

ON TWO ELLOBIIDAE FROM SOUTHERN BRAZIL

by

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(with 5 plates)

The Ellobiidae constitute a primitive family or superfamily (Taylor & Sohl 1962, p. 11) of the Pulmonata Basommatophora, as the Order is called in the traditional system. They emerged from the sea and passed onto the land. For this passage most of them used the easy way (Remane 1958, p. 23) offered by the amphibious mangrove thickets. Here the abundance of aerial oxygen is combined with wetness. Dead trunks, loose bark, fallen branches and leaves, and humus furnish food and shelter. The ground is soft, so that the snails can hide easily under its surface. Without much specialization of their structure snails can live in this environment, in contrast with the rocky shore, where another primitive pulmonate family, the Siphonariidae, passes from sea to land.

Generally, not always (l. c.), a physiological prerequisite for life in the mangrove formation is the tolerance of sudden salinity changes, a requirement for many inhabitants of brackish water. However more than these changes the mean salinity reduces the number of thalassogenous brackish water animals.

We recently studied *Melampus coffeus* (Linné, 1758) and *Detracia parana* Morrison, 1951, which live in the primitive habitat of the Ellobiidae (Morton 1955b, p. 131), in supratidal and estuarine locations. The same is true for *Ellobium pellucens* and *Blauneria heteroclita* treated here.

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Ellobium pellucens (Menke, 1830) (Figs. 1-16)

Occurrence: Cananéia (25° 01' S, 47° 50' W)

Further distribution: British Guiana, Demerara estuary; Lesser Antilles, Guadeloupe; Florida (Dall 1886, p. 275)

Among the figures that we have seen those referring to material from South America (Küster 1844, pl. 2, f. 16, 17) agree better with our shells than those illustrating Floridan specimens, viz. Dall (1886, pl. 18, f. 8), Kobelt (1898-1901, pl. 15, f. 5, 6), and Perry & Schwengel (1955, pl. 39, f. 285)

We must justify the name *Ellobium* Röding, 1798 (synonym: *Auricula* Lamarck, 1799) for a species with outwardly visible eyes. In the type-species of *Ellobium*, *E. aurismidae* (L.), and the related big snails from the Indopacific region the eyes lie concealed by the skin (Oken 1834, see Küster 1844, p. 14; Pelseneer 1894, p. 77, note 1), and therefore these snails are called blind (Fischer 1883 in 1887, p. 498) or eye-less (Simroth 1909, p. 240). Martens (1880, p. 207) introduced the subgenus, later on genus, *Auriculastra* for smaller species whose shells are similar to those of *Ellobium*, but whose eyes are external. Wenz and Zilch's photograph (1959, f. 249) of the type-species of *Auriculastra*, *A. subula* (Quoy et Gaimard), is better compatible with our shells of *E. pellucens* than the drawings of Küster, Reeve, and Kobelt. Knipper & Meyer (1956, pl. 5, f. 4, f) figure the aperture of *subula* much shorter than that of *pellucens*.

The visibility of eyes in *E. pellucens* (Figs. 1, 5) explains that Dall (1886, p. 275), followed by Kobelt (1898, p. 101), Johnson

(1934, p. 158), Haas (1950, p. 197), Coomans (1958, p. 103) and Ewald (1963), allotted the species to *Auriculastra*. The name means "small *Auricula*", so that Dall's modification "*Auriculastrum*", allusive to "astron" (star), is not justified. He was not right to indicate Fischer, 1883, as author of *Auriculastra*. Though the radula of *pellucens* does not agree completely with those of Odhner's species of *Ellobium* (1925, pl. 2, f. 26-28), it is still more different from that of *Auriculastra* (ibid., f. 25). Moreover, according to Kobelt (l. c.) the type-species of the latter has pointed tentacles, while those of *pellucens* are swollen at their ends (Figs. 1, 5) as in *Ellobium*; therefore we do not use the name *Auriculastra*.

Together with the so-called blind snails Kobelt mentioned a group of species, smaller than the typical *Ellobium*. He gave them the subgeneric name *Auriculina* (1898, p. 77), later on (Strand 1928) substituted by *Auriculodes*. The shell of the type-species, *A. gangeticum* (L. Pfeiffer), resembles that of *E. pellucens* in Reeve's (1878, pl. 2, f. 4) and Kobelt's (1901, pl. 14, f. 7, 8) drawings, but not in Wenz and Zilch's photograph (1959, f. 251). Knipper & Meyer's studies (1956) of the central nervous system (f. 6) and the reproductive organs (f. 12) of *Auriculodes gaziensis* (Preston, 1913) prove that this species and *E. pellucens* cannot be united in one and the same genus.

We therefore consider it to be advisable to follow Morrison (1958, p. 123) simply writing *Ellobium pellucens*.

Occurrence and habits

The material was collected at Cananéia in the same supratidal fringe where *Melampus coffeus*, *Detracia parana*, *Blauneria heteroclita*, *Gastrocopta-spec.*, *Assimineia succinea* *vina*, *Littorina flava*, and some *L. angulifera* live. High spring tides increased by onshore winds flood this beach with brackish water. During neap tides combined with rain falls, sometimes more than 25 cm in 24 hours, the place may be washed by rain water for days. Still more than *Melampus* and *Detracia*, *E. pellucens* avoids light and was only found in the humus on the soil, after the blackish undermost parts of the sheltering 30-50 cm high grass mat were parted and removed. At

daytime the snails lie dug into the humic soil. They were found accumulated in two small areas, where the soil was especially soft. About 60 specimens and some empty shells were obtained, a minute fraction of the numbers of the other ellobiids. Some snails were kept alive in a dish with rotten leaves, grass, and moistened humus from their natural habitat. They behave inactive at day-time, and hid between the plants when placed upon the surface. July 1, 1963, adult snails were brought from the beach to the laboratory in São Paulo and put into 3 dishes, containing 2, 6, and 15 specimens. September 12 they all began to lay eggs and continued with intervals to the middle of March 1964. There was a clear correlation between spawning and new moon, though the level of the water in the dishes and the light of a street lamp which fell upon them were the same all the time, and the temperature varied much, as is the rule in the city of São Paulo.

The stomach and the faecal rods contain particles of rotten vegetable matter. The snails feed principally on the blackish layer that covers the lower parts of the grass stalks and consists chiefly of humus with fungal mycelia and spores and a few diatoms.

Possibly the very numerous grapsids, *Sesarma miersi iheringi* Mary J. Rathbun, 1918, prey on *Ellobium pellucens* whose shell, especially that of specimens under 10 mm, is much thinner than that of *Melampus* and *Detracia*. We found one shell broken as by pincers and still containing some remains of the body

Shell (Figs. 1, 3)

Proportions between length and breadth from 1,75 to 2,22:1. Our biggest shell was 23 mm long, 10,5 mm broad, and the smallest 2 mm long. Shape oblong-oval, maximum width in the middle. Colour white, the thin periostracum horny-yellow. Texture generally semitransparent and delicate, but thickness not always correlated with size. Also living shells often eroded. Up to 7 smooth, slightly convex whorls with faint growth lines. Apex of present shells, even of the smallest, always eroded. Body whorl up to 90% of total length, spire prominent, conical. Sutures covered by shoulder of whorls, the latter often irregularly indented by erosion.

Aperture $2/3$ of shell height, evenly rounded in front, tapering behind. Outer lip of thin shells smooth and sharp, in thicker ones with slight thickening on inside, a little in front of middle. Inner lip with two white oblique folds, either of equal size or one of them larger. Parietal region sometimes covered with glaze of irregular outline.

By resorption the internal partitions of the spire disappear as drawn by Crosse & Fischer (1882, pl. 8, f. 1) and Morton (1955b, f. 12 C), leaving a low spiral covered with folded periostracum. This spiral moulds the surface of the compact visceral mass. The two bundles of the columellar muscle originate on the sutural crest at the beginning of the body whorl.

Head and foot (Figs. 1, 2, 4-7)

The body is white, except for the slightly pigmented tips of the tentacles. The snout is short, and the mouth (m) is concealed beneath a pair of rounded lobes (ro) separated by a notch.

