed of one or two parts.

Metaplax - a long narrow plate which covers the gap between the two valves on the dorsal margin behind the mesoplax. It is joined to the valves by periostracal folds.

Hypoplax - a long narrow plate which covers the gap between the two valves ventrally.

Callum - the calcareous deposit closing the pedal gape in adult Martesiinae. The two halves are joined medially by periostracum with only a minute pore remaining open.

Umbonal reflection - a reflection of the dorsal margin of the valve anterior to and often over the umbo. The anterior adductor muscle scar usually covers most of the umbonal reflection.

Apophyses - large styloid projections which extend from beneath the umbos and to which the pedal muscles are attached.

Chondrophore - projections of the hinge area to support the internal ligament. On the right valve, it is a small swelling with a central depression and, on the left, a small shelf-like projection.

Chimney - a tube formed of agglutinated particles of frasse and of particles broken off during boring activities but not ingested. The chimney fills the posterior end of the burrow.

Stenomorph - a term applied to a stunted, often malformed specimen usually one found in an abnormally hard substrate or in crowded conditions.

These and terms used in the key can be readily understood from the diagrams (Fig.1 and 2).

The genera and species of wood-boring pholads are easily distinguished provided the specimens are complete and in good condition. A single valve of Pholas dactylus Linnaeus can be identified as it is the only species in this genus with a beaked anterior margin. It would be impossible, however, to distinguish an isolated valve of a young Pholas campechiensis Gmelin from that of a young P. chiloensis Molina. Similarly, isolated valves of Zirfaea crispata Linnaeus and Z. pilsbry Lowe or Barnea truncata Say and B. subtruncata Sowerby would be impossible to separate. These are all closely related allopatric species, differing mainly in characters of the siphons and, in such cases, a knowledge of the locality is of help in identification. Using geographical data, however, might be misleading, particularly if the specimens come from a ship or from drift wood. Martesia or Xylophaga should be determined only to the generic level if the mesoplax is missing and for some species of Xylophaga the siphons must be present for positive identification.

An additional problem arises in the Martesiinae as the young and adult forms are quite different. The beaked young form of Martesia striata (Linnaeus) was at one time placed in a separate genus and appears in the literature as Hiata infelix Zetek and McLean. Therefore, in the key for the identification of wood-boring bivalves all callum-building species are keyed out twice - to the young and to the adult. Young Martesia have been confused with the Teredinidae and Xylophaginae but can be differentiated from the former by the lack of pallets and from the latter by the presence of apophyses.

The variability exhibited by all species of borers produces a third problem. Such variation may depend on the following : hardness of the substrate ; extent of crowding ; temperature, salinity, or pH of the water ; available food or a combination of these factors (Turner 1954, 1955, 1966 ; (Clapp and Kenk, 1963). Under adverse conditions a specimen of Martesia striata may reach a length of only 3.5 mm before producing a callum while another, growing in an ideal situation may reach over 40 mm before doing so.

Martesia, Lignopholas and Xylophaga normally bore into wood. Species of Pholas, Zirfaea and Barnea normally bore into peat, firm mud or soft rock but occasionally are encountered in drift wood or test panels. Only those species of the Pholadinae which have been taken from wood are included here. Specimens in these groups extracted from wood are often abnormally shaped and stenomorphic but they can be distinguished by their accessory plates and siphons.

A. CHECK LIST AND CLASSIFICATION OF THE PHOLADIDAE

Following the subfamily and generic names the major characteristics such as presence or absence of apophyses, callum and accessory plates are given as well as the substratum in which the group is most commonly found.

Ranges given are general as records for many species are few and scattered.

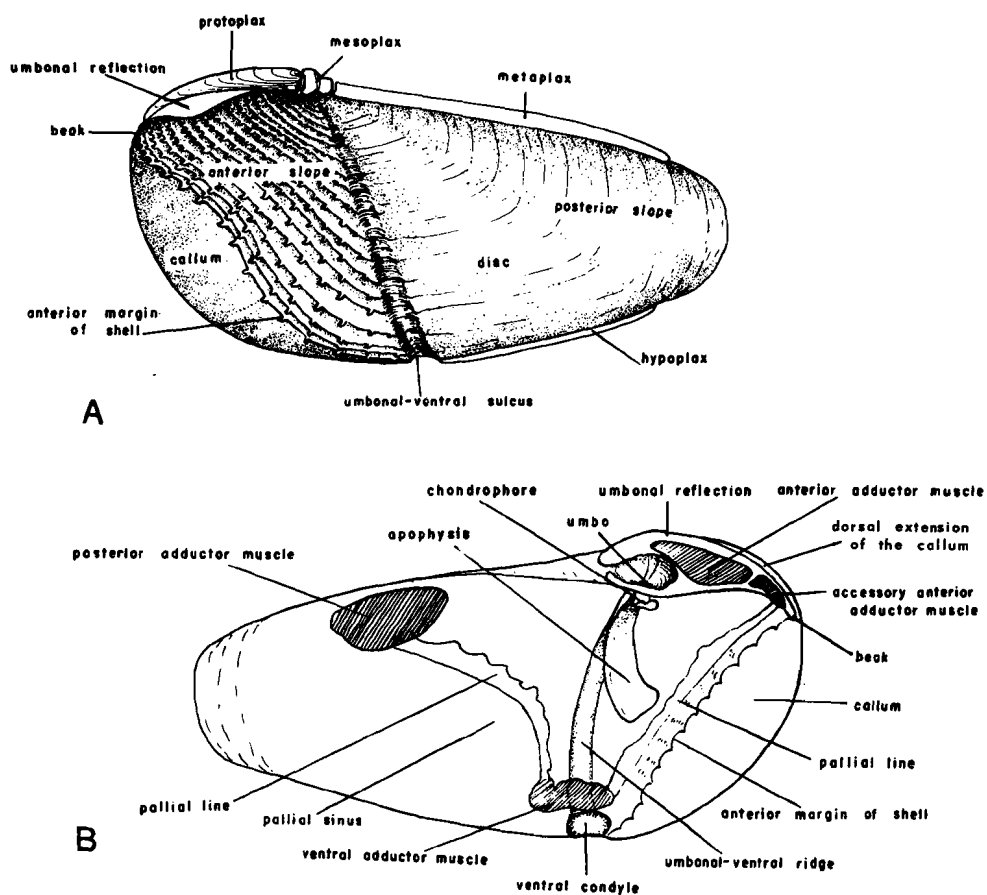


Figure 1.

Diagrammatic, composite drawing of a pholad shell giving nomenclature of parts.

A. External view of left valve to show the approximate relative position of the various accessory plates and the areas of the valve.

B. Internal view of the left valve to show the relative positions of the muscle scars and specialised parts of the shell.

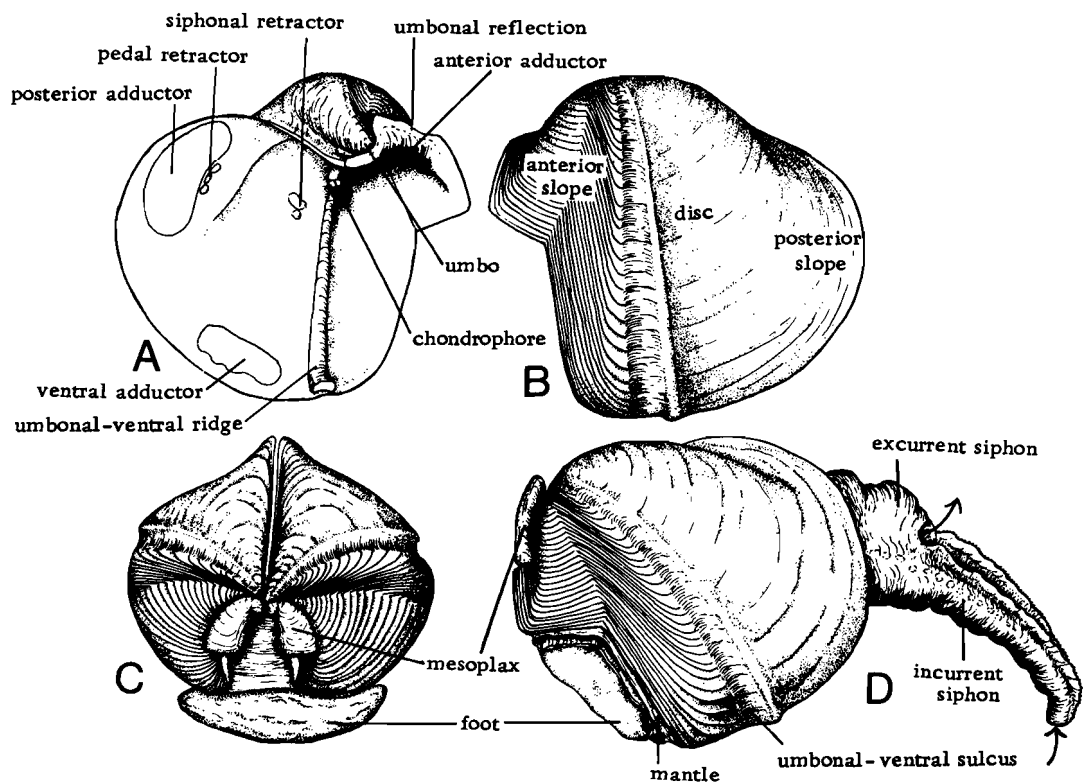


Figure 2.

Nomenclature of parts of Xylophaga.

- A. Internal view of left valve showing relative position of muscle scars.
- B. External view of left valve.
- C. Dorsal view of animal with siphons retracted.
- D. Lateral view of entire animal with siphons extended.

Their distribution within the range may be discontinuous as their presence locally is dependent on a suitable substratum and other factors mentioned above. In addition, new records are being added constantly as a result of increased testing and collecting.

Family Pholadidae

Subfamily Pholadinae - Apophyses present, callum absent.

Rare in wood - generally found in firm mud, peat or rock.

Genus Barnea - Accessory plate - protoplax.

1. Barnea candida (Linnaeus) - Eastern Atlantic : Norway to Mediterranean.
2. Barnea parva (Pennant) - Eastern Atlantic : British Isles to southern France.
3. Barnea lamellosa (d'Orbigny) - Western south Atlantic ; Uruguay to Rio Negro, Argentina.
4. Barnea truncata (Say) - Western Atlantic : Massachusetts to Brasil ; Eastern Atlantic : Senegal to Ghana.
5. Barnea subtruncata (Sowerby) - Eastern Pacific : Oregon to Chile.

Genus Pholas - Accessory plates - protoplax, mesoplax, metaplax. Rock borers - rare in wood.

1. Pholas dactylus Linnaeus - Eastern Atlantic : Scotland to North Africa.
2. Pholas campechiensis Gmelin - Western Atlantic : North Carolina to Brazil. Eastern Atlantic : Senegal to Liberia.
3. Pholas chiloensis Molina - Eastern Pacific : Mexico to Chile.

Genus Zirfaea - Accessory plate - mesoplax. Umbonal-ventral sulcus present. Peat and soft rock borers - rare in wood.

1. Zirfaea crispata (Linnaeus) - Eastern Atlantic : Norway to southern France. Western Atlantic : Labrador to New Jersey.
2. Zirfaea pilsbryi Lowe - Eastern Pacific : Alaska to Baja, California.

Subfamily Martesiinae - Apophyses and callum present. Many rock borers, but genera included here entirely wood borers.

Genus Lignopholas - Accessory plate - mesoplax. Ventral condyle and umbonal-ventral sulcus and ridge present. Wood borers in brackish to freshwater.

1. Lignopholas clappi Turner - Western Atlantic : Nicaragua to Venezuela.
2. Lignopholas rivicola (Sowerby) - Indo-Pacific : Borneo to India.

Genus Martesia - Accessory plates - mesoplax, metaplax and hypoplax. Ventral condyle and umbonal-ventral sulcus and ridge present. Marine to brackish water.

1. Martesia striata (Linnaeus) - World wide in warm temperate to tropical areas.
2. Martesia fragilis Verrill and Bush - Known distribution discontinuous, probably world wide in warm temperate and tropical seas. Specimens usually in floating wood or other plant material.

3. Martesia cuneiformis (Say) - Western Atlantic from New Jersey to Brazil in marine conditions. Wood borer with one record from coral at Boynton Beach, Florida.

