Observations on the morphology of *Australorbis glabratus*

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(With 9 text-figures and 4 plates)

The observations here presented are intended to contribute to the systematics of *Australorbis glabratus*. It is well known that snails exhibit a great amount of morphological variation, depending on both genetic and environmental factors. In this paper we study a sample of *A. glabratus* from a single breeding place, collected on the same occasion, and having the same shell diameter. So we aimed, as far as possible, to equalize the controllable causes of variation, related to limnic environment, climateric conditions, reproductive activity and stage of somatic development.

MATERIALS AND METHODS

We examined 50 specimens from irrigation ditches in the grounds of the Instituto João Pinheiro (Belo Horizonte, State of Minas Gerais, Brasil), collected on September, 1954. That breeding place was mentioned by LUTZ (1934) as being inhabited by his species *Planorbis centimetralis* exclusively. On the basis of a biometric study, PARAENSE & MALHEIROS SANTOS (1950) demonstrated the inexistence of such species in that place. The genitalia of the planorbid snails existing there showed the characteristics described by PILSBRY (1934), SCOTT (1940), BAKER (1945), and BUSTORFF PINTO & DESLANDES (1953) as belonging to *A. glabratus*.

Specimens with 18 mm in shell diameter, commonly found in this species, were selected, a small variation of more or less 0.4 mm being examined.

Dissections were made according to the techniques described by DESLANDES (1951).

This work was done through co-operation between the Instituto Oswaldo Cruz and the Serviço Especial de Saúde Pública, Brazil.

Serial histological sections (10μ) from three whole specimens fixed in Bouin's fluid, embedded in paraffin and stained with hematoxylin-eosin, were also examined. The diameters of these specimens were 18, 10 and 5 mm respectively, the two latter belonging to the F1 generation of the former.

SHELL

The freshly emptied shell was horny, translucent, covered with a slender epidermis, varying in colour (amber, blackish, dark olivaceous, ferruginous), with a fine oblique striation corresponding to the growth lines and showed 5 to 6 whorls. Right side slightly depressed but deeply umbilicated in the region of the central whorls. Left side broadly depressed. The last whorl, relatively high, extended over the preceding one up to the middle of the left surface of the latter. The heights of the last and penultimate whorls, taken between the sutures in the region of the shell aperture, were 5.96 ± 0.28 and 2.06 ± 0.16 mm respectively. The height ratio was 3: 1 in 40 cases in which the heights were 6 and 2 mm, varying from 2.4 to 2.7 : 1 in the 10 remaining cases. The aperture was either perpendicular or a little oblique to the right, sometimes to the left. The right wall of the aperture tended to be flat, the left one was more or less strongly convex. The aperture was 5.59 ± 0.24 mm wide (this measure corresponds to the greatest shell thickness) and 4.96 ± 0.26 mm high (internally).

The conformation of the shells exhibited a rather small variation both in our sample and in a great number of other specimens from the same breeding place. The shells closely resemble that illustrating Lutz's paper (1918) under the name *Planorbis guadaloupensis*. As stated by Pilsbry (1934, see discussion pp. 43-44), this name is synonymous with *A. glabratus*.

Some aspects of the shells are shown in pl. 1, figs. 1, 2 and 3.

ANIMAL

The head and foot are dark olivaceous. When the animal is removed from the shell, the mantle exhibits an olivaceous ground colour with black spots converging to the dorsal wall of the mantle cavity, so that the latter presents a black velvety aspect. The region of the mantle collar is olivaceous and externally shows a narrow yellow stripe just behind, and parallel to, the free margin of the mantle.

The uncoiled animal was 47.06 ± 3.31 mm long. We divided the body into a cephalic and a caudal portion, limited from each another by the stomach. The cephalic portion, 26.56 ± 2.65 mm long, is strongly muscular, containing the columella muscle which is inserted into the shell at the level of the stomach. The caudal portion, having no voluntary muscles, was 20.50 ± 2.24 mm. The lengths of the cephalic and caudal portions showed equivalent coefficients of variation (9.97 and 10.92%, respectively), thus indicating that killing by immersion into water at 70°C affords a satisfactory muscular relaxation.

RENAL TUBE

The waste products eliminated in the kidney (organ of Bojanus) are carried away by the renal tube.

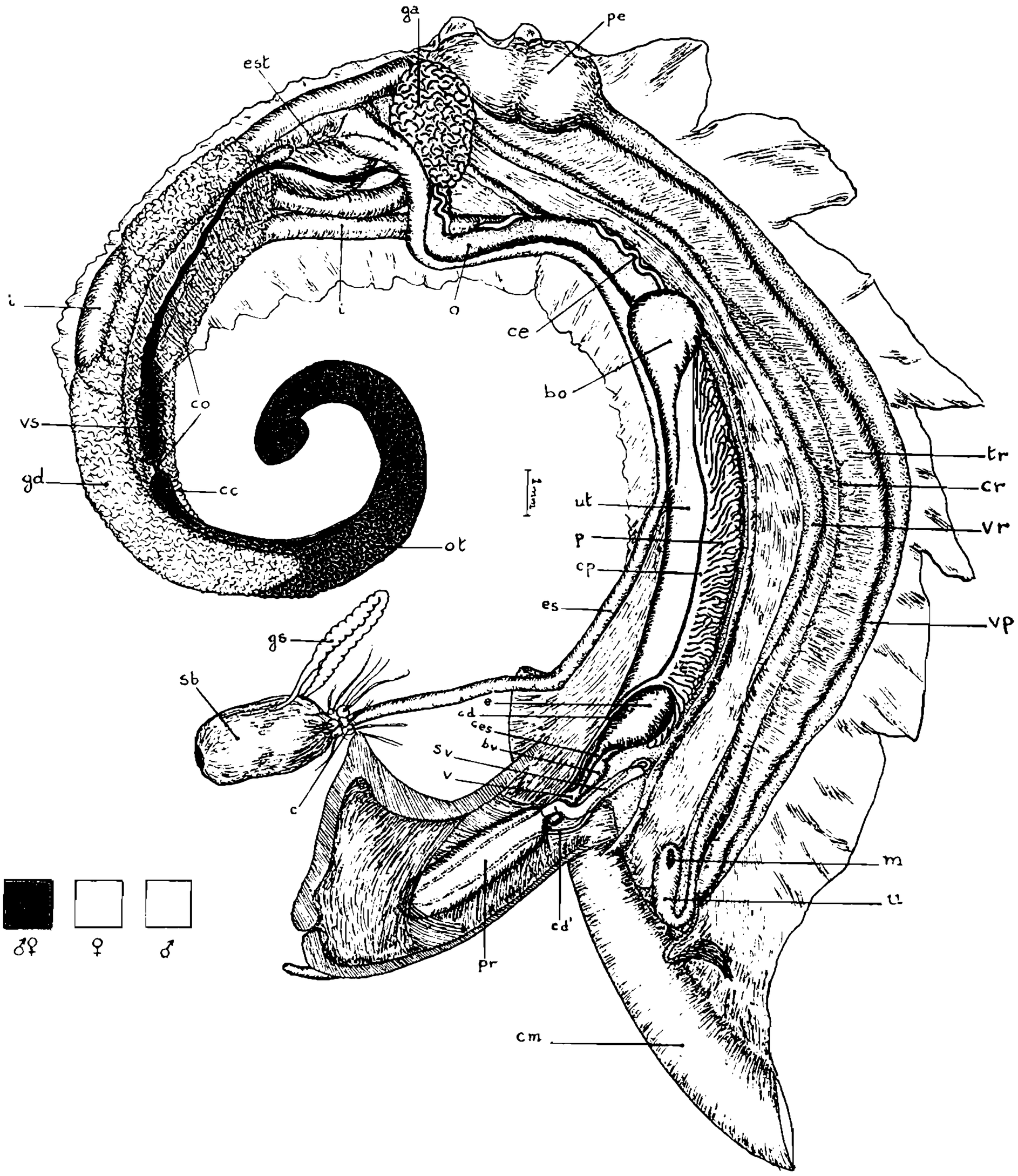


Fig. 1 — Right lateral view of the organs of *A. glabratus* with mantle and buccal sac dissected (bo = pouch of the oviduct; bv = vaginal pouch c = brain (periesophageal ganglia); cc = collecting canal of ovotestis; cd = proximal segment of vas deferens; cd' = distal segment of vas deferens; ce = sperm duct; ces = spermathecal duct; cm = mantle collar; co = ovisperm duct; cp = prostate duct; cr = renal ridge; e = spermatheca; es = esophagus; est =stomach; ga = albumen gland; gd = digestive gland; gs = salivary gland; i = intestine; m = meatus of ureter; o = oviduct; ot = ovotestis; p = prostate; pe = pericardium, around heart; pr = preputium; sb = buccal sac; sv = vergic sac; tr = renal tube; u = ureter; ut = uterus; v = vagina; vp = pulmonary vein; vr = renal vein; vs = seminal vesicle).

The long and narrow renal tube extends between the heart and the mantle collar (fig. 1, *tr*). In the proximity of the latter it gradually narrows and finally bends to the left as a hook, thus forming the ureter that is provided with a cleft-like subterminal meatus (fig. 1, *u*, *m*).

The renal tube was 23.84 ± 1.90 mm long, 1.51 ± 0.33 mm wide in the middle portion. The ureter was 2.66 ± 0.36 mm long.

The pulmonary and renal veins (fig. 1, *vp*, *vr*) lie at the right and left sides of the renal tube, respectively.

From the point of view of systematics, the most important feature of the renal region of *A. glabratus* is the so-called 'renal ridge', a median pigmented fold that runs along the length of the ventral surface of the renal tube (fig. 1, *cr*). Histologically this fold is a rather pulmonary structure.

The renal tube, lined by a columnar epithelium, is enclosed within the membrane that forms the roof of the respiratory cavity (pl. 1, figs. 4, 5, 6, *tr*). Laterally it adjoins the two above mentioned veins (pl. 1, figs. 4, 5, *vp*, *vr*). On the dorsal and ventral sides it is separated from the dorsal and ventral epithelia of the respiratory membrane by a thin layer derived from the lacunar tissue of the mantle (pl. 1, figs. 4, 5, *ll*, *ll'*). In a very young animal (5 mm in diameter) this layer of tissue, little developed, shows a number of small blood lacunae (pl. 1, fig. 4, *ll*, *ll'*). As the animal grows, that layer gradually thickens owing to the swelling of the lacunae (pl. 1, fig. 5, *ll*). The cells of the lacunar network become progressively loaded with melanin granules, so that a pigmented line develops along the path of the future ridge. The characteristic pigmented ridge finally emerges from the renal region (pl. 1, fig. 6, *cr*).