The long tentacles (Fig. 5) are cylindrical, thickened at their tips and bear the eyes (ei) inside their bases. A high sensory epithelium (na) supplied by branches of the tentacular nerve (ne) coats the tip. As in *Ovatella* (*Myosotella*) *myosotis* the tentacles are hollow, and the two bundles of the tentacular nerve run in the centre (Meyer 1955, p. 22). More peripheral lie the retractors of the tentacle which are separate from the longitudinal cutaneous muscle layer. The retractors originate on either side of the head and insert proximal to the sensory apex in the connective tissue that underlies the sensory area. When the tentacle is touched, it contracts and forms a pocket that lodges the tip (Fig. 7). The sensory epithelium which is not reached by the retractor fibres projects from the pocket on the side of the head (Fig. 6). The tentacles are stretched by the pressure of the blood; in anaesthetized snails they remain erect when the animals are preserved. As part of the outer wall of the tentacle is turned inwards when it is retracted, this retraction is, at least in part, an invagination, hence a process that is quite exceptional in basommatophores. The topography of the retracted tentacles of *E. pellucens* is comparable to that of a pleurembolic proboscis, and the

contrast between them and the posterior tentacles of the stylommato-phores, though still present, is reduced. This is also evidenced by Hubendick's (1945, p. 150, 161) and Meyer's descriptions of other ellobiids.

The foot (Fig. 2) is rounded in front and ends with a simple point; the sole is not divided transversely. The snails move gliding, not stepping nor by jerks. The anterior pedal gland (Fig. 23, vo) discharges its mucous secretion from below into the transverse furrow which separates snout and foot. The voluminous mass of blue-staining gland cells surrounds a narrow tube. This extends 0,6 mm inwards, then it bends upwards and ends under the nerve ring. The sole is ciliated and provided with insunk blue-staining glands. The nonciliate sides of the foot bear red and blue-staining glands. In contracted animals the sole is hidden by the bulging sides of the foot. In this condition the sides, together with the mantle edge, also supplied with red-staining glands, close the shell aperture.

Mantle and pallial organs (Fig. 11)

The anterior cavity covered by the mantle skirt is not as spacious as in *Melampus coffeus*; it lodges only the head of the withdrawn snail, not the foot. The whole mantle edge is thickened by blood lacunae and divided by two furrows into three parts or lobes, the quite short outer, and the long middle and inner pallial lobe (Fretter & Graham 1962, f. 80; 81: *Diodora apertura*; *Siphonaria*) The outer and middle lobes are separated by a deep groove, the "sillon palléal" or "gouttière marginale" (Simroth 1909, p. 180, pl. 10, f. 6; Perrier & Fischer 1911, p. 53 ff., pl. 3-4, f. 9) As in the figured snails *Helix aspersa* and *Acteon tornatilis*, also the groove of *Ellobium pel-lucens* receives the secretion of big, deeply insunk glands. The outer lobe, the "repli marginal" (l. c.) covers the groove as a fold with high columnar cells, the "bandelette palléale" or "bourrelet marginal" The outer lobe and the groove, the areas of shell-building processes, are more strongly developed in front and on the right side than on the left.

The furrow that separates the middle and inner lobes is shallow. The inner sharp edged lobe surrounds the back of the retracted foot

as a thin lamella. The bulging middle lobes from right and left unite behind. Here they form, as in *Marinula juanensis*, *Leucophytia bidentata*, *Melampus coffeus*, and others, a thick lappet apposed to the posterior angle of the shell aperture. The pneumostome in front and the outer opening of the anal groove behind lie on the right side of the triangular surface of this lappet. So the anal opening is outermost in contracted state and continues to release faecal strings. The two apertures are confluent, but a transverse fold from the left side separates them. In front of the pneumostome the mantle cavity is closed by the pallial septum (se), a membrane between the body wall of the trunk and the mantle.

Inside the pallial opening the wall of the cavity is thickened by a ring of large subepithelial gland cells which corresponds to the sleeve of gland cells in *Otina otis* (Morton 1955a, p. 116) and to the glandular pads in *Melampus coffeus* and *Detracia parana*. This ring is the only area of the mantle cavity of *E. pellucens* that bears cilia. Between the intestine (i) and kidney the roof of the mantle cavity is slightly pigmented, and its epithelium is thrown into folds over blood lacunae (xi). This is the pulmonary area. As in *Leucophytia bidentata* (Morton 1955c, p. 89) a hypobranchial gland was not found, neither in dissected animals nor in serial sections, nor are there other pallial glandular or lymphatic organs.

The colourless kidney (Fig. 11, k) is a long transverse strip, short in antero-posterior direction. It broadens to the right, where the small, slit-like renal aperture (no), provided with a sphincter, lies nearer to the pneumostome than in the Melampodinae. On the left side, opposite to the nephropore, the 0.15 mm long reno-pericardial canal (rc) communicates with the atrial part of the pericardium (c). The wall of the renal sac is beset with numerous villi (vs). The afferent renal vessels come from the intestinal sinus (si) and enter the hind border of the outer wall. The villi are simple or compound, but there are no lamellae. The renal structure is especially distinct when the kidney is distended by liquid.

Central nervous system (Fig. 13)

This system is difficult to be isolated in *Ellobium pellucens*, because it is tightly packed between the muscles of the head and

buccal bulb. Two big species of the genus, *E. aurisjudae* and *E. aurismidae*, whose nerve rings agree with one another, have been studied by Ihering (1877, p. 22-23, pl. 4, f. 15). As features in common to the Ellobiidae these species have a nearly equal size of the cerebral and pedal ganglia, long cerebral and short pedal commissures and the pleural ganglia approached to the pedal ganglia. Generally the last character is more pronounced on the left than on the right side in the Ellobiidae with dextral shell. *Ellobium pellucens* corresponds to this plan of a gastroneurous nerve ring. It agrees with Ihering's species in its rather long visceral loop which contains, in addition to the pleural ganglia, three ganglia with distinct connectives between them. To this middle-long type of the visceral loop belong *Ovatella myosotis* (Pelseneer 1894, f. 205; Meyer 1955, f. 13), *Leucophytia bidentata* (Morton 1955c, f. 31), *Cassidula labrella* (Knipper & Meyer 1956, f. 7), and *Blauneria heteroclita* (Fig. 28). The loop is longer in *Pythia scarabaeus* (Plate 1897, p. 123) and especially in *Auriculodes gaziensis*, where it is even twisted (Knipper & Meyer 1956, f. 6), and much shorter in *Marinula juanensis* (Odhner 1925, pl. 1, f. 9), *Melampus*, and *Detracia*.

The nerve ring of *E. pellucens* differs from that of *E. aurisjudae* by its asymmetry. This is brought about by the cerebro-pedal and cerebro-pleural (nu) connectives shorter on the right than on the left side. The same occurs in *Melampus coffeus*, and with regard to the right cerebro-pleural connective, in *Ovatella myosotis*. Also the visceral loop of *E. pellucens* is asymmetrical, because both branches, the supra-intestinal or right (zr) and the parietal or left one (zi) run to the right side as in *Ovatella* and *Leucophytia*.

As in *Pythia* and *Ovatella* each tentacle nerve (Fig. 4, ne) is bipartite. In the cerebral ganglia (ce) the lateral lobes preserve their connexion (rs) with the skin, also described in the following species. Cerebro-buccal connectives and buccal commissure are long. The pedal ganglia (ea) are contiguous. No nerves go out from the pleural ganglia, but two from each parietal ganglion. The length of the right pleuro-parietal (supra-intestinal) connexion surpasses that of the left one in *E. pellucens* much more than in *L. bidentata* and *O. myosotis*. The two latter species have the left parieto-visceral connective much longer than the corresponding right section of the loop. This contrasts

with *E. pellucens* whose left parieto-visceral connective is especially short. One of the nerves going out from the visceral or abdominal ganglion (as) is thick and forms a ganglion near the female genital aperture and the pneumostome. At least 3 nerves, in part covered with nerve cells, go out from this ganglion.

Alimentary canal (Figs. 8-10, 12)

The brown jaw (Fig. 9) is 600-700 μ broad, 250-350 μ in antero-posterior direction, and crescent-shaped in outline. The anterior, concave border which acts during ingestion of food is irregular by wear, the hind border is smooth. The mandible is reinforced transversely by stratified layers of conchiolin, but the jaw as a whole is compact, not fibrous.

