APICAL SHELL SCULPTURE OF SOME AFRICAN FRESHWATER LIMPETS (MOLLUSCA: BASOMMATOPHORA: ANCYLIDAE)*

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ABSTRACT

A Scanning Electron Microscope has been used to describe in detail the apical shell sculpture of sevenAfrican species (three genera) of freshwater limpet snails (Ancylidae). The apical sculpture of *Ancylus fluviatilis* (? syn. *strigatus* and ? *brondeli*) is striate, but quite different in basic pattern from the other three striate species studied, *Ferrissia cawstoni*, '*Gundlachia*' *burnupi* and '*G.*' *l'hotelleriei*. The apices of the last three are nearly identical, and most likely all three species are congeneric. The apical sculpturing of radiating punctae of the three species of *Burnupia* is quite distinct, not only from the striate *Ancylus* and *Ferrissia*, but also from the sub-apically pitted South American *Uncancylus*.

INTRODUCTION

The use of apical shell sculpture for taxonomic separation of species-group taxa in the freshwater limpet family Ancylidae goes back to 1902 when Bryant Walker recognized two groups of North American ancylids on that basis. A year later (1903) he formally named these two groups as *Laevapex* (with smooth shell apices) and *Ferrissia* (with radially striate apices). Later (1912), he gave the name *Burnupia* to those southern African freshwater limpets having radially punctate apices. Pilsbry (1913; 1924) described the apices of his genera *Uncancylus* as being pitted and *Hebetancylus* and *Anisancylus* as being smooth. The fact that the common freshwater ancylid limpet of Eurasia and North Africa, *Ancylus fluviatilis* Müller, had radial striae has been known for many years, but this character has generally been disregarded for taxonomic purposes.

The purpose of the present paper is to describe in greater detail the apical shell sculpture of some African freshwater limpets, and to discuss these features as they relate to ancylid systematics. Such a study has been made possible because of the greater resolving power of the Scanning Electron Microscope (SEM).

METHODS AND MATERIALS

Shells of freshwater limpets used in this study were cleaned by immersing them in sodium hypochlorite (commercial "Clorox"), removing the periostracum and rinsing the shells in distilled water. The shells were then dried and glued with Duco cement or aluminium paint to the holder

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to be used in the SEM. The shells were coated with gold and viewed and photographed with a JEOL (Ltd.) JSM-U3 Scanning Electron Microscope. Photographs were taken at 100×, 200×, 220×, 300×, 600× and 1 000× with Polaroid Land P-55 P-N film.

The specimens used in this study were as follows:

Ancylus fluviatilis (? "*strigatus* Bourguignat 1853"). Ca. 1 mile north of Tizi-n-Tichka Pass, High Atlas Mountains, Morocco. Ca. 2 200 m elevation; headwaters of Oued Rdat. Coll. A. G. Smith. [Of the nominal species figured by Hubendick (1970, figs. 45–46, p. 13) from northwest Africa, the shell characters of the above Moroccan specimens seem closest to the nominal species *A. strigatus.*]

Ancylus fluviatilis (? "*brondeli* Bourguignat 1862"). University of Michigan Museum of Zoology (UMMZ) catalogue number 15942. Algiers, Algeria.

Burnupia capensis Walker 1912. UMMZ 102477. Escomba, Natal, South Africa.

Burnupia gordonensis (Melville & Ponsonby 1903). UMMZ 102509. Verulam Stream near Umhloti mouth, South Africa.

Burnupia stenochorias (Melville & Ponsonby 1903). UMMZ 102581 (co-types). Ebb en Vloed, Port Elizabeth, Cape Province, South Africa.

Ferrissia cawstoni Walker 1923. UMMZ 48245. Avoca, Natal, South Africa.

"*Gundlachia*" *burnupi* Walker 1926. UMMZ 41762. Malvern, Natal, South Africa.

"*Gundlachia*" *l'hotelleriei* Walker 1914. UMMZ 102024 (co-types). Alexandria, Egypt.