Subfamily Xylophaginae - Accessory plate - mesoplax. Apophyses and callum absent. Wood borers, occasionally going into cables, plastics and other materials. Mainly deep water, only shallower water species included here. For deep water species see Knudsen (1961).

Genus Xylophaga - Accessory plate-mesoplax. Umbonal-ventral ridge and sulcus present.

Some species produce a chimney.

1. Xylophaga dorsalis (Turton) - Eastern Atlantic : Norway to southern France.
2. Xylophaga globosa Sowerby - Eastern Pacific : Panama to Chile.
3. Xylophaga praestans Smith - Eastern Atlantic : Norway to England.
4. Xylophaga atlantica Richards - Western Atlantic : Canada to Virginia.
5. Xylophaga washingtona Bartsch - Eastern Pacific : Canada to southern California.

References to papers useful in the identification of Pholadidae are given after the Key. For synonyms, detailed descriptions, discussions of variation and distribution of the species listed above see Turner (1954, 1955) and Knudsen (1961).

II. IDENTIFICATION OF TEREDINIDAE

The generic classification of the Teredinidae is based on the morphology of the soft parts in conjunction with the type of pallets. The identification of species is based almost entirely on the pallets, though the siphons have proved useful. To date, however, there are not sufficient data on the inter- and intra- specific variation of the siphons of most species for them to be used in identification. The type of calcareous tube may also prove useful but unfortunately it is too insufficiently known in many species to form a reliable basis for identification. Study of the characters of the siphons and tubes is greatly needed and it is hoped that teredinid workers will keep careful notes on these. The characters of the shell can be useful in a few species but only in conjunction with the pallets. Generally the variation exhibited in a series of shells from a single locality is so great and the shells of species belonging to different genera are so similar that it is not possible to use them for taxonomic purposes.

The differences exhibited by the pallets are striking, and most species can be readily placed in a genus on this basis. There are, however, some closely related allopatric species which, in large series, have overlapping forms. In such cases differences in the siphons have proved useful, e.g. Nototeredo knoxi vs. N. norvagicus. The pallets are greatly affected by ecological conditions : they may be eroded by acids in the water or the wood ; discolored by the wood or by pollutants in the water ; misshapen due to crowding ; nibbled by browsing animals or broken by a blow on the entrance of the burrow. In addition the pallets of many species vary in shape with age. The variations which have resulted are reflected in the numerous names applied to various forms of some of the more common species such as Teredo navalis, Teredo furcifera and Lyrodus pedicellatus. When identifying teredinids it is, therefore, essential to have living or well preserved specimens and preferably a series showing the range of variation.

Numerous special terms are used in describing teredinids and these are defined in Figures 3 and 4.

It is often necessary to use transmitted light to see the internal structure of the pallets or the fringes on the cones of Bankia. Pallets which have become dried can often be restored to a point where identification is possible by soaking in trisodium phosphate.

A. CHECK LIST AND CLASSIFICATION OF THE TEREDINIDAE

The following check list includes the 14 genera and 66 species recognized at the present time. Previously published synonyms are given for each species. They are intended to aid in coordinating species mentioned in earlier reports with those recognized here. For references to the original citations, figures of the type specimens and a more detailed discussion on the classification and identification of the Teredinidae see Turner (1966).

Ranges given are general because most of the records for the various species are based on specimens taken from ships, wharves or test panels placed in commercially important ports. Such records imply discontinuous distributions which probably are not the case. Four general patterns of distribution are discernible, apparently a reflection of the life history of the species :

1) Marine larviparous species which are or may become world wide in distribution within the limits of their salinity and temperature tolerance : e.g. Teredo navalis, T. furcifera, T. clappi, Lyrodus pedicellatus, L. massa ;

2) Oviparous marine species which are or may become circumtropical, e.g. Bankia campanellata, B. carinata, B. fimbriatula ;

3) Oviparous temperate species which are usually restricted to large ocean basins, e.g. Bankia gouldi (north Atlantic), B. setacea (north Pacific), B. martensi (south Atlantic), B. australis (south Pacific) ;

4) Brackish water species, both larviparous and oviparous, which generally have a restricted range, e.g. Teredo poculifer, Bactronophorus thoracites, Nausitora dryas and N. fusticula. Occasionally brackish water species will have a discontinuous distribution ; e.g. Neoteredo reynei is found on the coast of Brazil and West Africa in mangroves. Artificial dispersal and additional collecting will continue to add to the number of species in these groups. For a discussion of the distribution and dispersal of teredinids see Edmondson (1962) and Turner (1966).

Family Teredinidae

Shell reduced, body long and worm-like, pallets present.

Subfamily Kuphinae - Shell greatly reduced with muscular collar surrounding posterior end of valves, pallets simple, very solid ; caecum lacking ; intestine traversing the pericardium.

Genus Kuphus - characters as above.

Kuphus polythalamia (Linnaeus) 1767 - Phillippines, Sumatra, Solomon Islands.

Soft rotted wood and probably mud borers.

Synonyms :

Serpula arenaria Linnaeus 1758 (in part)

Serpula polythalamia Linnaeus 1767

Teredo gigantea Home 1806

Septaria arenaria Lamarck 1818

Furcella gigantea Gray 1858

Kuphus gigantea Sowerby 1875

Teredo dubia Sivickis 1928

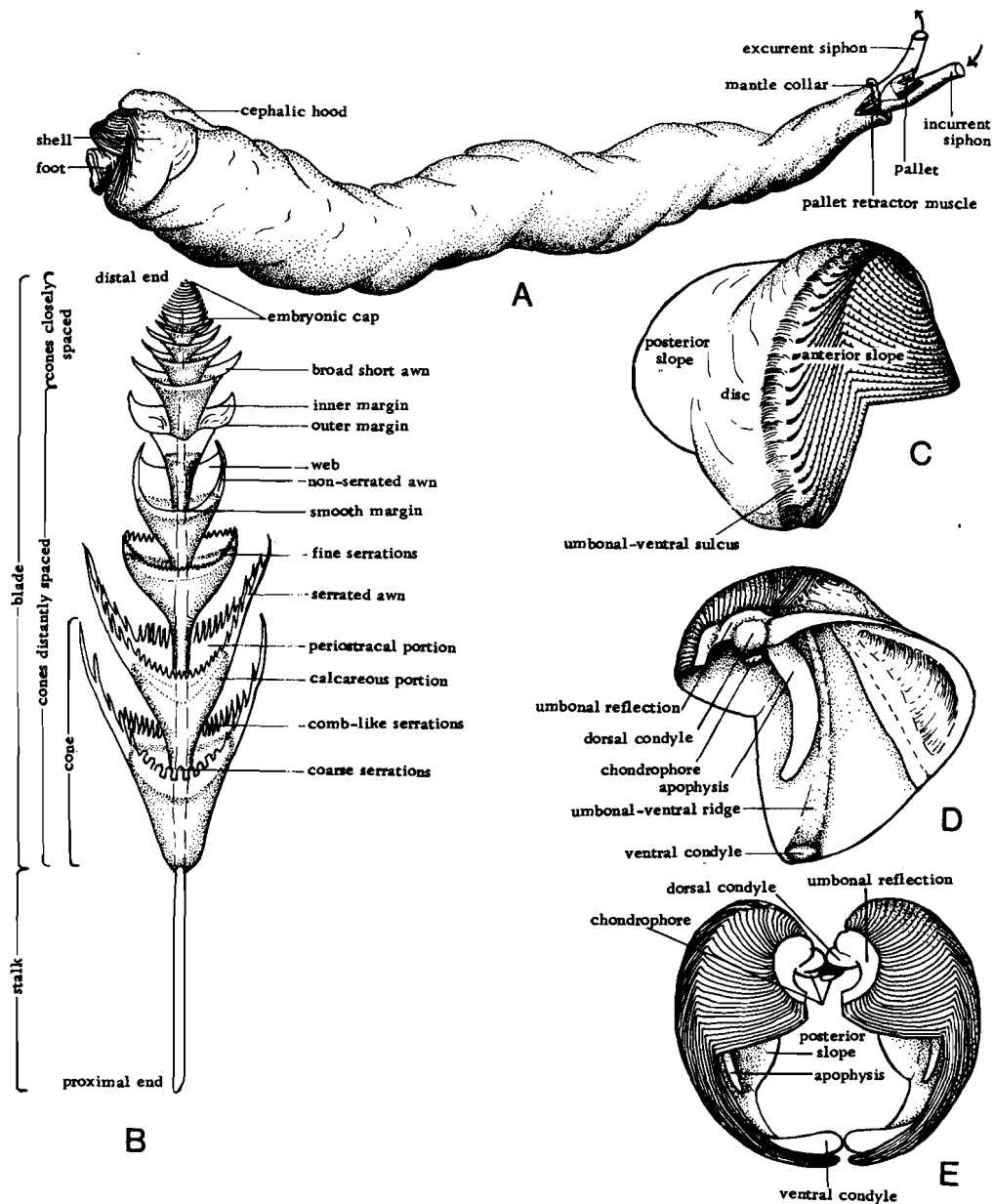


Figure 3.

Nomenclature of parts of Teredinidae.

- A. Entire animal (*Lyrodus*) showing relative position of shell, siphons and pallets.
- B. Hypothetical composite pallet of *Bankia* to show the parts and types of cones.
- C. External view of right valve.
- D. Internal view of right valve.
- E. Anterior view of opposed valves showing large pedal gape.

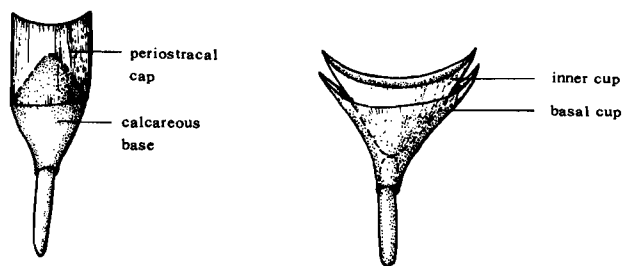
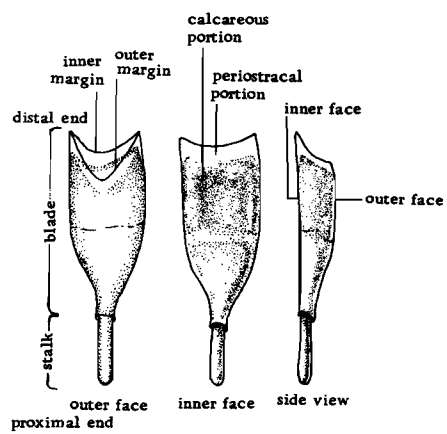


Figure 4.
Pallets of Teredo.

Subfamily Teredininae - shell typical for family, muscular collar absent ; pallets varied, non-segmental in structure ; caecum present ; intestine not traversing heart.

Genus Group I - stomach globular, gonads posterior to caecum, anal canal closed.

Genus Bactronophorus - pallets 'sheath and dagger' type. Dorsal surface of animal just anterior to siphons tuberculate ; caecum long, large, ventral.

Bactronophorus thoracites (Gould) 1856 - Australia Southeast Asia, India.

Brackish water.

Synonyms :

Teredo furcelloides Gray 1861

Calobates australis Wright 1866

Bactronophorus edulis Sivickis 1928

Bactronophorus filoteoi Sivickis 1928

Bactronophorus subaustralis Iredale 1936

Genus Neoterredo Bartsch - pallets simple, solid, slightly cupped, dorsal surface of animal anterior to siphons with 2 long lappets, caecum long, large, ventral.

Neoterredo reynei (Bartsch) 1920 - western Atlantic tropical to subtropical in brackish water. Also west coast of Africa from Sierra Leone to the Congo.

Synonym :

Teredo adami Moll. Rancurel 1967, non adami Moll

Genus Dicyathifer Iredale - pallets triangular, solid. Caecum small, globular, surrounded by digestive gland.

Dicyathifer manni (Wright) 1866 - Indo-Pacific, tropical to subtropical, marine and brackish water.

Synonyms :

Teredo bartschi Sivickis 1928

Dicyathifer caroli Iredale 1936

Teredo sivickisi Miller 1956

Teredo ancilla Barnard 1964

Genus Teredothyra Bartsch - pallets divided medially and with a secondary inner cup. Caecum small, globular, surrounded by digestive gland.

