

DESCRIPTION OF A NEW SPECIES OF *CHAMA* FROM THE GULF OF
CARPENTARIA WITH COMMENTS ON *PSEUDOCHAMA* ODHNER (MOLLUSCA:
BIVALVIA: CHAMIDAE)

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A new species of Chamidae, *Chama isaacooki* sp.nov., is described from northern Australia and a key to the Australian Chamidae presented. In addition, the phenomenon of left versus right valve attachment in chamids is discussed, particularly in relation to recognition of the genus *Pseudochama* Odhner, 1917. It is concluded that the identity of valve attachment is not a reliable, sole basis for distinguishing *Pseudochama* from *Chama*. □ *Mollusca, Bivalvia, Chamidae, new species, taxonomy, Pseudochama.*

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The Chamidae (Superfamily Chamoidea) is a widespread and common family of (typically) attached heterodont bivalves, characterized by pronounced leaf-like or spinose ornamentation, coiled umbones and often marked disparity in valve size. The living chamids of Australia have most recently been treated by Lamprell & Whitehead (1992), but the family has yet to be formally revised. During our recent investigations we have had the opportunity to examine numerous specimens from the various Australian State museums as well as material from a number of large private collections. This work revealed the existence of many synonyms as well as a new species from the Arafura Sea and the Gulf of Carpentaria. In the present paper we describe this species of *Chama* and compare it to other chamids from the Indo-Pacific region. We also take the opportunity to discuss Odhner's (1917) claim that *Pseudochama* Odhner can be separated from *Chama* solely on the basis of the valve of attachment (left versus right valve).

Abbreviations used in text: AM = Australian Museum; QM = Queensland Museum; WAM = Western Australian Museum; MV = Museum of Victoria; Q = Queensland; lv = left valve; rv = right valve; pv = paired valves; L = length; H = height; W = width.

MATERIAL AND METHODS

This study is based primarily on material held in the Australian Museum (Sydney), Museum of Victoria and Queensland Museum as well as numerous specimens in private collections includ-

ing the Lamprell collection. All measurements were made with Vernier callipers.

SYSTEMATICS

Superfamily CHAMOIDEA Lamarck, 1809
Family CHAMIDAE Lamarck, 1809
Chama Linnaeus, 1758

Type species: *Chama lazarus* Linnaeus, 1758; SD Children, 1823

Chama isaacooki sp.nov.
(Figs 1-4, Table 1)

ETYMOLOGY

The name honours the memory of Isaac Cook, son of Mr Steve Cook who provided the material for this study.

