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THE RENAL RIDGE A DISPUTED FEATURE OF THE ANATOMY OF THE PLANORBID SNAIL *AUSTRALORBIS TENAGOPHILUS*

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SUMMARY

Studies on the gross anatomy as well as the histology of the kidney in 498 specimens of the planorbid snail *Australorbis tenagophilus* were made in comparision to the same organ in 717 specimens of *Australorbis glabratus*. These snails are very closely related species differing in that in *A. tenagophilus*, as generally admitted, the renal ridge is always lacking.

The specimens of *A. glabratus* showed a well developed renal ridge with one exception. Details on the structure of the renal ridge were presented. In the only specimen of *A. glabratus* in which the renal ridge was lacking the ventral surface of the kidney was only slightly elevated.

In *A. tenagophilus* the renal ridge was absent or it was very variable in size and pigmentation. The renal ridge was absent in 488 specimens. Poor developed ridges were found in 8 specimens. In 2 specimens however there was a typical renal ridge. This ridge has the same gross morphology as well as the same histological structure of the renal ridge of *A. glabratus*.

INTRODUCTION

The presence of a typical fold running over the surface of the kidney of the snail *A. glabratus*, has been considered to be of specific taxonomic value since the work of PINTO & DESLANDES [11]. This structure had been found first by BAKER [1] who believed that the ridge was a characteristic feature of the genus *Australorbis*.

The nature and development of the renal ridge in *A. glabratus* was studied by PARAENSE & DESLANDES [8] and PAN [7] produced a detailed study on the micro-anatomy of *A. glabratus* in which the renal region is carefully described.

According to PARAENSE & DESLANDES [8, 9] *A. glabratus* and *A. tenagophilus* are very closely related species but differ in that the renal ridge is lacking in the latter. However, REY [12] noticed that in some specimens of *A. tenagophilus* from São Paulo the kidney showed a slightly elevated ridge with little or no pigment. BARBOSA & COELHO [4] found that a complete pigmented renal ridge running along the kidney can be found in few specimens of *A. tenagophilus* from the State of Rio de Janeiro and reported that the ridge was indistinguishable from the same structure known to occur in *A. glabratus*. Recently, PARAENSE & DESLANDES [10] were unable to find the renal ridge in any of 12,776 specimens of *A. tenagophilus* from several localities in Brazil.

In view of such contradictory results it was believed important to reinvestigate the renal tube and the attached structures in *Australorbis tenagophilus* and in *A. glabratus*.

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MATERIAL AND METHODS

For the present study 498 specimens of *A. tenagophilus* and 717 specimens of *A. glabratus* were dissected and the renal regions of each was observed. The specimens of *A. tenagophilus* came from São Gonçalo (360) and from Niterói (138) in the State of Rio de Janeiro. The specimens of *A. glabratus* originated as follows: Salvador, Bahia (450); Belo Horizonte, Minas Gerais (111); Bragança, Pará (13); Touros, Rio Grande do Norte (33); Paulista, Pernambuco (100); and Alhandra, Paraíba (10). All the snails examined were fully grown specimens.

The snails were first relaxed by immersion in a solution of menthol and the animals were then frozen and later removed from the shells by traction in the case of those to be dissected. Those snails to be studied histologically were, after relaxation, fixed in Bouin's fluid, sectioned at 8 to 10 microns and stained with hematoxylin-eosin. Cross sections through the renal tube were made at several levels in each snail.

RESULTS

The general structure of the kidney — The planorbids are gastropods possessing a single kidney or renal organ lying on the interior wall of the pulmonary sac. The kidney is an elongated organ occupying a considerable portion of the animal's body. It consists of a small upper saccular portion at the left side of the pericardium and a lower elongated tubular portion. The short ureter arises at the lower end of the tubular portion. It consists of a small tube sharply reflexed to the left so that the external opening is very close to the renal tube. The ureter discharges into the mantle cavity. The tubular portion of the kidney is flanked on the left side by the renal vein and on the right side by the pulmonary vein.