GENITALIA

Hermaphrodite organs

Ovotestis — This organ, occupying the utmost caudal portion of the body, appears as a coiled cornucopia, the base of which looks to the cephalic direction (figs. 1, 2, *ot*). From about the junction of its middle and cephalic thirds forward, the ovotestis is covered, first dorsally and then dorso-laterally, by the digestive gland (fig. 1, *gd*).

The ovotestis was 12.78 ± 1.50 mm long. Its greatest width, in the cephalic extremity, was 1.57 ± 0.26 mm.

The organ is composed of a great number of diverticula, the walls of which are lined by germinal epithelium lying on a slender connective network. The ova and spermatozoa develop together in the same diverticula (pl. 1, figs. 8, 9).

The diverticula empt into an extremely thin-walled ventral canal (figs. 1, 2, *cc*) which starts caudally as a narrow tube that gradually swells, so that it bulges as a pouch on the ventral surface of the cephalic

portion of the ovotestis. After bulging, it suddenly narrows to give origin to the ovisperm duct.

The utmost caudal diverticula are simple, arranged in one row, and empty singly into the collecting canal. They are followed by bi- and trifurcate diverticula, the latter being the most frequent. Of those branched diverticula, the most caudally situated prolong the dorsal row of the simple ones. Then they form groups of either two or three branched units that converge into a common stem through which they join the dorsal wall of the collecting canal. As the latter progressively widens in the cephalic direction, the branched diverticula become more numerous, and gradually develop a fan-like appearance by attaching separately to the dorsal and lateral walls of the collecting canal (fig. 6).

Ovisperm duct — This is a long and thin tube (figs. 1, 2, *co*) starting at the cephalic extremity of the ovotestis and ending at the region of the carrefour. Shortly after its outset it enlarges to form the seminal vesicle.

The first portion of the ovisperm duct, about 1 mm long and 0.10 mm wide, is lined by a columnar ciliated epithelium surrounded by a layer of melanophorus connective cells (pl. 1, fig. 10, *co*). Then the tube gradually swells and convolutes, its walls put forth numerous diverticula, the longest of which may divide into primary branches. After some windings the tube uncoils and narrows again to about 0.10 mm.

The convoluted portion provided with diverticula, always filled with spermatozoa, is the seminal vesicle (figs. 1, 2, *vs;* pl. 1, fig. 10; pl. 2, fig. 1). Its wall is lined by a ciliated epithelium, and shows no glandular structure. Histologically the diverticula resemble the central duct; we were unable, however, to distinguish cilia in their epithelium.

The blind ends of the diverticula are occupied by the heads of the spermatozoa; thus the diverticula may be considered as recesses within which the spermatozoa find a harbor away from the current that flows along the central tube.

The greatest width of the seminal vesicle was 1.14 ± 0.29 mm.

After leaving the vesicle, the ovisperm duct reassumes its primitive aspect and turns to the right ventral side of the body (pl. 1, fig. 7), where it runs along a line parallel to the right bundle of origin of the columella muscle; at the level of the stomach it bends to the ventral midline, and empties into the carrefour.

The whole length of the ovisperm duct, including the non-unwound seminal vesicle, was 13.70 ± 1.68 mm.

Carrefour — The carrefour is a bulbous swelling, lined by ciliated columnar epithelium, into which the ovisperm duct and the excretory duct of the albumen gland enters, and from which the sperm duct and the oviduct arise by independent openings (fig. 2; pl. 2, figs. 2, 3, *ca*).

The carrefour is the last place where normally the ova and spermatozoa of the same individual may be found together. We do not as yet

surely know the mechanism by which each kind of gamete is segregated into its respective duct.

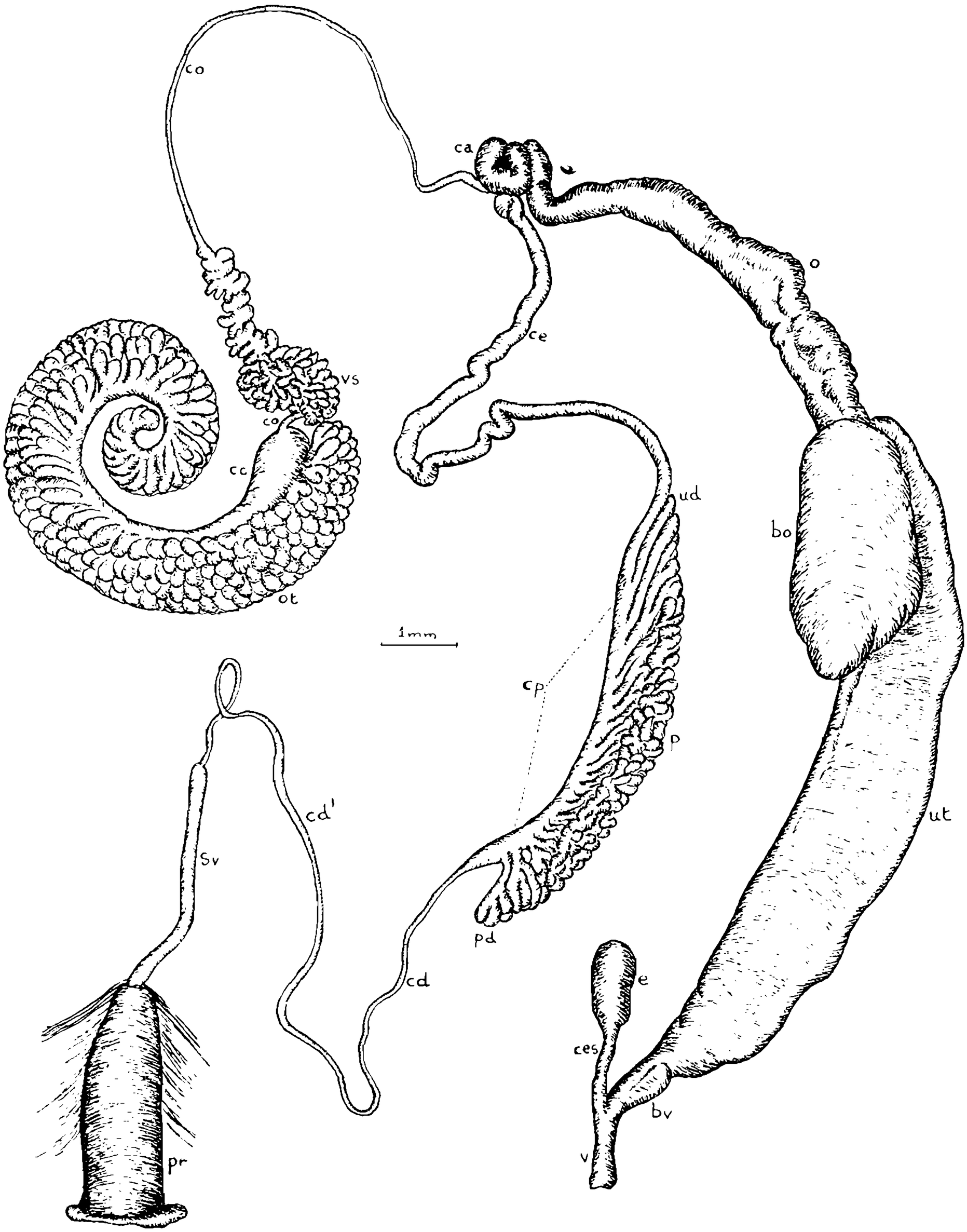


Fig. 2 — Whole genitalia dissected (bo = pouch of the oviduct; bv = vaginal pouch; ca = carrefour; cc = collecting canal of ovotestis; cd = proximal segment of vas deferens; cd' = distal segment of vas deferens; ce = sperm duct; ces = spermathecal duct; co = ovisperm duct; cp = protate duct; e = spermatheca; o = oviduct; ot = ovotestis; p = prostate; pd = foremost prostate diverticulum; pr = preputium; sv = vergic sac; ud = hindermost prostate diverticulum; ut = uterus; v = vagina; vs = seminal vesicle).

MALE ORGANS

Sperm duct — This tube, 14.16 ± 1.27 mm long and 0.23 ± 0.05 mm wide, extends from the carrefour to the beginning of the prostate (figs. 1, 2, *ce*), running along the oviduct, from which it may be easily dissociated. It pursues a sinuous course, chiefly at its first part. Histologically the sperm duct is an epithelial tube of glandular appearance coated with a very thin pigmented connective membrane (pl. 2, figs. 2, 3, *ce*). The non-ciliated chief cells, resembling truncated pyramids, have rounded basal nuclei, and their cytoplasm appears stuffed with refractile granules. Another type of cell seen in the walls of the sperm duct, squeezed among the mentioned ones, is tall and slender and has very pale nucleus and cytoplasm. In cross sections they show a filiform appearance; due to their disposition, they may be termed sustentacular cells. The cytoplasmic granules, distinctly acidcphilic in the first part of the sperm duct, are gradually replaced, towards the distal portion, by less acidophilic ones.

Prostate — This organ consists of the prostate duct and its diverticula (figs. 1, 2, *p;* fig. 8). It adheres to the right lateral surface of the uterus, extending from the cephalic swelling of the oviduct to the spermatheca.

The prostate duct (figs. 1, 2, *cp*), 5.53 ± 0.74 mm long, is merely a continuation of the sperm duct, comprised between the points of attachment of the first and last diverticula. It is similar in structure to the distal portion of the sperm duct (pl. 2, fig. 4, *cp*).