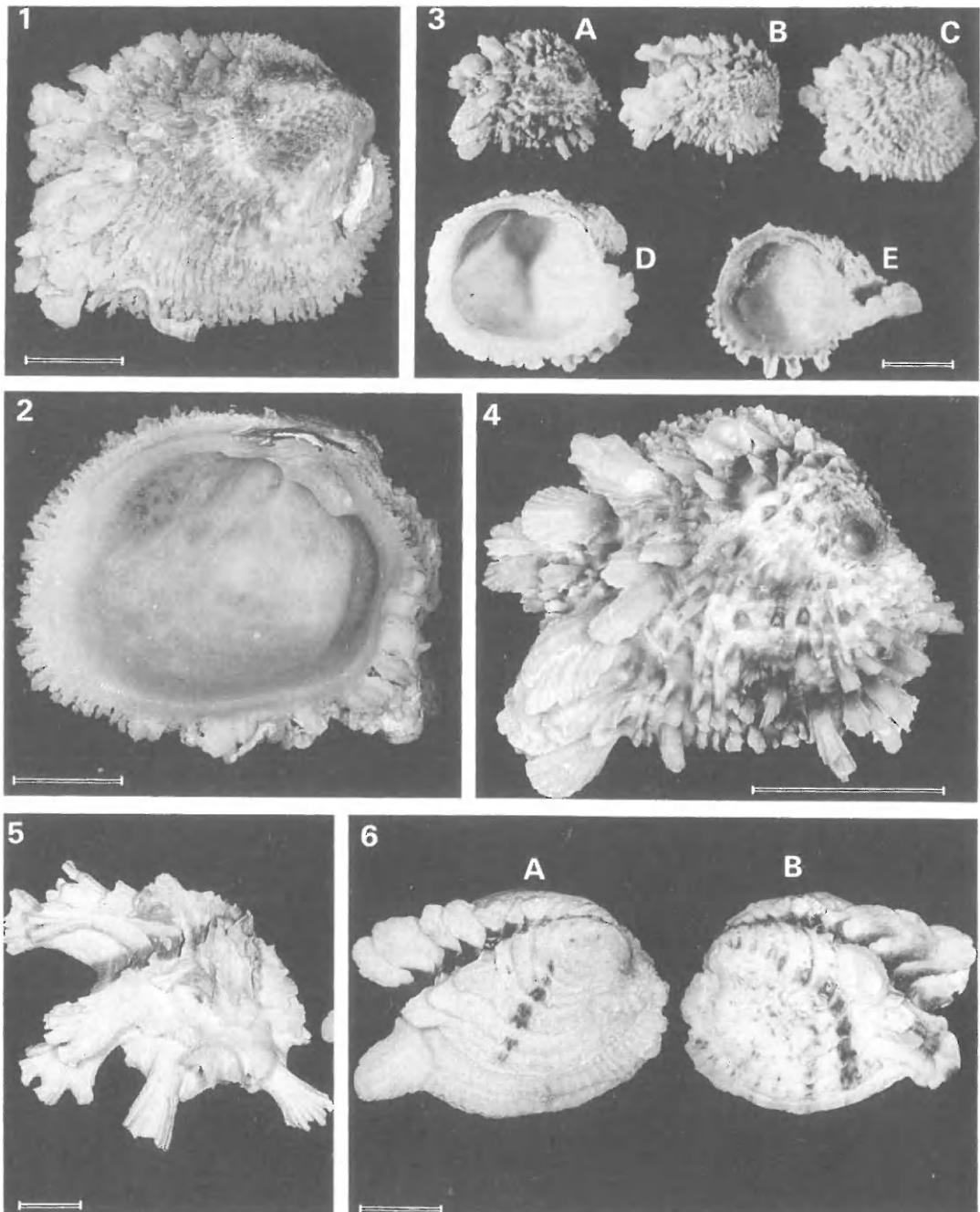
MATERIAL EXAMINED

HOLOTYPE: QMMO38412, 1 pv, Gulf of Carpentaria, 12°23.7'S, 140°41.1'E, dredged 58m, 26 Nov. 1991, S. Cook.

PARATYPES: AMC171008, 1 pv, Gulf of Carpentaria, 10°07.09'S, 141°48.36'E, dredged 47m, 1989, K Colgan; WAM83.92, 1pv, Timor Sea, 12°12'S, 129°15'E, dived 37m, 17 Nov. 1989, K. Colgan; QMMO38410, QMMO38411, 2pv, Gulf of Carpentaria, 13°07'S, 141°41'E, dredged 53.5m, 29 Nov. 1991, S. Cook.

DIAGNOSIS

Shell elongate-ovate; solid; small to moderately large; valves unequal and inequilateral; umbones prosogyrate. Externally, top (right) valve



FIGS 1-6. 1-4, *Chama isaacooki* sp.nov. 1, holotype (QMMO38412), external view of rv showing two broad bands of foliaceous spines posteriorly. 2, holotype (QMMO38412), internal view of lv showing teeth, crenulate margins and ligament. 3A,B,E, external (rv) and internal (lv) views of paratypes (A,E, WAM83.92; B, AMC171008); 3C,D, external and internal of specimen from Lamprell Collection. 4, external view of paratype (AMC171008) showing ribbed sculpture of broad spines. 5, *C. lazarus* Linnaeus, external view of rv, showing broad, foliate spines, Gove, NT. 6, *C. pulchella* Reeve. A, external view of top valve (rv), Torres Strait, NQ; B, external view of top valve (lv), Hervey Bay, SEQ. All scale bars = 10mm.

TABLE 1. Measurements (mm) of type series.