DESCRIPTION OF SHELL APICES

Ancylus fluviatilis (? *strigatus*) (Figure 1a, c). The centre of the apical tip of the shell is "pushed in" or "dimpled". This area is devoid of strong sculpturing, the surface simply appearing somewhat irregular and malleated. About 0,2 mm radially from the exact centre of the apex a more distinct and patterned sculpture begins. This sculpture starts weakly, but rapidly becomes prominent. The strongest part of the pattern consists of radiating ridges or cords, more or less equally spaced at first. As these cords radiate distally, and thereby diverge, new radial cords emerge. These new radial cords are not as prominent as the original ones. The radial cords continue distally to the edge of the shell (apertural edge). Near the apex, before they become straight, they spiral sinistrally (as one would expect for a sinistral shell). Running perpendicular to the radiating cords are lower, more closely spaced transverse ridges. These transverse ridges are especially closely spaced where the first begin apically, so that the space between adjacent transverse ridges is only a narrow crack.

Ancylus fluviatilis (? *brondeli*) (Figure 1b). The apical sculpture of this Algerian population is nearly identical in basic details to that described for the Moroccan population above.

Burnupia capensis (Figures 1d, 2a). At the exact centre of the apex is a very regular pit (the "apical scar" of Pilsbry 1896, and Bourguignat 1853), surrounded by a smooth area with a radius of about 0,1 mm. From the distal edge of the smooth area radiate rows of pits or punctae. These rows run distally for about 0,7 mm, where they rather abruptly stop. The pits are square, or more usually rectangular, with the greatest length of the rectangle running transversely, *i.e.*, at right angles to the radiating rows. There is a tendency for new rows of punctae to form as the rows radiate outward and diverge. Although the punctae are rather regularly spaced radially, the punctae of any two adjacent rows do not necessarily occur evenly side by side, so that they are not arranged in perfect concentric circular rows. The radiating spaces between the radiating rows of punctae vary in width, being sometimes very narrow, and occasionally being rather wide (more than 0,07 mm). These radiating spaces between rows are relatively smooth. Some of the punctae are traversed lengthwise by narrow partitions, presumably formed when there was a brief growth rest in the middle of the formation of a puncta.

Burnupia gordonensis (Figure 2b). The apical region of the single specimen of this species differed from *B. capensis* above mainly in that more of the apical region between the central pit and the radiating punctae was smooth, especially on the right and left sides where the rows of punctae are nearly absent. The obsolescence of the punctae of this shell may have been due to wear, since it was from an old specimen.

Burnupia stenochorias (Figure 2c, d). The apical shell sculpturing of this species is similar to *B. capensis*, except that the punctae are a little more sparse and tend to be more irregularly round than rectangular or square. Also, when they are elongate rather than nearly round, the greater length of the puncta usually tends to run radially rather than transversely. Additionally, the radial rows of punctae are a bit shorter and several are somewhat wider than those of *B. capensis*.

Ferrissia cawstoni (Figure 3c). At the exact centre of the apex is an apical scar or pit surrounded by a circular relatively smooth area less than 0,2 mm in diameter. At the periphery of this smooth area radiate grooves, beginning faintly at first, but rapidly becoming more strongly impressed. These grooves are very uniform in width. The ridges between the grooves are uniform in height and considerably wider than the grooves. Adjacent ridges are rather uniform in width, increasing equally in width as they proceed distally from the apical region. Before the ridges get very wide distally, new grooves appear, dividing the ridges medially. The grooves fade out about 0,6 mm from the apical pit. Within the radial grooves and transverse to them are many fine concentric ridges.

"*Gundlachia*" *burnupi* (Figure 4a, b). The apical sculpture of this species seems to be nearly identical to that of *Ferrissia cawstoni* described above.

"*Gundlachia*" *l'hotelleriei* (Figure 4c, d). The apical sculpture of this species is nearly identical to the two preceding species.

