

LYMNAEA COLUMELLA IN NORTHERN BRAZIL

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The occurrence of a mollusc of the family Lymnaeidae is recorded for the first time in Brazil north of parallel 15°S, as a result of the finding of Lymnaea columella in Manaus and Benjamin Constant, state of Amazonas. A description is given of its shell, renal organ, genital system and radula, pointing to the morphological characteristics of diagnostic value to separate it from two other species previously studied by the author, Lymnaea viatrix and L. rupestris, which also occur in Brazil.

In a previous study (Paraense, 1982a) on the distribution of *Lymnaea viatrix* and *L. columella* in the Neotropical region, I stressed the fact that "there are no records of lymnaeids in Brazil north of latitude 15°S, and also in the Guianas", and considered that "this fact seems to reflect a real situation, seeing that a good deal of collecting has been done in the area by workers of domestic and foreign institutions". In November 1982, about a year after having written those words, I collected a sample of 60 *Lymnaea columella* at Manaus, state of Amazonas (3°08'S, 60°01'W). Subsequently, another sample of 18 specimens was collected at Benjamin Constant (4°22'S, 70°02'W), about 1,100 km westward, on the Peru border. The mentioned material is studied in the present paper.

MATERIAL AND METHODS

The specimens from Manaus were found among aquatic plants, chiefly *Eichhornia*, in a marshy area connected with the Igarapé da Cachoeirinha, a subaffluent of the Negro river. They were more easily found not under water, but on moist mud, often partly buried, near the water edge. The specimens from Benjamin Constant were collected from drainage ditches with water grass. They were preserved in Railliet-Henry's fluid after relaxation in a 0.05% nembutal solution, and the larger ten of each sample were dissected under the stereomicroscope (for technical details see Paraense, 1981 : 200).

DESCRIPTION

The specimens from Manaus ranged in size from 6.5 by 3.5 mm to 13 by 7 mm. The largest shell (Fig. 1) is ovate, has 5 well-rounded whorls, a short spire of pointed apex and a voluminous body whorl occupying about three times the length of the rest of the shell. It is sculptured with coarse growth lines crossed by fine spiral lines, and shows a well-marked suture. The aperture is oblong-ovate, 9 mm in length by 5.5 mm in width,

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occupying about two thirds of the shell length. The inner lip is reflected outward, covering the umbilicus, and the peristome is thin.