The radula (Fig. 8) is 2,4 mm long and 1,2 mm broad in a 17 mm long snail. It consists of 70 rows, each half-row with 24 teeth. The rhachidian tooth (R) is narrow. Its notched basal plate is longer than broad. The cusp is tricuspid with a central denticle flanked by a recess on either side. The teeth of each half-row are rather uniform and have strong mesocones. From the middle of the half-row outwards a more or less distinct, generally slight, ectocone appears; the reduced outermost tooth without an ectocone may be called marginal tooth. An inconspicuous denticle, generally between the teeth 9 and 19, is located like a basal endocone. In our examined radulae the 2nd lateral tooth is highest.

The number of teeth in the half-row and also their general aspect agrees with Odhner's statements concerning a species of *Ellobium* (1925, p. 11). The absence of ectocones in the marginal teeth characteristic of group II in Odhner's key (p. 14) occurs only in the outermost tooth of *Ellobium pellucens*. In our Fig. 8, where the basal plates are stippled, the 22nd tooth still shows an outer angle of the cusp which corresponds to an ectocone.

The salivary glands (sa) are knobby tubes; their ducts open into the dorsal food channel of the pharynx (uu); their fundi are separate from one another, and each is fastened to the oesophagus by a strand of connective tissue. The lining of the whole oesophagus (o) is ciliated and thrown into longitudinal folds. The oesophagus

is pigmentfree and enters the white stomach (es) on the left side. The oesophageal folds end abruptly at the first gastric section, the oesophageal atrium (Morton 1955b, p. 138 ff.; 1955c, p. 100 f.). The atrium (or) receives the wide tube (va) of the voluminous anterior diverticulum (za) of the brown intestinal gland. The whole anterior gastric chamber is lined with cilia; its wall contains muscle fibres. It is incompletely divided into a left, oesophageal, and a right, pyloric, compartment by a muscular fold. The muscles of the fold are continuous with the outer longitudinal fibres of the gizzard. On either side of the fold the anterior wall of the stomach is thickened. On the oesophageal side one such cushion (ov) occurs, while there are two (is) in the pyloric part. A loose connective tissue supports these bulges, and some muscle fibres traverse this tissue.

The largest region of the stomach is the gizzard lined with a 12μ thick cuticle (co) and coated by circular muscles forming a 0.2 mm thick layer (rm). When the stomach is contracted, the wall of the gizzard is thrown into 6-8 high longitudinal folds.

Apically to the gizzard lies a small semiglobular caecum (Fig. 10, ca). Its epithelium bears cilia, and its wall is thickened in the fundus. The thickening (ue) is a plug of spongy connective tissue with a few muscle fibres and agrees with the anterior cushions. To judge from Morton's figure 10, an equal thickening occurs at the apex of the caecum in *Ellobium aurisjudae* (1955b, p. 147). The under side of the caecum receives the duct (x) of the posterior digestive diverticulum (zo) which is much smaller than the anterior one. Sometimes in living and in most preserved snails the caecum is tucked into the gizzard, forming a conical plug (Fig. 12).

The right anterior or pyloric region contains ciliary grooves and ridges; in this part ciliary currents are important for the movement of the gastric contents. Between the two above-mentioned thickenings begins a deep groove (u) which runs along the intestine (i) for a short distance.

The stomach of *Ellobium pellucens* retains more primitive characters than that of *E. aurisjudae*. In the latter neither a posterior digestive diverticulum nor any partition of the anterior chamber into an oesophageal and a pyloric compartment is present. The intestinal groove between thickenings comparable with typhlosoles of a ves-

tigial style sac and the left anterior cushion, possibly a remnant sorting area, are further primitive features of the stomach of *E. pel-lucens*. The most primitive gastric structure of any of the ellobiids, that of *Ophicardelus* (Morton 1955b, p. 138, f. 3 B), is rather similar to that of the present species. On the other hand the inversion of the caecum resembles the specialized stomach of *Leucophytia bidentata* (id. 1955c, p. 99). In the present species neither a fold nor cilia connect the anterior chamber with the posterior digestive diverticulum. The inversion of the caecum approaches the ciliated surface of the caecal plug to the aperture of the posterior diverticulum. Possibly the beat of these cilia facilitates the entrance of small particles from the contents of the gizzard into the posterior liver or the egress of hepatic wastes.

The intestine (i) rises to the surface of the body whorl and describes two loops around the anterior digestive gland. The muscles of its wall are weak, and the whole tube is distended by loose masses of digested matter. Surrounded by a blood sinus the intestine follows the suture along the mantle cavity and ends straight without encircling the pneumostome as it does in *Leucophytia bidentata* (Morton 1955c, p. 94). Similar to the latter (p. 95) the anus proper (ar) lies inside a funnel-shaped pit with high transverse margins. The epithelium of the pit is thrown into a number of longitudinal folds with blue-staining glands at their inner end and with long cilia whose beat leads the slightly compacted egested matter to the surface.

Reproductive organs (Figs. 14-16)

As in many snails the size of the animal and the developmental stage of its genital organs are not correlated. Of three small specimens preserved in January 1963 one (shell 6 mm) had a well developed hermaphrodite gland containing spermatozoa with tails, and yolk-laden ovocytes. Its female duct, however, had no glands, and its penis was still young. In the next snail (shell 7 mm) neither gonad nor genital ducts were found in sections, only a young penis was present. The third, 8 mm long animal had an ovotestis with few germ cells and rather well developed oviducal glands; its penis was

still in the stage of the 6 mm snail. In a 14 mm long animal the penis was complete, and its preputium had secreting glands. Sperms in the spermoviduct only occurred in a 12 mm long specimen. In one of our bigger, a 17 mm long snail, the spermoviduct was empty, while the female glands were fully developed.

The ovotestis (w), clusters of orange follicles, is situated over the posterior digestive diverticulum. In *Melampus* and *Leucophytia* the gonad has the same apical position, while in *Ovatella* and *Carychium* (Morton 1955c, p. 140) it lies buried beneath the tubules of the digestive gland. *Ellobium pellucens* and *Melampus coffeus* show that suppression of the posterior digestive diverticulum is not always correlated with the apical position of the hermaphrodite gland. The winding spermoviduct (s) or little hermaphrodite duct has a dilatation, the ampulla or seminal vesicle, in our material only slightly distended by sperm. Farther in front the spermoviduct running along the albumen gland (a) lodges a fold which separates a seminal groove from the female way. This short section may be called a large hermaphrodite duct. It merges (em) into the region between the albumen gland and mucus gland (g), where it bifurcates into male and female ducts, both ciliated.

The albumen gland (a) is a massive organ with a folded lumen as in *Leucophytia bidentata* (Morton 1955c, f. 10); it has not the character of a duct. The entrance of the large hermaphrodite duct must be assumed to be the site of fertilization, though a special chamber was not recognizable. The albumen gland contains red-staining gland cells between which ciliated ones are scattered. The following winding section, the posterior mucus gland (g), has more or less intensely blue-staining gland cells, also with ciliated cells in between. Above the albumen gland is ivory, the mucus gland yellowish. The next part of the female duct, the anterior mucus gland (nn), runs rather straight forwards to the female aperture (y). The outermost section of the anterior mucus gland is nonglandular, this strongly muscular part may be called nidamental duct or vagina. At its inner end the ciliated bursa canal (cu) originates. This narrow, long tube ends with the bursa copulatrix (b) located at the level of the albumen gland. The bursa canal and ampulla are empty in our material. The female aperture lies outwards of the pallial sep-

tum, the closing membrane of the mantle cavity. Here on the right side a cutaneous fold (Fig. 1, rv) extends from the female opening towards the head where it ends behind the right oral lappet (ro). The fold covers a groove with dense cilia. In the connective tissue of the fold runs the completely closed male duct as in *Leucophytia bidentata* and *Ovatella myosotis* (Morton 1955c, p. 113, 129).

The male duct (e) goes out from the seminal groove of the hermaphrodite duct. As a ciliated and muscular tube it runs embedded in the posterior mucus gland, and farther in front courses along the anterior mucus gland (nn). In the latter section its epithelium is glandular in *Blauneria heteroclita*, whose reproductive organs are similar to those of *Ellobium pellucens*. In the latter species the nonglandular continuation of the anterior mucus gland, the nidamental duct or vagina, and the efferent duct are surrounded by a common layer of circular muscle fibres. A little inward from the female aperture (y) the male duct (e) is united with the bursa canal (cu) by a minute tube, the junction duct (am).

