TWO AUSTRALIAN TERTIARY NEOLAMPADIDS, AND THE CLASSIFICATION OF CASSIDULOID ECHINOIDS

by G. M. PHILIP

ABSTRACT. Two new neolampadids, Pisolampas concinna gen. et sp. nov., and Neolampas flocculus gen. et sp. nov., are described from the Tertiary of south-eastern Australia. The classification of cassiduloid echinoids is discussed, and it is suggested that the order Cassidulidae Claus should include three suborders, viz. Cassidulina s.s., Conochypina Zittel, Neolampadina subord., nov.

Although the Tertiary echinoids of south-eastern Australia are being revised in a series of papers elsewhere (Philip, 1963a, b), it is desirable to present at an early stage aspects of this work of more general significance. In this note two new neolampaid genera are proposed, the phylogeny of the family discussed, and suggested alterations made to the current classification of the cassiduloid echinoids.

Up to the present no fossil neolampadids have been described. Living representatives (placed by Mortensen, 1948, in the family Neolampadidae of the order Cassiduloida), although rare, are cosmopolitan, widely distributed through tropical and subtropical seas. The absence of petals and the single or atrophied pores of the adapical ambulacra distinguish the group from other cassiduloids.

SYSTEMATIC DESCRIPTIONS

Genus Pisolampas gen. nov.

Generic name. From the Greek πισολαμπάς, pea; λαμπή, torch.

Type species. Pisolampas concinna sp. nov.

Diagnosis. Subhemispherical neolampadids with compact apical system possessing three genital pores. Ocellars small, often separated from the central part of the apical disk. Adapical ambulacra with pores rudimentary or lacking. Periproct superimarginal, at the upper end of a shallow groove. Floscels moderately well developed with well-defined bourrelets, and expanded phylloides with an occluded plate in each posterior phylloide.

Remarks. Pisolampas is similar to Neolampas in the character of the compact apical system which has three genital pores. However, the separation of the ocellars from the central part of the apical system is a feature not seen in Neolampas (although present in Tropioelamprus), and the position of the periproct, with its ventral groove, in particular distinguishes Pisolampas. The floscelles is better developed in Pisolampas, although similar occluded plates have been noted in the posterior phylloides of some specimens of Neolampas rostellata (Agassiz, 1904, pl. 119, fig. 156).

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Pisolampas concinna sp. nov.

Plate 106, Plate 107, fig. 11; text-fig. 1

_Echinobrissus concinna_ Tate MS, museum label.


**Locality and horizon.** Aldinga, South Australia, St. Vincent Basin, Tortarchia Limestone, Upper Eocene.

**Description.** Test small, usually oval in outline, sometimes with greatest width posteriorly; adapical surface usually subhemispherical, rarely with the posterior interambulacrum raised, so that the posterior part of the test is flattened; adoral surface flat, sunken around the peristome. Peristome anterior, elongate oval in shape. Periproct mounted high on the adapical surface, narrow, with an introverted rim, and a prominent groove running downward to the ambitus. Test covered with small, irregularly disposed, sunken crenulate perforate primary tubercles between which are small closely spaced granules.

Apical system (text-fig. 1d, e) slightly anterior, compact, with genital pores 1, 2, 4 developed. Genital pores show marked dimorphism, being, in some specimens, much larger than in others. Oculars very small, and in some specimens well separated from the genital disk (text-fig. 1a, b). Usually three or four small, centrally located hydropores, but as many as twelve may be present.

Ambulacrae narrow adapically with small plates and rudimentary or atrophied pores, seen only rarely on some plates (text-fig. 1b, e). Floscelsae (text-fig. 1c) with moderately prominent, closely granulated bourelets and expanded phyllocids with single pores and sunken peripodia, arranged in two irregular series, but with inner occluded plates in each posterior phylloide; two buccal pores in each phylloide.

**Remarks.** The enlarged genital pores of some specimens are seen in many living echinoids and are a characteristic of neolampadids (e.g. Agassiz, 1883, pl. 22, figs. 1, 13). They are due to sexual dimorphism, the specimens with large pores being females (Agassiz, op. cit.). It is reasonable to give a similar interpretation in these fossil forms.

Whether or not the adapical ambulacral pores were absent cannot be decided positively; very small pores (text-fig. 1b) in some specimens suggests that their seeming absence in others could perhaps be a secondary effect due to fossilization.