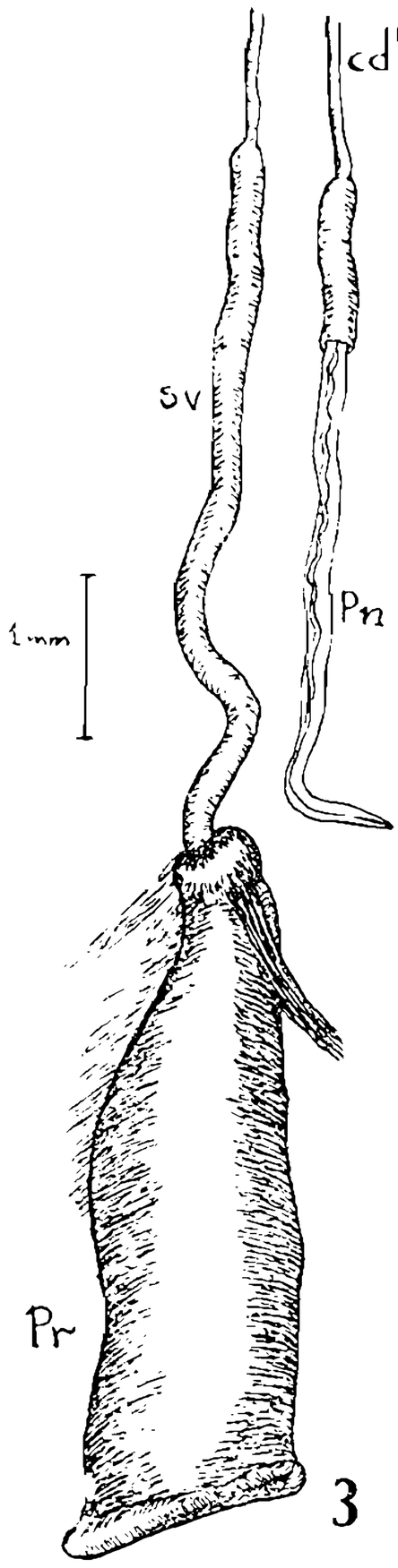
The diverticula are arranged in a single row of rather long glandular tubes emptying into the prostate duct. They are histologically identical with the prostate duct in the basal portion of their stalks. The remaining portions of the diverticula exhibit a somewhat different appearance due to cytoplasmic vacuolation and nuclear enlargement in connexion with their greater secretory activity (pl. 2, fig. 4).

The number of diverticula varies from 15 to 30 (mean 21.6 ± 3.5), no correlation being observed between their number and the length of the prostate duct. As an instance we may cite the prostates with 6 mm, which showed from 15 to 27 diverticula.

The diverticula may be simple and branched. The latter may have two, three and more branches (bifurcate, trifurcate and arborescent). With the exception of the three hindermost ones and of anomalous cases, all the others are arborescent.

The last diverticulum was simple in 28, bifurcate in 19, trifurcate in 1, arborescent in 4 cases. The penultimate one was arborescent in 28. bifurcate in 11, simple in 10, trifurcate in 1 case. The antepenultimate was arborescent in 40, bifurcate in 8, simple in 2 cases. Short, either club-shaped or nodular diverticula may occasionally be found at any

position. Small outpocketings may appear at any point on the surface of every diverticulum.



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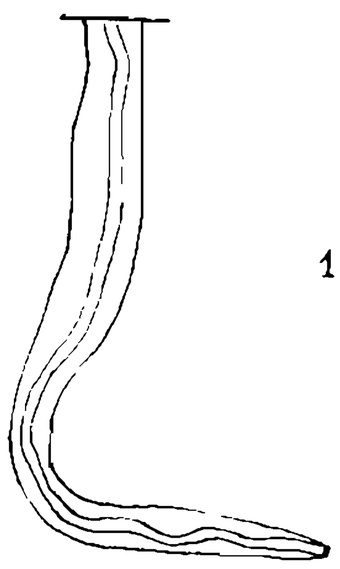

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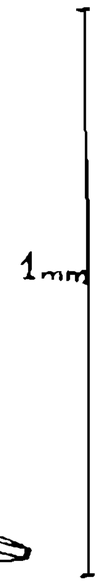

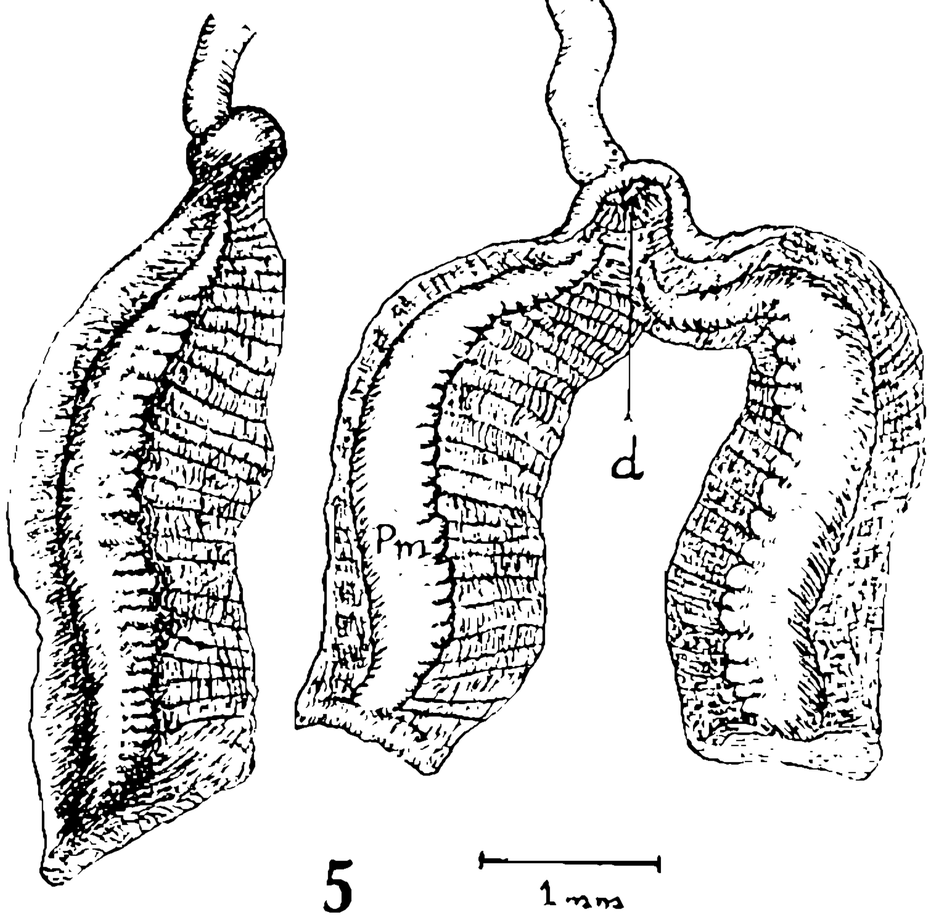

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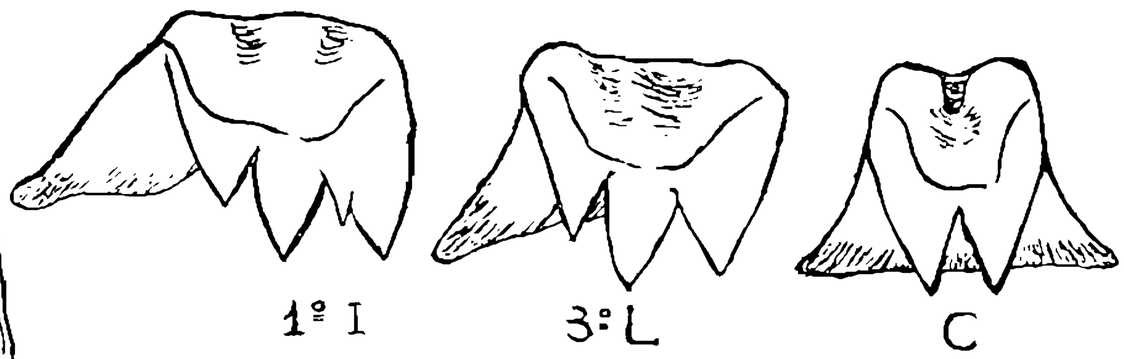

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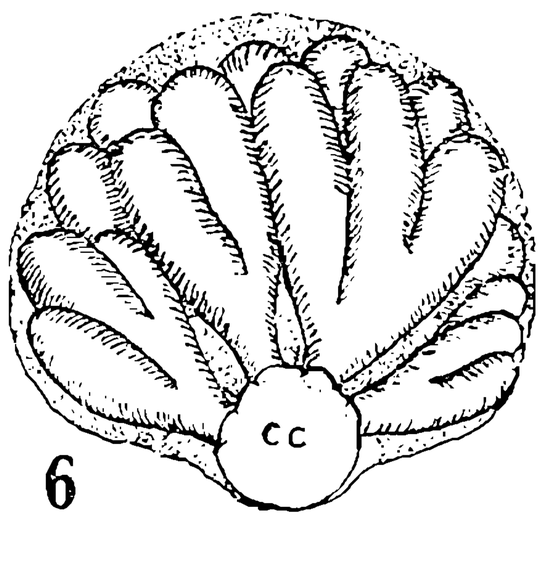

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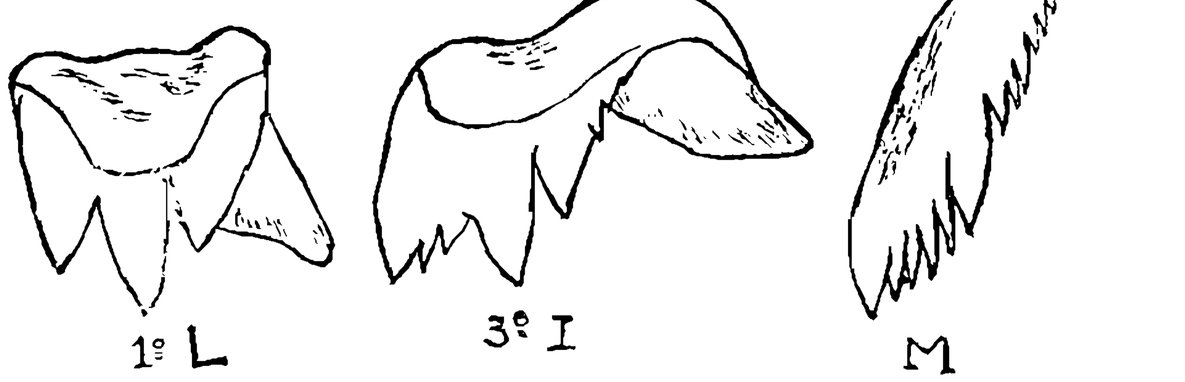

Fig. 3 — Penial complex (left) and verge within vergic sac partly removed (right); fig. 4 — verge, showing apical outlet of sperm canal; fig. 5 — preputium from within; fig. 6 — arrangement of diverticula in cephalic half of ovotestis (diagrammatic); fig. 7 — radula teeth: C, central; L, lateral, 1st and 3rd; I, intermediate, 1st and 3rd; M, marginal. (cc = collecting canal of ovotestis; cd' = distal segment of vas deferens; d = muscular diaphragm between vergic sac and preputium; pm = muscular pilaster in the wall of preputium; pn = verge; pr = preputium; sv = vergic sac).