	L	H	W
Holotype: QMM038412, lpv	36.8	37.5	25.1
Paratype: AMCI71008, lpv	28.5	21.4	16.5
Paratype: WAM83.92, lpv	26.9	21.1	14.6

convex, densely ornamented with rows of hollow spines radiating from the umbonal area. Spines erect or curved, ribbed and broad terminally. Posteriorly the spines become leaf-shaped and organized into two loosely defined rows, separated by smaller, vaulted spines. Externally, bottom (left) valve deeply convex and densely ornamented with vaulted spines which frequently fuse laterally to form concentric foliations. Posterior margin with small non-fused spines. Internally, margins of both valves finely crenulate. Adductor scars elongate-ovate, prominent, anterior larger than posterior. Hinge plate featuring one large, broad cardinal and one posterior (remote) lateral tooth per valve. External colouration white with orange to purple-brown blotches; spines white, purple or pink with a dark spot at the base. Internal colouration white, often with large purple blotches, particularly in young specimens. Ligament brown, elongate, parivincular.

Sample size: 8 pv. Length:height ratio — range 1:1-1:0.73; mean 1:0.86. Length:width ratio — range 1:0.75-1:0.51, mean 1:0.65.

HABITAT AND DISTRIBUTION

Attached to living *Spondylus*, *Cardita* and *Crassostrea* in the Arafura Sea, Torres Strait and Gulf of Carpentaria at depths of 10 to 58m.

REMARKS AND COMPARISONS

Valve ornamentation, particularly the shape and arrangement of the spines, and the consistent presence of a dark spot at the base of each spine (spot frequently absent near margin) immediately distinguish *Chama isaacooki* from others of the genus. The degree of spine preservation in exposed reef dwelling species is often poor, hence unworn juvenile material has been examined in addition to adult shells. Two prominent, posterior rows of broad spines are also present in *C. pulchella* Reeve, 1847 (Fig. 6), *C. limbula* Lamarck, 1819 (Fig. 7B), *C. fibula* Reeve, 1846 (Fig. 8) and *C. plinthota* Cox, 1927 (Fig. 7A) but not in *C. lazarus* Linnaeus, 1758 (Fig. 5), *C. pacifica* Broderip, 1834 (Fig. 9A), *C. asperella* Lamarck, 1819 (Fig. 9C) or *C. ruderalis* Lamarck, 1819 (Fig. 9B). *C. lazarus*, *C. pulchella* and *C. ruderalis* differ from *C. isaacooki* and other Australian

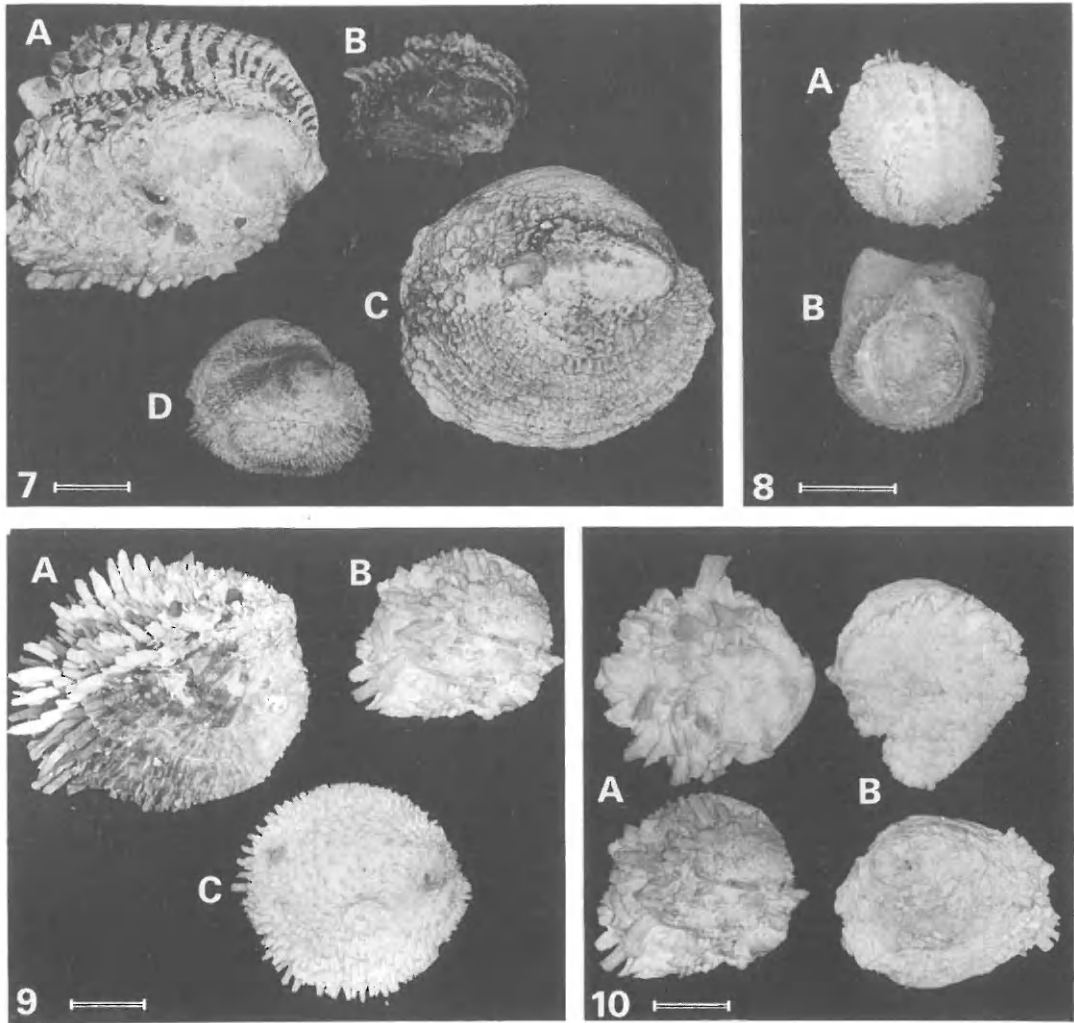
chamids by totally or almost totally lacking sharp spines.