**Genus Notolampas gen. nov.**

**Generic name.** From the Greek _νότος_, south; _λάμπας_, torch.

**Type species.** _Notolampas fuscus_ sp. nov.

**Diagnosis.** Somewhat posteriorly elongated neolampadids, with compact apical system possessing three genital pores, and pierced oculars; adapical ambulacral plates with single pores continuing to oculars. Periproct submarginal, overhung by posterior interambulacrum. Floscelles well developed, with prominent bourelets and wide phyllocids with pores arranged in four irregular series in each.
Remarks. This combination of characters provides no basis for comparison with previously described genera. In particular, the floscelle is much better developed than in other neolampadids.

Notolamps flosculus sp. nov.

Plate 107, figs. 1-10; text-fig. 2

(Non) Pygorkynachus Vassali Wright; Duncan, 1877, Quart. J. geol. Soc. Lond. 33, pp. 51, 67;
Duncan, 1887, ibid. 43, p. 420.
— Studeria elegans (Laube).
— Studeria elegans (Laube).
(Non) Pygorkynachus vassali Wright; Ludbrook, 1961, Bull. Geol. Surv. S.A. 36, p. 44.
— Prongolampsus Nanoe-hollandiae Bittner, 1892, Sitz. k. Akad. Wissen. Wien, pp. 357-9,
pl. 3, fig. 1.
— Echolampsus novochollandiae (Bittner).
(Non) Pygorkynachus Vassali Wright, 1864, Quart. J. geol. Soc. Lond. 20, p. 479, pl. 22, fig.
6a-c.

specimens in the Tate Collection.

Locality and horizon. Mannum, South Australia, Murray Basin, Mannum Formation, Lower Miocene.

Description. Test small, suboval in outline and somewhat pointed posteriorly, greatest
width posteriorly, adanal surface gently arched to the greatest height posterior to the
apical system. Adoral surface tumid, markedly sunken around the peristome. Peristome
anterior, elongate oval in shape. Periproct submarginal, overhung adapically by the
posterior interambulacrum, subquadrato in shape, with an introverted rim. Test covered
with small, irregularly disposed, sunken primary tubercles and small granules.

Apical system (text-fig. 2a) central, compact with genital pores 1, 2, 4 present. Oculi
abutting against genital disk, and subtending narrow ambulacra with single pores (text-
fig. 2a). Up to six hydropores present.

Floscelle (text-fig. 2b) well developed, with prominent granulated bourrelets, and
expanded phylloids, possessing single pores arranged in four very irregular series. Adoral
pores with sunken peripodia. Two buccal pores in each phylloide.

Remarks. Small specimens of the Australian Miocene species Studeria elegans (Laube)
are similar in shape to Notolamps flosculus, but differ obviously in the presence of
petals. On such a specimen (British Museum Nat. Hist. E2375) is based Duncan's (1877,

EXPLANATION OF PLATE 106

Figures 2 unless otherwise stated.

Figs. 1-10. Pygorkynachus concinnus gen. et sp. nov. 1, Adoral view. 2, Posterior view. 3, Anterior view.
4, Adapical view. 5, Left anterior view of holotype A.U.G.D. T269a (2). 6, Left lateral view.
7, Adapical view of P.19252 (9). 8, Enlargement of floscelle, P.19253, × 12. 9, Apical system of
A.U.G.D. F15748 (6), showing numerous hydropores, × 12. 10, Adapical surface of A.U.G.D.
T269b (9), showing apical system, sutures, and occasional ambulacral pores, × 12.
All specimens from the Upper Eocene Tortichella Limestone, Aldinga, South Australia.
p. 51) record of *Pygorhynchus vassali* Wright from 'East of the Glenelg River', Victoria. This record, in turn, gave rise to Tate's (1891) identification of the present species. *P. vassali*, currently placed in *Pliolampas* Pomel, has typical echinolampadid morphology, with prominent ambulacral petals.
The nature of the tubercles cannot be seen in the available material. As in Pisolampas concinna, some specimens show enlarged genital pores, which is interpreted as sexual dimorphism.

