

Limnaea peregrina Clessin, 1882, Synonym of *Lymnaea columella* Say, 1817 (Gastropoda: Lymnaeidae)

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A description is given of the shell, radula, renal region, reproductive system and egg capsules of topotypic specimens of Limnaea peregrina Clessin, 1882. This investigation intends contributing to define the specific identity of that nominal species. A close anatomical comparison with Lymnaea columella Say, 1817 from Michigan, USA, shows that both forms are indistinguishable, giving support to previous inferences from some authors. Data on egg hatching are presented.

Key words: *Limnaea peregrina* - *Lymnaea columella* - morphology - taxonomy - egg hatching

The present lymnaeid was described by Clessin (1882:188-189):

3. *Limnaea peregrina* n.sp. t. 4, f 6.

T. elongato-oblonga, angustissime rimata, tenuissima, cornea, subtiliter irregulariterque striata; anfractus 5, convexiusculi, rapide crescentes, sutura subprofunda separati; ultimus fere 3/5 longit. aequans; columella subtorta, apertura ovata, superne acuminata; peristoma acuta, non dilatata.

Lg. 19-20 mm, diam. 9-10 mm. Hab. Taguara del mundo novo, Brasiliae. Gehäuse: verlängert eiförmig, sehr fein geritzt, sehr dünnchalig, hornfarben, fein, aber unregelmässig gestreift; Umgänge 5, ziemlich rasch zunehmend, wenig gewölbt, durch eine wenig vertiefte Naht getrennt; der letzte Umgang nimmt etwa 3/5 der Gehäuselänge ein; Mündung eiförmig, nach oben zugespitzt; Mundsaum scharf, nicht erweitert, durch eine schmale, schwache Spindelschwiele zusammenhängend.

The shell described by Clessin (Fig. 2 of this paper) was collected at Taquara (misspelled Taguara) by Dr Reinhold Hensel during his travel (1864-1866) as a naturalist through the Brazilian state of Rio Grande do Sul. Taquara (29° 39' S, 50° 47' W) was then a hamlet in the district of Mundo Novo, one of the former German agricultural colonies established between 1824 and 1859 in the São Leopoldo region of that state (see Hensel 1867).

MATERIALS AND METHODS

This study is based on two samples, collected in January 1976 and April 1993 from a marsh and a pond at Taquara.

The specimens to be dissected were relaxed overnight in aqueous solution of nembutal (0.05%). Then they were immersed for 50 sec in water heated at 70°C, from which they were transferred to water at a room temperature. While under water the animals were drawn from the shell with a small forceps applied to the cephalopedal mass, and fixed in slightly modified Railliet-Henry's fluid (distilled water 930 ml, sodium chloride 6g, formalin 50 ml, glacial acetic acid 20 ml). The radulae were separated from the buccal mass by digestion for 12 hr in a solution of NaOH at 56°C. They were then rinsed in tap water and mounted in a drop of glycerin on a microscopic slide, with the dorsal (toothed) surface upwards as in the living animal. Measurements were made on camera lucida drawings.

Live snails were kept at a room temperature of 25 ± 1°C in aquaria containing 1,200 ml of dechlorinated tap water (10 specimens in each of 10 aquaria) and, at the bottom, a thin layer of a 2:1 mixture of screened reddish soil and ground oyster shells as a source of mineral nutrients and of grit to aid the gizzard's food-grinding function. Half of the water content of each aquarium was renewed every week, when sedimentary materials were also removed. Withered lettuce leaves floated on the surface were given for food. Egg capsules were deposited preferably on the underside of floating styrofoam tablets (less frequently on the aquarium wall), from which they were removed to small petri dishes with aquarium water for examination under the stereomicroscope. Eggs were considered inviable when they failed to divide or stopped development at any stage before hatching. Viable eggs, therefore, were those that developed to hatching.

Voucher specimens were deposited at the malacological collections of Instituto Oswaldo Cruz (no. 4221), Museum of Zoology, University of

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Michigan and Natural History Museum, London.