KEY TO THE AUSTRALIAN CHAMIDAE

- 1a. Spines broad only, often fused to form lamellae 2
 - Spines sharp or a mix of broad and sharp, broad spines never fused to form lamellae... 3
- 2a. Spines equally developed across valve
 - *C. lazarus*
 - Spines inequally developed across valve
 - *C. pulchella*
- 3a. Two prominent rows of broad spines dorso-posteriorly 4
 - Two dorso-posterior rows of spines poorly developed or not distinguishable 5
- 4a. Valve with strong transverse corrugations dorso-posteriorly *C. plinthota*
 - Valve without strong transverse corrugations 6
- 5a. Spines equally developed across valve 7
 - Spines inequally developed across valve 8
- 6a. Valve margin finely crenulate... *C. isaacooki*
 - Valve margin smooth *C. limbula*
- 7a. Valve white, almost circular, strongly convex usually with rose-coloured umbone
 - *C. asperella*
 - Valve usually purple dorso-posteriorly, slightly elongate, weakly convex, umbone purple *C. fibula*
- 8a. Spines raised, organized into clearly defined radial rows *C. pacifica*
 - Spines prostrate, not organized into well defined rows *C. ruderalis*

NOTES ON THE GENUS *PSEUDOCHAMA* ODHNER, 1917

Within the family Chamidae, attachment to the substrate may involve either the left valve (often referred to as the 'normal' condition) or the right valve (the 'inverse' condition) (Odhner, 1919; Cox, 1969). Early workers such as Broderip (1835) and Reeve (1846-7) indicated that both conditions may occur in the same species (for example *Chama pulchella*). Odhner (1917) disagreed and erected the genus *Pseudochama* for chamids attaching via the right valve, thereby reserving the genus *Chama* exclusively for species showing left valve attachment. He supported this division by drawing attention to differences in hinge teeth, the nepionic shell and anatomy between *Pseudochama* and *Chama* (see Odhner, 1919 for details). Although a number of recent authors have since accepted Odhner's opinion



FIGS 7-10. 7A, external view of top valve (rv) of *Chama plinthota* Cox (note strong transverse corrugations), Palm I., NEQ; 7B,C, external views of top valves (rv) of *C. limbula* Lamarck (B, immature, Fantome I., NEQ; C, One Arm Point, NWA); 7D, external view of top valve (rv) of *C. fibula* Reeve, Turkey Beach, MEQ. 8A, external view of top valve (rv) of *C. fibula*, Turkey Beach, MEQ; 8B, top valve (lv) of *C. fibula*, Redcliffe, SEQ. 9A, external view of top valve (rv) of *C. pacifica* Broderip, Swain Reefs, MEQ; 9B, external view of top valve (rv) of *C. ruderalis* Lamarck, Spencer Gulf, SA; 9C, external view of top valve (rv) of *C. asperella* Lamarck, Gloucester I., MEQ. 10A, top valves (rv) of two specimens of *C. ruderalis*, Spencer Gulf, SA; 10B, top valves (lv) of two specimens of *C. ruderalis*, Spencer Gulf, SA. All scale bars = 10mm.