The histology of the renal organ is essentially the same in both *A. glabratus* and

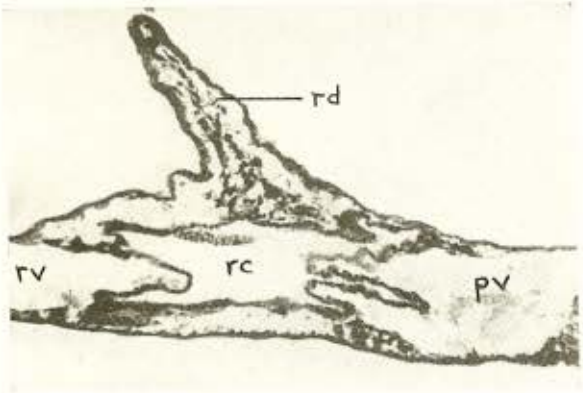

Fig. 1 — *A. tenagophilus* from Niterói, 20 mm in shell diameter. Cross section about midway of the renal region, showing a fully developed renal ridge (*rd*) and the renal cavity (*rc*), flanked by lateral veins (*pv* pulmonary and *rv* renal). 63×.

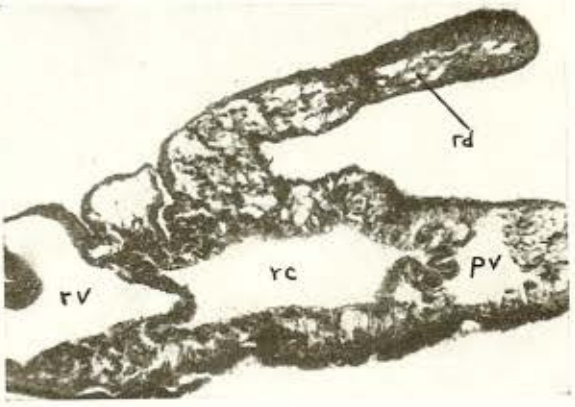

Fig. 2. *A. glabratus* from Paulista, 25 mm in shell diameter. Cross section about midway of the renal region, showing the renal cavity (*rc*), lateral veins (*pv* and *rv*) and the renal ridge (*rd*) projecting into the pulmonary cavity. 63×.

A. tenagophilus. The tube is lined with a simple epithelium. The renal cells, which are somewhat variable in appearance, are usually vacuolated. These vacuoles are variable in number, size and position. The nuclei are round or oval. The histology of the upper saccular portion of the kidney differs from the lower elongated portion. In the former the epithelium shows prominent vertical folds and the cells are columnar and taller than those of the tubular portion. The epithelium of the tubular portion is composed of low columnar to cuboidal cells. The nuclei are located in the peripheral zone of the cells of the tubular portion while they are basal in position in the saccular portion. The veins are flanked on each side by lines of dark pigment.

The renal ridge of A. glabratus — In this species (Fig. 2) a structure called the renal ridge is located on the ventral surface of the tubular portion of the renal organ. It consists of a network of lacunar tissue projecting into the lumen of the pulmonary sac. It is usually triangular in cross section. In the full grown snail the renal ridge is large and well developed. Scattered in the loose vascular tissue are numerous pigment cells and free amoebocytes. Thin muscular fibers lie just beneath the portion of the epithelium which is in contact with the pulmonary sac. The pigment cells are more numerous at the base of the ridge and form a dark median line along the surface of the kidney. This line of pigment is more noticeable at the distal half of the tubular portion of the organ. However, the amount and distribution of the pigment varies greatly from specimen to specimen and from place to place along the kidney.

In one instance the typical renal ridge was lacking in this species. The unridged *A. glabratus*, measuring 20 mm maximum diameter, was collected in Paulista (Pernambuco). The lacunar tissue in the ventral surface of the kidney of this snail was only slightly developed (Fig. 3).

The renal ridge in A. tenagophilus — In this species the renal organ has essentially the same appearance as that of *A. glabratus* except that the renal ridge, usually so uniformly well developed in *A. glabratus*, was absent or it was very variable in size and pigmentation. In the great majority of specimens (488) there was no renal ridge. In a few others (8) there was a rather typical renal ridge (Fig. 4) though it was smaller than that of *A. glabratus*. Finally, in two specimens there was a renal ridge in no way different from that of *A. glabratus* either grossly or histologically (Figs. 1, 5 and 6).

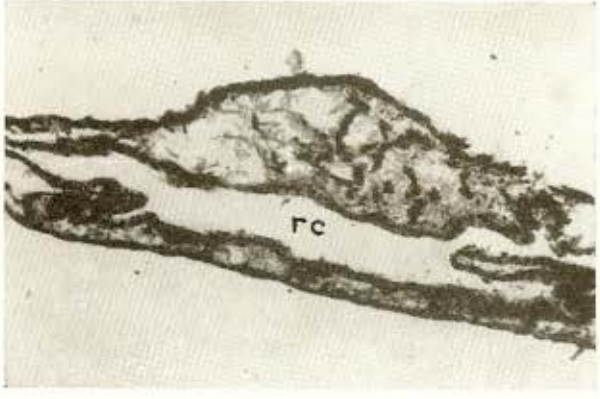

Fig. 3 — Non ridged *A. glabratus* from Paulista, 20 mm in shell diameter. Cross section of the renal ridge showing thickening of the lacunar tissue between the ventral renal epithelium and the epithelium of the pulmonary sac. 63×.