The branches of the diverticula may be either short or long; they arise either from the same or from different points of their stalk. Primary branches frequently give secondary ones. Arborescent diverticula show at least four ultimate divisions.

In figs. 8 and 9 several aspects of prostate diverticula are shown.

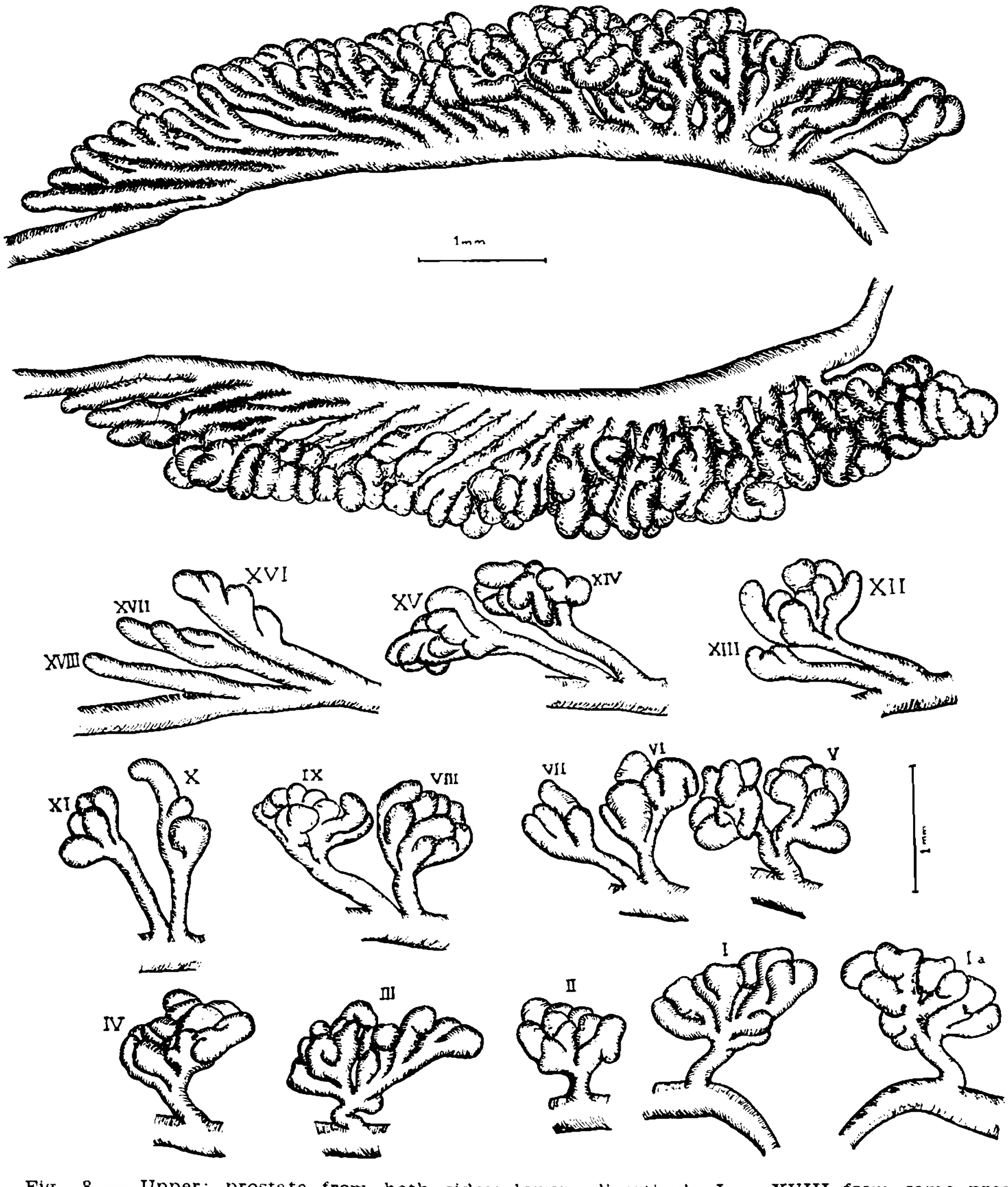

Fig. 8 — Upper: prostate from both sides; lower: diverticula I — XVIII from same prostate (I from both sides).

Vas deferens — The vas deferens appears as a thread (17.50 ± 2.05 mm long and 0.14 ± 0.02 mm wide) extending from the prostate duct to the verge (figs. 1, 2, *cd*, *cd'*). Small knobs may occasionally be found

at any point of its surface, due to the fixation of peristaltic waves. It leads off from the prostate duct at the level of the blind end of the spermatheca, and pursues its course in the cephalic direction. It then enters the tissues of the neck and runs along the left side of the preputium, reaching a point near the external opening of the latter. At this point the external muscular coat of its wall merges into the adjacent tissues, and the vas deferens loops back as an ascending limb

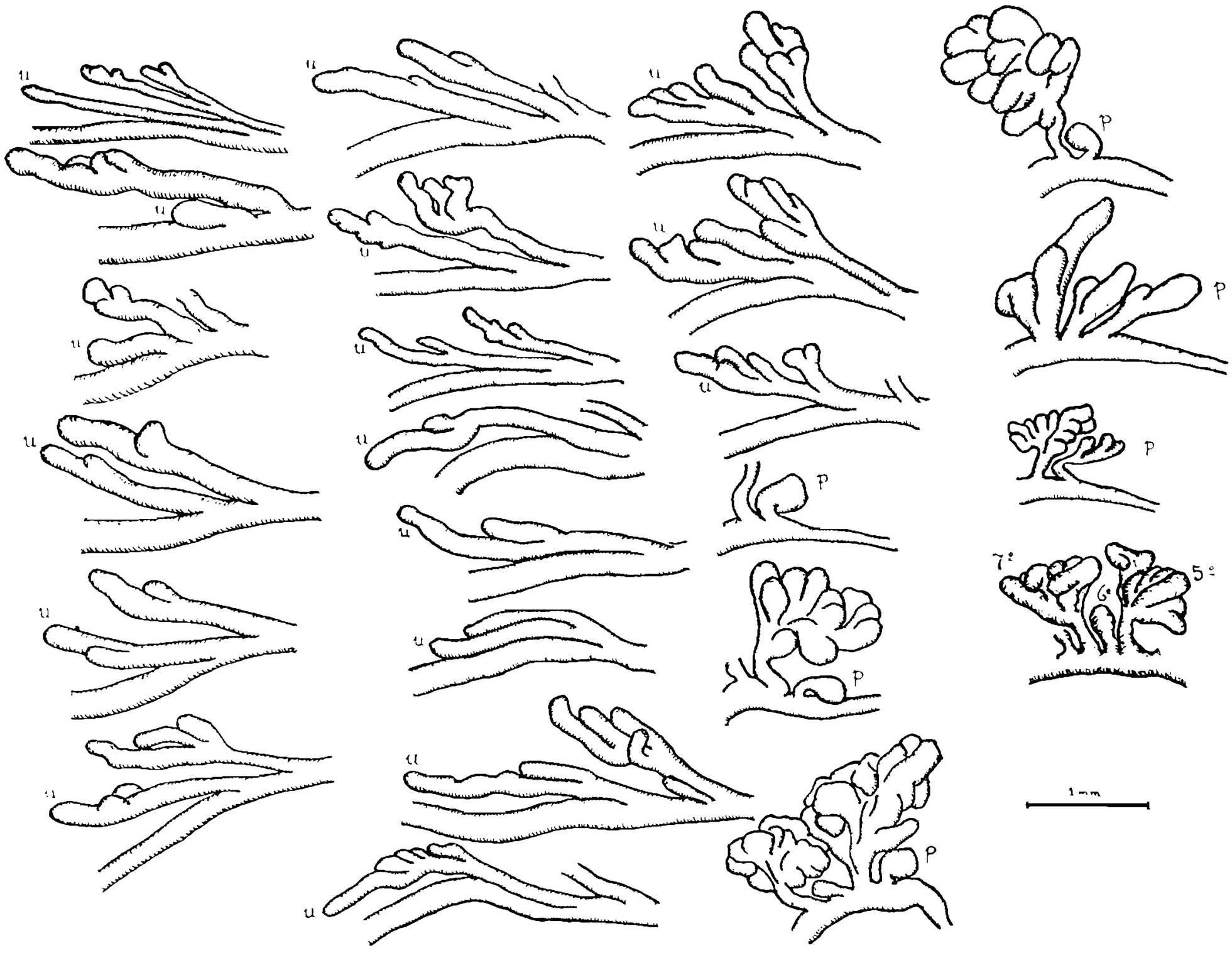

Fig. 9 — Variation of last (*u*), first (*p*) and contiguous prostate diverticula. Anomalous intermediate (VI) diverticulum.

that becomes free into the body cavity to finally reach the base of the verge.

The first part of the vas deferens is histologically similar to the prostate duct (pl. 3, fig. 1). After a short distance, however, its character changes due to the gradual replacement of the epithelial lining cells by cells of a single kind, cuboidal and ciliated. A muscular coat consisting of two rather thin layers, an inner one, circular, and an outer one, longitudinal, appears around the epithelial tube (pl. 3, fig. 2).

The character of the vas deferens does not change histologically as it reaches the point where it loops back in the neck. From this point onwards its lumen progressively becomes narrower, the cells of its epithelial lining become lower and with shorter cilia, and the muscular layers become thicker (pl. 3, figs. 3, 5).

This distal segment of the vas deferens, besides conveying the semen, also performs the function of propelling the verge through the preputium during copulation. The latter function is facilitated by the muscular rigidity and freedom of movements of the duct within the body cavity, and by the fulcrum provided by its attachment to the tissues of the snail neck.

The relation *vas deferens/vergic sac* was 4.7 ± 0.6.

Penial complex — It consists of the verge, vergic sac and preputium.