DISCUSSION

Apical shell sculpture traditionally has been important in delineation of species-group taxa (genera, subgenera and sections) in the Ancylidae, and some African species, especially various species from South Africa, have been described (as seen with the light microscope) now for some time (*e.g.*, Walker 1912; Connolly 1939). Connolly (1939:513–534) even used aspects of the apical microsculpture of South African ancylids as specific characters. The present study, using the Scanning Electron Microscope, describes this apical sculpture as it occurs in several African species much more clearly, and in doing so shows that the striate apical sculpture of *Ancylus* is basically different from the striate apical sculpture of *Ferrissia*. *Ferrissia rivularis* (Say), *F. shimeki* (Pilsbry) and *F. walkeri* (Pilsbry & Ferriss) (Figure 3d), all of North America, have the same kind of apical sculpture (Burch & LoVerde 1974) found on the South African species of *Ferrissia*, showing that in this respect species on the two continents have not diverged.

The apical sculpture of "*Gundlachia*" *burnupi* is like that of *Ferrissia*. The ancylid genus *Gundlachia* Pfeiffer 1849 has been generally considered to comprise those freshwater limpet-like basommatophoran snails possessing a septate shell, *i.e.*, having a posterior shelf-life projection of shell material extending anteriorly, partially covering the shell aperture. The original specimens, from Cuba, on which Pfeiffer based both his new species (*G. ancyliformis*) and new genus (*Gundlachia*) were septate. However, it has long been suspected that the septate condition is not genetically determined, but ecologically conditioned, and more specifically, induced by drought conditions (*e.g*. Dall 1904, 1911; Connolly 1939). And further, it has been surmised that the ecologically produced septate condition can occur in several different ancylid generic-group taxa (Basch 1959). If that should be the case, then Pfeiffer's genus name would comprise a special group of normally nonseptate (but occasionally septate) ancylids from Cuba, but perhaps having a wider distribution. Harry & Hubendick (1964) believe this to be the group represented by "*Ancylus*" *radiatus* Guilding, of which they consider *G. ancyliformis* to be a synonym. But, to whatever species group the original septate Cuban species of Pfeiffer belongs, it is somewhat unlikely that it belongs to the same group as the South African septate ancylids, such as the species previously called *Gundlachia burnupi* studied here. It would seem from the pattern of apical sculpture that Walker's "*G*." *burnupi* is the septate form of a South African *Ferrissia*. Watson (in Connolly 1939:525–526) came to the same conclusion earlier about the relationship of South African septate and non-septate ancylids with striate apices.

Burnupia has a peculiar apical sculpture of radiating punctae rather than lines. The South American *Uncancylus* has been described as having a pitted apex, and Walker (1920) has commented on the apparent similarity of the shells of South American and South African freshwater limpets. However, as can be seen from Figure 3a, b, the apical pitted sculpture of *Uncancylus concentricus* (d'Orbigny) from Brazil is quite different from that of the three species of *Burnupia* described in the present paper.

This is no doubt only the beginning of the application of the Scanning Electron Microscope to details of African ancylid shell morphology. It will be interesting to see if the study of additional species will confirm that the apical sculpture is the same in all basic details for all species of any particular genus (as I believe), and if each genus has its own characteristic sculpture distinguishing it from other genera.

