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Glacidorbis IREDALE 1943, a genus of freshwater prosobranchs with a Tasmanian-Southeast Australian-South Andean distribution.

By

CLAUS MEIER-BROOK,
Tropenmedizinisches Institut der Universität, Tübingen, Germany.

&

BRIAN J. SMITH,
National Museum of Victoria, Melbourne, Victoria, Australia.

With 11 figures.

Abstract *Glacidorbis*, described by IREDALE, 1943, as a genus of Planorbidae is redescribed as a prosobranch genus with a Tasmanian — Southeast Australian — South Andean distribution. Besides the type species, *Glacidorbis hedleyi* IREDALE 1943, a new species *Glacidorbis magallanicus* n. sp. is described and *Valvata* (?) *pedderi* SMITH 1973 is referred to this genus. The systematic position of the genus is speculated upon and the zoogeographical implications discussed.

Two species of small freshwater prosobranchs were collected at approximately the same time from mountain oligotrophic lakes at the southern extremities of two separate continents. Although similar in shell characters to certain groups of the Valvatidae and Hydrobiidae, the radula structure of these species readily separated them from these and all other groups of prosobranchs and pointed to a close phylogenetic relationship between the species. A third species of the same genus was collected in a mountain river in central Victoria, Southeast Australia in July, 1975. This find caused one of us (B. J. S.) to compare the specimens with a species of snail described by IREDALE (1943) as a new planorbid genus and species from Blue Lake, Mt. Kosciusko, in southern New South Wales called *Glacidorbis hedleyi*. Re-examination of the type series of this species has revealed the incorrect family placement of the species and confirmed its relationship to these recent discoveries. The discovery of a species of the same genus in Southern Chile gives the genus an amphinotic distribution. Amphinotic groups occur both (gr: ampho) in the Australian and South American parts of the former southern (gr: notos = south wind) continent which is postulated to have comprised Antarctica, New Zealand, Tasmania, and the southernmost parts of South America, Africa, and Australia.

Redescription of the genus *Glacidorbis* IREDALE, 1943.

Type species: *Glacidorbis hedleyi* IREDALE 1943. O D: Austr. Zool., 10 (2): 227

The original generic description is as follows:

"A series of Planorbid collected by Mr. C. HEDLEY from 35 feet, Blue Lake, Mount Kosciusko, New South Wales, provides a distinct genus, the shell being small, thin, three whorled, evenly coiled, mouth round, free, umbilicus wide, spire sunken, no sculpture, save growth lines observed. Nearest *Pygmanisus,* but differing in the few whorls and greater depth to breadth."

New diagnosis: Freshwater prosobranch with a radula in which the rhachidian teeth are roughly triangular in shape consisting of a mesoconus with marginal denticles and in which all other teeth are completely or almost completely reduced.

Description: Shell planispiral, very small, more or less carinated on the periphery, aperture roundish, *Valvata*-like, as is the operculum which is corneous, paucispiral with a central nucleus. The animal is viviparous. The pallial cavity contains no ctenidia, but a peculiar tentacle is present. The radula consists of one longitudinal row of rhachidian teeth. The lateral teeth are either reduced to vestiges or completely lacking as are the marginal teeth. The rhachidian teeth are roughly triangular in shape, the basal part without denticles, bearing one large mesoconus with several marginal denticles. The mesoconus resembles the bow of a canoe. The rhachidian teeth appear to articulate with those in adjacent rows.

The genus contains three species, *Glacidorbis hedleyi* IREDALE, 1943, from central Victoria and southern N. S. W., *G. pedderi* (SMITH, 1973) from southern Tasmania, Australia, and *G. magallanicus* n. sp. from southern Chile.

Glacidorbis hedleyi.

Figs. 8-11.

1943 IREDALE, Austr. Zool., 10 (2): 227.
1944 IREDALE, Austr. Natural., 11: 125, fig. 7

Diagnosis: A species of *Glacidorbis* with a long, wide mesocone on the rhachidian bearing 6 to 8 denticles on each side; shell smooth with no carination present.

Description: Shell planispiral, $2^1/_2$ whorls, smooth, rounded without carination. Fine, brown periostracum present. Operculum thin, paucispiral.