**DISCUSSION**

Mortensen (1948) included the Neolampadidae in the suborder Cassidulina of the order Cassidulida. Kier (1962), on the other hand, did not mention the neolampadids in his revision of the order. The two Tertiary genera described above, with their well-developed floscelles, clearly establish the cassidulid ancestry and affinities of the family.

![Image](image.png)

**TEXT-Fig. 2.** _Neolampas flosculus_ gen. et sp. nov. _a_ Adapical plating of holotype, A.U.G.D. F15747

_b_ Adoral plating of same. Both × 5.

The neolampadids are, however, strikingly dissimilar from other cassiduloids in their non-petalloid adapical abulacra, the plates of which possess only single pores. Indeed, not only are petals absent, but also the ambulacral pores (and tube feet) may be atrophied, and the ambulacral columns and oculars even separated from the genitals (in *Tropholampas* and *Pisolampas*). The ambulacra thus are the most degenerate of all irregular echinoids. Because of this, a suborder is here proposed for the reception of the family.

Stefanini (1913) has suggested that the neolampadid ambulacra were neotenously derived from the cassidulid ambulacra, and this view must be fully endorsed. Because the earliest neolampadids possess a floscelle, it seems that the absence of this in some living genera must be regarded as further neotenous simplification of the ambulacra. Mortensen (1948, p. 331) has suggested that, if _Aphanophora_ possessed phyllodes, it
would ‘be the most advanced of the Neolampadidae in this respect’. Rather than this, it would now seem that floccellose-bearing neolampadids should be thought of as the least modified and least degenerate.

The detailed derivation of the neolampadids is speculative. Because *Nannolampas* has disparate genital plates, it must be suggested that the family arose from forms such as the Nucleolitidae with a similar apical system. It must be noted that the Upper Eocene *Pisolampas* possesses advanced neolampadid characters suggesting that even older representatives of the family await discovery.

A complete summary of the classification of the Cassiduloidea demands the brief introduction of broader issues, which are discussed in more detail elsewhere (Philip, 1963).

Mortensen (1948) recognized two suborders of the Cassiduloidea, viz. Cassidulina and Conoclypina. Durham and Melville (1957) removed the Conochyphina to the Holecypoda, and divided the remaining cassiduloids into two orders, viz. Cassidulina emend. and Nucleolitoida. Grouped together were forms with unequal pores in the pedals and disparate apical systems, as opposed to forms with equal pores in the petals and compact apical systems. Kier (1962, p. 23) rightly rejected this twofold subdivision of the Cassidulina, observing that ‘As a matter of fact there are more genera with monobasal apical system and unequal pores than with equal pores’. As noted previously, Kier’s usage of the Cassidulida excluded the neolampadids.

Durham and Melville’s (1957) removal of the Conochyphina to the Holecypoda stems from a particular emphasis on the value of the lantern and girdle in echinoid classification. They divide the irregular echinoids into two superorders, viz. Gnathostomata (roughly corresponding to the holecystoids and Elypeasteroida) and Atelostomata (cassiduloids and spatangoids).

This return to nineteenth-century classification ignores the findings of the last sixty years.

It seems that, with the development of the irregular condition and the construction of the peristome, the lantern became superfluous, and so must be considered as a truly regressive character, lost in different lines of descent. The adult holecystoid *Echinonoeus* lacks a lantern and girdle, although these are present in early growth stages. A similar condition obtains in living cassiduloids such as *Apatopygs* and *Echinolampas*. Even among spatangoids MacBride (1918, p. 264) has described what he considered to be the rudiments of dental apparatus in the early larval stages of *Echinoocardium cordatum*. Although this has been questioned (Mortensen, 1948, p. 6), the living meridosternous spatangoid *Pilemactechiodes* possesses ‘well developed auricles around the peristome, indicating the probable existence in young stages of dental apparatus’ (Mortensen, 1950, p. 116). These facts indicate that no clear-cut division into gnathostomatous and atelostomatous irregular echinoids is possible. It also follows that some so-called atelostomatous irregular echinoids, particularly the cassiduloids, are strictly gnathostomatous.

This clarified, the question of the systematic position of the Conoclypina can be discussed. The Tertiary Conoclypidae are virtually identical externally with some of the more advanced cassiduloids. Indeed, Kier (1957) gives as the restrictions between *Conoclypus* and *Echinolampas* the more slit-like outer pores in the pedals, and the more longitudinally elongate peristome of the fomer. However, *Conoclypus* possesses a lantern
in adult stages, and hence Durham and Melville remove it to the largely gnathostomatous order Holecypoida.