This duct recalls the canalis junctor of the Vaginulidae (Hoffmann 1925, p. 74) which passes from the efferent duct to the bursa ampulla. As for these slugs the function of the junction duct is not known in *E. pellucens*. It might serve for internal self-fertilization without copulation which occurs in higher limnic Basommatophora (Boettger 1944, p. 398-99), or possibly abbreviate the way of alien sperm from the bursa through the male duct to the site of fertilization (Hoffmann, l. c.) Among the ellobiids subdeveloped and supradveloped male copulatory organs are known (Morton 1955c, p. 144-45; 1955b, p. 149). These make self-fertilization without copulation understandable. In certain pulmonates the male germ cells must pass through the bursa to become ready for fertilization (Simroth & Hoffmann 1912, p. 614; 1927, p. 1128 ff.; Boettger, l. c.)

From the level of the female aperture (y) the efferent duct (e) runs in the above-mentioned right side fold (Fig. 1, rv), bends inwards near the male aperture (mi), passes under the nerve ring, accompanies the penis enclosed in the outer musculature of its wall, describes a spiral around it, and enters the penial papilla (Fig. 15, d) at the point where the retractor (re) inserts on the penial sheath (p). The retractor originates in the middle of the nuchal region, in

the contracted snail dorsally to the buccal bulb (uu) The contracted muscle is 0,7 mm long, and the length of the penis from the origin of the retractor to the male opening (mi), 3,4-4 mm. In *Melampus coffeus* the retractor measures 1,2 mm, the penis about 12 mm. The shape of the penial papilla (d) varies according to contraction, sometimes it is a short cone surrounded by the sheath (p) as in Fig. 15, or it projects from it with its needle-like tip. The sheath is connected with the skin by the eversible preputium (qi) The lining of the proximal, after eversion distal, part of the preputium is glandular, the following one a low epithelium.

Odhner (1925, p. 6-7) and Morton (1955b, p. 147), who only had a very small material of *Ellobium subnodosum* and *E. aurisjudae* (one specimen) respectively, attribute to these species a common spermoviduct which reaches the female aperture. They call the glandular tube that topographically corresponds to the male duct of *E. pellucens* an "uterus" whose function is not known. In view of this discrepancy we have carefully examined, in sections and dissected snails, the continuity of the tube (e) which runs along the anterior mucus gland (nn), crosses its outermost section and enters the penis.

Ewald (1963) was the first to find the spawn of *Ellobium pellucens*. We described it independently in the same year (Marcus 1963, p. 43, f. 3-8)

Blauneria heteroclita (Montagu, 1808) (Figs. 17-29)

Occurrence: Cananéia (25° 01' S, 47° 50' W)

Further distribution: Bermudas; Southeastern States of North America; Mexico, Yucatan Peninsula; West Indies. Its mention in the original description as from Dunbar, Scotland, is erroneous (Fischer & Crosse 1880, p. 6), though Dall (1886, p. 287) still indicates the species as introduced into England.

As there is only one genus of the Ellobiidae with a sinistral shell, and a single species on the coasts of the western warm Atlantic, the classification needs no discussion, though the minute fold of the columellar lip of our shells is not mentioned in the earlier descriptions.

The species was found in the previously described supralittoral fringe in front of the garden of the Base, together with *Melampus*

coffeus, *Detracia parana*, *Ellobium pellucens*, and *Assiminea succinea vina*. However, the snails were much more frequent in another biotope, about 40 m from our original collecting site. There, together with other garbage of the garden, banana stalks are heaped on the beach, and between the rotting sheaths of the leaves the snails hide and feed on the slimy surface layer. We took the stalks out of the deeper layers of the heap, where regular high tides flood them. We gathered hundreds of snails and found eggs in June 1963. Negative phototaxis is strongly pronounced in *B. heteroclita*. Of the accompanying snails *Assiminea succinea vina* was very common in this biotope; *M. coffeus* and *D. parana* occurred too, and also *Ellobium pellucens* was found there.

Shell (Figs. 17, 18, 20)

Coiling sinistral. Proportion between length and breadth about 3:1 in adult shells, young ones much broader, lenticular. Present shells up to 7 mm long and 2,2 mm broad, smallest shell 0,36 mm. Shape turreted, ovate elongate, large shells broadest in front of middle, smaller ones in middle. Colour whitish, periostracum thin, colourless. Texture transparent, delicate. Up to 7 smooth, almost straight whorls with faint growth lines. Apex large, a little inclined, often eroded and then closed secondarily. Body whorl 2/3 of total length, spire conical. Sutures shallow, but distinct, appressed.

Aperture about thrice as long as broad, and 42-60% of shell height; rounded in front with a slight notch, narrow and pointed behind. Outer lip smooth, sharp. Columella twisted, with a weak fold. A stronger fold on parietal lip, and a thin callus on parietal region.

The resorption of the internal calcareous walls, first described by Crosse & Fischer (1882, p. 179, pl. 8, f. 8), destroys the partitions, except the inner wall of the body whorl (Fig. 18), leaving only an apical ridge. This ridge covered with folded periostracum cuts a spiral groove round the visceral mass as in *Ellobium*. The reduction of the columella goes farther outwards than in *Melampus* and *Detracia*, as is shown by Fig. 25 with the pallial cavity extending far beyond the folded remains of the periostracum.

The diameter of the first whorl is 0,25 mm. It is dextral; the direction of the coiling is reversed, when the shell is 0,4-0,5 mm long (Marcus 1963, p. 43, f. 2)

Head, foot (Figs. 19, 23) and locomotion

The body is whitish. The black eyes, the yellowish brown digestive gland, and the dark brown contents of the intestine can be seen through the shell; when the latter is removed, also the yellow mandible, the silky white stomach, and the orange gonad are visible. The snout is short; the oral lappets are broadly rounded. The shape of the cylindrical tentacles varies rapidly, they may be slender and finger-like or short contracted cones. The tentacular adductors are longitudinal fibres of the dermal layer, contrary to *Ellobium pellucens* whose retractors run free through the lumen of the tentacle. The tentacle nerve is simple, undivided. The fold (Fig. 29, rv) mentioned in *Ellobium pellucens*, that begins at the female aperture, occurs in *Blauneria heteroclita* too. Here it extends farther forwards than in our first species. It runs on the left oral lappet and ends near the median notch. The closed male duct embedded in the connective tissue of the fold, and the ciliated groove covered by it are the same as in *E. pellucens*.

The foot is as broad as the shell and half its length. Under the mouth opens the anterior pedal gland (vo) whose secretion lubricates the food. In sections stained with haematoxylin-eosin a red pad (wi) of subepithelial granular gland cells with a few blue ones in between lies on the back of the foot. While the epithelium is 6 μ high, the gland cells are 50-80 μ long. Such principally protein-producing glands are known in terrestrial and aquatic gastropods, e. g., in the amphibious *Succinea putris* (Mazek-Fialla 1933, p. 457, 466); generally their secretion is considered to be protective, repugnatorial, or antiseptic (Graham 1957, p. 138-139). In *Ellobium pellucens* the same glands are not so concentrated, but also present in the middle of the back of the tail; in *Melampus coffeus* they are not developed. The anterior pedal border of *B. heteroclita* is truncated, slightly concave in the middle, and furrowed transversely; the posterior end is pointed. About the end of its anterior third the foot has a transverse groove

(n) previously questioned by Fischer & Crosse (1880, p. 5) and Dall (1886, p. 287) As the related *Leucophytia bidentata* with a transverse pedal groove and *Ellobium pellucens* without it *B. heteroclita* glides without stepping. The wave of contraction which originates at the hind end of the foot stops for a moment when it reaches the groove, but then continues to the anterior pedal border. The alternate affluence and effluence of blood into and from the pedal lacunae modify the shape of the sole.

Mantle and pallial organs (Fig. 25)

The anterior cavity, Régondaud's supranuchal cavity (1961, p. 180), overhung by the mantle skirt, is roomier than in *Ellobium pellucens* and lodges the withdrawn head, oral lappets, and the fore end of the foot. The epithelium on the inner side of the free mantle edge contains high gland cells as in our previously described Melam-podinae. The tripartition of the mantle edge, evident in *E. pellucens*, is not developed, only an inconspicuous mantle groove (Fig. 23, mv) is marked. The left side pneumostome (us), lying together with the orifice of the anal groove on the posterior lappet, and the pallial septum (se) correspond to those in *E. pellucens*. This holds also for the glandular and ciliated area (ac) inside the pallial opening and the longitudinal folds of the anal groove (ve), whose cilia lead the faeces to the edge of the mantle.