The radula consists of a single rhachidian in each of 25 rows. The rhachidian is a large triangular recurved mesocone with two rows of 6 to 8 denticles along the lateral edges. The base of each tooth is a solid structure articulated with the adjacent teeth of the radula.

Type material Lectotype, here designated, in the Australian Museum, Reg. No. C100597, Diameter 2 mm. Paralectotypes: 18 specimens in Australian Museum, Reg. No. C22789. Type series collected by C. HEDLEY. Specimens dry but with remains of animals present.

Type locality: Blue Lake, Mount Kosciusko, N. S. W., dredged from 35 ft. (10·7 m).

Other material 20 specimens were collected alive from organic debris in a backwater of the Acheron River, Great Dividing Range between Warburton and Narbethong, Central Victoria, by L. MACMILLAN, R. PLANT and B. J. SMITH in July, 1975. National Museum of Victoria Reg. No. F29973 and Senckenberg-Museum Frankfurt SMF 242880/3.

Remarks: A more complete account of the species with further anatomical and ecological data will be published separately by one of us (B. J. S.).

Glacidorbis magallanicus n. sp.

Figs. 1-6.

Diagnosis: A species of *Glacidorbis* with short mesocone on the rhachidian bearing 4 to 5 denticles on each side; shell smooth, almost glossy with weak carination.

Description: Shell planispiral, 2-2·8 mm wide, 0·8-1·0 mm high, with $2^1/_2$ to $2^3/_4$ whorls. Periphery with one keel situated centrally between upper and under side. Last whorl loosely touching the penultimate whorl. Aperture round. Growth rings straight. Periostracum brown, surface smooth, almost glossy. Operculum thin, corneous with the same number of whorls as the shell.

The radula consists of 28 rows of teeth consisting either of the rhachidian only or accompanied by vestiges of a lateral tooth. The dimensions of the rhachidian teeth are: 42 µm wide and 27 µm long. The mesoconus is armed with 4 to 5 denticles on each side; no basal denticles occur. The vestiges of the lateral teeth, if present, are reduced, 6 to 7 µm wide and 15 to 16 µm long, rhombic in shape and lacking denticles.

Preservation of the animals of the few specimens collected alive was insufficient to allow anatomical studies. After extraction from the shell preservation of one individual was good enough to show that no ctenidia were present but a structure similar to a pallial tentacle occurred at the right side of the mantle cavity.

Each of the 3 specimens preserved in alcohol had embryos of varying sizes in the uterus, the holotype containing 5, and another individual 8 with a size range from 0·2 to 1·6 mm diameter.

Material 5 specimens (3 alive, 2 empty shells) were collected in February 1971 by Mr. KARSTEN REISE, Zool. Inst. Univ. Göttingen. The type series has been deposited in Senckenberg Museum, Frankfurt.

Holotype — SMF 239465; dimensions: 2·85 mm wide, 1·0 mm high.