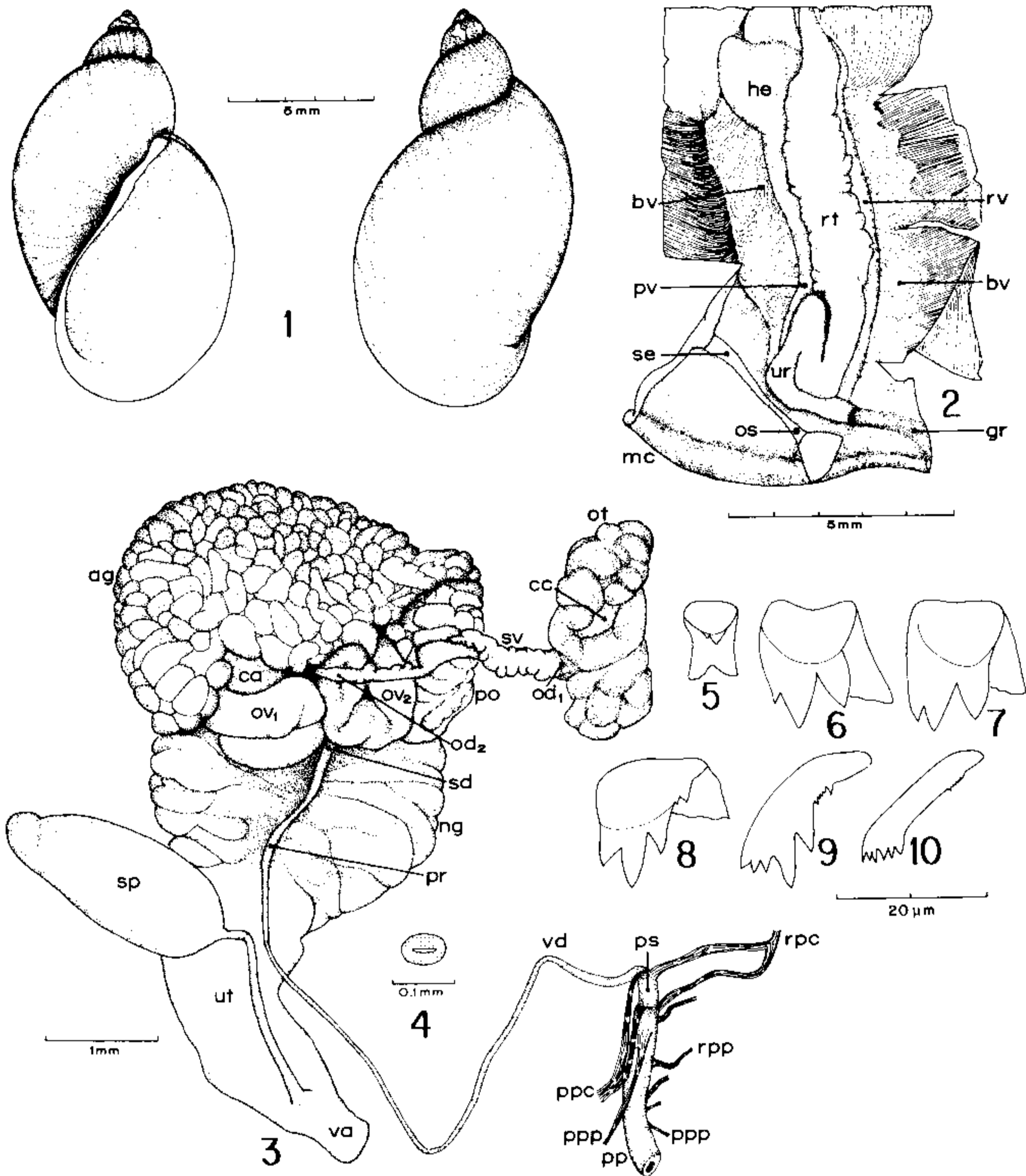
The cephalopedal mass is diffusely pale gray. The mantle is almost uniformly dark gray with small white spots on the roof of the pulmonary cavity, growing paler caudalward. On the roof of the hypopeplar cavity the pigmentation is distributed into a mottled pattern against a whitish background.

The renal organ (Fig. 2) extends straightly from the right side of the pericardium toward the mantle collar, bordered by the renal vein on the right and the pulmonary vein on the left. Reaching the septum between the pulmonary and hypopeplar cavities, just behind the osphradium, it comes back upon itself and, after a short course, bends sharply cephalad and then rightward between the first loop and the pulmonary-hypopeplar septum, forming a ureter which opens behind the pneumostome. In favorably fixed specimens a groove can be seen connecting the meatus of the ureter to the extreme right of the pneumostome (Fig. 2, gr). On both sides of the renal tube the pulmonary wall is richly supplied with blood vessels which are especially conspicuous in specimens fixed under favorable conditions of blood afflux. The left side of the pulmonary wall, from the pulmonary vein sideward, where those vessels usually appear more distinctly, was described by Baker (1911 : 16, Plate I) as "a second portion [of the renal organ] which is plentifully supplied with blood vessels".

The genital system is shown in Fig. 3. The ovotestis is a cluster of lobulate acini pressed against each other around a collecting canal which continues into the ovispermiduct. The latter, after a very short smooth-walled portion, gets studded with numerous outpocketings which give it the character of a seminal vesicle; its distal portion, smooth-walled as the proximal one, empties into the carrefour.