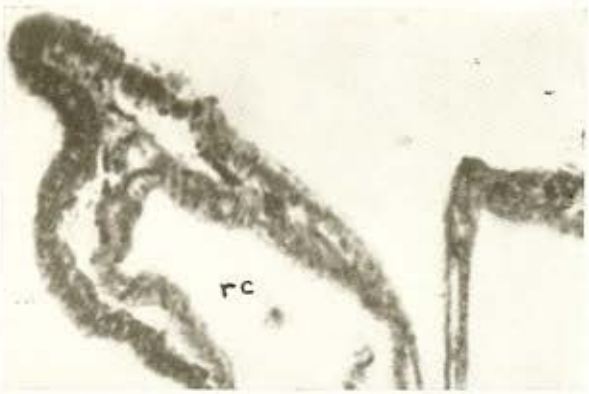

Fig. 4 — *A. tenagophilus* from Niterói, 17 mm in shell diameter. Cross section of the renal region showing a poor developed renal ridge. 63×.

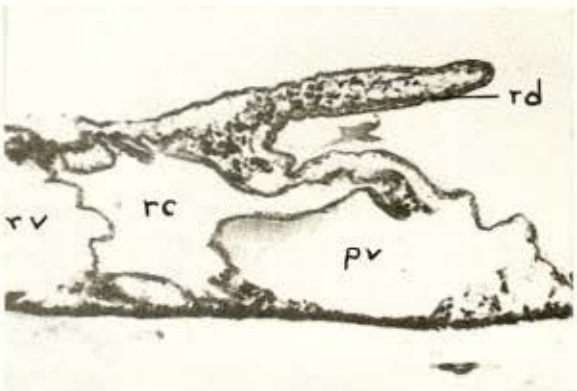

Fig. 5 — *A. tenagophilus* from Niterói, 18 mm in shell diameter. Another specimen bearing fully developed renal ridge. Cross section of the renal region. 63×.

Sometimes only a thickening of the lacunar tissue on the ventral surface of the renal tube was observed but a true ridge was not noticeable.

It may be added that the contour of the renal tube in *A. tenagophilus* varies a great deal probably due to hydrostatic pressure inside its cavity. Sometimes the walls of the renal tubes were found to be almost completely collapsed while in other cases the walls of the renal tubes were extended and their lumen showed different aspects. Since the pulmonary sac is the only empty space around the kidney very often in the non ridged snails or in those showing poorly developed ridges, the renal cavity projects into the lung cavity (Figs. 4, 7 and 8). However, when the snails' kidney bears a fully developed ridge the ventral wall of the kidney becomes much more resistant. In that case the renal cavity is commonly seen extending in other directions especially around the lateral veins (Figs. 1 and 5).

COMMENTS AND CONCLUSIONS

It is quite clear from the present study that the renal ridge occurs in some specimens of *A. tenagophilus* from Niterói and that in two specimens it is indistinguishable (Figs. 1, 5 and 6) from that of *A. glabratus* (Fig. 2). Findings of BARBOSA & COELHO [2] that a characteristic and fully developed renal ridge occurs in some specimens of *A. tenagophilus* from the State of Rio de Janeiro, Brazil, were therefore confirmed.

The "false ridges" described by PARAENSE & DESLANDES [10] are simply wrinkles which disappear easily when stretched out. They occur very frequently in non-ridged snails when the lumen of the renal tube is collapsed and in consequence the ventral edge of the renal tube is folded. Abnormal development of the lacunar tissue which may exist between the ventral renal epithelium and the epithelium of the pulmonary sac should not be confounded with the true renal ridge.