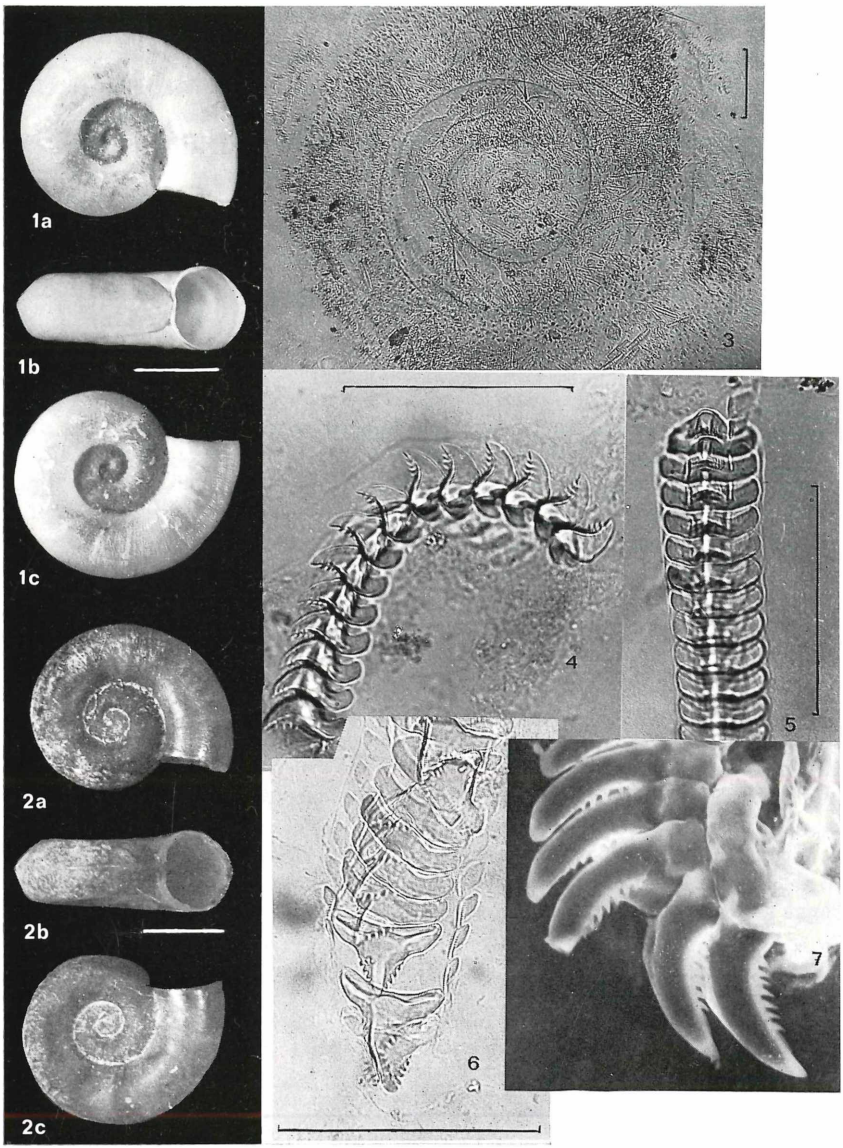
2 paratypes — SMF 239466; dimensions: Ind. no. 4 2·7 mm wide, 0·95 mm high, Ind. no. 5 2·0 mm wide, 0·8 mm high.

The shells of 2 individuals were broken for further studies:

Ind. no. 2 (fig. 2) 2·8 mm wide, 1·05 mm high, Ind. no. 3 2·5 mm wide, 1·0 mm high.

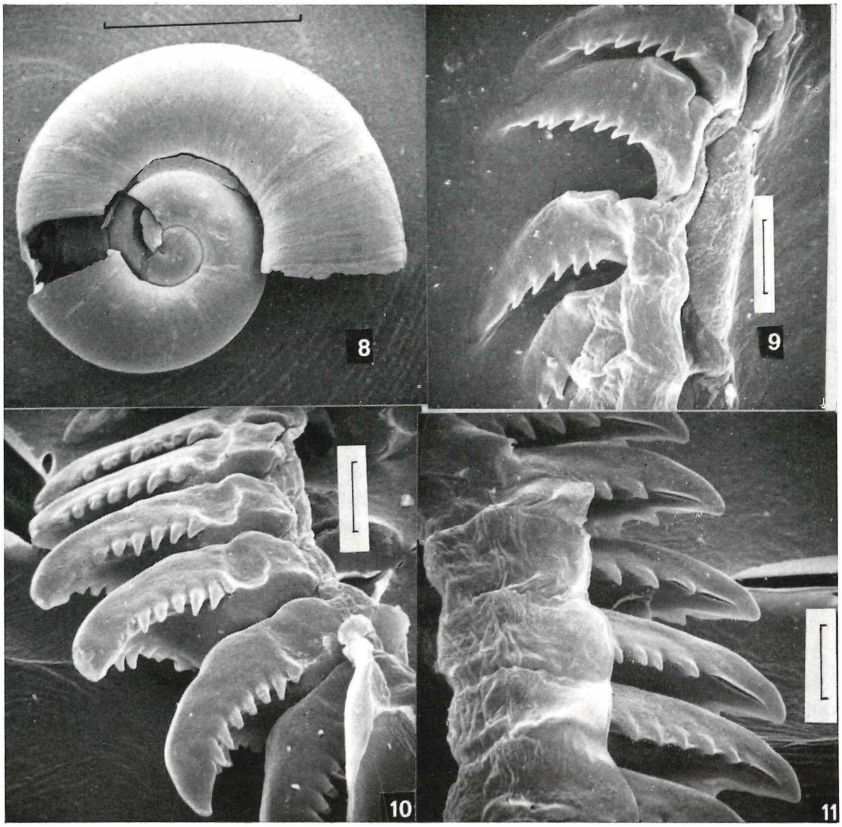
Type locality Small creek near Lago Pehoe, Paine Mountains, South Chile (50°57′ S/ 73°03′ W).