1. Teredothyra dominicensis (Bartsch) 1921 - western Atlantic, tropical to subtropical.

Synonym :

Teredo (Teredothyra) atwoodi Bartsch 1923

2. Teredothyra excavata (Jeffreys) 1860 - probably world wide, tropical and subtropical.

Synonyms :

Teredo tritubulate Moll 1941

Teredo (Teredothyra) linearis Nair 1955

Teredo (Teredothyra) palauensis Edmondson 1959

Teredo (Teredothyra) subicensis Edmondson 1959

Teredo (Bitubuloterredo) bitubula Li Kié-Min 1965

Teredo (Teredothyra) remiformis Li Kié-Min 1965

3. Teredothyra smithi (Bartsch) 1927 - Indo-Pacific, tropical and subtropical.

Synonyms :

Teredo (Teredothyra) radcliffei Bartsch 1927

Teredo (Teredothyra) tanonensis Bartsch 1927

Teredo (Phylloterodo) lanceolata Moll 1937

Kuphus (Idioteredo) kiiensis Taki and Habe 1945

Teredo (Zopoteredo) bengalensis Nair 1956

Teredo (Nototerodo) nambudalaiensis Nair and Gurumani 1957

4. Teredothyra matocotana (Bartsch) 1927 - probably world wide, tropical to sub-tropical.

Synonyms :

Teredo (Ungoterodo) chamberlaini Bartsch 1927

Teredo (Ungoterodo) pujadana Bartsch 1927

Teredo uniguiculata Roch 1935

Genus Group II - stomach globular, anal canal open, gonads dorsal to caecum.

Genus Teredora Bartsch - gills extending from siphons to mouth, pallets solid, double cupped in young and with thumb-nail depression in adult.

1. Teredora malleolus (Turton) 1822 - Atlantic, temperate to tropical.

Synonyms :

Teredo nana Turton 1922

Teredo thomsonii Tryon 1863

2. Teredora princessae (Sivickis) 1928 - Indo-Pacific, temperate to tropical.

Synonyms :

Teredo petersi Moll 1928

Teredo diderichseni Roch 1929

Teredo gazellae Roch 1929

Teredo sparcki Roch 1931

Teredo (Teredora) gregoryi Dall, Bartsch and Rehder 1938

Teredo alfredensis van Hoepen 1941

Teredo (Teredora) minori Nair 1958

Genus Uperotus Guetard - gills extending from siphons to mouth, pallets paddle-like with radiating ribs.

1. Uperotus clavus (Gmelin) 1791 - Indo-Pacific, tropical, in nuts.

Synonyms :

Teredo nucivorus Spengler 1792

Fistulana cornicula Lamarck 1801

Fistulana gregata Lamarck 1801

Fistulana corniformis Lamarck 1818

Fistularia gregaria 'Lamarck' Blainville 1820

Serpula retorta Mawe 1823

Teredo foliiformis 'Valisniere and Sellius' Laurent 1848

Teredo plumiformis 'Valisniere and Sellius' Laurent 1848

Guetera corniformis Gray 1851

Glumebra elegans Iredale 1936

Glumebra shionomisakiensis Habe 1953

2. Uperotus rehderi (Nair) 1956 - Indo-Pacific, tropical. In wood, probably ecological variant of clavus.

Synonym :

Teredo (Teredora) vattanansis Nair and Gurumani 1957

3. Uperotus panamensis (Bartsch) 1922 - Atlantic, tropical.

4. Uperotus lieberkindi (Roch) 1931 - Atlantic, tropical - is probably an ecological variant of panamensis.

Genus Psiloteredo Bartsch - gills extending from siphons to posterior end of pericardial cavity. Pallets paddle-like with thumb nail depression in adults.

1. Psiloteredo megotara (Hanley) 1848 - Atlantic, temperate, marine.

Synonyms :

Teredo navalis Turton 1822 non Linnaeus

Teredo denticulata 'Gray' Sowerby 1875

Teredo dilatata Stimpson 1851

Teredo denticulata 'Gray' Fischer 1856

Teredo subericola Jeffreys 1860

Teredo subericola microtara Jeffreys 1860

Teredo subericola minor Jeffreys 1860

Teredo megotara mionota Jeffreys 1865

Teredo magotara striatior Jeffreys 1865

2. Psiloteredo healdi (Bartsch) 1931 - western Atlantic, tropical. Brackish water.

Synonym :

(?) Teredo (Neoterodo) miraflores Bartsch 1922

3. Psiloteredo senegalensis (Blainville) 1828 - west Africa, tropical. Brackish water.

Synonyms :

Teredo adami Moll 1941. Turner 1966.

Teredo petitii Recluz 1849. Rancurel 1967.

Genus Group III - stomach elongate, young held in brood pouch to straight hinge or pediveliger stage.

Genus Teredo - pallets variously shaped, largely calcareous without periostracal cap.

1. Teredo aegypos Moll 1941 - Mozambique.

2. Teredo bartschi Clapp 1923 - world-wide, tropical to subtropical.

Synonyms :

(?) Teredo fragilis Tate 1888

Teredo (Teredo) batilliformis Clapp 1924

Teredo balatro Iredale 1932

Teredo shawi Iredale 1932

Teredo aegyptia Roch 1935

Teredo (Teredo) grobbai Moll 1937

Teredo (Teredo) hiloensis Edmondson 1942

3. Teredo clappi Bartsch 1923 - world-wide, tropical to subtropical.
Synonyms :
Teredo trulliformis Miller 1924
Teredo hermitensis Roch 1929
Teredo adanensis Roch 1935
Teredo renschi Roch 1935
(?) Teredo horsti 'Roch' Moll 1941
4. Teredo fulleri Clapp 1924 - world-wide, tropical to subtropical.
Synonyms :
Teredo bicorniculata Roch 1935
Teredo indomalaiica Roch 1935
5. Teredo furcifera von Martens 1894 - world-wide, tropical to subtropical.
Synonyms :
Teredo (Teredo) parksi Bartsch 1921
Teredo (Teredo) parksi madrasensis Nair 1955
Teredo furcillatus Miller 1924
Teredo australasiatica Roch 1935
Teredo furcata Moll 1935
Teredo krappei Moll 1935
Teredo laciniata Roch 1935
Teredo (Teredo) bensoni Edmondson 1946
6. Teredo johnsoni Clapp 1924 - world-wide, tropical to subtropical.
7. Teredo mindanensis Bartsch 1923 - New Guinea, Java, tropical Australia.
Synonym :
(?) Teredo (Coeloteredo) bayeri Roch 1955
8. Teredo navalis Linnaeus 1758 - temperate, world-wide.
Synonyms :
Pholas teredo Muller 1776
Teredo batavus Spengler 1792
Teredo japonica Clessin 1893
(?) Teredo troscheli Troschel 1916
Teredo (Teredo) beachi Bartsch 1921
Teredo (Teredo) beaufortana Bartsch 1922
Teredo (Teredo) morsei Bartsch 1922
Teredo (Teredo) novangliae Bartsch 1922
Teredo sinensis Roch 1929
Teredo navalis borealis Roch 1931
Teredo pocilliformis Roch 1931
Teredo austini Iredale 1932
9. Teredo poculifer Iredale 1936 - Queensland, Australia. Brackish water.
10. Teredo portoricensis Clapp 1924 - western Atlantic, tropical to subtropical.
11. Teredo somersi Clapp 1924 - western Atlantic, tropical to subtropical.
Synonym :
Teredo (Teredo) radicis Moll 1937

12. Teredo triangularis Edmondson 1942 - Indo-Pacific, tropical to subtropical.

Synonym :

(?) Kuphus (Coeloteredo) teredoides Taki and Habe 1945

Genus Lyrodus Gould

1. Lyrodus pedicellatus (Quatrefages) 1849 - world-wide, temperate to tropical.

Synonyms :

Teredo pedicellata truncata Jeffreys 1865

Teredo chlorotica Gould 1870

Teredo diegensis Bartsch 1916

Teredo (Teredops) floridana Bartsch 1922

Teredo (Lyrodus) townsendi Bartsch 1922

Teredo samoanensis Miller 1924

(?) Teredo (Lyrodus) linaoana Bartsch 1927

Teredo (Teredo) siamensis Bartsch 1927

Teredo franziusi Roch 1929

Teredo lamyi Roch 1929

Teredo lomensis Roch 1929

Teredo nodosa Roch 1929

Teredo togoensis Roch 1929

Teredo yatsui Moll 1929

Teredo calmani Roch 1931

Teredo dagmarae Roch 1931

Teredo dalli 'Watson' Moll and Roch 1931

Teredo (Lyrodus) hibicola Kuronuma 1931

Teredo pochhammeri Moll 1931

Teredo robsoni Roch 1931

Teredo (Teredops) tateyamensis Kuronuma 1931

Teredo pertingens Iredale 1932

(?) Teredo arabica Roch 1935

Teredo malaccana Roch 1935

Teredo helleniusi Moll 1936

Teredo (Pingoteredo) tristi Iredale 1936

Teredo (Teredops) hawaiensis Dall, Bartsch and Rehder 1938

Teredo (Teredops) kauaiensis Dall, Bartsch and Rehder 1938

Kuphus (Idioteredo) kiiensis Taki and Habe 1945

Teredo (Lyrodus) taiwanensis Taki and Habe 1945

Teredo (Teredo) honoluluensis Edmondson 1946

Teredo (Teredops) diegensis midwayensis Edmondson 1946

Teredo (Teredo) madrasensis Nair 1956

Teredo (Teredo) indica Nair 1958

2. Lyrodus affinis (Deshayes) 1863 - Indo-Pacific, tropical to subtropical.

3. Lyrodus takanoshimensis (Roch) 1929 - probably world-wide in tropical and sub-tropical areas.

Synonym :

(?) Teredo dicroa Roch 1929

4. Lyrodus medilobatus (Edmondson) 1942 - Indo-Pacific, tropical to subtropical.
5. Lyrodus bipartitus (Jeffreys) 1860 - probably world-wide in tropical and subtropical areas.

Synonym :

Teredo (Lyrodus) schizoderma Li Kié-Min 1965

6. Lyrodus massa (Lamy) 1923 - world-wide, tropical to subtropical.

Synonyms :

Teredo infundibulata Roch 1935

Teredo singaporeana Roch 1935

Subfamily Bankiinae - pallets segmented.

Genus Nototeredo Bartsch - pallets paddle-shaped composed of indistinct, closely packed segments best seen with transmitted light. Intestine very long, labial palps large and free.

1. Nototeredo norvagica (Spengler) 1792 - eastern Atlantic, from Norway to the Mediterranean.

Synonyms :

(?) Teredo utriculus Gmelin 1791

Teredo bruguierii Delle Chiaje 1830

Teredo navalis Deshayes 1839 non Linnaeus

Teredo deshaili Quatrefages 1849

Teredo fatalis Quatrefages 1849

Teredo senegalensis Laurent 1849 non Blainville

Teredo divaricata 'Deshayes' Fischer 1856

Teredo utriculus 'Gmelin' Hanley 1882

2. Nototeredo knoxi (Bartsch) 1917 - Atlantic, warm temperate to tropical.

Synonyms :

Teredo (Psiloteredo) jamaicensis Bartsch 1922

Teredo (Psiloteredo) sigerfoosi Bartsch 1922

Teredo (Psiloteredo) stimpsoni Bartsch 1922

Teredo (Psiloteredo) tryoni Bartsch 1922

Teredo bisiphites 'Lesueur' Roch 1931

Teredo rosifolia Moll 1941

3. Nototeredo edax (Hedley) 1895 - Indo-Pacific, tropical to warm temperate.

Synonyms :

Teredo apendiculata Sivickis 1928

Teredo hydei Sivickis 1928

Nototeredo remifer Iredale 1932

Psiloteredo (Phylloterredo) kirai Taki and Habe 1945

Psiloteredo (Psiloteredo) pentagonalis Taki and Habe 1945

Psiloteredo (Phylloterredo) yakushimae Habe 1952

Teredo (Dactyloterredo) juttingae Roch 1955

Teredo (Psiloteredo) tondiensis Nair and Gurumani 1956

(?) Psiloteredo (Phylloterredo) septa Mawatari and Kitamura 1960

Genus Spathoteredo Moll - pallets paddle-shaped, segments indistinct, with dark periostracal band around mid portion and pustulose calcareous incrustation at distal end.