The *verge* is a differentiation of the distal end of the vas deferens, appearing as a slender tube 3.70± 0.54 mm long and 0.12 ± 0.03 mm wide. Situated within the vergic sac, it is attached to the latter b its base as a narrow cylindric pendant having a pointed free extremity (fig. 4). The axial sperm canal may be seen by transparence through the wall of the verge. There is no penial stylet.

The verge is covered with a visceral squamous epithelium that loops back at the base of the organ to become continuous with the parietal epithelium lining the vergic sac (pl. 3, fig. 6). The sperm canal is lined by a low epithelium continuous with the lining of the vas deferens. The lacunar vergic tissue fills the space between the two epithelial layers (pl. 3, fig. 7).

The *vergic sac*, 3.77 ± 0.50 mm long and 0.19 ± 0.01 mm wide, extends between the vas deferens and the preputium (figs. 1, 2, *sv;* fig. 3). The relation *vergic sac preputium* was 1 ± 0.02 (the relation 1 was observed in 28 specimens). The wall of the vergic sac is composed of a thin muscular coat lined by a cuboidal epithelium (pl. 3, fig. 7).

The *preputium* (figs. 1, 2, *pr;* figs. 3, 5) is a muscular sac-like tube, 3.79 ± 0.40 mm long and 0.89 ± 0.12 mm wide, deeply pigmented due to the presence of abundant melanophores among the muscular fibers of its wall. The preputium extends from the vergic sac to the male genital opening situated just behind the left tentacle. Before continuing with the vergic sac, its apical end becomes somewhat narrower. On both sides of its wall a strong muscular pilaster extends lengthwise, causing the epithelial lining to protrude toward the lumen of the organ (figs. 5 and pl. 3, fig. 8). The external surface of the preputium has a pilose appearance. Internally the preputium is separated from the vergic sac by a muscular diaphragm that controls the passage of the verge (fig. 5; pl. 3, fig. 9).

Female organs

Albumen gland — This is a voluminous compound tubulous gland that lies on the first portion of the intestine (fig. 1, *ga*). Its dorsal surface is convex and the ventral one is divided into two parts by a furrow occupied by the intestinal loop that passes beneath it. The gland secretions are conveyed by an excretory duct that empties into the carrefour. The cytoplasm of secretory cells that make up the tubuli is highly vacuolated and shows a nucleus disposed toward the base of the cell. The lumens of the tubuli are always filled with a viscid secretion (pl. 2, figs. 2, 3).

Oviduct — The oviduct, 10.24 ± 1.29 mm long and 0.81 ± 0.16 mm wide in its middle portion, leads off from the carrefour, extending to the level of the hindermost prostate diverticula, accompanied by the sperm duct (figs. 1, 2, *o*). It tends to become wider throughout its course. In the proximity of its cephalic end it abruptly swells, thus forming a fold-walled pouch (figs. 1, 2, *bo*) that caps the caudal end of the uterus. Its greatest width in that pouch was 2.34 ± 0.39 mm. The oviduct is lined by a non-ciliated epithelium consisting of two kinds of cells (pl. 3, figs. 4, 10). The columnar chief cells have vary pale cytoplasm and ellipsoidal nuclei. The sustentacular cells, tall and slender, resemble those referred to in the sperm duct. The histological character of the oviduct arises abruptly, no transitional steps existing between its epithelium and that of the carrefour (pl. 2, figs. 2, 3). The oviduct is covered with a thin pigmented membrane of connective tissue.

Uterus — We consider the uterus as that wide tube extending from the pouch of the oviduct to the caudal limit of the vagina. It is 10.58 ± 1.18 mm in length and has a diameter of 1.84 ± 0.32 mm in its middle part.

In dissected specimens the limit between the nidimental gland and the uterus proper cannot be distinguished with any degree of certainty. Histologically, however, the two portions are quite different. The beginning of the nidimental gland is marked by the appearing of strongly acidophilic granules within some epithelial cells at a point dorsally situated in the wall of the cephalic end of the oviduct (pl. 3, fig. 10), at the level of the hindermost prostate diverticulum. From this site the acidophilic granules spread around to the remaining of the gland wall (pl. 4, fig. 1). A progressive restriction of the acidophilic granules to the portion of the wall of the tube that comes into contact with the spermatheca (pl. 4, fig. 3) signalizes the cephalic end of the nidimental gland and the beginning of the uterus. The opposite wall, in which the granules are no longer present, resembles the wall of the oviduct, differing from the latter in their cells being ciliated and staining pale pink with eosin. At the region that touches the spermatheca, the remaining acidophilic cells are finally replaced by vacuolated, ciliated

ones. This character remain unchanged through the entire length of the uterus (pl. 4, fig. 2).

Vagina — The vagina is a tube continuous with the uterus, the two organs being separated externally by a rather shallow partial constriction. Its external orifice opens a short distance behind the male genital outlet (figs. 1, 2, *v*). The swollen part of the vagina which immediately follows the constriction is the vaginal pouch (figs. 1, 2, *bv*). The organ was 2.06 ± 0.15 mm long and 0.32 ± 0.05 mm wide. Its greatest diameter at the pouch was 0.46 ± 0.08 mm.

The wall of the vagina and vaginal pouch has three coats: a lining ciliated columnar epithelium, a moderately muscular coat and a thin pigmented adventitia (pl. 4, figs. 4, 5, 6).

Spermatheca — The bulk and form of this organ depends on the degree of distension of its wall, the latter in turn depending on the degree of repletion of its lumen. When filled it is egg-shaped, when empty it is club-shaped. Its dimensions were 1.57 ± 0.41 mm in length and 0.92 ± 0.23 mm in diameter.

The spermathecal duct arises from the cephalic end of the spermatheca and joins the vagina at the level of the limit between the latter and the vaginal pouch (figs. 1, 2, *ces*). It was 1.15 ± 0.23 mm long and about 0.15 mm wide.

The body of the spermatheca (figs. 1, 2, *e*) is surrounded ventrally by the first segment of the vas deferens, and caudally and dorsally by the foremost prostate diverticulum. It is composed of a thin muscular wall lined by ciliated columnar epithelium and covered with a pigmented membrane of connective tissue (pl. 4, fig. 3). The lumen normally contains a jelly-like substance with more or less changed cells desquamated from the epithelium, acidophilic granules and amorphous material (pl. 4, figs. 2, 3). The semen is stored up in a layer between that substance and the epithelial lining. The animal from which pl. 4, figs. 2 and 3 were taken was grown in isolation, so that its spermatheca contained no spermatozoa.

Histologically the spermathecal duct is similar to the spermatheca, and its epithelial lining presents a wavy appearance in sections (pl. 4, figs. 4, 5).

RADULA

Two snails having anomalous radulae were excluded from the following description.

In the 48 remaining specimens the number of teeth rows varied from 125 to 163 (mean 141.4 ± 9.8). The radula formula ranged from 27-1-27 to 34-1-34; the formula 31-1-31 corresponded to the mode and median, and practically also to the mean, the latter being 30.9 ± 1.7.

As regards the form of the teeth, the following characteristics were observed:

Central tooth (fig. 7, C) — With two cusps extending below the lower margin of the base of attachment. The latter is symmetrical, twice to thrice as wide as the summit of the tooth.

Lateral teeth (fig. 7, L) — From 7 to 11 in number, tricuspid, wider than the central one, with asymmetrical base of attachment, the latter being overlapped by the cusps.

Intermediate teeth (fig. 7, I) — From 3 to 5, tricuspid, showing one or two interstitial cusps between the entocone and mesocone, somewhat more oblique than the lateral teeth. Some small cusps may be present above the ectocone.

Marginal teeth (fig. 7, M) — From 18 to 24, elongated, strongly oblique, the entocone and ectocone splitting into several small cusps arranged obliquely. The base of attachment is narrower than the summit of the teeth. The outermost marginals are short, without serrations, rudimentary.

SUMMARY

The present morphological study of *A. glabratus* was based on the observation of shell, radula, renal region and genitalia of 50 specimens having a shell diameter of 18 mm.

In this summary we record the data pertaining to the characteristics that can be used in systematics. The numerals refer to the means and their standard deviations; no special reference being made, they correspond to length measurements.

Shell: 18 mm in diameter, 5.59 ± 0.24 mm in greatest width, 5 to 6 whorls. Right side umbilicated, left one weakly depressed. Last whorl about thrice as tall as the penultimate one at the aperture, the measurements being taken on the right side. Aperture perpendicular or a little oblique.

Body, extended: 47.06 ± 3.31 mm.

Renal tube: Narrow and elongated, 23.84 ± 1.90 mm, showing a pigmented ridge along its ventral surface.

Ovotestis: 12.78 ± 1.50 mm. Mainly trifurcate diverticula attaching in fan-like manner to the collecting canal (this arrangement is seen to best advantage in the cephalic middle of the ovotestis). The collecting canal greatly swells at the cephalic end, narrowing suddenly as it leaves the ovotestis.

Ovisperm duct: 13.70 ± 1.68 mm, including the non-unwound seminal vesicle. The latter, situated about 1 mm from the beginning of the ovisperm duct, was 1.14 ± 0.29 mm in greatest diameter, and is beset by numerous short diverticula.

Sperm duct: 14.16 ± 1.27 mm, pursuing a sinuous course along the oviduct.

Prostate: Prostate duct 5.53 ± 0.74 mm, collecting a row of long diverticula, the latter 21.6 ± 3.5 in number. Last diverticulum generally simple or bifurcate, penultimate generally arborescent, bifurcate or simple, antepenultimate nearly always arborescent, the remaining ones arborescent. The arborescent diverticula frequently give off secondary branches.

Vas deferens: 17.50 ± 2.05 mm. The ratio *vas deferens/vergic sac* was 4.7 ± 0.6.

Verge: 3.70 ± 0.54 mm long, 0.12 ± 0.03 mm wide. Free end tapering to a point where the sperm canal opens. No penial stylet.

Vergic sac: 3.77 ± 0.50 mm long, 0.19 ± 0.01 mm wide. The length ratio *vergic sac/preputium* was 1 ± 0.02.

Preputium: Deeply pigmented, 3.79 ± 0.40 mm long, 0.89 ± 0.12 mm wide in the middle. Muscular diaphragm between it and the vergic sac. Two muscular pilasters along its lateral walls.

Oviduct: 10.24 ± 1.29 mm, suddenly swollen at the cephalic end so that it forms a folded pouch capping the beginning of the uterus.

Uterus: 10.58 ± 1.18 mm.