Biotope: The collector kindly gave the following information (in litt. 27-2-74): "Lago Pehoe in Paine-Park (Parque National Torres del Paine) is an oligotrophic lake which is fed by glacial water and by some lowland streams; it is surrounded by low bushes of *Nothofagus antarctica*; this original vegetation is now mostly replaced by trundra vegetation (due to previous grazing and burning). On the east side of the lake, near the connection with Lago Toro, there



Figs. 1-6. *Glacidorbis magallanicus* n. sp. — 1) holotype SMF 239465; 2) Shell of ind. No. 2, a = top view, b = apertural view, c = basal view; 3) Operculum of ind. no. 3 (microscop. preparation MD 91 in coll. MEIER-BROOK); 4-5) Radula of ind. no. 3 (MD 91): 4 = lateral view, 5 = basal view; 6) Radula of ind. no. 2 (MD 92) showing vestiges of lateral teeth.

Fig. 7. *Glacidorbis pedderi* (SMITH, 1973). — Radula.



Figs. 8-11. *Glacidorbis hedleyi* IREDALE, 1943. — 8) lectotype; 9) Radula of paralectotype; 10-11) Radula of a specimen from Acheron River, Central Victoria, Australia.

Scale: 1 mm in fig. 1 and 2 and 8; 0·1 mm in fig. 3 through 6; 0·01 mm in fig. 9 to 11.

Photographs: Senckenberg-Museum Frankfurt (fig. 1), MEIER-BROOK (2-6), B. J. SMITH (SEM-micrographs, fig. 7 to 11).

is a small bay in a lowland part. This lowland is slightly peat and densely covered with *Nothofagus*-bushes. It is crossed by that creek (I suppose it is connected with the stream between Lago Pehoe and Lago Toro; but I do not remember exactly) ..... the creek was 1 to 2 m wide, ... of rubber-boots-depth and marginally overgrown with Cyperaceae. A small pool was also in the peat meadow; it was connected with the creek. On the pool I found diptera, which were skating on the water surface like Gerridae. ..... The pH of the creek should have been below 7."

The accompanying mollusk fauna consisted of *Pisidium (Neopisidium) magellanicum* DALL and *Chilina fulgurata* PILSBRY.

Relationships: *Glacidorbis magallanicus* differs from the two Australian species of the genus by the shorter mesocone on the rhachidian which bears 4 to 5 denticles a side instead of 6 to 8. It also differs from *G. pedderi* in the absence of the strong shell keels.

Relationships of the genus: The radular characters are so unique that placing the new genus in one of the known families at present appears unsatisfactory. Indeed it might appear to be closely related to Valvatidae because of the presence of a "pallial tentacle", and the opercular and shell characters, but the apparent lack of ctenidia together with the radula opposes this assumption. Its placement in the Hydrobiidae would be favoured by the similarity of the shell to that of some groups of this family (Horatiinae) and by a certain similarity to the rhachidian tooth shape to *Somatogyrus* GILL, 1863. Dr. G. M. DAVIS (pers. comm. 1973) suggested that the central teeth be "typical hydrobiid" However, the lack of ctenidia prohibits the assumption of a closer relationship. Any relationship to Vitrinellidae (= Tornidae, Adeorbidae) should also be examined. The establishment of a new family may later prove necessary, but a thorough examination of the anatomy should precede further conclusions.