1. Spathoteredo spatha (Jeffreys) 1860 - Atlantic, tropical to subtropical.

Synonym :

Teredo molli Roch 1931

2. Spathoteredo obtusa (Sivickis) 1928 - Indo-Pacific, tropical.

Synonyms :

Teredo variegata Sivickis 1928

Teredo semoni Moll 1929

Teredo bataviana Moll and Roch 1931

Teredo murrayi Moll 1931

Teredo palula Roch 1935

Psiloteredo (Phylloterodo) amboinensis Taki and Habe 1945

Genus Nausitora Wright - pallets elongate, segments distinct but fused. Usually in brackish water, mangrove areas.

1. Nausitora dunlopei Wright 1864 - Indo-Pacific, tropical to warm temperate. Brackish water.

Synonyms :

Calobates fluviatilis Hedley 1898

Bankia (Nausitora) smithi Bartsch 1927

Bankia globosa Sivickis 1928

Bankia quadrangularis Sivickis 1928

Bankia triangularis Sivickis 1928

Nausitora messeli Iredale 1932

Nausitora madagassica Roch 1935

Bankia pennaanseris Roch 1935

Nausitora schneideri Moll 1935

Nausitora queenslandica Iredale 1936

Bankia (Nausitora) madrasensis Nair 1956

Nausitora lanceolata Rajagopal 1964

2. Nausitora hedleyi Schepman 1919 - Indo-Pacific, tropical. Marine.

Synonym :

Bankia (Nausitora) gabrielii Nair 1955

3. Nausitora dryas (Dall) 1909 - Eastern Pacific, tropical to subtropical.

Brackish water.

Synonym :

Bankia (Nausitora) jamesi Bartsch 1941

4. Nausitora fusticula (Jeffreys) 1860 - tropical, western Atlantic and possibly eastern Pacific, brackish water.

Synonyms :

Bankia (Nausitora) braziliensis Bartsch 1922

(?) Bankia (Nausitora) excolpa Bartsch 1922

Genus Bankia Gray - pallets elongate, segments separated as distinct cones.

1. Bankia anechoensis Roch 1929 - eastern Atlantic, tropical.
2. Bankia australis (Calman) 1920 - Australia, New Zealand.

Synonyms :

Bankia archimima Iredale 1932
Bankia debenhami Iredale 1932
Bankia occasiuncula Iredale 1932
Bankia rosenthali Iredale 1932
Bankia gabrieli Cotton 1934
Bankia grenningi Iredale 1936

3. Bankia bagidaensis Roch 1929 - tropical, West Africa.
4. Bankia barthelowi Bartsch 1927 - Philippines, New Guinea.

Synonym :

Bankia (Bankiella) davacensis Bartsch 1927

5. Bankia bipalmulata (Lamarck) 1801 - Indo-Pacific, tropical to subtropical.

Synonyms :

Teredo palmulatus Lamarck 1818
Bankia rubra Sivickis 1928
Bankia (Neobankia) konaensis Edmondson 1942
Bankia (Neobankia) hawaiiensis Edmondson 1942

6. Bankia bipennata (Turton) 1819 - world-wide, tropical to subtropical.

Synonyms :

Teredo pennatifera Blainville 1828
Teredo cucullata Jeffreys 1860
Teredo carinata 'Gray' Sowerby 1875
Bankia kingyokuensis Roch 1929
Bankia (Neobankia) lineata Nair 1955
Bankia (Neobankia) denticuloserrata Daniel 1956

7. Bankia brevis (Deshayes) 1863 - Indo-Pacific, tropical to subtropical.
8. Bankia campanellata Moll and Roch 1931 - world-wide, tropical.

Synonyms :

Bankia (Liliobankia) katherinae Clench and Turner 1946
Bankia (Bankia) bengalensis Nair 1956

9. Bankia carinata (Gray) 1827 - world-wide, tropical to subtropical.

Synonyms :

Teredo navalis Spengler 1792
Teredo minima Blainville 1828
Teredo stuchburyi 'Leach' Blainville 1828
Teredo bipalmata Delle Chiaje 1829
Teredo palmulata 'Lamarck' Philippi 1836
Xylotra philippi Gray 1851
Nausitora kamiyai Roch 1929
Bankia kuronunii Roch 1929

- (?) Nausitora orientalis Roch 1929
Bankia segaruensis Roch 1929
Bankia (Bankia) nakazawai Kuronuma 1931
Bankia syriaca Roch 1936
Bankia (Bankiopsis) caribbea Clench and Turner 1946
Bankia (Bankiella) edmondsoni Nair 1956
Bankia (Bankiella) indica indica Nair 1956
10. Bankia oieba Clench and Turner 1946 - western Atlantic, tropical to subtropical, also Gulf of California.
11. Bankia destructa Clench and Turner 1946 - western Atlantic, tropical.
12. Bankia fimbriatula Moll and Roch 1931 - tropical to subtropical, world-wide.
 Synonyms :
Teredo palmulata 'Lamarck' Forbes and Hanley 1853
Bankia canalis Bartsch 1944
13. Bankia fosteri Clench and Turner 1946 - western Atlantic, tropical to subtropical.
14. Bankia gouldi (Bartsch) 1908 - western Atlantic, tropical to temperate.
 Synonyms :
Bankia (Bankiella) mexicana Bartsch 1921
Bankia schrencki Moll 1935
15. Bankia gracilis Moll 1935 - Indo-Pacific, tropical to subtropical.
16. Bankia johnsoni Bartsch 1927 - Philippine Islands, New Guinea.
17. Bankia martensi (Stempell) 1899 - South America and Africa, temperate.
 Synonyms :
Xylotre capensis Calman 1923
Bankia (Bankia) chiloensis Bartsch 1923
Bankia odhneri Roch 1931
Bankia argentinica Moll 1935
Bankia valparaisensis Moll 1935
18. Bankia nordi Moll 1935 - Indo-Pacific, tropical to subtropical. Is possibly Bankia orcutti Bartsch 1923.
 Synonym : Nausitora sajnakhaliensis Rajogopal 1964
19. Bankia orcutti Bartsch 1923 - Caribbean and Gulf of California.
 Synonym : (?) Bankia nordi Moll 1935
20. Bankia philippiensis Bartsch 1927 - Philippines, Malaya, New Guinea, northern Australia.
 Synonym : Bankia tenuis Sivickis 1928
21. Bankia rochi Moll 1931 - Indo-Pacific, tropical to subtropical.
 Synonyms : Bankia (Neobankia) roonwali Rajagopalaiengar 1961
Bankia thielei Roch 1935
22. Bankia setacea (Tryon) 1863 - northern Pacific, temperate.
23. Bankia zeteki Bartsch 1921 - western Atlantic and eastern Pacific, tropical.

III. KEY TO WOOD-BORING BIVALVES

Note : This key is based on living or well preserved specimens but it will usually be possible to determine a species for which only the hard parts are available. Because of space limitations a series of figures showing variation within the species is impossible. Typical examples are illustrated and in the genus Bankia, two cones are illustrated to show the spacing of the elements. When working with species in Nototeredo, Spathoteredo, Nausitora and Bankia, it is usually necessary to use transmitted light. Generally this key is arranged in couplets but in a few cases 3 closely related species are included in the same number. Illustrations of entire specimens and accessory plates of the Pholadidae are to be found beneath the species 'keyed out'. Illustrations of the pallets of the Teredinidae are to be found above the species 'keyed out'. Legends to the figures are to be found at the end of the chapter.

1	Animal long, worm-like ; shell small, covering only anterior end of the animal. Valves small, with apophyses. Pallets at posterior end. (family Teredinidae - Figs. 3 and 4)	26
1	Animal not long and worm-like, capable of complete or nearly complete retraction within valves. Shells with one or more accessory plates. Apophyses present or not. Pallets lacking, (family Pholadidae - Figs. 1 and 2)	2
2(1)	Valves with apophyses	3
2(1)	Valves lacking apophyses, (pedal retractor muscles inserted on valve near posterior adductor muscle)	22
3(2)	Shell with a callum	4
3(2)	Shell without a callum	8
4(3)	One accessory plate, longitudinally divided mesoplax ; posterior slope, with a series of fringe , overlapping chitinous lamellae which may be slightly impregnated with calcium	5
4(3)	Three accessory plates, mesoplax, metaplax and hypoplax ; posterior slope lacking chitinous lamellae	6

- 5(4) Mesoplax lobed anteriorly, pointed posteriorly ; lamellae on posterior slope thin, not divided longitudinally ; fingers of fringe fine, simple or T-shaped. Lignopholas clappi Turner [adult]

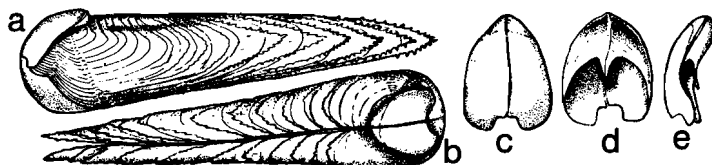


Figure 5.

- 5(4) Mesoplax truncate anteriorly, rounded posteriorly ; lamellae on posterior slope divided longitudinally ; fringe coarse, fingers often branched or Y-shaped. . . Lignopholas rivicola (Sowerby) [adult]



Figure 6.

- 6(4) Mesoplax oval to circular, metaplax and hypoplax pointed or truncate posteriorly 7

- 6(4) Mesoplax wedge-shaped or cuneiform, pointed posteriorly, often with median groove and pronounced growth lines, metaplax and hypoplax divided posteriorly . . . Martesia cuneiformis (Say) [adult]

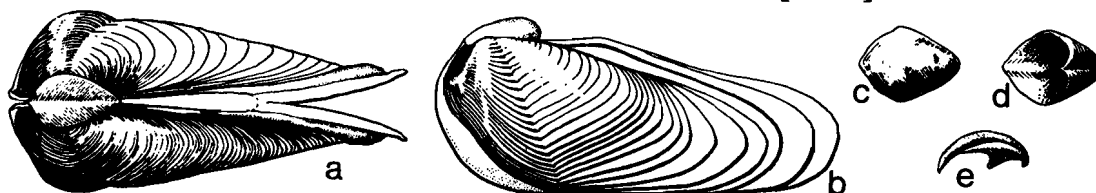


Figure 7.

- 7(6) Mesoplax more or less circular, inflated and sculptured only by irregular wrinkles Martesia striata (Linnaeus) [adult]

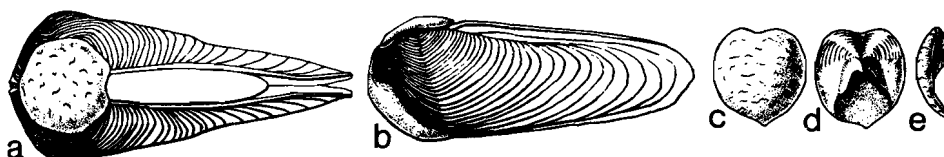


Figure 8.

- 7(6) Mesoplax oval, dorsal portion depressed with a peripheral keel and definite concentric sculpture Martesia fragilis Verrill and Bush [adult]

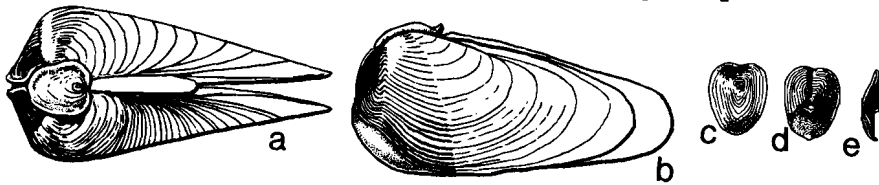


Figure 9.