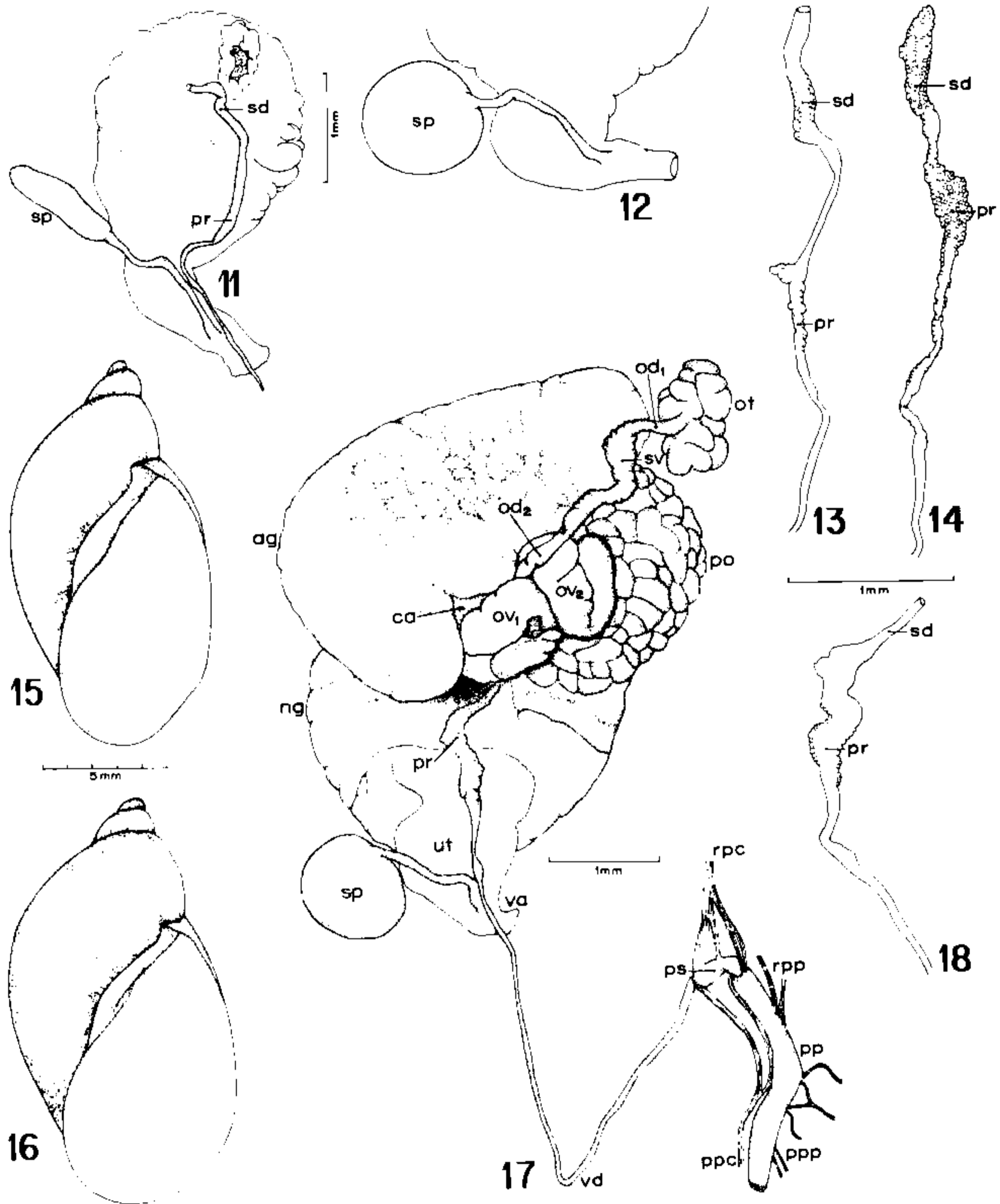
The voluminous albumen gland shows no special features, and partially covers the oviduct and the pouch of the oviduct. The oviduct, highly convoluted, emerges ventrally from the carrefour, winds on the upper left half of the nidamental gland, bends dorsad and then rightward, following a more or less circular course between the albumen and nidamental glands, so that its distal portion appears on the upper right ventral half of the nidamental gland to get in touch, on the middle line, with the proximal portion. Near its distal end, at a point hidden by its terminal folds, the oviduct is connected with a wrinkle-walled pouch (the pouch of the oviduct) which projects from its right side. Right after that point the oviduct ends in the nidamental gland. This is a bulky organ of hemispherical shape, with a dorsal convexity and a usually shallow ventral concavity which, however, may be so deep in a few specimens as to give the organ a cup-like appearance. The surface of the nidamental gland is marked with very thin furrows. Its ventral aspect is depressed into a medial groove which is usually occupied by the prostate. The latter, however, may infrequently run more or less distant from the groove, as in the extreme instance shown in Fig. 11. The next portion of the female duct is the thin-walled uterus, which gradually narrows distalward and bends to the right, continuing into the vagina. The spermatheca has a variously shaped body, from more or less elongated (Fig. 3, sp) to globoid (Fig. 12, sp), and a slender duct about as long as or longer than the body. The body of the spermatheca is in loose contact with the right wall of the esophagus.