The strip (xi) of the roof of the mantle cavity between the rectum and the kidney is the principal respiratory area. Here a series of small blood lacunae extended from left to right is overlain by longitudinal muscle fibres whose contraction and relaxation impel the blood from the intestine to the kidney and atrium. The kidney (k) bears clusters of villi (vs) on both outer and inner walls as in *E. pellucens*. As in that species the renal pore (no) is located near the pneumostome and the ciliated reno-pericardial canal on the opposite, right, side.

Cilia others than those on the glandular area (ac) inside the pallial opening are not developed in the mantle cavity, nor is its roof pigmented. A hypobranchial gland is absent like in *Leucophytia*

bidentata and *E. pellucens*, nor are there pallial glands of the types described for *Pythia*, *Ovatella*, and *Carychium*.

The juvenile stages of rhabditoid nematodes, that we found in *Assimineia succinea* *vina* from the same biotope, occur also between the mantle and shell of *Blauneria heteroclita*.

Central nervous system (Fig. 28)

The asymmetrical nerve ring and the visceral loop of *B. heteroclita* are very similar to those of *E. pellucens*, and the general aspect approaches the central nervous system of *Leucophytia bidentata* (Morton 1955c, f. 31) too. Corresponding to the sinistral coiling the nerve ring and visceral loop are displaced to the left side. The left cerebropedal and pleuro-parietal (supra-intestinal) connectives are shorter than the corresponding right ones. The especially short distance between the pedal and pleural ganglia lies on the right side in *B. heteroclita*.

The cerebral ganglia (ce) have distinct lateral lobes, whose connexions with the epidermis, the cerebral tubes, are still recognizable as cellular strands (rs) in full grown snails. Also in *Ellobium pellucens*, *Trimusculus*, and others the cerebral tubes persist in adult animals (Schumann 1911, p. 54; see also Hanström 1928, p. 184). The cerebral ganglia are far distant from one another and a little larger than the broadly contiguous pedal ganglia (ea). The tentacular and the optic nerves have a common root as in *Ellobium pellucens*, *Melampus fasciatus* (Meyer 1955, f. 14), and probably also *M. semisulcatus* (Knipper & Meyer 1956, f. 8). The cerebro-buccal connectives and the buccal commissure are long.

In the visceral loop there are three ganglia besides the pleural ganglia, a small one (zi) in the middle which corresponds to the left parietal ganglion in *Leucophytia* and *E. pellucens*, and two big, almost contiguous ones on the left side. These are homologous with the right parietal or supra-intestinal (zr) and the abdominal ganglion (as) of *Leucophytia* and *Ellobium*. In *L. bidentata* these ganglia are united by a short connexion; in *E. pellucens* this part of the visceral loop is longer. The parieto-abdominal connexion of *B. heteroclita* is shorter than the corresponding tract in *Leucophytia* and longer than in *Ellobium*.

Alimentary canal (Figs. 21-24)

The compact jaw (Fig. 21) is light brown with a darker anterior thickened border. From right to left it measures 0,18 mm, and in antero-posterior direction 60μ .

The radula (Fig. 22) comprises about 70 rows and is 0,72 mm in length, 0,32 mm in breadth. Each half-row contains 18-20 teeth. Coalescence of teeth or suppressed cusps are frequent along whole longitudinal rows. The small rhachidian tooth (R) is a short, broad triangle, with a tongue-shaped cusp, convex sides and a deeply excavate base. The mesocone of the lateral and marginal teeth is long and surpasses the length of the base, especially the broad rectangular one of the marginal teeth. The endocones of all teeth are basal. As they are not recognizable in Fischer & Crosse's figure of the marginal teeth (1880, pl. 36, f. 2), *Blauneria* was placed with a wrong group in Odhner's key (1925, p. 14) where it stands under group II A "marginal teeth with apical endocone". Whether the minute outer angle of the cusp should be called an ectocone appears doubtful.

The salivary glands agree with those of *E. pellucens* in their openings into the buccal bulb, attachment to the oesophagus, and general shape, though they are less knobby. The longitudinal folds of the unpigmented oesophagus (Fig. 24, o) end at the right-sided oesophageal atrium (or). The long duct (va) of the digestive gland which consists of few big acini distends the atrium forwards and obliquely to the right in many of the dissected snails. The small anterior chamber of the stomach, which is ciliated, contains one cushion in the right, oesophageal, and two in the left, pyloric, half.

The gizzard with its circular muscles (rm) and the lining folded cuticle is the same as in *E. pellucens*, but the ceiling of the stomach is different. *B. heteroclita* has no posterior digestive diverticulum and a much larger semiglobular caecum (ca) at the top of the gizzard. This muscular caecum can be introverted into the gizzard like in *Leucophytia bidentata* (Morton 1955c, p. 102) as a plug whose apex reaches the anterior gastric chamber. In extroverted position the ciliated epithelium of the caecum is thrown into numerous longitudinal folds, so that its lumen is stellate in transverse section. When

the caecum is introverted, the folds disappear, and the ciliated epithelium coats the plug. The action of these cilia could not be seen.

The transverse ciliated ridges of the pylorus and the intestinal groove originating between the cushions described for *E. pellucens* occur in *B. heteroclita* too. The groove disappears in the first, rather straight section of the intestinal course whose width varies. The intestine continues with an 8-shaped loop around the digestive gland and finally runs along the upper margin of the body whorl. This rectal section is surrounded by a blood sinus and ends, as in *E. pellucens*, inside the aperture of the pallial cavity. Also the folded ciliated anal groove and the thick, ciliated pads of pneumostomatal glands (ac) inside the pallial opening are the same in both species.

Reproductive organs (Figs. 27-29) and spawn

The ovotestis (w) is the most apical organ; it is visible through the shell as an orange, rather compact mass. Snails with a shell length of 3 mm or more contained big germ-cells in June 1962 and 1963 as well as in January 1963. The ovocytes are principally apical and peripheral, the spermatocytes anterior and central.

The anterior wall of the gonad narrows like a funnel whose tube is the ciliated hermaphrodite duct (s), slightly dilated by sperm. At its entrance into the albumen gland (a) the hermaphrodite duct forms a spacious fertilization chamber (r) lined with 60μ long cilia. At this point large subepithelial blue-staining gland cells form the bifurcation gland (Morton 1955c, p. 112). The albumen gland of mature snails consists of compact lobules, whose cells are tightly packed with secretory spherules. The gland cells of the posterior mucus gland (g) which originates from the fertilization pouch stain bluish-greyish, distinctly different from the bright blue cells of the bifurcation gland. In January 1963 eggs were seen in the folds of the posterior mucus gland. This part of the oviduct is ciliated along its entire length. It courses forwards with broad windings in oblique transverse direction, while the anterior mucus gland (nn) runs nearly straight.

The outermost part of the female duct is a spacious genital vestibulum without glands, lined with cilia and coated by muscles.

It opens (y) under the mantle skirt, just in front of the pallial septum, on the left side. From the atrium the canal of the bursa (cu) goes out as a long and narrow tube. The globular ampulla of the bursa (b) lies on the level of the albumen gland, in front of an intestinal loop and behind the heart. The epithelium of the bursa is high, when the organ is empty, and its nuclei, 8μ in diameter, are exceptionally big in comparison with those of the other organs whose cells are small in *B. heteroclita*. When the bursa contains sperm, its epithelium is low. Morton (1955c, p. 114) described the secretion of the bursa epithelium in *Leucophytia bidentata*.

The efferent duct (e) goes out from the fertilization pouch and runs over the posterior mucus gland. From this level and along the anterior mucus gland the male duct is glandular, prostatic. Around the efferent duct and the nonglandular distal part of the anterior mucus gland, the so-called vagina (Morton 1955c, p. 113), there is a common investment of circular muscle fibres. The male duct communicates with the bursa canal immediately behind the origin of the latter by a minute pore (am). In front of the female genital aperture the efferent duct runs embedded in the connective tissue of the fold (rv) described together with the organs of the head. This section of the male duct is a narrow, thin-walled, slightly sinuous tube. It courses towards the right side and reaches the penis at the base of the left tentacle. The tubular copulatory organ is 0,8-1 mm long, it courses from the level of the left to that of the right tentacle, where it turns to the left again. The efferent duct runs intimately apposed to the muscular wall of the copulatory organ, the preputium (qi) and penial sac, and enters its fundus where the retractor (re) inserts. This muscle is 0,2-0,3 mm long in contracted condition. The short penial papilla (d) is almost cylindrical; it is surrounded by a wide sheath (p). The tip of the papilla projects into the tubular preputium, whose epithelium is not glandular.