that the valve of attachment can be used to determine generic placement (e.g. Keen, 1969; Delsaerdt, 1986), others have maintained the earlier Broderip-Reeve view that left and right valve attachment may occur in the same species (Lamy, 1927; Cotton, 1961; Lamprell & Whitehead, 1992).

During the present study we observed both left and right valve attached specimens in *Chama pulchella*, *C. fibula*, *C. limbula* and *C. ruderalis*. Typically the left valve is favoured but in *C. limbula* the ratio of left versus right attached specimens may approach 1:1 (Cotton, 1961). Although Odhner (1919: 11,17) accepted that certain chamids showing right valve attachment and

those showing left valve attachment may appear strikingly similar to each other in external colouration, sculpture and even attached valve dentition, he maintained that such similarity was due to convergence (pp.21,22) and that right valve attachment consistently differentiated *Pseudochama* from *Chama*. He therefore held that no species of Chamidae exhibited both left and right valve fixation. Odhner stressed differences in dentition between *Pseudochama* and *Chama*, but dismissed the possibility that any similarity in the arrangement of teeth between left and right attached valves could be the result of hinge teeth 'inversion' (= transposition). According to Cox (1969: N57) transposition of the hinge teeth in chamids 'goes hand-in-hand with reversal of the valve of fixation'.

Cox cited other examples of hinge teeth transposition in living and fossil taxa and in fact recommended that the Bernardian system of tooth notation (used throughout Odhner's work) not be applied in cases of tooth transposition at least until shell ontogeny has been examined in these taxa. In fact even Odhner stated that in various species of *Chama* (sensu Odhner) the details of hinge teeth may vary significantly through acceptance, suppression or addition of teeth (Odhner, 1919: 11). Yonge (1967), who made a detailed study of chamid anatomy, shell dentition and shell growth patterns, concluded that the process of cementation determined the morphology of the hinge teeth and valve profile in this family (significantly, Yonge examined both left and right valve attached specimens of *Chama pellucida* and *Pseudochama exogyra*). He supported the claim of Munier-Chalmas (1882) that free and attached valves of left valve attached specimens were mirror-images of the valves of right valve attached specimens. For this reason Yonge, like Munier-Chalmas, suggested recognizing 'free' and 'attached' valves rather than 'left' and 'right' and the application of non-Bernardian notation for Chamidae. Subsequently Yonge (1979) reverted to useage of 'left' and 'right' valves in discussing cementation in chamids (among other bivalves), but reiterated his earlier conclusion that genera within the family cannot be recognized by the valve of attachment (Yonge, 1979:100, in fact stating that 'There is no valid reason for separating the species into two genera'). By strict application of Odhner's valve of attachment rule (that is, all *Pseudochama* attach via the right valve), it would be necessary to hypothesize that left valve attached *Chama limbula*, *C. ruderalis*, *C. pulchella*

and *C. fibula* each coexist with a conchologically similar, but right valve attached species of *Pseudochama*. However, in view of the fact that hinge teeth transposition has now been well demonstrated in a number of heterodont groups (Cox, 1969), and after considering Yonge's (1967, 1979) findings that cementation has had an overriding effect on hinge teeth and valve morphology in the Chamidae, we conclude that a number of chamid species are truly capable of attaching by the left or the right valve. Any observable differences in dentition between left and right 'free' valves and left and right 'attached' valves should therefore be viewed as the result of transpositional effects.

The remaining features cited by Odhner (1917, 1919) as being diagnostic of *Pseudochama* — nepionic shell sculpture and morphology and/or position of the stomach caeca and the nephridia — seem worthy of detailed investigation. It would, for example, be interesting to determine whether such features occur in right valve attached specimens of *Chama limbula*, *C. fibula*, *C. ruderalis* and *C. pulchella*, particularly the latter which Odhner (1917) named *Pseudochama similis*. Should this not be the case, then the basis for the genus *Pseudochama* would have to be reassessed.

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