Associated fauna: The type localities of the three species of *Glacidorbis* are very similar, all being mountain oligotrophic lakes or in the feeder creeks to these lakes. In all cases the land around the lakes consists of peat bogs which provide a large input of dissolved and suspended organic matter which imparts a brown coloration to the water and renders it acidic. It therefore came as a considerable surprise to discover populations of *Glacidorbis hedleyi* in clear water of a mountain river in the Great Dividing Range of Central Victoria, Australia. However the animals are mainly concentrated in very heavy build-ups of leaf debris in backwaters of the river where micro-habitat conditions are probably quite different from the stream in general. The particular stretch of river flows through and is fed from heavy climax temperate rain-forest and wet sclerophyll forest with large direct and indirect organic inputs into the water system.

Lake Pedder in Tasmania has a small, restricted aquatic fauna with several endemic species of invertebrates (SWAIN 1972). The associated mollusc fauna consists of a *Bulinus* sp., *Potamopyrgus* sp. and *Pisidium* sp. The Blue Lake, Mt. Kosciusko, N. S. W. has very fresh, slightly acid water (WILLIAMS et al., 1970) with an associated mollusc fauna of the sphaeriid *Glacipisum kosciusko* IREDALE, 1943, and the lymnaeid *Glacilimnea gelida* IREDALE, 1943.

The molluscan fauna of the section of the Acheron River where *G. hedleyi* was recently discovered is *Pisidium* sp. and two species of hydrobiids (L. MACMILLAN, pers. comm.).

Zoogeographical implications. The past existence of a Notogaea or southern land mass comprising the southern parts of South America, South Africa, and Australia and Tasmania and New Zealand has been postulated by BRUNDIN (1965) and others with examples from many groups of plants and animals quoted as evidence. We contend that *Glacidorbis,* with one species in Southern Chile and the other species in Tasmania and Southeastern Australia,

provides additional support to this postulate in an animal group not previously mentioned in this context.

Species of animals or plants used to support the theory of transatlantic land bridges should meet, as far as possible, the following requirements:

(1) There should be a number of common morphological characters which are as unique as possible, thus proving the species to be synapomorphs. The difficulty of establishing such synapomorphic relationships in the absence of structures capable of displaying a series of easily recognisable and variable features is self-evident. When considering mollusks, the bivalves fall into this category of containing few useful characters whereas the gastropod radula and copulatory organs, so important in the taxonomy of this group, are both structures displaying easily recognisable characters which often show unique variation. It is only in such groups, rich in these characters, that the risk of wrongly judging a pair of taxa to be synapomorphs can be kept sufficiently low.

(2) Their geographical distribution should be confined to the extreme south of South America (viz. South Chile and Patagonia), South Africa, New Zealand and/or Tasmania-SE Australia. Any occurrence (recent or fossil) outside these areas may obstruct an interpretation in favour of transantarctic land bridges since a migration from common northern areas (Gondwana) cannot be excluded in such cases.

The species of *Glacidorbis* appear to fulfil these two requirements though it is admitted that such tiny snails could have been overlooked in other parts of the southern hemisphere.

BRUNDIN (1965) was able to present sufficiently detailed evidence from work on Chironomidae to document the probable sequence of separations of the various southern continents. Prior to the present study the only groups of mollusks to be used in any way to suggest a transantarctic pathway of relationship has been the freshwater mussel family Mutelidae (ORTMANN 1920). However the freshwater mussels do not meet either of the criteria for species which would provide good evidence of a transantarctic relationship as set out above. On the contrary, MCMICHAEL & HISCOCK (1958) postulated a common northern origin for the mutelids of South America, Africa, and Australia. We therefore consider that *Glacidorbis* is the first group of mollusks to be advanced as strong evidence to support the hypothesis of distribution via transantarctic bridges and the past existence of a habitable antarctic continent. The postulated sequence of separation of the various sections of the mesozoic antarctic continent is: Southern Africa, New Zealand, South-eastern Australia and finally Patagonia. Thus the separation of the areas now inhabited by *Glacidorbis* (Tasmania-SE-Australia and Southern Chile) occurred relatively recently in geological time. This may explain the fairly close relationship and surprising similarity between these two species. It is to be expected that should further species of this group be discovered in New Zealand or South Africa their grade of relationship will be markedly less than that between *G. hedleyi* and *pedderi* on the one side and *G. magallanicus* on the other.

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