In June 1963 spawns of 2, 3, 4, and 10 eggs were found fastened to dead leaves. They resemble those of *Ovatella myosotis* (Meyer 1955, f. 24; Morton 1955c, f. 21). The largest spawn was 1,6 mm long and 1 mm broad; the egg capsules measured 0,5-0,56 mm. The diameter of the eggs begins with 0,1 mm and increased

about 0,01 mm a day (average temperature 18-20° C.) On the 12th day the embryo was 0,24 mm long.

On the third day the stage of 64 cells was completed, on the 6th day the embryos rotated, and on the 7th day the bilobed velum was recognizable. First the velum increases in size and is reduced later on. After about 3 weeks the metamorphosized snails hatch with a lenticular shell 0,35 mm in greatest diameter and consisting of one-and-a-quarter of a whorl. The hatching snails still have their larval operculum. This organ persists to a shell length of 0,68 mm and is shed when 0,7 mm.

General remarks

The internal shell resorption with a consequently compact visceral mass has proceeded far in *Ellobium pellucens* and *Blauneria heteroclita*, but only in the latter the posterior digestive diverticulum has disappeared. Further advanced characters of *E. pellucens* are: the retractile tentacles, the absence of a hypobranchial gland, the reduction of cilia in the pallial cavity, and the radula. The latter is rather homodont in *Ellobium*, but the small number of teeth per row, the reduced rhachidian tooth, and the broad, feebly denticulate lateral and marginal teeth suggest a secondary simplification (Odhner 1925, p. 12-13) Knipper & Meyer (1956) found a compact mandible (f. 9) in *Auriculodes gaziensis* securely defined as primitive by its central nervous system (f. 6) and reproductive organs (f. 12) Therefore they regard the dissolved jaw of *Melampus* as secondary and, on the whole, do not attribute phylogenetic value to the jaw. The stomach of *E. pellucens* is essentially pulmonate, advanced, but contains several archaic remnants, as described in the preceding.

The same holds for the reproductive organs. The internal separation of the male and female ducts is an important and advanced character. Advanced too is the apical position of the ovotestis. However the penis of *E. pellucens* and *E. subnodosum* (Odhner 1925, p. 7, pl. 1, f. 10) is much simpler than in *E. aurisjudae* (Morton 1955b, p. 149) In these three examined species of *Ellobium* the efferent duct runs along the male copulatory organ, and the same

applies to *Blauneria*, *Ovatella*, *Carychium*, and *Auriculodes*, to judge from the figure (Knipper & Meyer 1956, f. 12). In *Pythia*, *Marinula* (Robson 1915; Odhner 1925), *Leucophytia*, *Melampus*, and *Detracia* the duct is separated from the male organ. As in two ellobiid genera with on the whole primitive reproductive organs, *Ovatella* and *Pythia*, the distal male duct courses differently, this disposition can hardly be discussed from a phylogenetic point of view.

As mentioned in our paper on *Melampus* and *Detracia* a distally inserted bursa is a primitive feature, if the most primitive reproductive organs, those of *Pythia* and *Auriculodes*, are compared. The bursa canal is a part of the female duct. Hence the junction canal of *E. pellucens* could be understood as a remnant of an ancient common spermoviduct (Plate 1897, p. 135). Similar connexions exist in primitive mesogastropods (Johansson 1948, f. 14; 1956, p. 462) and in the above-mentioned Vaginulidae. The specialized character of accessory genital glands does not occur in *Ellobium pellucens*.

The central nervous system is unconcentrated, and remains of cerebral tubes in adult snails are primitive too. Though shorter than in *Pythia* and *Auriculodes* the visceral loop is long, and its ganglia are widely spaced; these are primitive features. The simple kidney seems to be primitive too, as there are no signs of a secondary simplification.

The family Ellobiidae forms a natural group (Morton 1955b, p. 156), it is true, a rather polymorphous one (Plate 1897, p. 120). If the shell resorption, heterostrophic apex, special pallial glands, nerve ring, visceral loop, buccal armature, stomach, reproductive organs, direct development or free swimming larvae, and habitat are all considered together, one cannot recognize a most basal, and still less a most advanced genus. Moreover some conchologically separated genera, as *Melampus* and *Detracia*, are anatomically less different than the three studied species of the genus *Ellobium*. Several genera, e. g., *Leucophytia* and *Blauneria*, are judged by single species. Under these circumstances the establishment of the subfamily Ellobiinae (Morton 1955b, p. 158) must be provisional. Evidently *Blauneria* can tentatively be included in this subfamily whose important features are:

Body whorl high, outer lip smooth, 1-2 folds of inner lip, high degree of resorption of internal shell partitions, absence of hypobranchial gland, middle-long visceral loop, invertible gastric caecum (also in *Melampodinae*), and apical position of ovotestis. Due to the above-mentioned descriptions of the spermoviduct and uterus of *E. sub-nodosum* and *aurisjudae* the reproductive organs cannot be used as characters of the subfamily, though they are very similar in *Leucophytia bidentata*, *Ellobium pellucens*, and *Blauneria heteroclita*.

A transverse groove of the foot, a small parietal ganglion, the supra-intestinal and abdominal ganglia very near to one another, the absence of a posterior digestive diverticulum, and a long, pouch-like gastric caecum are characters of *Blauneria heteroclita* that approach it to *Leucophytia bidentata*. In the lateral cerebral lobes, jaw, radula, ciliated cushions of the anterior gastric chamber, and the communication between the male duct and bursa canal *B. heteroclita* is more related to *E. pellucens*. If the characters of *B. heteroclita* are judged, those of the foot, radula, hypobranchial gland, and liver are advanced; the remains of cerebral tubes, the gastric cushions and the junction canal are primitive. Also the simplicity of the penis appears as a primitive feature, not as a secondary reduction, hence specialization. Simplified male copulatory organs were described of *Otina otis* and *Carychium tridentatum*. With the very small size of the latter species its reduced penis may be correlated (Morton 1955c, p. 155). In *B. heteroclita*, however, all parts of the ellobiidan penis, the papilla, sheath, and preputium (penial sac) are developed, only preputial glands are absent.

The sinistral coil and the above-mentioned peculiarities of the visceral loop are indifferent features of *Blauneria heteroclita*.

RESUMO

Ellobium pellucens (Menke, 1830) e *Blauneria heteroclita* (Montagu, 1808) foram encontrados em Cananéia (25° 01' S, 47° 50' W). A 1a. espécie é nova para o Brasil; a 2a., para o continente sul-americano. Ambas são lucifugas, e vivem no solo coberto por gramíneas altas (50 cm), um pouco acima da preamar regular; *Blauneria* era especialmente numerosa entre troncos de bananeiras amon-

toados na praia. Nas duas espécies a fase de véliger é percorrida no ovo. Jovens de *Blauneria* (0,36 mm) recém-saídos do ovo possuem opérculo que conservam até o tamanho de 0,68 mm, perdendo-o com 0,7 mm. *Ellobium* e *Blauneria* comem matéria vegetal em decomposição, pequenas algas, e micélios e esporos de cogumelos. Locomovem-se rastejando uniformemente; em *Blauneria* cuja sola tem sulco transversal, a contração vinda de trás pára momentaneamente ao atingir o sulco.