The features unknown in holecypoids which indicate the manifestly cassiduloidal morphology of the test of Conoclypus are:

1. The presence of petaloid ambulacra.
2. The presence of `pseudo-phylloides` and bourrelets around the peristome.
3. The disordered interambulacral ornament.
4. The absence of gill-slits, which are present in all holecypoids which have a lantern in adults.
5. The compact apical system.

These characters indicate close similarity with advanced cassiduloids. This is also seen in other features such as the presence of single pores in the ambulacra outside the petals. Indeed, these, coupled with the compact apical system, are a combination of features found only in Cenozoic cassiduloids (with a few minor exceptions).

As various cassiduloid groups must strictly be considered gnathostomatous, this evidence suggests that it is far more probable that the Conoclypina were a neotenous derivative of advanced cassiduloid stock (such as the Echiolampadidae, which are known to possess a girdle and lantern in young stages) than primary descendants of the holecypoids. This interpretation is supported by the fact that no satisfactory holecypoid ancestor of the Conoclypina can be distinguished. The alternative view is to regard the Conoclypina as a sudden `saltation` of the holecypoids to give a form of advanced cassiduloid morphology and the most remarkable example of homoeomorphism in the class Echinoidea.

As an outcome of these considerations the following classification of the echinoid order Cassiduloida is advocated.

**SUMMARY OF CLASSIFICATION**

**Order CASSIDULOID A** Claus, 1880 emend.

*Diagnosis.* Atelostomatous irregular echinoids (except Conoclypina) lacking gill-slits; ambulacra adapically petaloid (except Neolampadina) with petals usually all similar; floroscelle usually well developed; apical system disparate or compact; plastron undifferentiated; fascioles absent.

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**EXPLANATION OF PLATE 107**

Figures ×2 unless otherwise stated.


All specimens from the Lower Miocene Mannum Formation, Mannum, South Australia.

**Fig. 11.** *Pseudoclypeus conicus* gen. et sp. nov. Enlargement of perforate crenulate primary tubercles at the ambitus of A.U.G.D. T269a. ×20. From the Upper Eocene Toroweapia Limestone, South Australia.
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1. Suborder Cassidulina Claus emend.

Diagnosis. Cassiduloids lacking a lantern in adult stages; ambulacra adapically petaloid.

Families. Apatopygidae Kier, 1962; Archiacidae Cotteau & Triger, 1869; Cassidulidae L. Agassiz & Desor, 1847; Clypeidae Lamert, 1898; Clypeolampadidae Kier, 1962; Echinolampadidae Gray, 1851; Faujasitidae Lamert, 1905; Galeropygidae Lamert, 1911; Nucleolithidae L. Agassiz & Desor, 1847; Pilolampadidae Kier, 1962.

Remarks. For present purposes, the families recognized by Kier (1962) in his restricted usage of the order Cassiduloida are listed as the complement of the Cassidulina. It is to be noted, however, that some of these are poorly differentiated (e.g. Nucleolithidae, Clypeidae; Echinolampadidae Clypeolampadidae, Pilolampadidae) and probably should be considered at most as subfamilies.

2. Suborder Conoclypina Zittel, 1879

Diagnosis. Cassiduloids possessing a lantern in adult stages; ambulacra adapically petaloid.

Families. Conoclypidae Zittel, 1879; Oligopygidae Duncan, 1891.

Remarks. As a lantern-bearing cassiduloid, Bonairexter Pijpers finds its place with the Conoclypidae. Whether or not the other genera (Oligopygus, Haimea, Microlampas, Protolampe, and Oryxchelum), placed with Bonairexter in the family Oligopygidae by Durham and Melville (1957), rightly belong together is uncertain. Durham and Melville's interpretation is followed to the extent that the family Oligopygidae is unquestionably referred to the Conoclypina.

3. Suborder Neolampadina subord. nov.

Type genus. Neolampas A. Agassiz, 1869.

Diagnosis. Cassiduloids lacking a lantern in adult stages; petals lacking, and adapical ambulacral plates with single pores.

Family. Neolampadidae Lamert, 1918.


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