- 8(3) Umbonal reflection septate. Three dorsal plates, divided protoplax, small transverse mesoplax, long narrow metaplex 9
- 8(3) Umbonal reflection not septate. One dorsal plate, protoplax or a mesoplax 11

- 9(8) Valve sinuously beaked anteriorly Pholas dactylus Linnaeus

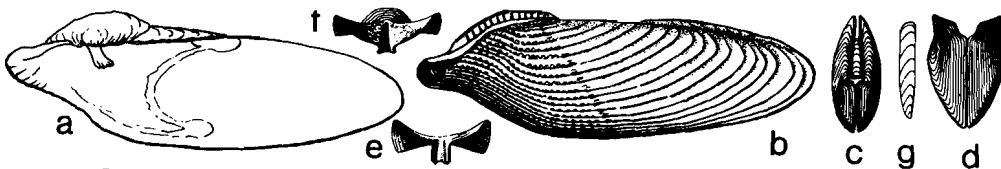


Figure 10.

- 9(8) Valves rounded anteriorly 10

- 10(9) Sculpturing extending entire length of shell Pholas campechiensis Gmelin

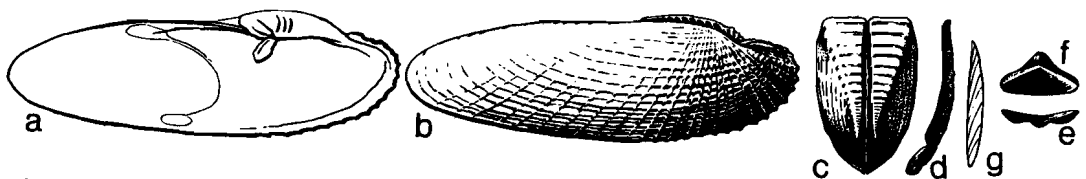


Figure 11.

- 10(9) Posterior slope of shell nearly smooth, sculptured with growth lines only Pholas chiloensis Molina

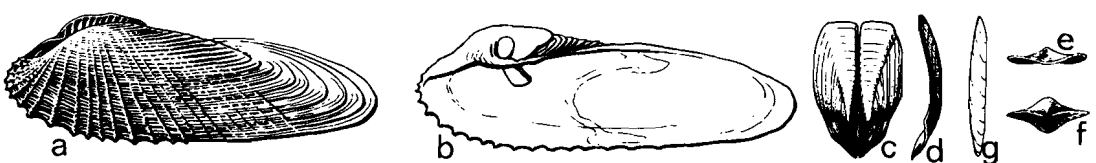


Figure 12.

11(8) One dorsal plate consisting of a protoplax lying on dorsal surface of anterior adductor muscle ; anterior margin of valves rounded or sinuously beaked ; umbonal-ventral ridge and sulcus absent ; ventral condyle absent 12

11(8) One dorsal plate consisting of a mesoplax lying posterior to or wholly beneath the posterior portion of the anterior adductor muscle ; umbonal-ventral ridge and sulcus, and ventral condyle present 16

12(11) Valves rounded anteriorly and posteriorly ; protoplax pointed anteriorly Barnea candida (Linnaeus)

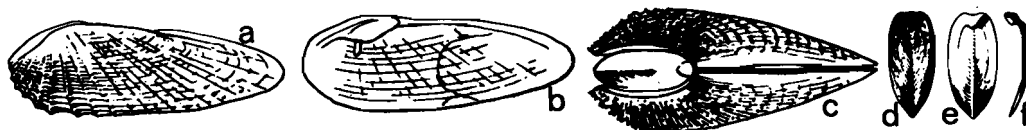


Figure 13.

12(11) Valves beaked anteriorly, rounded or truncate posteriorly 13

13(12) Valves beaked anteriorly rounded posteriorly 14

13(12) Valves truncate posteriorly 15

14(13) Protoplax truncate and nearly straight and not lobed posteriorly Barnea parva (Pennant)



Figure 14.

14(13) Protoplax, laterally lobed posteriorly Barnea lamellosa (d'Orbigny)



Figure 15.

15(13) Post umbonal area usually about 2 times beaked area.

Protoplax rounded anteriorly. Western Atlantic Barnea truncata (Say)

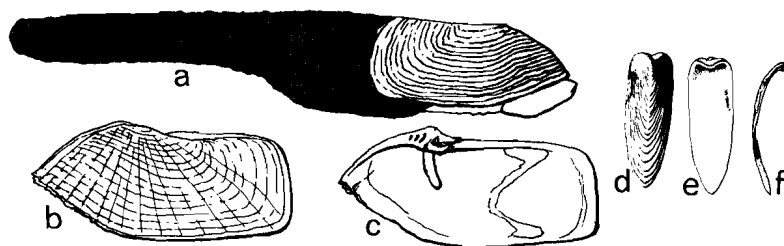


Figure 16.

15(13) Post umbonal area usually more than 2 times beaked area. Protoplax pointed anteriorly. Eastern Pacific . . .

Barnea subtruncata (Sowerby)

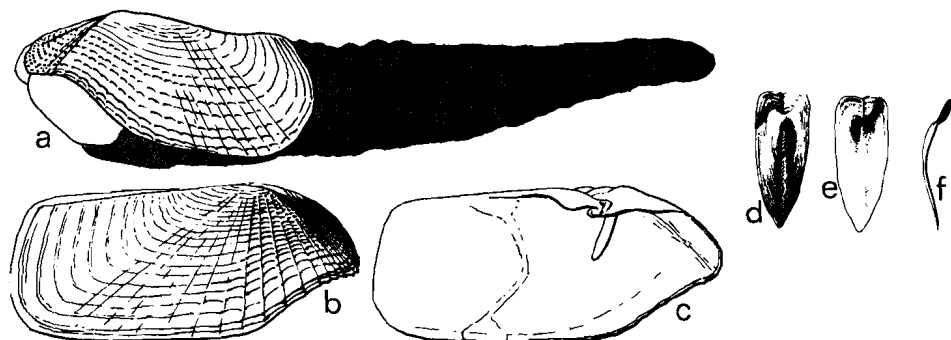


Figure 17.

16(11) Valve sinuously beaked anteriorly, rounded posteriorly. Umbonal-ventral ridge and condyle weak 17

16(11) Valves teredo-like, sinuously to sharply truncate, anteriorly ; umbonal-ventral ridge well developed, ventral condyle prominent 18

17(16) Valves in contact on ventral margin for short distance near condyle, siphons smooth Zirfaea crispata (Linnaeus)

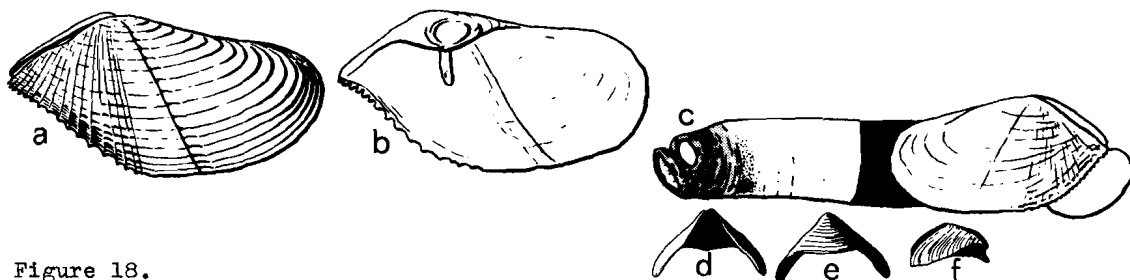


Figure 18.

- 21(20) Mesoplax wedged shaped or cuneiform, often with median groove ; attachment area for anterior adductor muscle closely appressed to the umbo Martesia cuneiformis (Say) [young]

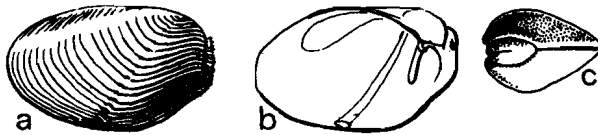


Figure 23.

- 21(20) Mesoplax more or less circular, concentrically sculptured and covering the anterior adductor muscle ; attachment area for anterior adductor muscle raised as a sickle-shaped flange over the umbo Martesia fragilis Verrill and Bush [young]

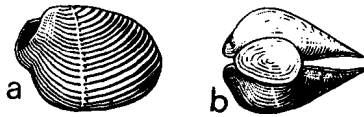


Figure 24.

- 22(2) Mesoplax composed of two ear-shaped parts ; excurrent siphon truncated just posterior to valve, lappets extending from truncation on dorsal surface of incurrent siphon 23

- 22(2) Mesoplax composed of two triangular parts ; excurrent siphon truncated but lappets not present 24

- 23(22) Dorsal plates slightly coiled posteriorly, umbonal-ventral sulcus moderately impressed. Excurrent siphon truncated at posterior margin of valve Xylophaga dorsalis (Turton)

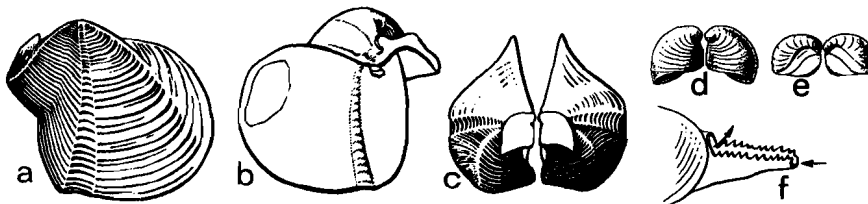


Figure 25.

- 23(22) Dorsal plates strongly coiled, umbonal-ventral sulcus deep. Excurrent siphon about 1/3 length of incurrent siphon Xylophaga globosa Sowerby

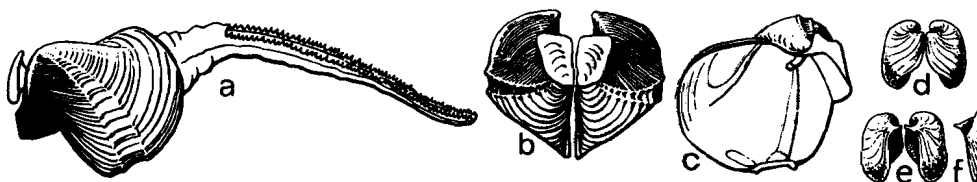


Figure 26.

- 24(22) Dorsal plates triangular, wider than long, extending over umbos. Excurrent siphon only slightly shorter than incurrent, both incurrent and excurrent siphons lacking cirri Xylophaga praestans Smith

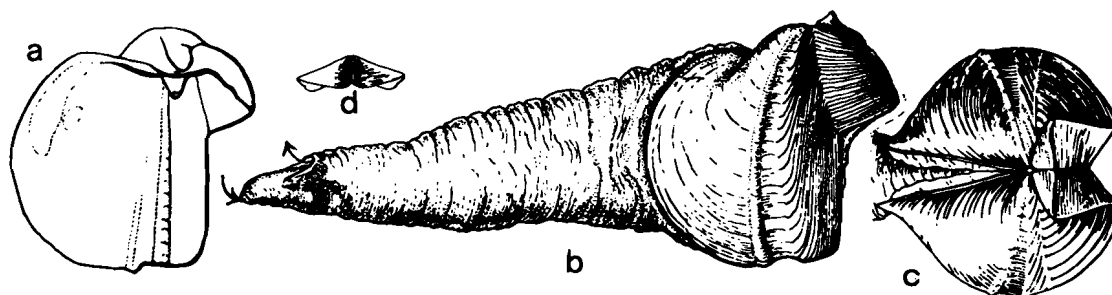


Figure 27.

- 24(22) Dorsal plates triangular longer than wide, set between umbos, and slightly over the anterior portion of the umbos. Excurrent siphon never more than $\frac{3}{4}$ the length of incurrent siphon 25

- 25(24) Ventral portion of mesoplax narrow, not meeting ventrally ; posterior adductor muscle scar irregularly marked. Excurrent siphon about $\frac{3}{4}$ incurrent siphon Xylophaga atlantica Richards

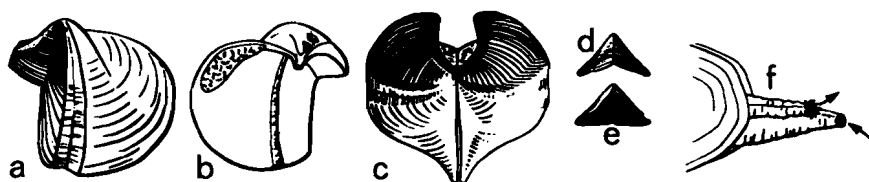


Figure 28.