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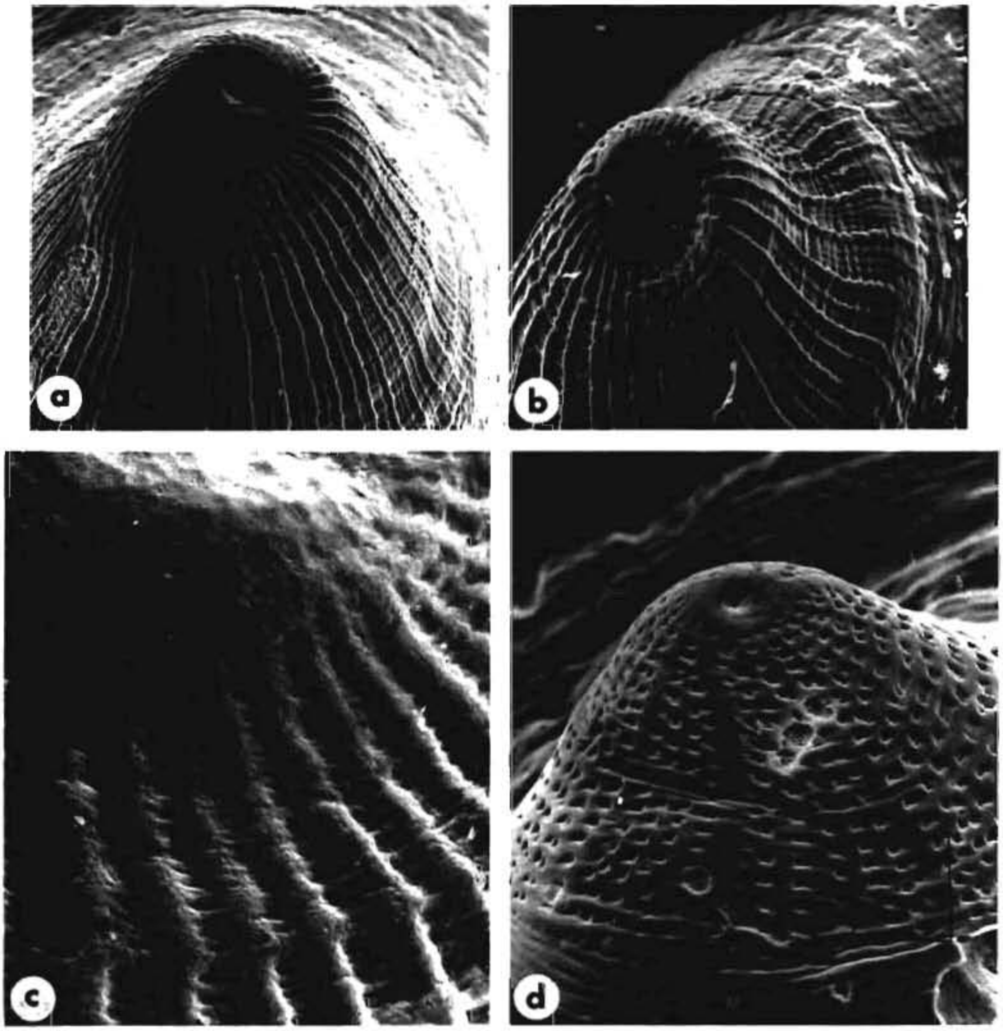

FIGURE 1
SEM photographs of (a) *Ancylus fluviatilis* (? *strigatus*), (b) *A. fluviatilis* (? *brondeli*), (c) *A. fluviatilis*, enlargement of area marked in a, and (d) *Burnupia capensis*. Approximate magnification: a = 75×, b = 75×, c = 450×, d = 150×.