The spermiduct begins at the carrefour and continues into the prostate, without a clear distinction between the two, which are thread-like, and show the same external appearance and about the same width. In cross-section the prostatic lumen is slit-like (Fig. 4). Reaching the ventral wall of the uterus, the prostate merges insensibly into the vas deferens. The latter descends to the level of the preputial opening, where it interweaves with the surrounding tissue and bends on itself, ascending to the top of the penial sheath into which it merges. The penial sheath is short and cylindrical; no apical chambers could be discerned by inspection of its outside and of longitudinal sections. The prepuce is longer than the penial sheath (from 2.4 to 6 times in the examined sample) and somewhat wider, and has a poorly developed sarcobelum. In 5 of the dissected specimens the penial



Lymnaea columella from Manaus - Fig. 1: shell of largest specimen. Fig. 2: roof of pulmonary cavity (bv = blood vessels, gr = groove from ureter to pneumostome, he = heart, mc = mantle collar, os = osphradium, pv = pulmonary vein, rt = renal tube, rv = renal vein, se = septum between pulmonary and hypopleuric cavities, ur = ureter). Fig. 3: genital system (ag = albumen gland, ca = carrefour, cc = collecting canal of ovotestis, ng = nidamental gland, od₁ = proximal portion of ovispermiduct, od₂ = distal portion of ovispermiduct, ot = ovotestis, ov₁ = initial portion of oviduct, ov₂ = terminal portion of oviduct, po = pouch of oviduct, pp = prepuce, ppc = protractor muscle of penial complex, ppp = protractor muscle of prepuce, pr = prostate, ps = penial sheath, rpc = retractor muscle of penial complex, rpp = retractor muscle of prepuce, sd = spermiduct, sp = spermatheca, sv = seminal vesicle, ut = uterus, va = vagina, vd = vas deferens). Fig. 4: cross-section through middle of prostate. Figs. 5-10: radular teeth. Fig. 5: central tooth. Fig. 6: 1st right lateral. Fig. 7: 6th right lateral. Fig. 8: 1st right intermediate. Fig. 9: 1st right marginal. Fig. 10: 19th right marginal.

sheath was partially invaginated in the prepuce, distending the proximal portion of the latter and preventing an accurate measurement being taken. The extrinsic muscles of the penial complex are arranged into a retractor and a protractor, both common to the



Lymnaea columella – Fig. 11: prostate shifted to the right of middle line (specimen from Manaus). Fig. 12: spermatheca with globe-shaped body (specimen from Manaus). Figs. 13, 14: spermiduct (sd) and prostate (pr) of specimens from Benjamin Constant. Fig. 15: shell from Michigan. Fig. 16: shell from Burlington, N.J., USA (H.A. Pilsbry, Ac. Nat. Sci. Phila. No. 98525). Fig. 17: genital system, specimen from Michigan (abbreviations as in Fig. 3). Fig. 18: spermiduct (sd) and prostate (pr) of specimen from Michigan.

penial sheath and the prepuce, besides which there is a variable number or exclusively preputial retractors and protractors. The common retractor and protractor arise, respectively, from the columellar muscle and from the tissue that surrounds the distal portion of the prepuce. At a variable distance from its origin each of them splits into two branches, one of which attaches to the top of the penial sheath whereas the other attaches to the top of the prepuce; these branches may be simple or subdivided into two or more slips.

The extrinsic muscles of the prepuce proper connect the wall of this organ either to the tissue that surrounds its distal portion or to the head wall (protractors), or to the columellar muscle (retractors). Most of the mentioned muscles being exceedingly thin, they must be approached very cautiously during dissection to avoid severing them. Owing to its especial tenuity, the long preputial branch of the common protractor may be hardly visible, in which case it can be traced by following the tiny spots of melanic pigment which accompany it or by staining the preparation with diluted Lugol.

The radula of the largest specimen has 95 transverse rows of teeth and its formula is 30-1-30. The central tooth (Fig. 5) has a small cusp and a minute accessory cusp high on its left. There are 8 laterals, all tricuspid (Figs. 6, 7), 2 intermediates (Fig. 8) and 20 marginals (Figs. 9, 10).

The foregoing description applies quite well to the specimens from Benjamin Constant (largest shell 11 by 6 mm), with the only difference that their spermiduct and prostate are not more or less uniform in width and outer appearance throughout their length. In the specimens from Benjamin Constant the two organs are represented by more or less marked dilatations of the male duct separated by a narrower portion (Figs. 13, 14), as described in *Lymnaea columella* by Baker (1911).