- 25(24) Ventral portion of mesoplax wide, meeting and forming ventral keel ; posterior adductor muscle scar with chevron-shape marks. Excurrent siphon truncated just posterior to valve Xylophaga washingtona Bartsch

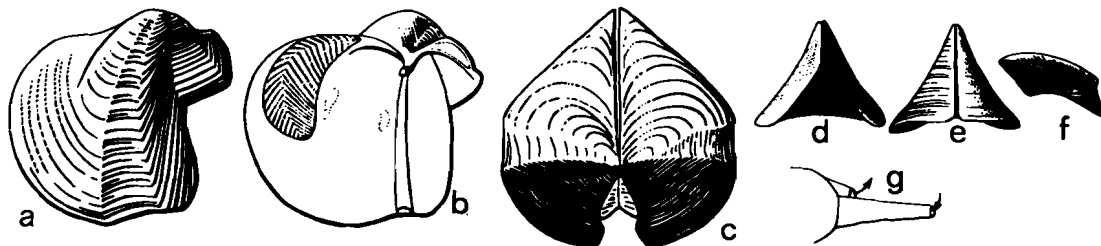


Figure 29.

- 26(1) Pallets with blade broadly oval to greatly elongate, composed of segments built on a stalk which extends the length of the blade ; segments may be : a.) closely packed, fused and indistinct (best seen with transmitted light), blade paddle-like ; b.) closely packed and fused but distinct ; c.) separated as distinct cones 59
- 26(1) Pallets variable in shape, non segmented 27

- 27(26) Calcareous portion of blade composed of a basal cup with an inner element protruding or a second divided cup inserted . 28
- 27(26) Calcareous portion of blade composed of a single piece. . . 32

- 28(27) Basal cup with dagger-like extension Bactronophorus thoracites (Gould)

- 28(27) Basal cup with a second medially divided cup inserted, stalk of pallet extending into blade only to the base of the inner cup (seen with transmitted light) 29

- 29(28) Blade longer than wide 30
- 29(28) Blade wider than long . . Teredothyra matocotana (Bartsch)

- 30(29) Distal margin of both faces slightly concave, the outer more than the inner ; inner cup divided, extending only a little beyond the outer basal cup 31
- 30(29) Distal margin on inner face nearly straight ; margins of two cups on the outer face deeply U-shaped. Basal cup usually clearly visible, much shorter on outer face . . Teredothyra excavata (Jeffreys)

- 31(30) Blade sheathing stalk for distance about equal to length of wide portion of blade, stalk thin, curved, tapering. Blade thin, stalk showing as rib, distal margin usually with periostracal border Teredothyra smithi (Bartsch)



Figure 30.

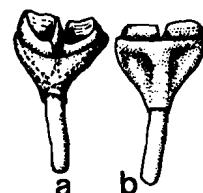


Figure 31.

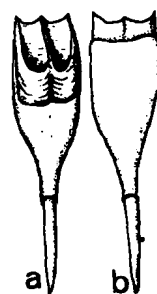


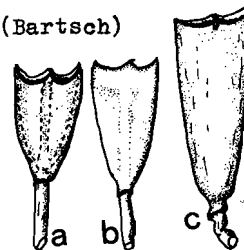
Figure 32.



Figure 33.

- 31(30) Blade thick, not sheathing stalk ; stalk short,
often irregular, knobby and twisted Teredothyra dominicensis (Bartsch)

Figure 34.



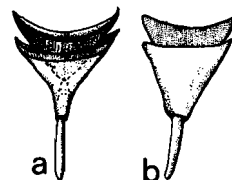
- 32(27) Blade variable in shape, almost entirely calcareous ; periostracal covering thin, following the outline of the calcareous portion, not extending beyond or only slightly so in young specimens . . 37

- 32(27) Distal half of blade composed of a brown to nearly black periostracal cap which overlaps the calcareous portion or with a periostracal cup inserted in a basal mainly calcareous cup 33

- 33(32) Periostracal cap enveloping upper portion of calcareous base which may be rounded or conical distally ; colour variable, light golden brown to nearly black 34

- 33(32) Periostracal cup inserted in calcareous base ; varying from light golden brown to dark red-brown or nearly black Lyrodus massa (Lamy)

Figure 35.

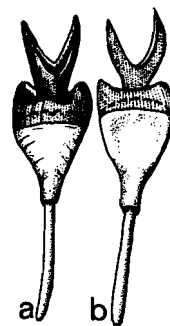


- 34(33) Calcareous base of blade conical distally 36

- 34(33) Calcareous base rounded to nearly flat distally 35

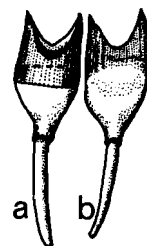
- 35(34) Calcareous base broadly rounded distally ; periostracal cap with long inner cup-like projection set in a shallower outer one, distal margin deeply V-shaped, the outer face more so than the inner, cap a dark red-brown to black Lyrodus affinis (Deshayes)

Figure 36.



- 35(34) Periostracal cap golden-brown with lateral thickenings extending to distal end and projecting slightly ; distal margin of inner face U-shaped, of outer face V-shaped Lyrodus takanoshimensis (Roch)

Figure 37.



- ✓ 36(34) Periostracal cap more or less straight sided ;
distal margin slightly concave to U-shaped,
occasionally extending as lateral horns ; distal
end often eroded so that conical calcareous base
protrudes. Color of cap varying from light brown
to nearly black Lyrodus pedicellatus (Quatrefages)

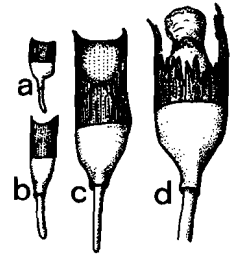


Figure 38.

- 36(34) Periostracal cap similar to that above but with
deep longitudinal furrow on outer face . . Lyrodus bipartitus (Jeffreys)

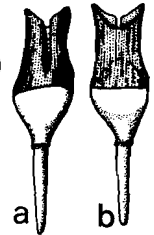


Figure 39.

- 36(34) Periostracal cap similar to above, distal margin
of outer face nearly straight, that of inner face
deeply U-shaped with median lobate process .
Lyrodus medilobatus (Edmondson)

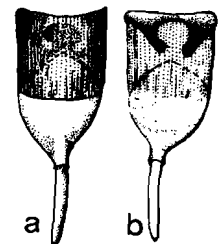


Figure 40.

- 37(32) Blade broadly oval to sub-rectangular, basal
portion thickened, distal portion with prominent
radiating ribs. Gills extending from siphons to mouth . . . 38

- 37(32) Blade variable, not as above ; if thumb-nail depression
is present it lacks radial ribs. Gills extending
from siphon to posterior end of visceral mass 41

- 38(37) Blade long, narrow, subrectangular 39

- 38(37) Blade broadly oval 40

- 39(38) Blade long, narrow, nearly straight sided, distal
margin broadly rounded to straight, basal portion
thickened and usually extending in a rounded lobe
over radiating ribs of the distal portion. Shell
reduced, particularly the posterior slope, denti-
culated ridges on anterior slope few - in nuts .

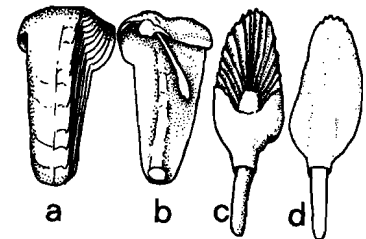


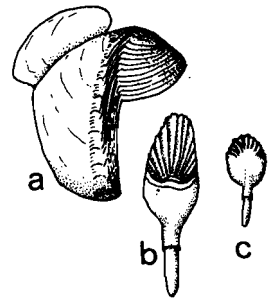
Figure 41.

Uperotus clavus (Gmelin)

- 39(38) Pallet similar to above, shell typical - from wood -
(probably only wood boring form of Uperotus clavus).

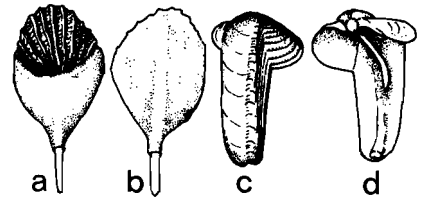
Uperotus rehderi (Nair)

Figure 42.



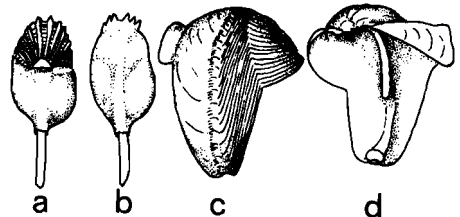
- 40(38) Blade broadly oval. Shell reduced, particularly the
posterior slope, only few rows of denticulated
ridges on anterior slope . Uperotus panamensis (Bartsch)

Figure 43.



- 40(38) Blade similar to above but shell with numerous rows
of ridges. (Probably an ecological variant of
U. panamensis) . . . Uperotus lieberkindi (Roch)

Figure 44.



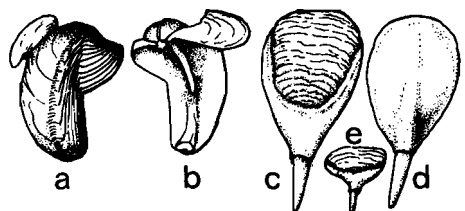
- 41(37) Blade broadly oval with distinct thumbnail-like
depression or a shallow depression with 2 finger-
like projections or paddle-shaped 42
- 41(37) Blade not as above 46

- 42(41) Blade with prominent thumbnail-like depression ;
posterior slope of valves small, high and set at an
sharp angle to the dorsoventral axis ; gills extending
from siphons to mouth without reduction (Teredora) 43

- 42(41) Blade with moderate thumbnail-like depression or
a slight depression with two finger-like projections
extending from it or paddle-shaped. Posterior slope
of valves moderate to large, ear-shaped and usually
flaring ; gills reduced (Psiloteredo) 44

- ✓ 43(42) Pallet broadly oval, the thumbnail-like depression
marked with concentric growth lines . Teredora malleolus (Turton)

Figure 45.

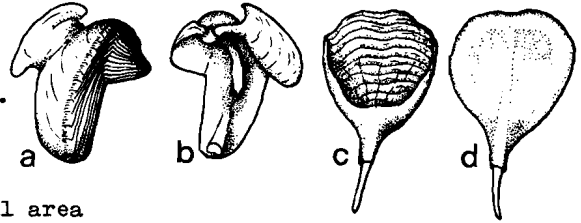


43(42) Pallets as above but with weak radiating wrinkles .

Teredora princessae (Sivickis)

(These two species are very close and may prove to be the same).

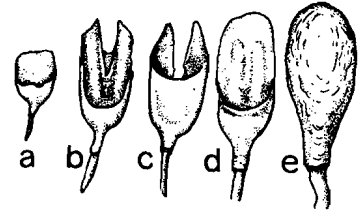
Figure 46.



- ✓ 44(42) Pallets with slightly depressed thumbnail area varying with age from smooth to having 2 finger-like projections (form petiti Recluz) to heavy, paddle-like ; depression over-grown in adult .

Psiloteredo senegalensis (Blainville)

Figure 47.

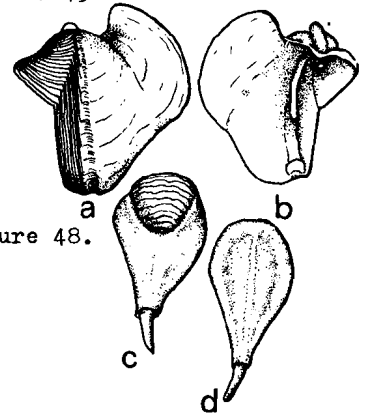


- 44(42) Pallets with thumbnail depression always evident but often proportionally small in adult. 45

- ✓ 45(44) Pallet thin, usually longer than wide and tapering toward the stalk. Stalk short, tapering. Shell with large, ear-shaped, flaring posterior slope which often extends higher than umbos .

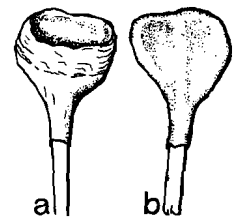
Psiloteredo megotara (Hanley)

Figure 48.



- 45(44) Pallets thick, usually wider than long ; stalk thick, not tapering, and with a division at anterior end. Posterior slope of shell not enlarged Psiloteredo healdi (Bartsch)

Figure 49.