As paredes internas da concha são reabsorvidas em grande extensão. Os tentáculos de *E. pellucens* são, em parte, invaginados, não somente contraídos. Glândulas concentradas no dorso do pé de *Blauneria* lembram as repugnadoras conhecidas de muitos gastrópodos. Como em *Leucophytia bidentata* falta glândula hipobranchial, e o orifício anal situa-se internamente à abertura palial, para onde as matérias fecais são conduzidas num rêgo ciliado. No rim, há vilosidades, não lamelas (Melampodinae). As conexões dos lobos laterais dos gânglios cerebrais com a epiderme mantêm-se nos animais adultos. A alça visceral é mais comprida que nas Melampodinae, mais curta que em *Pythia scarabaeus* e *Auriculodes gaziensis*, e contem 3 gânglios, além dos pleurais. Na câmara gástrica anterior há almofadas ciliadas, 1 na metade esofágica, 2 na pilórica, originando-se curto tiflosole entre as últimas. Os cecos, pequeno em *E. pellucens*, grande em *Blauneria*, podem ser invertidos para dentro do estômago mastigador, como em *Leucophytia* e, como nesta, falta o divertículo hepático posterior em *Blauneria*. As vias genitais masculina e feminina separam-se na câmara de fertilização. O duto eferente comunica-se com o canal da bursa copulatrix nas 2 espécies. Do poro feminino para a frente, o duto eferente fechado corre do mesmo modo como em *Leucophytia bidentata* (Morton 1955c). Os órgãos copuladores das 2 espécies são simples, mas completos; somente glândulas prepuciais inexistem em *Blauneria*.

As duas espécies pertencem à subfamília Ellobiinae Morton 1955.

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EXPLANATION OF LETTERS

a — albumen gland	oo — forefoot
aa — supranuchal cavity	or — oesophageal atrium
ac — pneumostomatal glands	ov — anterior cushion
am — junction duct	p — penis sheath
ar — anus	qi — preputium
as — abdominal ganglion	r — fertilization chamber
b — bursa copulatrix	rc — renopericardial duct
c — pericardium	re — penial retractor
ca — caecum	rm — circular muscle layer
ce — cerebral ganglion	ro — oral lappets
ci — mass of conchiolin	rs — remains of cerebral tube
cn — columellar muscle	rv — fold around efferent duct
co — cuticle	s — spermooviduct
cu — bursa canal	sa — salivary glands
d — penial papilla	se — pallial septum
e — efferent duct	si — blood sinus
ea — pedal ganglion	so — sole glands
ei — eye	t — tentacle
em — entrance of hermaphro- dite duct	u — intestinal groove
es — stomach	ue — caecal cushion
ew — renal vessels	ur — pleural ganglion
g — posterior mucus gland	uu — buccal bulb
i — intestine	va — duct of anterior digestive gland
io — hindfoot	ve — anal groove
is — pyloric cushions	vi — ventricle
j — jaw	vn — pulmonary vein
k — kidney	vo — anterior pedal gland
m — mouth	vs — renal villi
mc — pallial cavity	w — gonad
mi — male aperture	wi — glands on back of foot
mr — mantle edge	x — duct of posterior digesti- ve gland
mv — mantle groove	xi — parallel lacunae
n — second pedal groove	y — female aperture
na — tip of tentacle	za — anterior digestive gland
nc — dorsovisceral artery	zi — parietal ganglion
ne — tentacle nerve	zo — posterior digestive gland
nn — anterior mucus gland	zr — supra-intestinal ganglion
no — renal aperture	zz — buccal ganglion
nu — cerebropleural connective	
o — oesophagus	

PLATES

PLATE 1

ELLOBIUM PELLUCENS

- Fig. 1 — Moving snail.
- Fig. 2 — Ventral view of foot.
- Fig. 3 — Big (17 mm) and small (6 mm) shell, drawn to the 10 mm scale.
- Fig. 4 — Transverse section of tentacle.
- Fig. 5 — Anterior view of head.
- Fig. 6 — Contracted fore end.
- Fig. 7 — Retracted tentacle, longitudinal section.

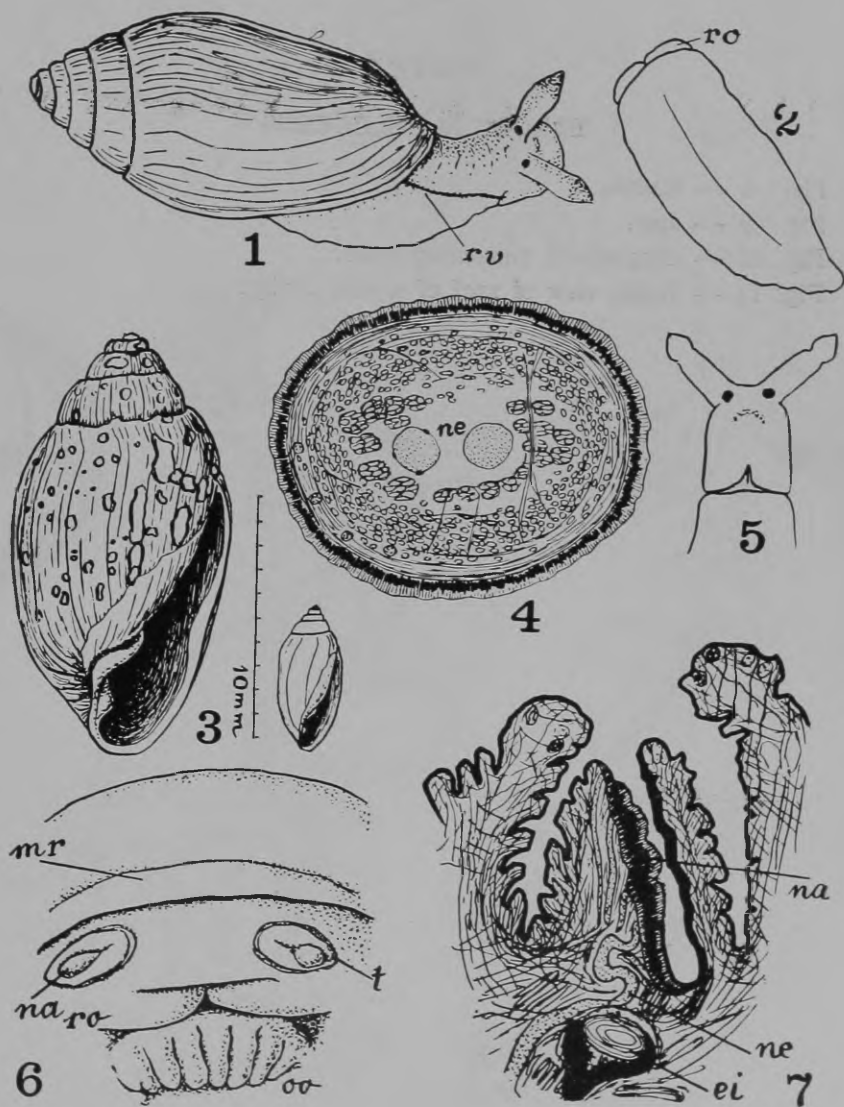


PLATE 2

ELLOBIUM PELLUCENS

Fig. 8 — Radula.

Fig. 9 — Jaw.

Fig. 10 — Diagram of alimentary tract.