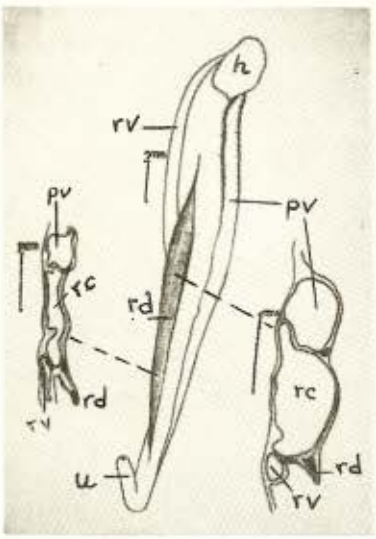

Fig. 6

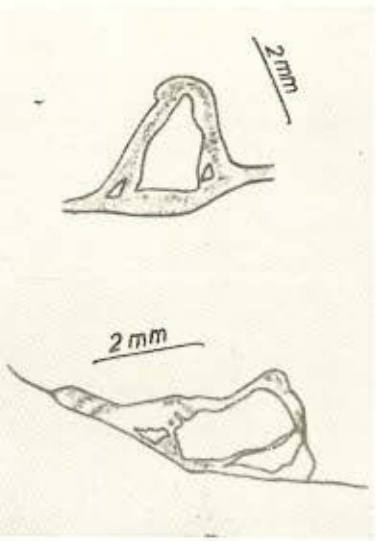

Fig. 7

Fig. 8

Fig. 6 — *A. tenagophilus* from Niterói. Same specimen from Fig. 1. Entire view of the kidney and two cross sections at different levels (indicated by dotted lines) of the renal tube. Symbols as follow: *h*, heart; *pv*, pulmonary vein; *rc*, renal cavity; *rd*, renal ridge; *rv*, renal vein; and *u*, ureter. *Camera lucida*. Figs. 7 and 8. *A. tenagophilus* from Niterói. Cross sections through the renal ridge of two specimens whose shells measured 18 and 20 mm, showing the renal cavity projecting into the lung cavity. *Camera lucida*.

In the material prepared for the present paper it was not possible to distinguish two different types of loose lacunar tissue as did PARAENSE & DESLANDES [10]: the palisade-like type in *A. tenagophilus* and the network in *A. glabratus*. When the ridge is absent or very short, i.e., when the amount of lacunar tissue is scant it appears as "palisade-like". On the other hand, when the renal ridge attains a larger size the space to be filled by the lacunar tissue is great enough to permit a network type arrangement. Moreover, transition types are very common and PARAENSE & DESLANDES [10] admitted that in larger specimens of *A. tenagophilus* "a comparatively ill-developed network" may be found.

Other differences in what PARAENSE & DESLANDES [10] called "ventral membrane" are pointed out by them. However, comparison between that region in the two species is rather difficult in view of the fact that in *A. glabratus* the ridge appears precociously. Comparisons could only be made between the full grown renal ridges of both species. However, the well developed ridges either in *A. glabratus* or in *A. tenagophilus* are indistinguishable.

Since the presence of a renal ridge is a rather uncommon condition in *A. tenagophilus* it was not possible to make a complete study of the development of this structure in that snail.

Besides the fully developed ridges that may appear in *A. tenagophilus*, several other types of poorly developed ridges (Fig. 4) can also be found in snails of large size. These short ridges have the same structure as the fully grown ones.

Attention should also be called to the fact that even in *A. glabratus* the renal region does not always present a complete and well developed ridge. According to HUBENDICK [6] in *A. glabratus* from Venezuela "all stages from a well developed ridge to none can be observed". Similar observation was made by BARRETO [5] in the same species from Bahia, Brazil. In the present study only in one specimen of *A. glabratus* the renal ridge

was lacking. The snail which measured 20 mm. maximum diameter showed only a thickening of the lacunar tissue in the ventral surface of renal tube (Fig. 3). This aspect is very similar to what may be found in the kidney of *A. tenagophilus*.

The possibility that the few ridged specimens of the Niterói snails described in this paper could be *A. glabratus* living sympatrically with *A. tenagophilus* could be raised. However, the shells of *A. tenagophilus* from Niterói were very uniform respect to the lateral carination which was particularly distinct on the left side of the snail and typical *A. glabratus* shells were not found. Moreover, the graded variation character presented by the renal ridge in these fully grown snails from Niterói exclude the possibility that two species could be in play.

The presence in one species of a morphological character which is considered of primary taxonomic importance in other species is of difficult interpretation. This subject has already been discussed by BARBOSA & COELHO [4] and very recently BARBOSA, BARBOSA & CARNEIRO [2] discuss the taxonomic position of three South-American *Australorbis* species (*sericeus*, *glabratus* and *tenagophilus*) plus the African species *Biomphalaria alexandrina* (Ehremberg) which are all very closely related species both from a morphological as well as genetical point of view.