DESCRIPTION

The largest shell (Fig. 1) is 17 mm long and 8 mm wide, and has five whorls; spire length 6 mm, aperture length 11 mm. The shell is thin, fragile, translucent, light yellowish horn. Surface moderately shiny, with clearly traced growth lines crossed by very fine, irregularly distributed spiral lines. Spire small, pointed, protoconch rounded exerted. Whorls well-rounded, suture moderately indented. Body whorl very large. Aperture dilated, ovate. Peristome thin and acute, inner lip covering to a variable extent the umbilical chink; columellar plait moderately twisted. The following ratios were calculated from 32 specimens, 13.5-17mm long (means \pm SD): shell width/shell length = 0.47-0.57 (0.52 ± 0.02); spire length/shell length = 0.30 - 0.39 (0.35 ± 0.02); aperture length/shell length = 0.62-0.70 (0.65 ± 0.02). Thus the shell tends to be twice as long as it is wide, and its aperture tends to be twice as long as the spire.

In the living animal the cephalopedal mass is yellowish gray, dotted with minute white specks which also appear in the mantle collar and very sparsely in the mantle wall; a granular pigmentation, ferruginous in color, is distributed along the mantle, velum and foot borders, and in the tentacles. The melanic pigmentation of the mantle, which persists after fixation, is distributed into discrete flecks over the roof of the hypopeplar cavity, and tends to overspread on the rest of the mantle roof, encompassing numerous circular unpigmented spots.

The renal tube (Fig. 7, rt) extends straightly from the right side of the pericardial region toward the mantle collar, bordered by the renal vein on the right and the pulmonary vein on the left. On 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 (Fig. 7, ur) which tapers to a subterminal meatus just behind the pneumostome.

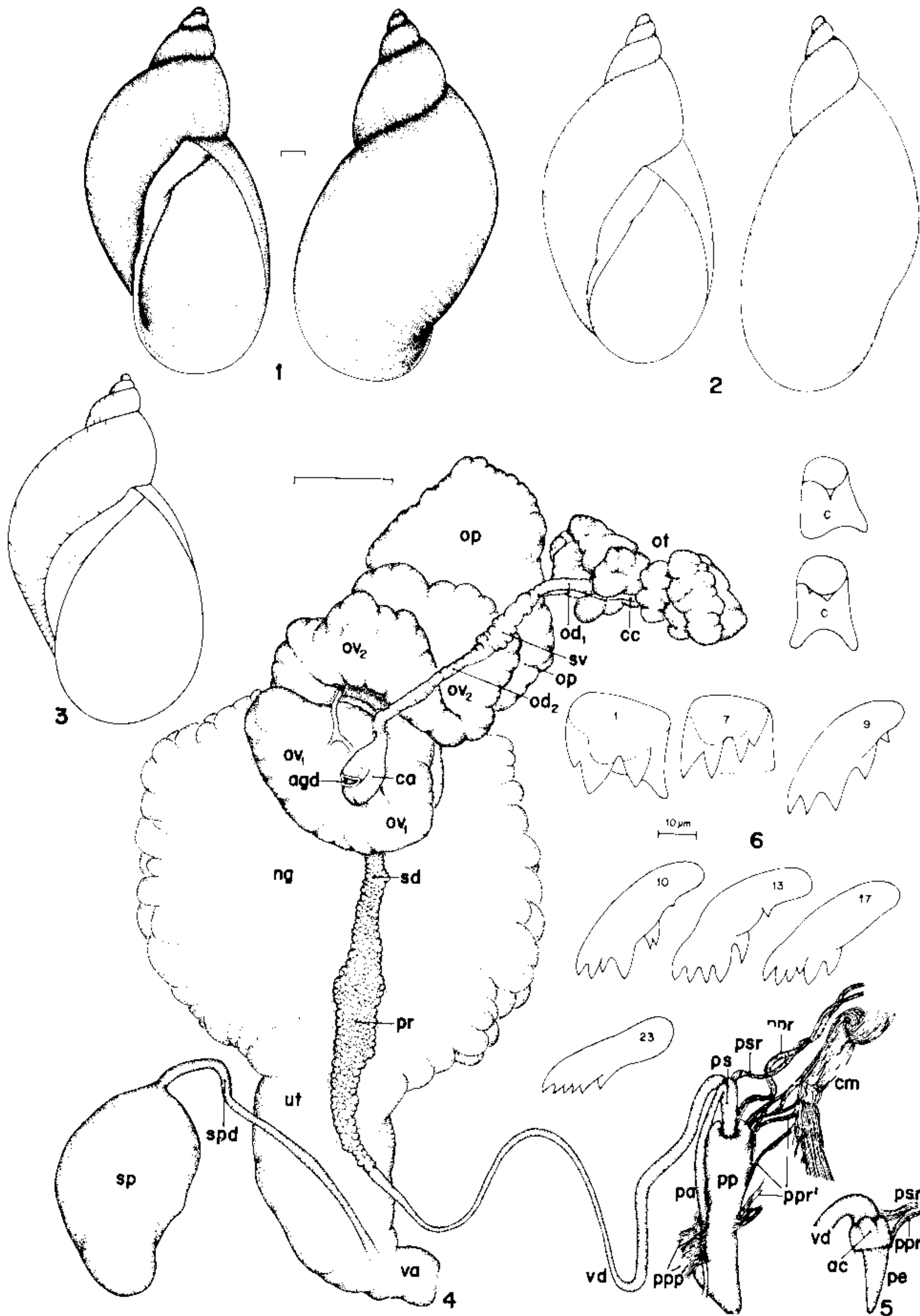
The reproductive system is shown in Figs 4, 8, 9. The ovotestis (Fig. 4, ot) has a ginger-like appearance, composed of acini pressed against each other around a collecting canal (cc) which continues into the ovispermiduct. The dimensions of the ovotestis are proportionally small, if compared with the nidamental gland, a character unique among the Neotropical limnaeids so far studied anatomically. The ovispermiduct has a very short smooth-walled proximal segment (od_1), followed by a