Fig. 11 — Inside view of roof of mantle cavity

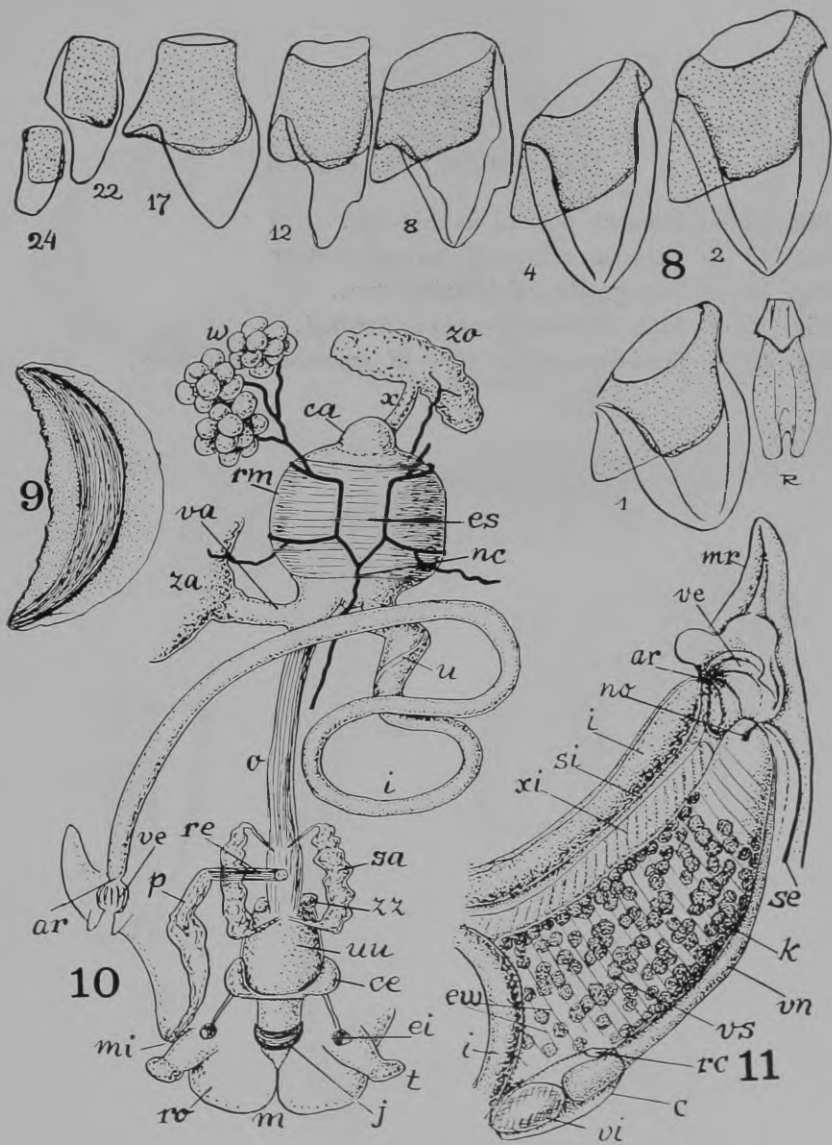


PLATE 3

ELLOBIUM PELLUCENS

- Fig. 12 — Stomach opened in mid-line.
- Fig. 13 — Diagram of central nervous system.
- Fig. 14 — Topography of junction duct.
- Fig. 15 — Male copulatory organ, clarified.
- Fig. 16 — Semi-diagrammatic view of reproductive organs.

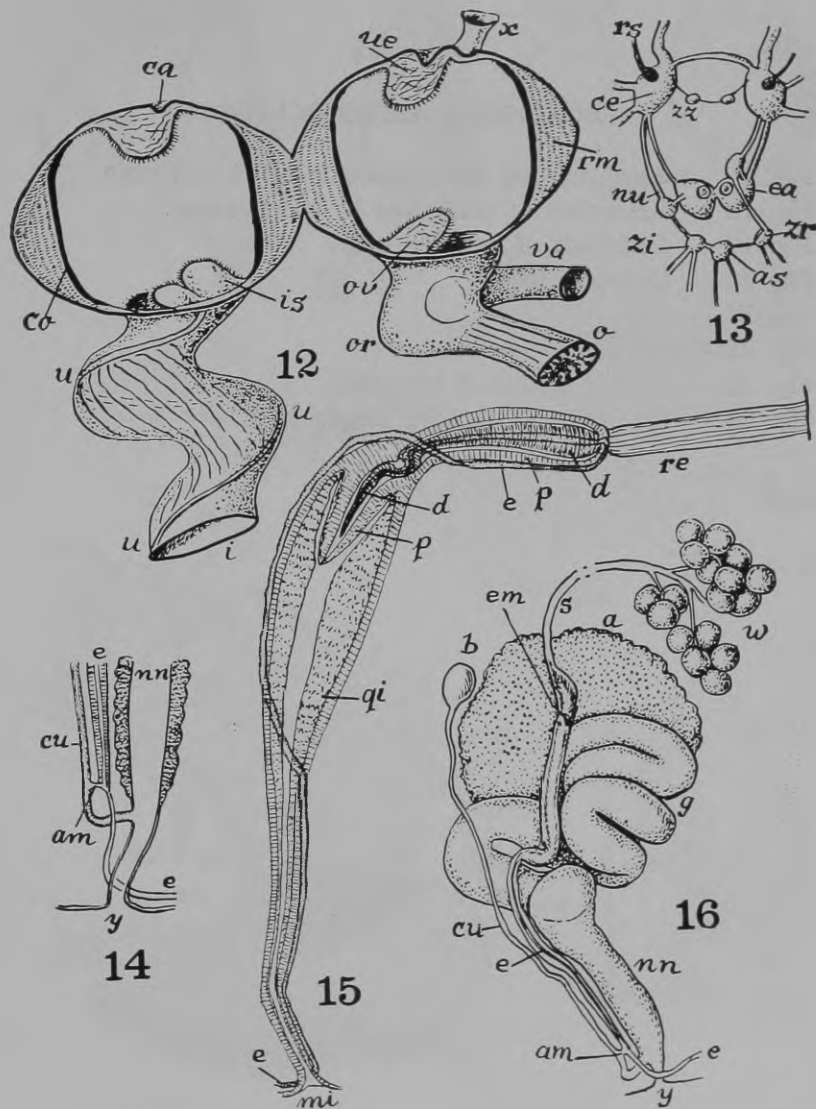


PLATE 4

BLAUNERIA HETEROCLITA

- Fig. 17 — Small and big shell, drawn to the 2 mm scale.
- Fig. 18 — Resorption of shell, seen by transparency
- Fig. 19 — Underside of creeping snail.
- Fig. 20 — Youngest snail.
- Fig. 21 — Jaw.
- Fig. 22 — Radula.
- Fig. 23 — Sagittal section of fore end.
- Fig. 24 — Stomach and digestive gland.

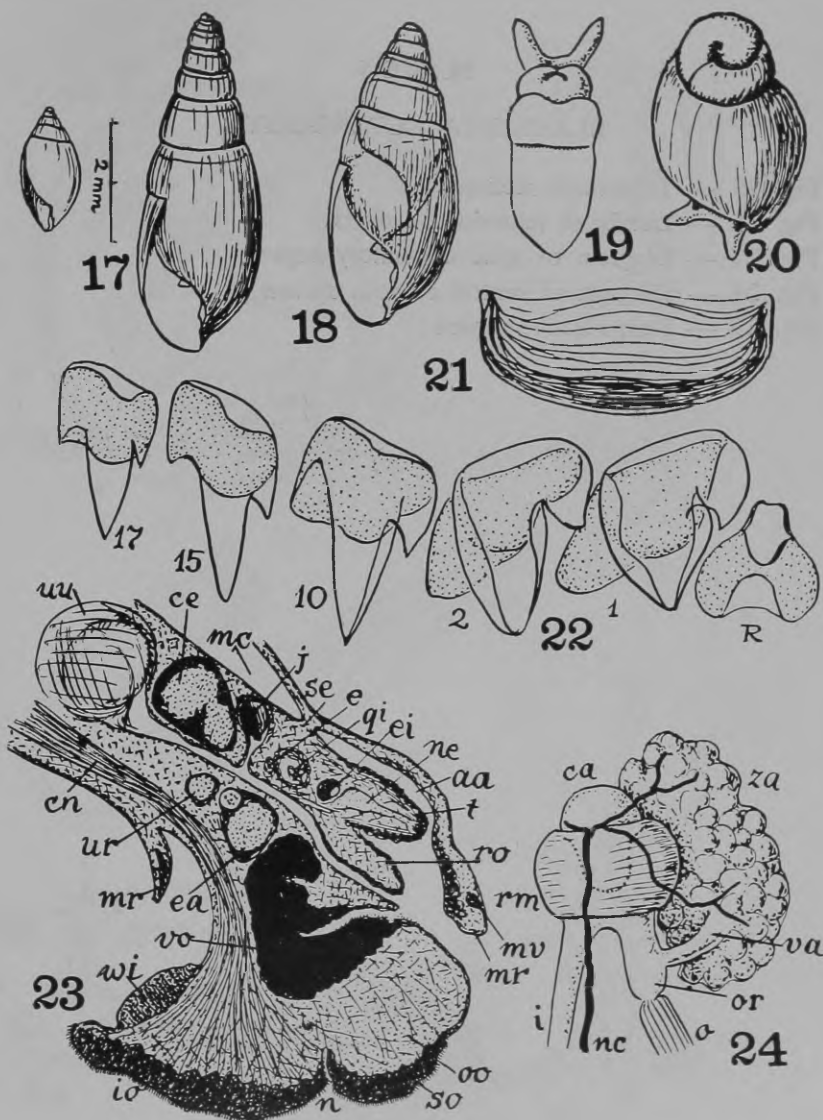


PLATE 5

BLAUNERIA HETEROCLITA

- Fig. 25 — Transverse section.
- Fig. 26 — Details of reproductive ducts.
- Fig. 27 — Diagram of male copulatory organ.
- Fig. 28 — Diagram of central nervous system.
- Fig. 29 — Reproductive organs.