Although *A. glabratus* and *A. tenagophilus* had attained a high degree of reproductive isolation at least in one instance they were able to hybridize under laboratory conditions (BARBOSA, BARBOSA & CARNEIRO [3]).

Morphological characters of specific level are usually polygenic. The presence of the renal ridge in fully grown specimens of *A. tenagophilus* occurring as graded variations suggests the possibility of natural hybrids bearing different gen combinations.

In conclusion, arguments presented by PARAENSE & DESLANDES [10] cannot be held since, as far as it can be judged by their paper, they have missed the real renal ridge that can be found in *A. tenagophilus* from Niterói.

RESUMO

A crista renal, um aspecto controvertido da anatomia do planorbídeo Australorbis tenagophilus.

Detalhes da anatomia e da histologia do rim de 717 specimens de *Australorbis glabratus* são apresentados em comparação com o mesmo órgão de 498 especimens de *A. tenagophilus*. Estas espécies são muito próximas, diferindo, como geralmente é admitido, no fato de que *A. tenagophilus* não possui crista renal.

Os especimens de *A. glabratus* mostraram crista renal bem desenvolvida, com uma única exceção. Alguns detalhes da estrutura da crista renal são apresentados. No único exemplar de *A. glabratus* no qual a crista renal estava ausente observou-se apenas espessamento da superfície ventral do rim.

Em *A. tenagophilus* a crista renal estava ausente ou variava muito em dimensões e pigmentação. Ela não foi encontrada em 488 exemplares e, em 8, era pouco desenvolvida. Entretanto, em dois especimens encontraram-se cristas renais típicas e completamente desenvolvidas, com a mesma morfologia, macro e microscópica, das cristas renais de *A. glabratus*.

REFERENCES

1. BAKER, F. C. — *The Molluscan Family Planorbidae*. The University of Illinois Press. Urbana, 1945.

2. BARBOSA, F. S.; BARBOSA, I. & CARNEIRO, E. — Description of *Australorbis sericeus* (Dunker) a possible intermediate host of *Schistosoma mansoni* in Ecuador. *Ann. Trop. Med. and Parasitol.* (in press), 1963.

3. BARBOSA, F. S.; BARBOSA, I. & CARNEIRO, E. — Hibridação experimental e natural entre planorbídeos brasileiros. *Bol. Soc. brasil. Genet.* 1:21, 1958.

4. BARBOSA, F. S. & COELHO, M. V. — Notes on the anatomy of two Brazilian planorbid snails. *Rev. Biol.* 1:113-115, 1957.

5. BARRETO, A. C. — *Esquistossomose mansônica na Cidade do Salvador*. Bahia, Fundação Gonçalo Moniz, 1959. (Thesis).

6. HUBENDICK, B. — Phylogeny in the Planorbidae. *Tr. Zool. Soc. London* **29** (part 6):453-542, 1955.

BARBOSA, F. S. — The renal ridge a disputed feature of the anatomy of the planorbid snail *Australorbis tenagophilus*. *Rev. Inst. Med. trop. São Paulo* **6**:64-70, 1964.

7. PAN, CHIA-TUNG — The general histology and topographic microanatomy of *Australorbis glabratus*. *Bull. Mus. Comp. Zool.* **119**:237-259, 1958.

8. PARAENSE, W. L. & DESLANDES, N. — Observations on the morphology of *Australorbis glabratus*. *Mem. Inst. Oswaldo Cruz* **53**:87-103, 1955.

9. PARAENSE, W. L. & DESLANDES, N. — Observations on the morphology of *Australorbis nigricans*. *Mem. Inst. Oswaldo Cruz* **53**:121-134, 1955.

10. PARAENSE, W. L. & DESLANDES, N. — The renal ridge as a reliable character for separating *Taphius glabratus* from *Taphius tenagophilus*. *Am. J. Trop. Med. & Hyg.* **8**: 456-472, 1959.

11. PINTO, D. B. & DESLANDES, N. — Contribuição ao estudo da sistemática de planorbídeos brasileiros. *Rev. SESP* **6**:135-167, 1953.

12. REY, L. — *Contribuição para o conhecimento da morfologia, biologia e ecologia dos planorbídeos brasileiros*. Rio de Janeiro, Serviço Nacional de Educação Sanitária, 1956. (Thesis Fac. Medicina Univ. São Paulo).

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