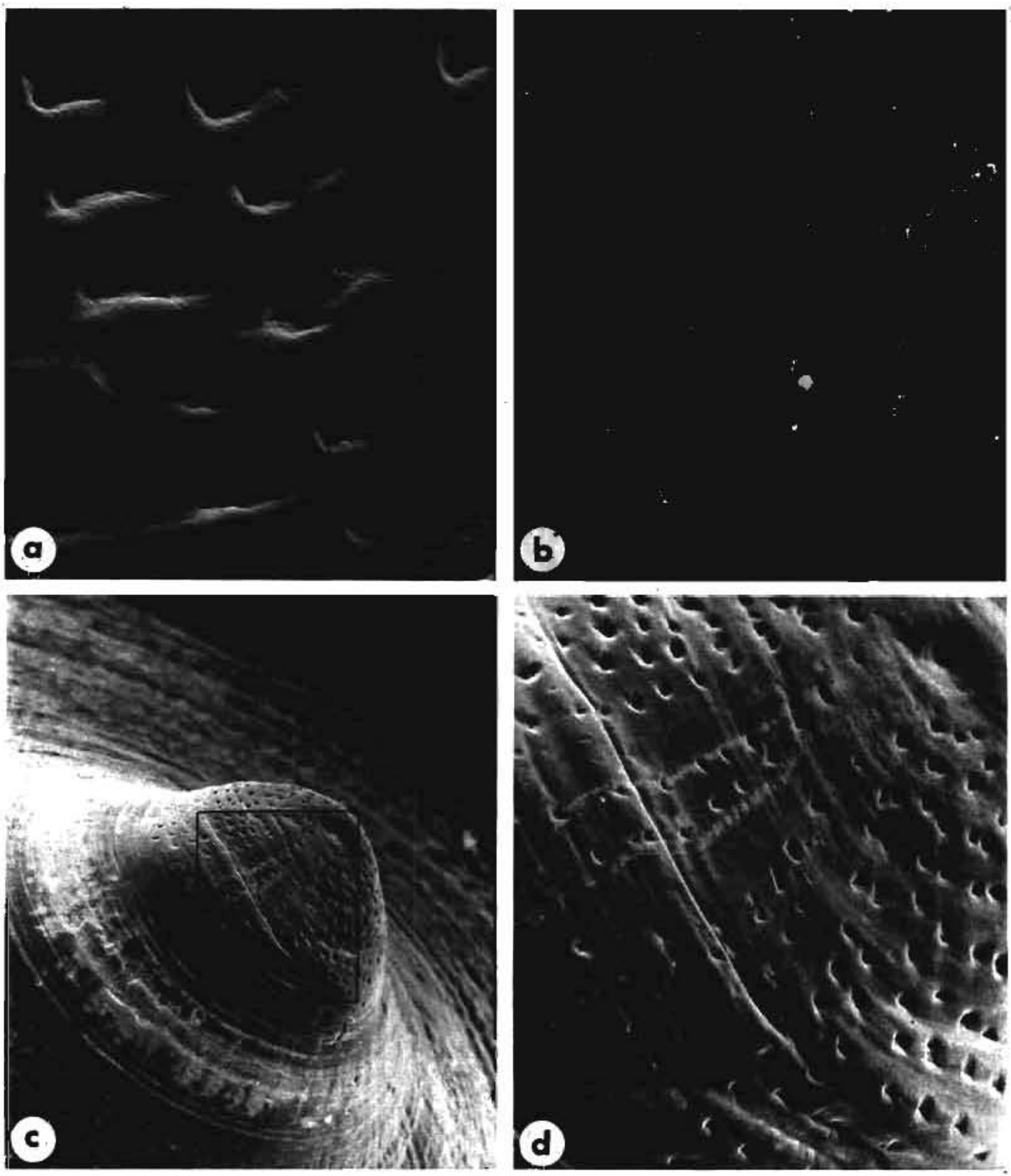

FIGURE 2
SEM photographs of (a) *Burnupia capensis*, enlargement of area marked in Fig. 1 d, (b) *B. gordonensis*, (c) *B. stenochorias*, and (d) *B. stenochorias*, enlargement of area marked in c. Approximate magnification: a = 750 ×, b = 450 ×, c = 75 ×, d = 225 ×.