bosselated swelling, the seminal vesicle (sv), and then narrows cephalad into a distal segment (od_2), which empties into the carrefour (ca).

The albumen gland (not figured) looks like that of other limnaeids, and covers the carrefour and the hindmost portions of the oviduct and spermiduct.

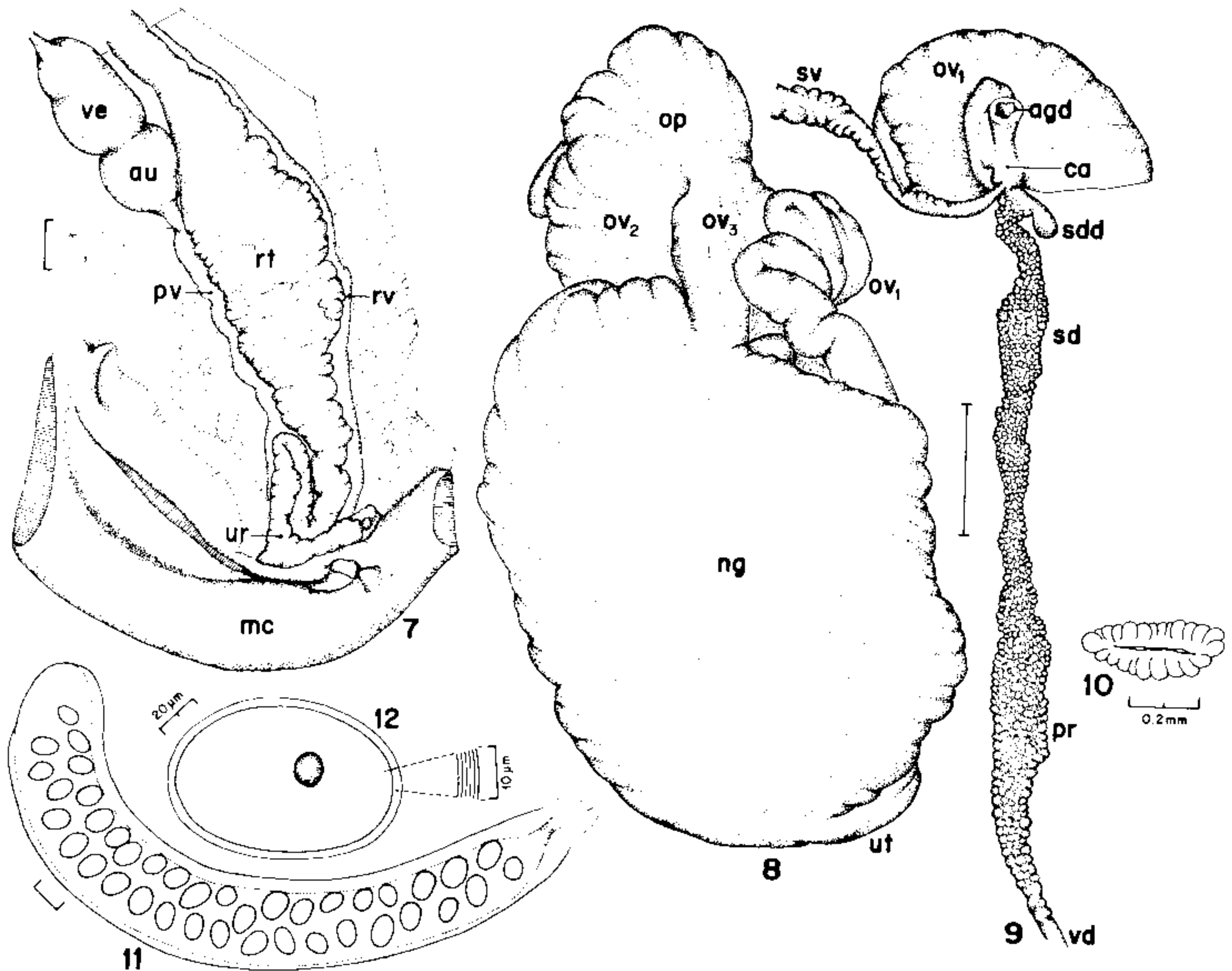
The oviduct (Figs 4, 8, 9, ov_1 , ov_2) arises ventrally from the carrefour as a tube of bosselated wall. It follows a convolute course (ov_1) around the region of the carrefour, between the albumen and nidamental glands, so that its distal portion (ov_2) gets in touch with the proximal portion. Near its distal end, at a point hidden by its terminal folds, the oviduct is connected with a wrinkle-walled sac, the oviducal pouch (Figs 4, 8, op), which projects from its right side and with which it communicates through a narrow orifice. Then the oviduct proceeds cephalad (Fig. 8, ov_3), continuing into the nidamental gland (Figs 4, 8, ng). The latter is the bulkiest part of the female duct, convex dorsally and flattened ventrally. Its outer surface is crossed by numerous grooves that give it a striated appearance. On its ventral surface there is a shallow longitudinal depression, coincident with the raphe, over which the distal portion of the spermiduct and the proximal portion of the prostate run. The nidamental gland narrows distally to merge into the smooth-surfaced, thin-walled uterus (Figs 4, 8, ut), which gradually narrows and bends to the right, continuing into a short vagina (Fig. 4, va). The vaginal wall is thin and collapsible, not reinforced with muscle fibers as in most limnaeid species. The spermathecal body varies in shape from more or less elongated (Fig. 4, sp) to globoid, depending on the amount of its contents and its degree of contraction on fixation; it is situated between the floor of the pulmonary cavity and the dorsal surface of the esophagus, free in the visceral hemocoel. The spermathecal duct (Fig. 4, spd) is uniformly thin, and from the same length to about twice as long as the body.

The spermiduct (Figs 4, 9, sd) emerges from the carrefour, beside the oviducal origin. Just at its beginning it gives off a short diverticulum (Fig. 9, sdd), first described as a "prostate pouch" by Rudolph (1983) in *L. columella*. The spermiduct runs distalwards as a ribbon appressed to the ventral surface of the nidamental gland, gradually widening to continue into the prostate (Figs 4, 9, pr). There is no morphological line of distinction between the two, although sometimes they are delimited by a narrower portion. The spermiduct is thin-walled, contrasting with the thicker prostate, and both of them have a granular surface. In cross-section the prostate lumen is slit-like (Fig. 10).