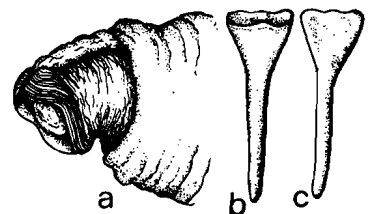
- 46(41) Pallets large, solid, triangular in outline, broadest at the distal margin, tapering toward the stalk and slightly to moderately cupped 47

- 46(41) Pallets variable ; not as above 48

- 47(46) Blade of pallet longer than wide, and slightly cupped with medial ridge, distal margin of outer face only slightly lower than that of inner face. Valves small, anterior slope nearly smooth and reduced, anterior margin sinuous ; posterior slope reduced. Animal with muscular collar surrounding posterior end of valves. Mud borer

Kuphus polythalamia (Linnaeus)

Figure 50.



47(46) Blade of pallet about as wide as long, moderately cupped, with a medial ridge partially or completely dividing it. Distal margin on outer face U-shaped, on inner face nearly straight. Shell typically teredinid, not surrounded by muscle at posterior end .

Dicyathifer manni (Wright)

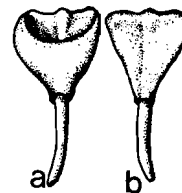


Figure 51.

48(46) Pallets large heavy, paddle-shaped with slight depression distally particularly evident in young specimens. Stalk heavy not tapering. Posterior end of animal with two longitudinal lappets on dorsal surface Neoteredo reynei (Bartsch)

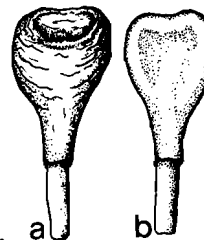
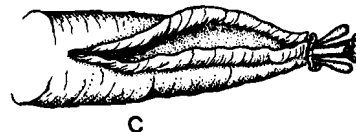


Figure 52.



c

48(46) Pallets small, variable in shape, broadly oval to elongate ; blade usually slightly to deeply cupped, cup sometimes divided, distal margins varying from nearly straight to deeply U or V shaped. Periostracal covering of distal half of blade not as a cap (Brood young). 49

49(48) Distal margin of inner face of blade nearly straight to U or V shaped but never as deeply concave as on outer face. 50

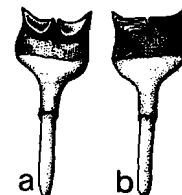
49(48) Distal margins of both inner and outer faces about equally concave 54

50(49) Distal margin of inner face nearly straight 51

50(49) Distal margin of inner face U to V shaped 53

51(50) Blade of pallet about as wide as long, divided distally into 2 cups, periostracum dark brown, sheath of blade extending about 1/3 length of heavy stalk Teredo johnsoni Clapp

Figure 53.



51(50) Blade not divided distally 52

52(51) Blade of pallet about as wide as long with the widest point about midway and tapering rapidly to stalk ; distal margin of inner face nearly straight, of outer face broadly and deeply U-shaped, periostracum pale horn yellow Teredo poculifer Iredale

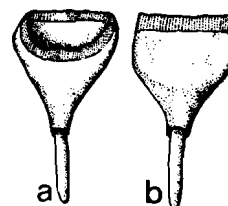
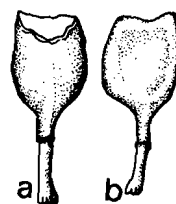


Figure 54.

52(51) Blade slightly longer than wide, distal margin of inner face slightly concave, of outer face deeply concave, periostracum dark brown . . . Teredo aegypos Moll

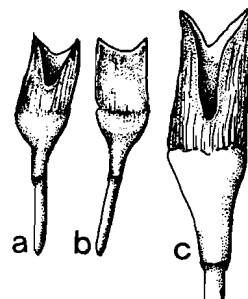
Figure 55.



53(50) Pallet variable, blade with a transverse ridge at widest point, calcareous portion extending to tip of blade, periostracum thin light, yellow to dark brown and often extending below ridge. Both inner and outer faces deeply U to V shaped but inner less so, inside of cup white. In young or worn specimens the inner margin may be only shallowly excavated .

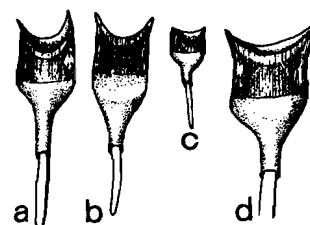
Teredo furcifera von Martens

Figure 56.



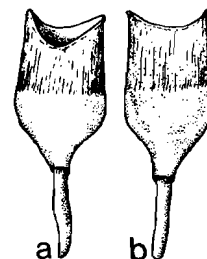
✓ 53(50) Blade without ridge at mid point, calcareous portion not extending to tip but visible internally, inside of cup covered by periostracum. Distal margin of inner face U-shaped, outer face U-V shaped. Periostracum a golden to dark brown and often extending laterally as small horns Teredo bartschi Clapp

Figure 57.



✓ 53(50) Pallet variable, without ridge, distal margin of inner face slightly concave to moderately U-shaped. Outer margin deeply U-shaped. Periostracum pale yellow, covering distal half and extending as narrow margin Teredo navalis Linnaeus

Figure 58.



54(49) Blade of pallet longer than wide 55

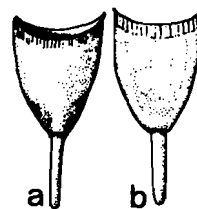
54(49) Blade of pallet wider than long 58

55(54) Blade triangular to goblet-shaped, widest at distal end ; not extending down the stalk as a sheath 56

55(54) Blade long, narrow, more or less parallel sided and sheathing the stalk 57

- 56(55) Blade thick, heavy, triangular to goblet-shaped, solid, tapered to short stout stalk but not sheathing it. Distal margin concave and with a border of dark brown periostracum . . . Teredo triangularis Edmondson

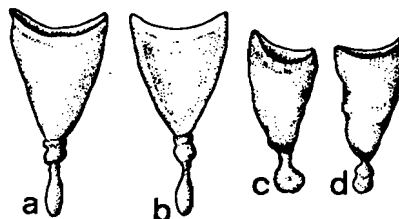
Figure 59.



- 56(55) Blade triangular to conical, hollow to stalk ; periostracum thin, yellow, not extending as border ; stalk short irregular and knobby at proximal end .

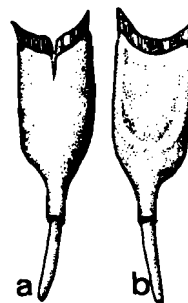
Teredo mindanensis Bartsch

Figure 60.



- 57(55) Pallet white with narrow fringe of pale yellow periostracum distally and with a medial cleft on distal end of outer face Teredo fulleri Clapp

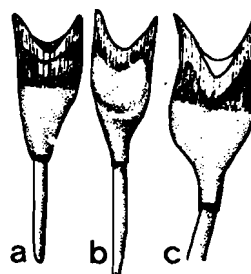
Figure 61.



- 57(55) Pallet slender, periostracum golden yellow covering distal half of blade and extending as a border, calcareous portion showing through.

Teredo portoricensis Clapp

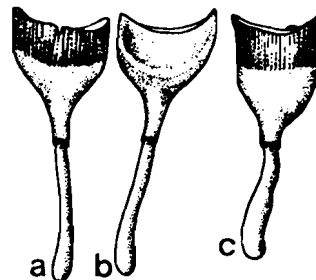
Figure 62.



- 58(54) Stalk usually longer than blade and slightly swollen proximally, distal half of solid calcareous blade covered with medium to dark brown periostracum. Distal margin on both inner and outer face slightly concave, young often with small cleft on outer face.

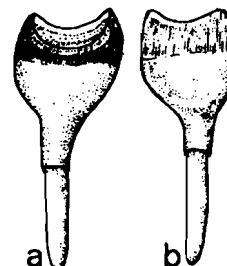
Teredo clappi Bartsch

Figure 63.



- 58(54) Stalk usually equal to or shorter than blade, straight and thick. Distal half of the blade covered by medium to dark red-brown periostracum, cavity often filled with debris Teredo somersi Clapp

Figure 64.



59(26) Blade greatly elongate, segments fused but distinct
or separated as distinct cones 63

59(26) Blade elongate to broadly oval, paddle-shaped ; segments
fused, indistinct and appearing as rib-like elements
radiating from the stalk which extends length of blade . . 60
(best seen with transmitted light)

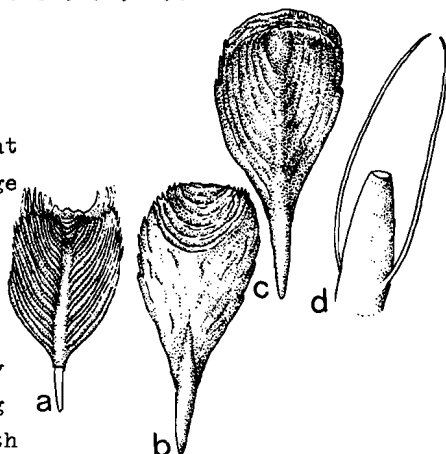
60(59) Blade with band of light to dark brown periostracum
around the mid-portion and a calcareous incrustation
distally (which may be worn off), lateral awns evident
on proximal segments particularly in young specimens . . . 62

60(59) Blade elongate to broadly oval in shape, perfect
specimens entirely covered by a yellowish periostracum,
lateral awns evident on all segments in young specimens,
older specimens become worn, lose the awns and appear
chalky, the surface scaly ; small thumbnail depression
evident at distal end 61

61(60) Pallet paddle-like, broadest distally, tapering
proximally ; stalk showing nearly length of blade.
Excurrent siphon with two long tentacles. Incurrent
siphon with 20 small tentacles at aperture, 4 large
and 4 small internal radiating tentacles .

Nototerredo norvagica (Spengler)

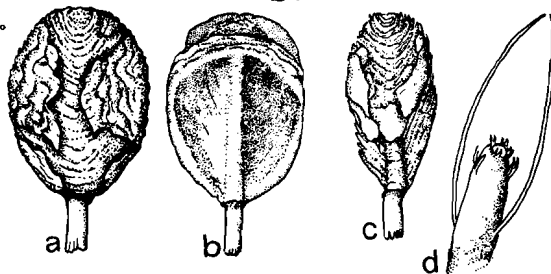
Figure 65.



61(60) Pallets similar to above but generally more evenly
tapered at both ends. Excurrent siphon with 2 long
and numerous short tentacles. Incurrent siphon with
numerous rather long, branched tentacles .

Nototerredo knoxi (Bartsch)

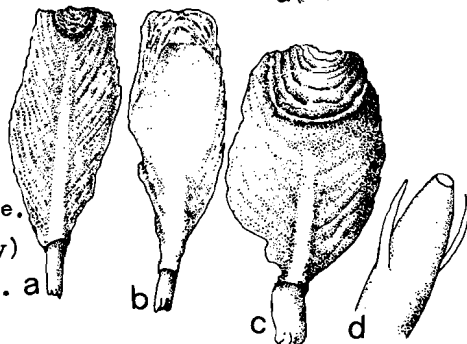
Figure 66.



61(60) Pallets similar to above but generally more elongate
and parallel sided. Excurrent siphon (preserved
specimen) with two short, stout tentacles set back
from aperture and numerous small ones around aperture.

Nototerredo edax (Hedley)

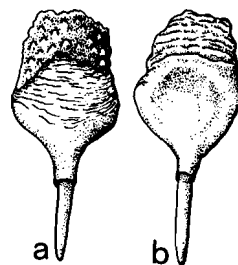
Figure 67.



62(60) Incrustation thick white, rather coarsely papillose .

Spathoteredo spatha (Jeffreys)

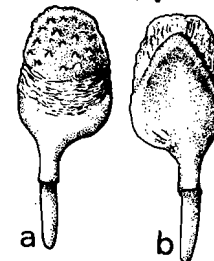
Figure 68.



62(60) Incrustation thin, usually light brown and

finely papillose Spathoteredo obtusa (Sivickis)

Figure 69.