Vagina: 2.06 ± 0.15 mm long, 0.32 ± 0.05 mm wide, showing a swelling at its caudal portion, just above the opening of the spermathecal duct.

Spermatheca: 1.57 ± 0.41 mm long, 0.92 ± 0.23 mm wide. Spermathecal duct 1.15 ± 0.23 mm.

Radula: 125 to 163 rows of teeth (mean 141.4 ± 9.8). Radula formula 27-1-27 to 34-1-34 (mean 30.9 ± 1.7).

SUMÁRIO

Foi feito um estudo da morfologia do *A. glabratus*, baseado na observação da concha, da rádula, da região renal e da genitália de 50 espécimes cujas conchas mediam 18 mm de diâmetro.

Apresentamos a seguir os dados referentes aos caracteres utilizáveis na sistemática. Os números representam as médias e seus desvios padrões; não havendo especificação, referem-se a medidas de comprimento.

Concha: 18 mm de diâmetro; 5,59 ± 0,24 mm de largura máxima; 5 a 6 giros. Face direita umbilicada, esquerda pouco deprimida. Último giro cêrca de 3 vêzes mais alto que o penúltimo na abertura, medidas tomadas na face direita. Abertura perpendicular ou ligeiramente oblíqua.

Corpo distendido: 47,06 ± 3,31 mm.

Tubo renal: Longo e estreito. 23,84 ± 1,90 mm. Crista pigmentada longitudinal.

Ovoteste: 12,78 ± 1,50 mm. Divertículos principalmente trifurcados implantando-se em forma de leque sôbre as faces laterais e dorsal do canal coletor (êste aspecto é observado de preferência na metade cefálica do ovoteste). O canal coletor é muito dilatado na extremidade cefálica e ao deixar o ovoteste torna-se bruscamente muito estreito.

Canal ovispermático: 13,70 ± 1,68 mm, incluindo a vesícula seminal enovelada. Vesícula seminal com divertículos curtos, 1,14 ± 0,29 mm de largura máxima, situada a cêrca de 1 mm do início do canal ovispermático.

Canal espermático: 14,16 ± 1,27 mm, correndo sinuoso ao longo do oviduto.

Próstata: Canal prostático mediu 5,53 ± 0,74 mm, recebendo uma fileira de divertículos longos em número de 21,6 ± 3,5, o último geralmente simples ou bifurcado, o penúltimo geralmente arborescente, bifurcado ou simples, o antepenúltimo quase sempre arborescente, os restantes arborescentes. As ramificações dos divertículos arborescentes são freqüentemente de segunda ordem.

Canal deferente: 17,50 ± 2,05 mm. Relação *canal deferente saco vérgico* igual a 4,7 ± 0,6.

Pênis: 3,70 ± 0,54 mm de comprimento e 0,12 ± 0,03 mm de diâmetro. Extremidade livre pontiaguda, com abertura apical do canal ejaculador, sem estilete penial.

Saco vérgico: 3,77 ± 0,50 mm de comprimento e 0,19 ± 0,01 mm de diâmetro. Relação *saco vérgico prepúcio* igual a 1 ± 0,02.

Prepúcio: Fortemente pigmentado. 3,79 ± 0,40 mm de comprimento e 0,89 ± 0,12 mm de diâmetro na parte média. Separado do saco vérgico por um diafragma muscular. Percorrido lateralmente por duas pilastras musculares longitudinais.

Oviduto: 10,24 ± 1,29 mm. Na extremidade cefálica dilata-se bruscamente formando grande bôlsa pregueada sôbre o início do útero.

Útero: 10,58 ± 1,18 mm.

Vagina: 2,06 ± 0,15 mm de comprimento e 0,32 ± 0,05 mm de diâmetro. Na parte caudal apresenta uma dilatação em forma de bôlsa, logo acima da implantação do canal da espermateca.

Espermateca: 1,57 ± 0,41 mm de comprimento e 0,92 ± 0,23 mm de diâmetro. Canal da espermateca 1,15 ± 0,23 mm.

Rádula: 125 a 163 filas de dentes (média 141,4 ± 9,8). Fórmula radular de 27-1-27 a 34-1-34 (média 30,9 ± 1,7).

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PLATE 1

Fig. 1 — Shells of four specimens, right side; fig. 2 — same specimens, left side; fig. 3 — shells of four specimens, front; fig. 4 — cross section through middle of renal tube from snail 5 mm in diameter: no renal ridge (100x); fig. 5 — idem from snail 10 mm in diameter: no renal ridge, pigment in cells of lacunar reticulum (100x); fig. 6 — idem from snail 18 mm in diameter: renal ridge, pigment in lacunar reticulum (100x); fig 7 — ovisperm duct after leaving seminal vesicle (200x); figs. 8 and 9 — ovotestis diverticula (200x); fig. 10 — seminal vesicle, the arrow indicates the blind end of a diverticulum occupied by heads of spermatozoa (100x). (car = respiratory cavity; co = ovisperm duct; cr = renal ridge; gd = digestive gland; ll = layer of lacunar tissue between renal tube and ventral epithelium of dorsal membrane of mantle; ll' = layer of lacunar tissue between renal tube and dorsal epithelium of dorsal membrane of mantle; ot = ovotestis; tr = renal tube; vp = pulmonary vein; vr = renal vein).

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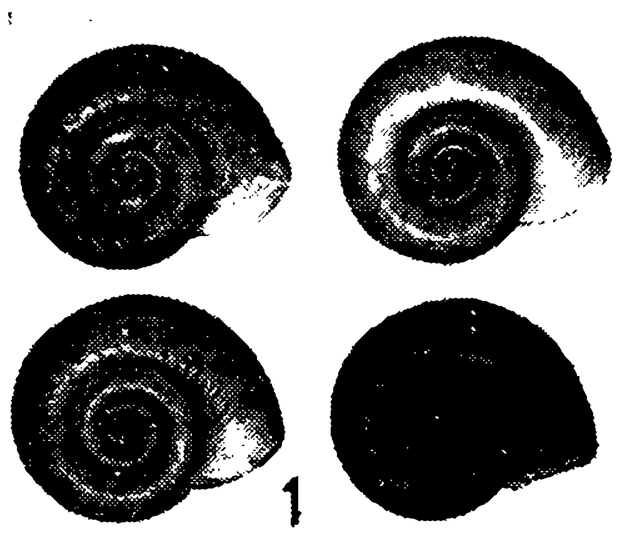