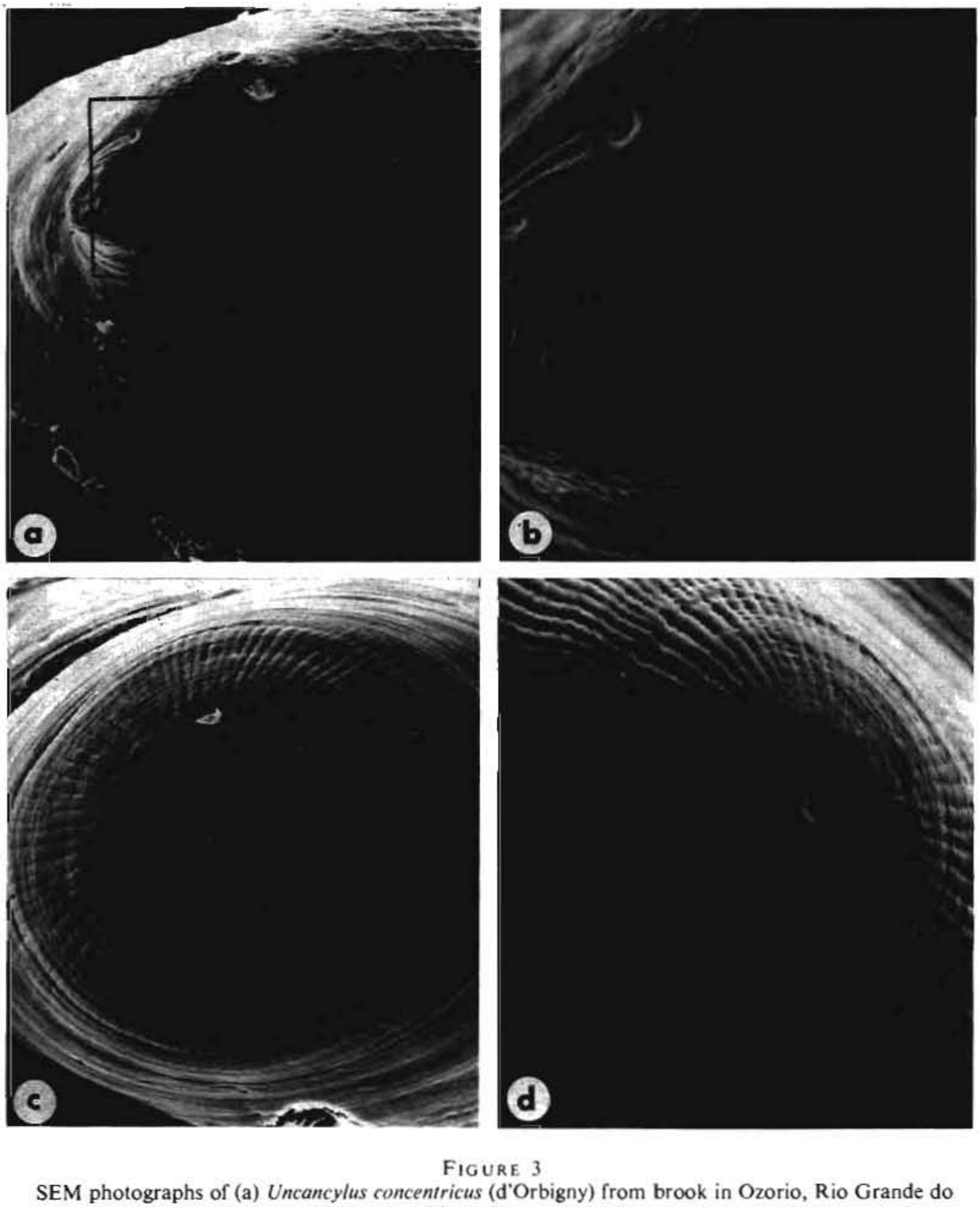

FIGURE 3
SEM photographs of (a) *Uncancylus concentricus* (d'Orbigny) from brook in Ozorio, Rio Grande do Sul, Brazil, for comparison with South African *Burnupia*, (b) *U. concentricus*, enlargement of area marked in a, (c) *Ferrissia cawstoni*, and (d) *F. walkeri* (Pilsbry & Ferriss) from Camp Colfax, La Porte, LaPorte County, Indiana, U.S.A., for comparison with South African *Ferrissia* and "*Gundlachia*".
Approximate magnification: a = 75 ×, q = 225 ×, c = 165 ×, d = 225 ×.