DISCUSSION AND COMPARISON WITH RELATED SPECIES

In a previous study (Paraense, 1982a) I dealt with the problem of identifying numerous Neotropical samples which, by the shell characteristics, seemed to belong to *Lymnaea columella*. With a view to comparing that material with reliably identified *L. columella*, I referred to Dr. George M. Davis, of the Academy of Natural Sciences of Philadelphia, for specimens from the area of Philadelphia. Say's (1817) description of that species was based on material of the United States, without mention of a definite locality. According to Baker (1911: 167) its type-locality is "probably near Philadelphia", perhaps because Say, at that time a member of the Philadelphia Academy, intensively explored its environs. Owing to difficulty in finding *L. columella* nowadays in the area, I had the loan of specimens of the Academy's collection. Later on Dr. Davis kindly sent me two samples from Michigan, preserved as described above (Material and Methods).

Comparison of the mentioned Neotropical specimens with those of the Philadelphia Academy and from Michigan showed no significant differences in shell and anatomical characters (Figs. 15-18). As to the Amazonian specimens, the comparative narrowness of their prostate, more pronounced in those from Manaus, should be considered an expression of intraspecific variability. Narrow prostates like those have been described as intrapopulational variants in Brazilian populations of *L. columella* by Ueta (1977).

As comparison with the closely related species *Lymnaea viatrix* and *L. rupestris* is made below, the reader is referred to Paraense's (1976, 1982b) papers on those species.

The shell of *L. columella* differs from that of *L. viatrix* and *L. rupestris* in its bulky outer whorl and large aperture, which occupies about two thirds of the shell length, whereas in the other two species the outer whorl is less developed and the aperture occupies about half the shell length.

The following anatomical differences are observed: 1) the ureter has a double flexure in *columella*, and is only bent to the right in *viatrix* and *rupestris*; 2) the ovotestis of *columella* tends to look comparatively more compact and smaller in proportion to the bulk of the genital system; 3) the pouch of the oviduct, clearly visible on the right of the oviduct in *columella* and *viatrix*, is rudimentary and imperceptible on the ventral side in *rupestris*; 4) the uterus of *columella*, as in *viatrix*, is slightly curved rightward, whereas in *rupestris* it is abruptly bent caudalward; 5) the body of the spermatheca lies in contact with the esophagus in *columella*; in *viatrix* and *rupestris* it projects into the pulmonary

cavity, pushing around itself a fold of the membrane that covers the dorsal surface of the visceral mass and adhering through it to the pericardial membrane and to the roof of the pulmonary cavity; 6) the prostate is from thread-like to ribbon-like in *columella*, expanded into an oblong, more or less ovoid and somewhat flattened body in *viatrix* and *rupestris*; 7) in cross-section the prostate shows a simple, slit-like lumen in *columella* and *rupestris*, without the inward fold present in *viatrix*; 8) the prepuce is about two to six times as long as the penial sheath in *columella*, about as long in *rupestris*, and from about as long to thrice as long in *viatrix*; these proportions are subject to wide variation and overlap, being in themselves unreliable as a diagnostic character; quite striking, however, is the impression of smallness of the penial complex in comparison with the bulk of the genital system in *columella*, not so marked when observing the other two species; 9) the penial sheath of *columella* seems to be devoid of the minute apical chambers present in *viatrix* and *rupestris*; 10) the first lateral tooth of the radula is tricuspid in *columella*, bicuspid (tricuspid in a number of teeth of some specimens) in *rupestris* and *viatrix*.

Owing to the scarcity of anatomical investigation on Neotropical lymnaeids, some item of the foregoing diagnosis may prove unsound in the light of further studies involving a larger number of populations.

RESUMO

Pela primeira vez é verificada a ocorrência de um molusco da família Lymnaeidae ao norte do paralelo 15°S no Brasil, como resultado do encontro da *Lymnaea columella* em Manaus e Benjamin Constant, Estado do Amazonas. É apresentada uma descrição da concha, do órgão renal, do sistema genital e da rádula, sendo indicados os caracteres morfológicos que permitem distinguir a *Lymnaea columella* de outras espécies que também ocorrem no Brasil, previamente estudadas pelo autor, *L. viatrix* e *L. rupestris*.

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