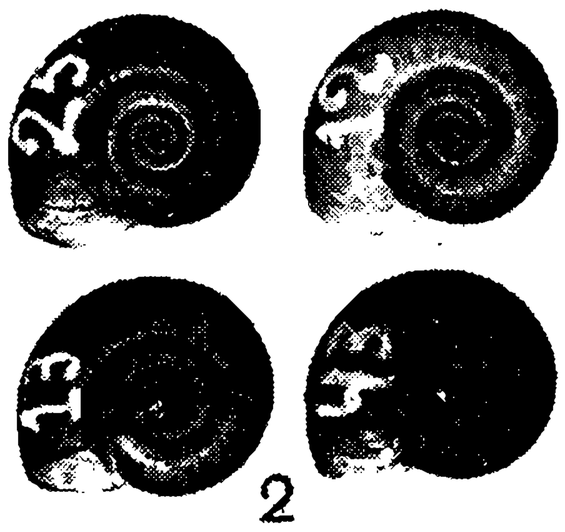

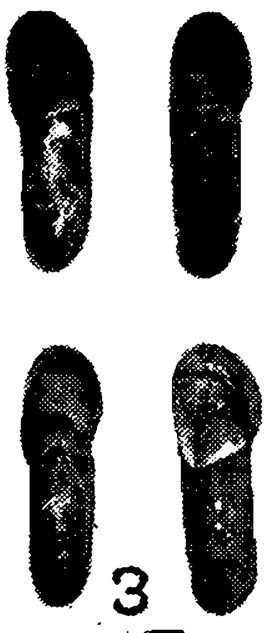

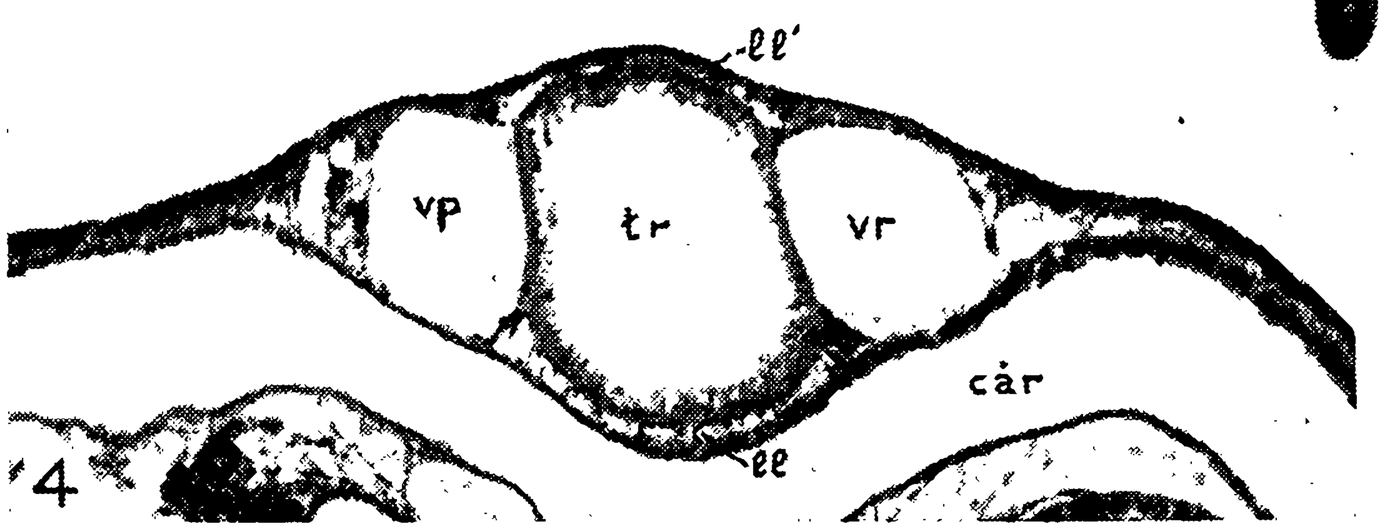

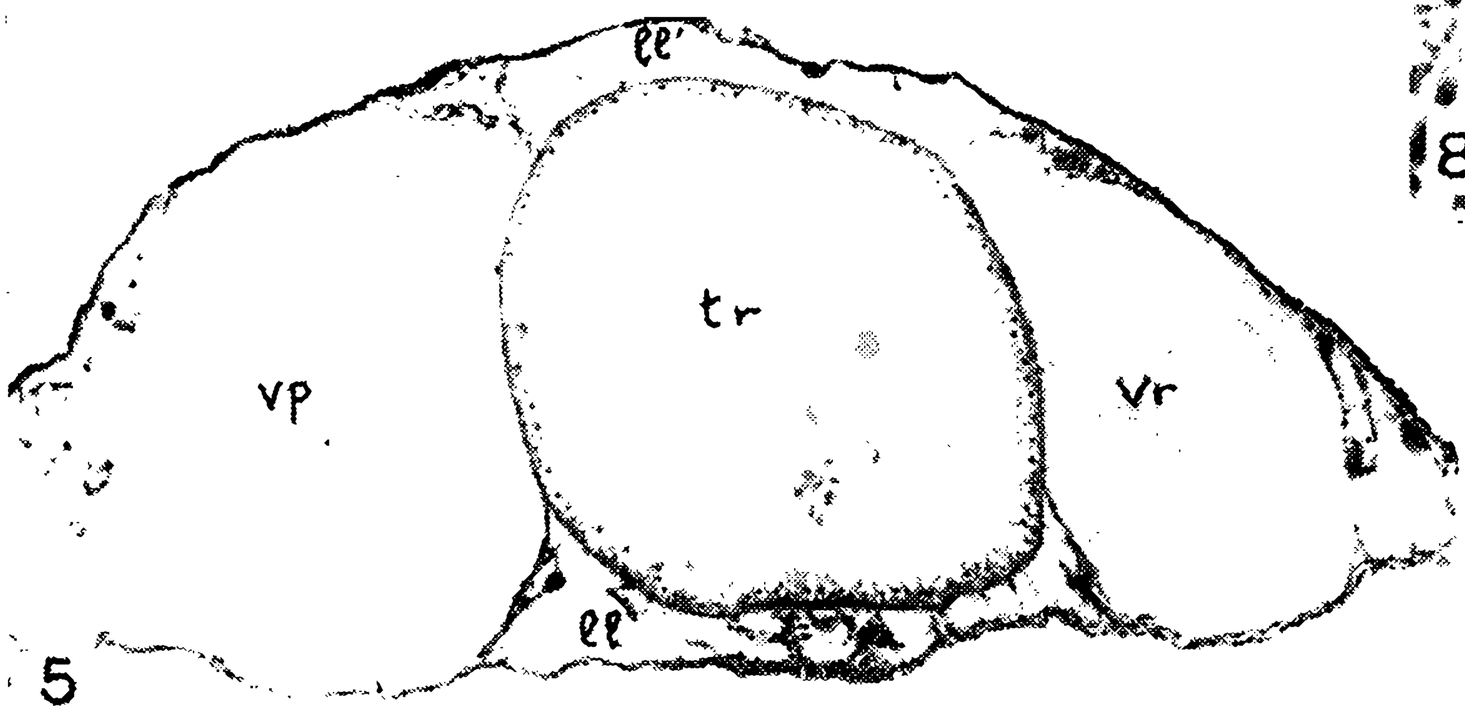

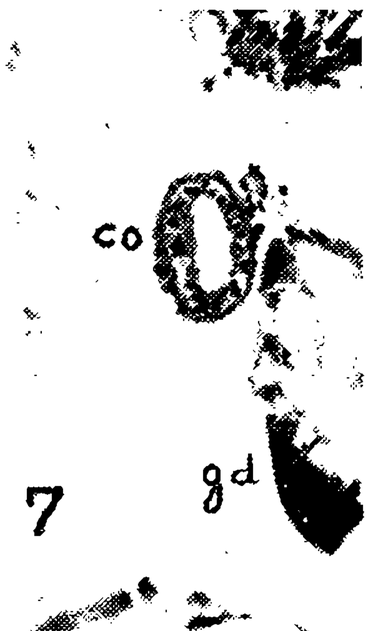

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PLATE 2

Fig. 1 — Seminal vesicle, the arrow indicates the blind end of a diverticulum occupied by heads of spermatozoa (100x); fig. 2 — region of carrefour (100x); fig. 3 — region of carrefour, showing beginning of oviduct (200x); fig. 4 — prostate diverticulum (100x); (ca = carrefour; ce = sperm duct; co = ovisperm duct; cp = prostate duct; ga =albumen gland; gd = digestive gland; i = intestine; mc = columella muscle; o = oviduct; p = prostate).

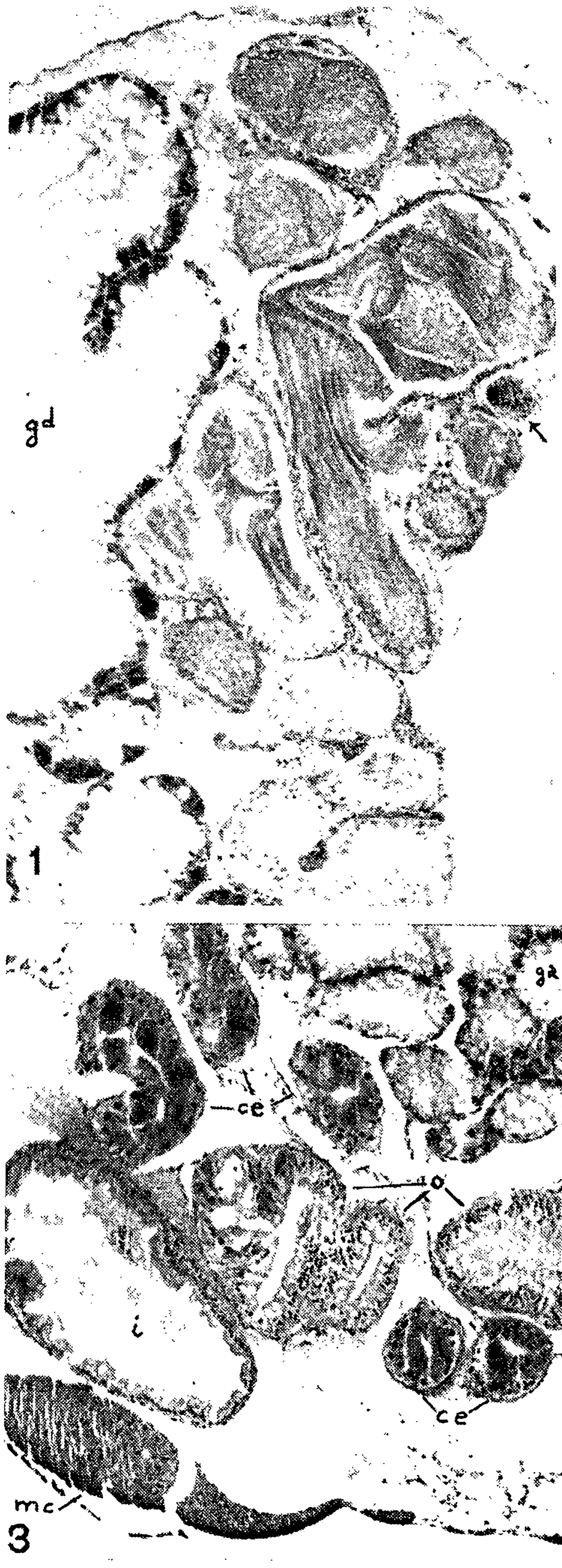

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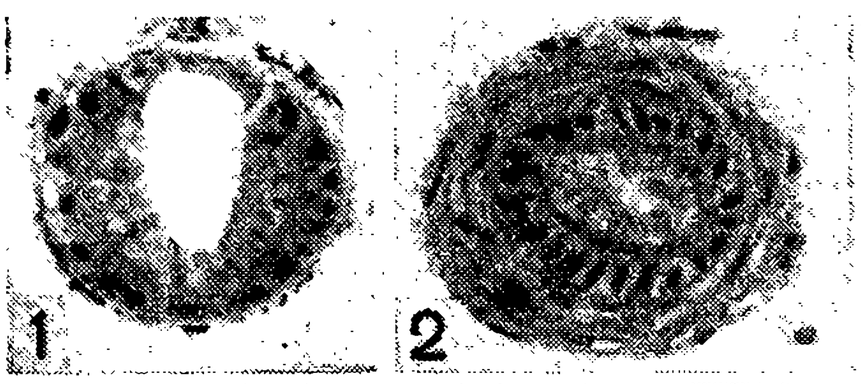
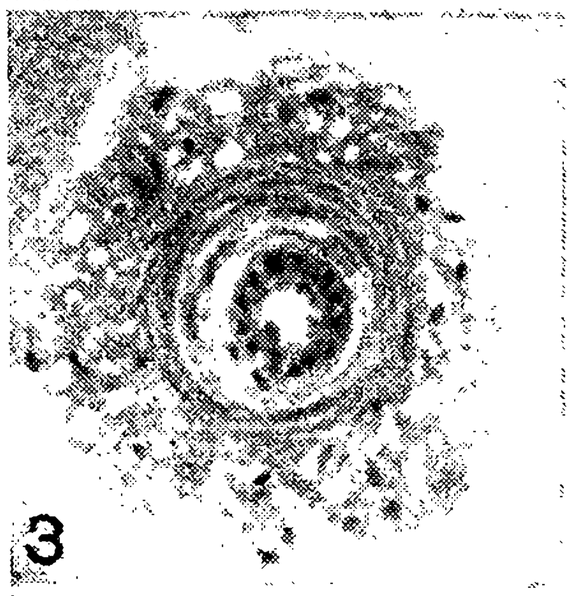
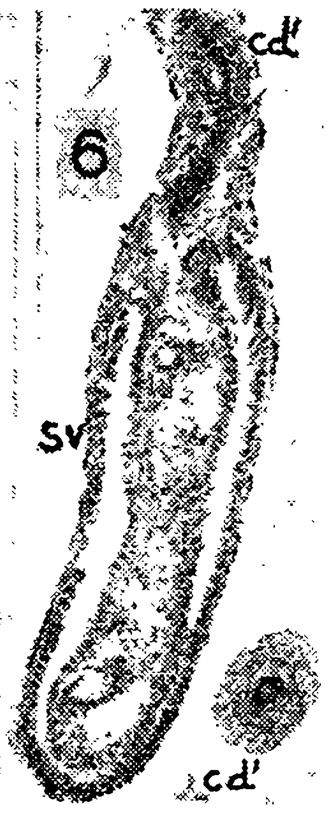
PLATE 3