J. E. PRADO

Lymnaea columella Say, 1817 (= *L. peregrina* Clessin, 1882). Fig. 1: shell of specimen from Taquara, Rio Grande do Sul, Brazil (type locality of *L. peregrina*). Fig. 2: copy of original figure of *L. peregrina* Clessin. Fig. 3: copy of Binney's (1865) figure of *L. columella*, drawn from one of Say's specimens. Figs 4, 5: reproductive system (albumen gland removed), and Fig. 6: radular teeth of specimen from Taquara; small numbers indicate position in transverse row (c = central, 1 = lateral, 7 = intermediate, 9, 10, 13, 17, 23 = marginals). ac = apical chamber, agd = albumen gland duct, ca = carrefour, cc = collecting canal of ovotestis, cm = columellar muscle, ng = nidamental gland, od₁ = proximal segment of ovispermiduct, od₂ = distal segment of ovispermiduct, op = oviducal pouch, ot = ovotestis, ov₁ = proximal portion of oviduct, ov₂ = distal portion of oviduct, pa = penial artery, pe = penis, pp = prepuce, ppp = protractor muscles of prepuce, ppr = retractor muscles of prepuce, ppr' = smaller retractor muscles of prepuce, pr = prostate, ps = penis sheath, psr = retractor muscle of penis sheath, sd = spermiduct, sp = spermathecal body, spd = spermathecal duct, sv = seminal vesicle, ut = uterus, va = vagina, vd = vas deferens. Bar = 1 mm, except Fig. 6. Figs 2 and 3 out of scale.



J.E. PRAO

Limnaea columella Say, 1817 (= *L. peregrina* Clessin, 1882), specimens from Taquara. Fig. 7: roof of pulmonary cavity. Fig. 8: reproductive system, dorsal view. Fig. 9: region of carrefour, and prostate complex. Fig. 10: cross-section through middle of prostate. Fig. 11: egg capsule. Fig. 12: egg. au = auricle, mc = mantle collar, ov₃ = distalmost portion of oviduct, pv = pulmonary vein, rt = renal tube, rv = renal vein, sdd = spermiduct diverticulum, ur = ureter, ve = ventricle. Other abbreviations as in Fig. 4. Bar = 1mm, except Figs 10 and 12.

Along the ventral wall of the uterus the prostate narrows gradually into the vas deferens (Figs 4, 9, vd). The latter descends to the level of the preputial opening, where it interweaves with the surrounding tissue, bends backwards into a wider ascending limb to end in the penis sheath. The penis sheath (Fig. 4, ps) is short and cylindrical, and shows at its top a circlet of minute, sometimes imperceptible protuberances corresponding to apical chambers communicating with the sheath lumen (Fig. 5, ac). As usual with lymnaeids, not infrequently is the penis sheath partly invaginated in the prepuce, which prevents an accurate measurement being taken. The penis (Fig. 5, pe) is elongately conic, about as long as the sheath, tapering to a slender point where the penis duct opens terminally. The prepuce (Fig. 4, pp) is longer than the penis sheath (from 2.5 to 4.5 times in the examined sample) and at least twice as wide. The extrinsic muscles of the penial complex are usually

two main retractors and several smaller retractors and protractors. The main retractors arise side by side from the columellar muscle. One of them, the penis sheath retractor (Figs 4, 5, psr), is inserted into the top of the penis sheath, and the other, the prepuce retractor (ppr), into the juncture of the penis sheath with the prepuce. These two main retractors may be fused at their origin, splitting at a variable distance from their insertion. The smaller extrinsic muscles are inserted into the preputial wall. A group of retractors (ppr') arise from a branch of the columellar muscle, and a group of protractors (ppp) originate on the right wall of the head. A branch of the cephalic artery, the penial artery (Fig. 4, pa), runs along the prepuce and penis sheath to reach the head of the latter.