63(59) Segments of pallets fused, distal end with calcareous
incrustation which may be worn off 64

63(59) Segments of pallets separated as distinct cones,
except very young of a few species 67

64(63) Stalk length about equal to blade 65

64(63) Stalk much shorter than blade 66

65(64) Blade about 2 - 3 times as long as wide, sheathing
long stalk, asymmetrical ; segments 10 - 15, wide
(best seen on inner face) and usually with awns ;
papillose calcareous incrustation largely on narrow
side of blade at distal end. Young often without
incrustation, blade with thick periostracum. Incurrent
siphon with 12 large tentacles. (See Turner and
Johnson Fig. 14A). Nausitora fusticula (Jeffreys)

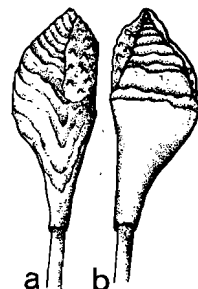
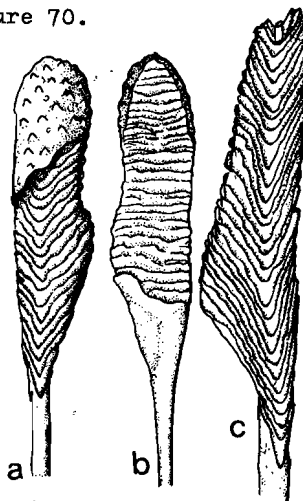


Figure 70.

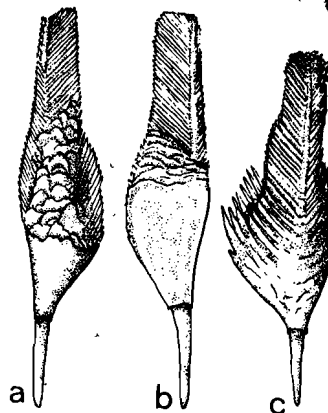
65(64) Blade usually 3 1/2 to 4 times as long as wide,
very asymmetrical, closely spaced segments,
papillose calcareous incrustation on distal end
of blade. Siphons without tentacles . Nausitora dryas (Dall)

Figure 71.



66(64) Blade usually broader at base, segments very closely
spaced, periostracal margins of segments and lateral
awns usually clearly evident. Calcareous incrustation
small, usually not evident. Stalk often showing on
outer face of blade. Incurrent siphon with numerous
fine tentacles and few larger ones which extend inter-
nally as ridges Nausitora dunlopei Wright

Figure 72.



66(64) Segments on lower portion of blade extending straight across blade, usually covered with golden-brown periostracum ; those on upper portion V-shaped, the edges of segments fluted. Siphons close to those of dunlopei.

Nausitora hedleyi Schepman

Figure 73.



67(63) Margin of cones serrated 71

67(63) Margin of cones not serrated 68

68(67) Cones with short blunt awns ; periostracal margin on inner and outer face about equal 69

68(67) Cones with long thin awns, periostracal margin on inner face forming a web connecting the awns 70

69(68) Cones funnel-shaped, moderately spaced, awns short, broad ; embryonic cones crowded and covered with periostracum forming compact tip . . Bankia carinata (Gray)

Figure 74.

69(68) Cones similar to above but awns long and recurved.

Bankia brevis (Deshayes)

69(68) Cones lily-like, widely spaced, embryonic cones not crowded Bankia campanellata Moll and Roch

70(68) Awns fine, seldom showing strengthening rib, narrow periostracal margin of outer face without longitudinal striations Bankia gouldi (Bartsch)

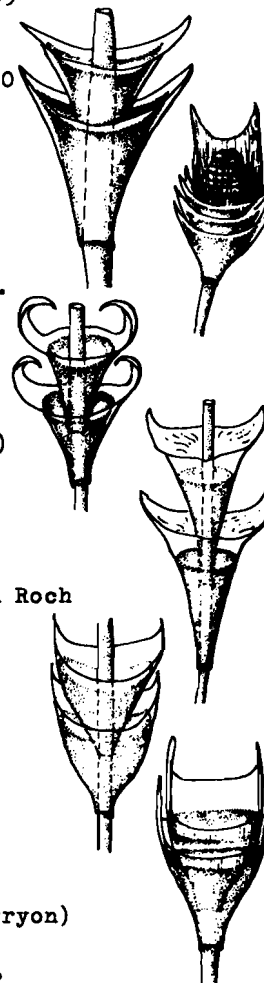
70(68) Awns fine but with strengthening rib, periostracal margin of outer face with longitudinal striations .
Bankia setacea (Tryon)

71(67) Cones with awns 72

71(67) Cones without awns 86

72(71) Both inner and outer margins of cones serrated ; awns serrated or smooth 75

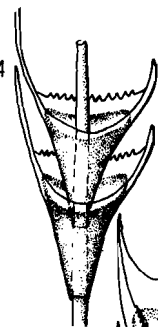
72(71) Only one margin serrated 73



73(72) Outer margin only serrated 74

73(72) Inner margin only serrated. Awns of unequal length .

Bankia bipalmulata (Lamarck)



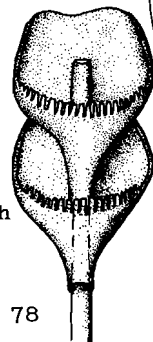
74(73) Serrations on outer margin fine, web connecting awns entirely of periostracum .

Bankia martensi (Stempell)



74(73) Serrations on outer margin coarse, blunt ; web usually thin ; fringe, web and awns impregnated with calcium especially in older specimens. Periostracum light yellow. Pallet heavy, solid, white

Bankia barthelowi Bartsch

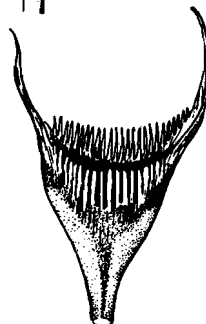


75(72) Awns serrated 78

75(72) Awns smooth 76

76(75) Serrations on outer face long, wide, and blunt ; on inner face, long and very narrow ; awns long. Calcareous basal portion with strengthening lobes. Periostracum heavy, light to dark brown.

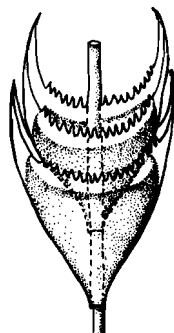
Bankia gracilis Moll



76(75) Serrations on inner and outer face about equal short and broad ; awns short to medium long and broad. Pallet without strengthening lobes. Periostracum thin 77

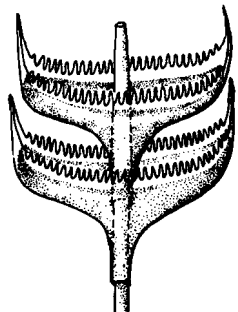
77(76) Cones longer than wide and tapering gradually, into stalks ; awns medium in length ; pallet with bracts at base of cups ; periostracum red-brown

Bankia rochi Moll



77(76) Cones wider than long and sloping abruptly into stalk ; awns short and broad ; pallets solid, rather heavily calcified .

Bankia johnsoni Bartsch



- 78(75) Awns short, broad 79
 78(75) Awns long and tapering sharply 81

- 79(78) Pallets solid, calcareous portion of cones
 extending to base of serrations . . .

Bankia anechoensis Roch

- 79(78) Pallets delicate, stalk thin. Calcareous portion
 of cones not extending to base of serrations 80

- 80(79) Serrations on both inner and outer face,
 fine and of equal strength .

Bankia philippinensis Bartsch

- 80(79) Serrations on outer face fine, on inner face
 longer and coarser .

Bankia destructa Clench and Turner

- 81(78) Periostracal margin of cones wide, extending well
 beyond calcareous portion 82

- 81(78) Periostracal margin narrow, calcareous portion often
 reaching and sometimes extending into the serrations 83

- 82(81) Calcareous portion deeply U-V shaped on both the
 inner and outer face ; awns long, serrations on
 outer face short, on inner face long .

Bankia fimbriatula Roch and Moll

- 82(81) Distal margin of calcareous portion of cone
 nearly straight ; serrations short and fine
 on outer face, long and thin on inner face

Bankia cieba Clench and Turner

- 83(81) Pallets solid, heavily calcified; stalk wide, strong85

- 83(81) Pallets not heavily calcified; stalk slender 84

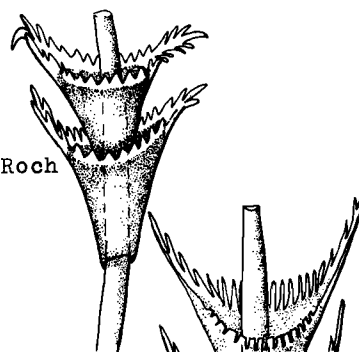
- 84(83) Awns long, slender ; serrations on inner and outer
 margins of cone about equal, long comb-like ; cal-
 careous portion extending into serrations, some of
 which are divided .

Bankia australis (Calman)



- 84(83) Awns rather broad ; serrations on outer and inner face about equal, coarse ; calcareous portion nearly reaching base of serrations

Bankia bagidaensis Roch

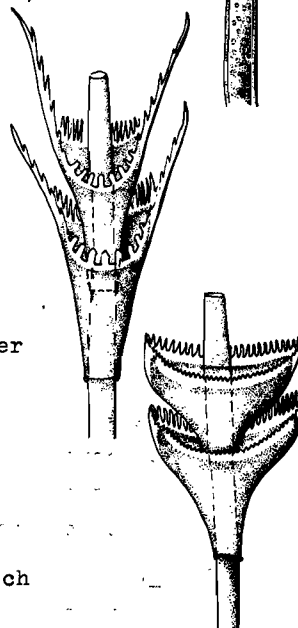


- 85(83) Cones tapering, periostracal border light yellow, narrow ; serrations on outer face coarse, closely spaced, truncated, the calcareous portion extending up into them ; serrations of inner margin long, thin ; awns coarsely fringed. Stalk thick, granular under periostracal sheath. Shell with posterior slope set high and nearly at right angles to umbonal-ventral axis.

Bankia bipennata (Turton)

- 85(83) Similar to above, cones more straight-sided, less flaring ; serrations on outer face coarse, broad, widely spaced and with blunt points ; serrations on inner margin long ; awns serrated to tips. Posterior slope of shell set at an angle of about 45° to the umbonal-ventral axis. Stalk thick but not granular

Bankia fosteri Clench and Turner



- 86(71) Cones widely spaced, wine-glass shaped ; distal margin on inner face nearly straight, on outer face slightly concave. Serrations fine short on outer face, long and thin on inner face

Bankia zeteki Bartsch

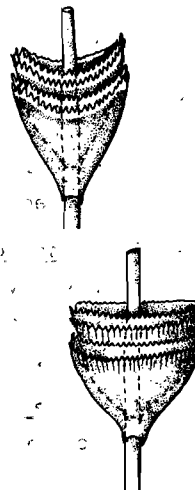
- 86(71) Margin of cones similar to above but with a double row of periostracal fringes to each cone87

- 87(86) Cones closely set and with two rows of fine fringes on each. Golden brown periostracum

Bankia orcutti Bartsch

- 87(86) Similar to above but with periostracal fringes more finely serrated, more closely appressed to the pallet and a medium brown in colour

Bankia nordi Moll



LEGENDS TO FIGURES 5 to 74

- Figure 5. Lignopholas clappi Turner. Adult specimen a) side view of entire specimen. b) dorsal view entire specimen. c) dorsal view of mesoplax. d) ventral view of mesoplax. e) lateral view of mesoplax.
- Figure 6. Lignopholas rivicola (Sowerby). Adult specimen a) lateral view of entire specimen, b) dorsal view of mesoplax, c) ventral view of mesoplax. d) side view of mesoplax.
- Figure 7. Martesia cuneiformis (Say). Adult specimen. a) dorsal view of an entire specimen. b) lateral view of an entire specimen. c) dorsal view of mesoplax. d) ventral view of mesoplax. e) lateral view of mesoplax.
- Figure 8. Martesia striata (Linnaeus). Adult specimen. a) dorsal view of entire specimen. b) lateral view of entire specimen. c) dorsal view of mesoplax. d) ventral view of mesoplax.
- Figure 9. Martesia fragilis Verrill and Bush. Adult specimen. a) dorsal view of an entire specimen. b) lateral view of an entire specimen. c) dorsal view of mesoplax. d) ventral view of mesoplax. e) lateral view of mesoplax.
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