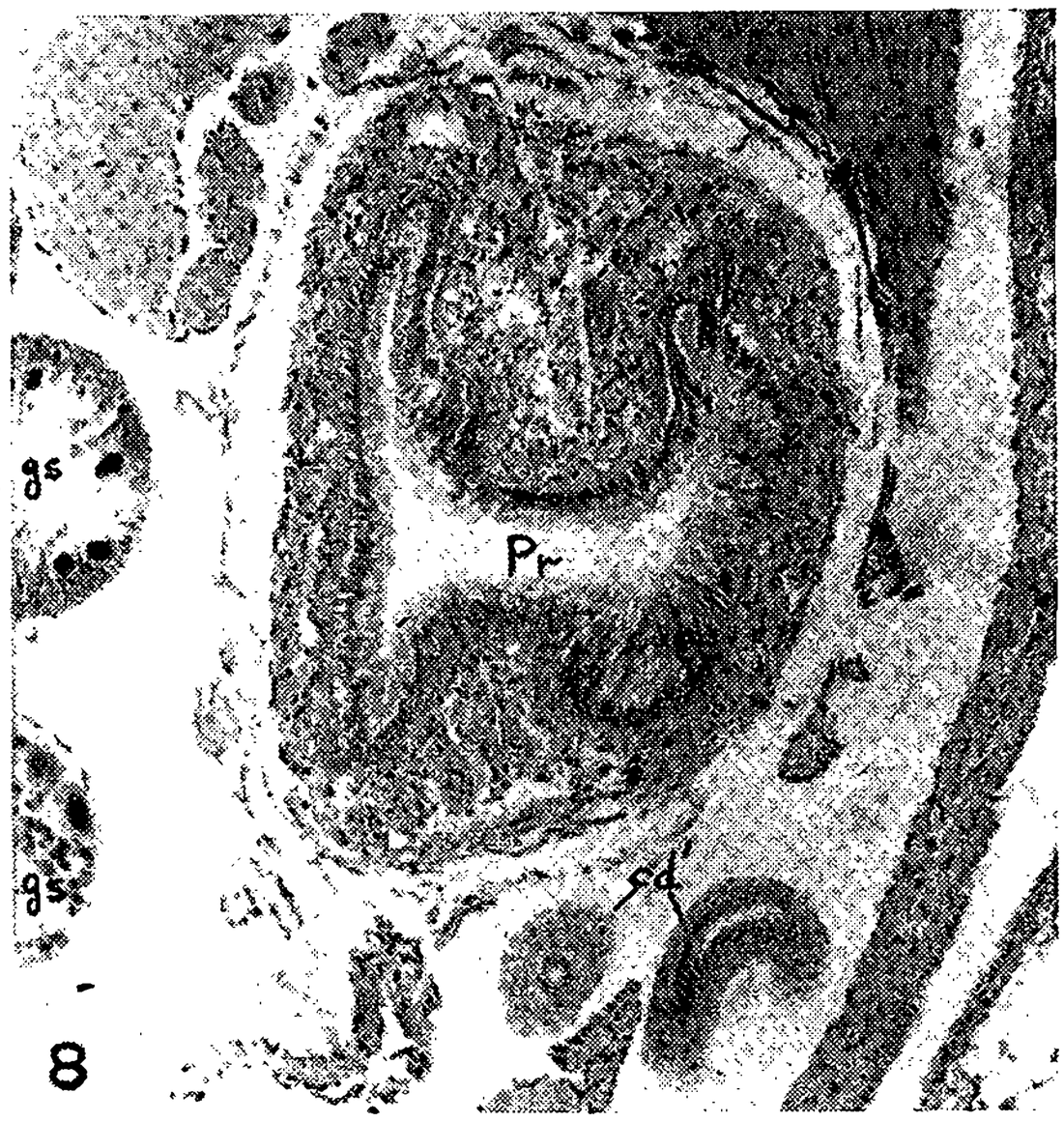
Fig. 1 — Vas deferens, near prostate duct (200x); fig. 2 — vas deferens, proximal segment (400x); fig. 3 — vas deferens, distal segment (400x); fig. 4 — oviduct (100x); fig. 5 — descending and ascending limbs of vas deferens loop (distal segment) near preputium (200x); fig. 6 — verge within vergic sac, showing transition to vas deferens (100x); fig. 7 — verge and vergic sac (200x); fig. 8 — preputium (100x); fig. 9 — diaphragm between vergic sac and preputium, in center apical end of verge (100x); fig. 10 — pouch of oviduct, upper right: beginning of nidimental gland (100x). (cd' = distal segment of vas deferens; es = esophagus; gs = salivary gland; pn = verge; pr = preputium; sv = vergic sac).

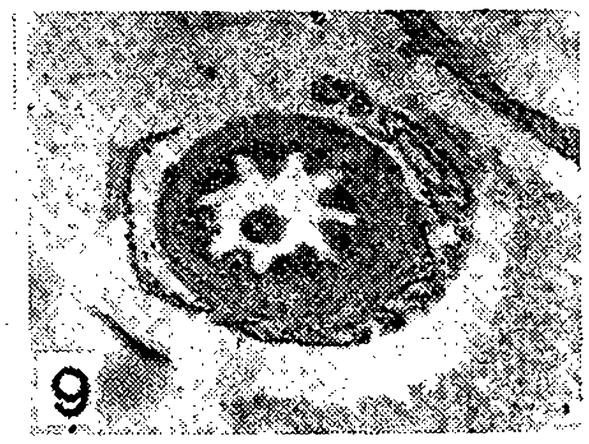
PLATE 3











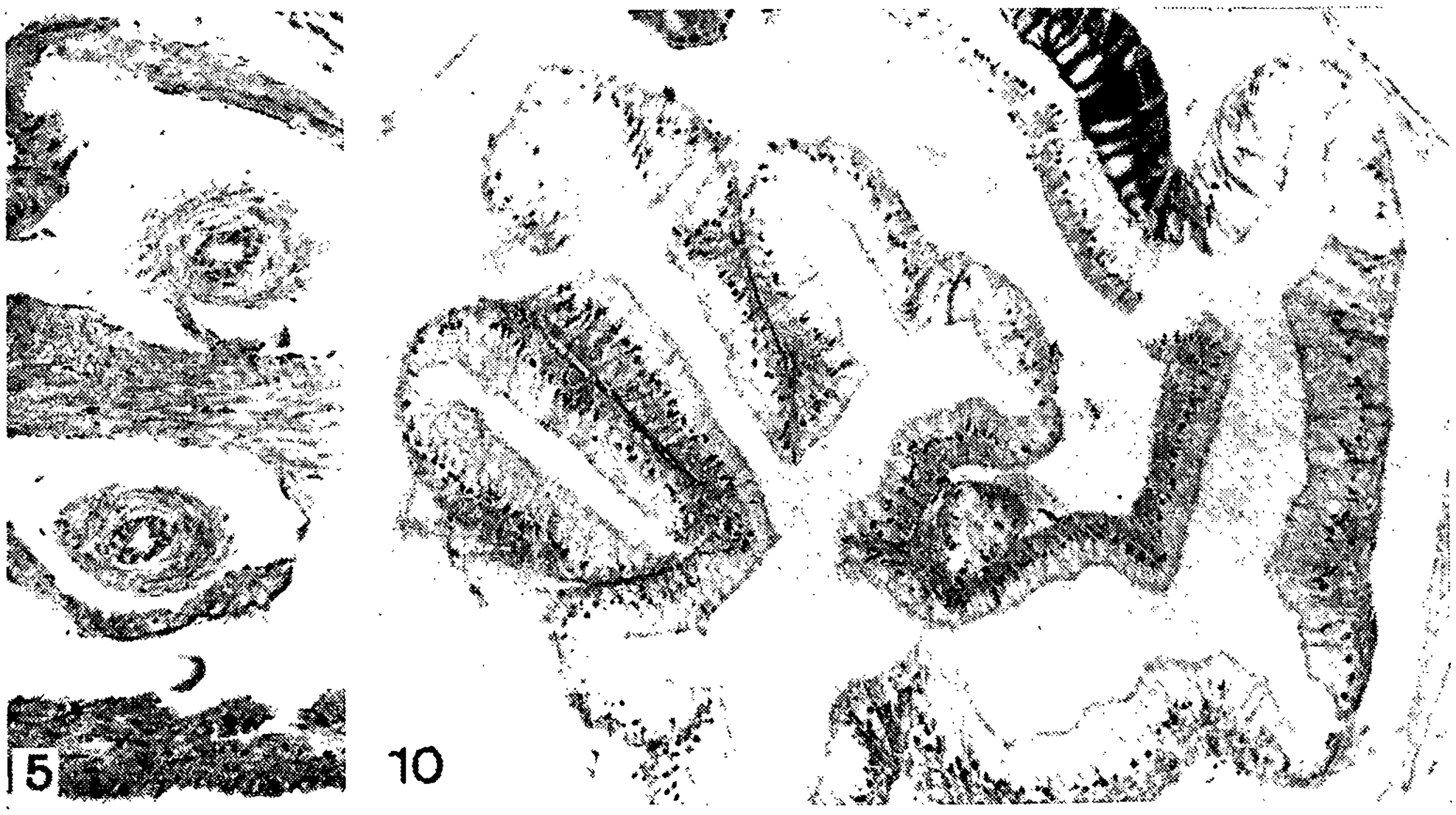


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PLATE 4

Fig. 1 — Nidimental gland in cross section (100x); fig. 2 — uterus and spermatheca (200x); fig. 3 — transition from nidimental gland to uterus, spermatheca (100x); fig. 4 — vagina continuing into uterus, spermatheca duct (100x); fig. 5 — vagina and vaginal pouch in cross section (100x); fig. 6 — vagina in cross section (100x). (bv = vaginal pouch; cd = proximal segment of vas deferens; cd' = distal segment of vas deferens; ces = spermathecal duct; cp = prostate duct; e = spermatheca; gn = nidimental gland; gs = salivary gland; p = prostate; pn = verge; sv = vergic sac; ut = uterus; v = vagina).

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PLATE 4

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