The radula of the largest specimen has the following features: formula 30-1-30; 109 transverse rows of teeth; central tooth with a small cusp and a minute accessory cusp high on its left, the latter

not clearly visible in many centrals; 6 laterals, all tricuspid, 2 intermediates, 22 marginals. Radular teeth are shown in Fig. 6.

At a room temperature of $25 \pm 1^\circ\text{C}$ egg-laying began when the snails were about 7 mm in shell length and 60 days old. The egg capsule (Fig. 11) is a jellylike straight to somewhat curved ribbon that attaches well to the substratum. Its size and number of enclosed eggs (usually up to about 40) is proportionate to the size of the animal. The eggs, elliptical or ovoid in outline, do not always display at full length in a horizontally spread capsule examined from above, so that under such conditions measurement of their long axes is not possible in all of them. The egg (Fig. 12), about 1 mm in length, is encircled by a continuous finely lamellate membrane; no egg strings were unequivocally seen.

The embryos began hatching on the 8th day (first those near the extremities of the capsule) and hatching extended to the 15th day, with a peak on the 10th (hatching rate of 96.97% for 1881 eggs). Once freed from the egg membrane the hatchling usually stayed for one to a few days crawling about inside the egg capsule, and apparently eating the jelly in which the eggs are embedded, before escaping from it. The young gnaw their way through the capsule wall, escape through the terminal tail (as described by Bondesen, 1950:146) having been observed only once.

REMARKS

The specific identity of *Lymnaea peregrina* has not been clearly defined. It was considered a good species by Clessin (1882), Roszkowski (1927), Schlesch (1928, 1930a, b), Boettger (1929), Urbański (1933), Henrard and Meeuse (1942), Meeuse and Hubert (1949), comparing numerous shells of museum and wild specimens from South America (named *L. peregrina*) and North America (named *L. columella*), concluded that "as long as it has not been proved that there are anatomical differences, we consider these two species to be identical. The only objection that might be raised is that they are geographically separated, *columella* occurring in North America and *peregrina* in South America". Hubendick (1951:97,98) dealt with *L. peregrina* and *L. columella* separately, though (p. 139) asserting that his studies "have shown that there exist no distinguishing anatomical characteristics". His figures represent the penial and vaginal complexes of *peregrina* and *columella*, and the prostate of the latter.

In a previous study (Paraense 1982) I stated that "on anatomical evidence (to be published) *Lymnaea peregrina* Clessin, 1882 (topotypic specimens from Taquara, Brazil) is a synonym of *L.*

columella". Now it is shown that the whole reproductive system of topotypic *peregrina* (Fig. 4) is indistinguishable from that of North American *columella* from Michigan (compare with Paraense 1983, Fig. 17), confirming anatomically that both forms are conspecific. The similarity between their shells may be appreciated comparing Figs 1 and 2 with Fig. 3, which is a reproduction of Binney's (1865) Fig. 38, drawn from one of Say's specimens.

L. columella has a noteworthy capacity to overcome geographic barriers, often passively transported in consignments of freshwater plants and tropical fishes. Very likely by such means it was introduced into greenhouses of several European countries: Denmark (Schlesch 1928, as *Pseudosuccinea peregrina*); Germany (Boettger 1929, Schlesch 1930a, as *Ps. peregrina*); Poland (Urbański 1933, as *Ps. peregrina*); the Netherlands (Meeuse & Hubert 1949, as *Ps. columella*); and Switzerland (Van Bruggen 1955, as *L. columella*). According to Meeuse and Hubert (1949), it was also collected from greenhouses in Belgium and Scotland.

Outside the natural range of *L. columella* in the Nearctic and Neotropical regions, and besides greenhouses in European botanic gardens, naturalized populations of the species have been recorded in the open in South Africa (Barnard 1948, van Eeden & Brown 1966, De Kock et al. 1974), Rhodesia (Mandahl-Barth 1962), Mozambique, Zambia, Egypt (Brown 1980), Tenerife (Hubendick 1951), Australia (Campbell 1976), New Zealand (Pullan 1969), and Honolulu (Alicata 1953).

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