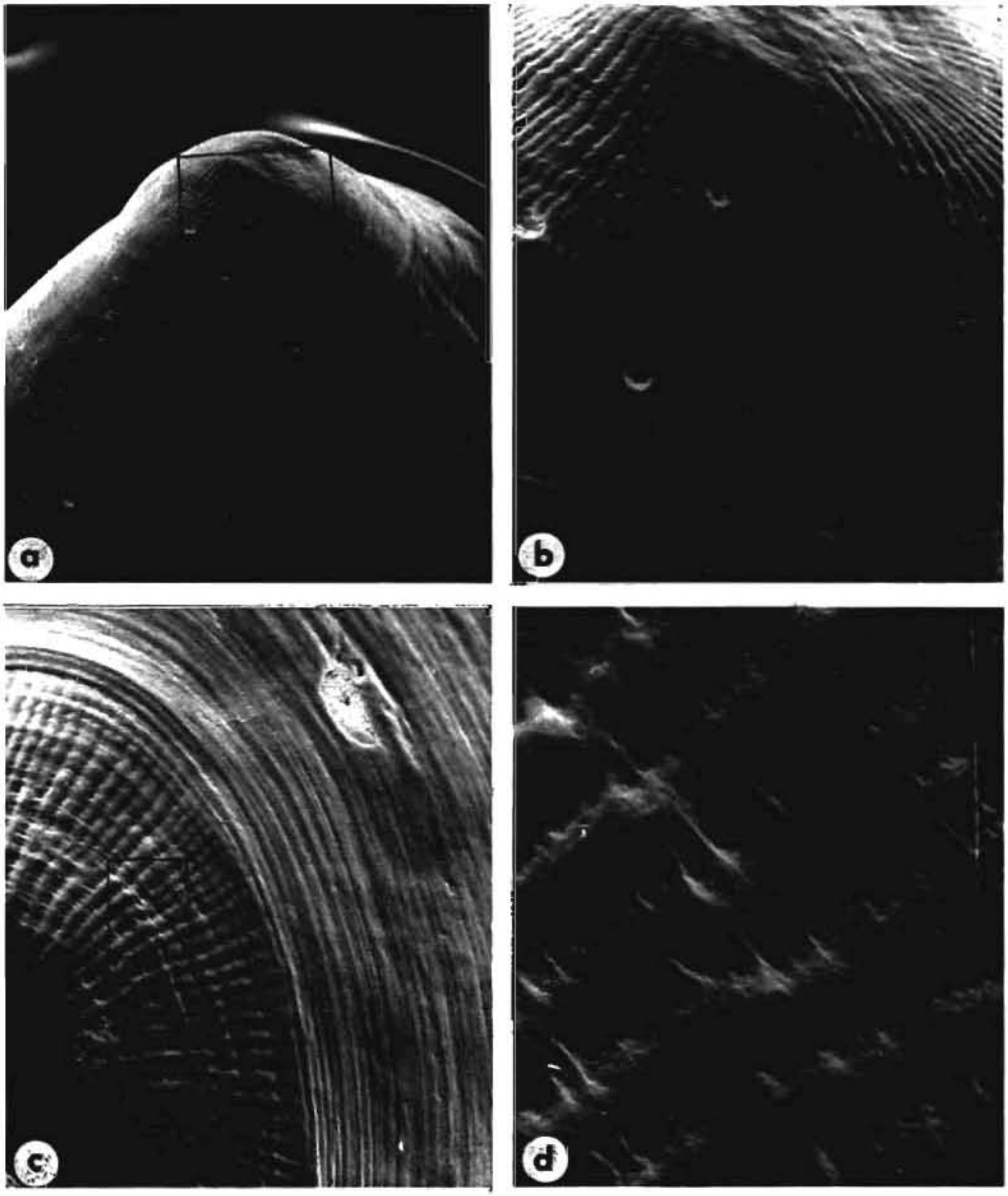

FIGURE 4
SEM photographs of (a) "*Gundlachia*" *burnupi*, (b)"*G.*" *burnupi*, enlargement of area marked in a, (c) "*G.*" *l'hotelleriei*, and (d) enlargement of area marked in c. Approximate magnification: a = 75 ×, b = 225 ×, c = 225 ×, d = 750 ×.

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