

The Conchological Society of Great Britain and Ireland

(Founded 1876)

Papers for Students No. 12

KEY TO BRITISH SLUGS

by

A.E.Ellis

Amended and updated by A.Norris, 1st January 1979.

DEFINITION.

Gastropoda in which the shell is either vestigial or absent; when present, the reduced shell is usually enclosed within the mantle, or if external is incapable of containing the entire body of the animal. The internal shell is a white, oval plate marked with lines of growth; in Arion the shell is represented by loose chalky granules. The line of demarcation between snails and slugs is not clear-cut; most conchologists regard Testacella, Daudebardia and Farmacella as slugs and Vitrinidae as snails, though the intermediate position of the last is indicated by names such as Semilimax, Helicolimax and Phenacolimax (Greek phenax, impostor). The families of slugs are not closely related and have evolved from diverse groups of shell-bearing ancestors. The land slugs, with which this key is concerned, belong to the subclass Pulmonata, and are not connected, except in so far as they are gastropods, with sea slugs, which are opisthobranchs.

CLASSIFIED LIST

The classification is based on that of Quick (1960),
updated after Waldén (1976)

Superfamily Oleacinacea

Family Testacellidae

Testacella (Cuvier) Draparnaud 1801

Testacella (Testacella) maugei Ferussac 1819

" " haliotidea Draparnaud 1801

" " scutulium Sowerby 1821

Superfamily Endodontacea

Family Arionidae

Geomalacus Allman 1846

Geomalacus maculosus Allman 1843

Arion Ferrussac 1819

- Arion (Arion) ater (Linnaeus 1758)
" " rufus (Linnaeus 1758)
" " lusitanicus Mabilie 1868
" (Mesarion) subfuscus (Draparnaud 1805)
" (Carinarion) circumscriptus Johnston 1828
" " silvaticus Lohmander 1937
" " fasciatus (Nilsson 1823)
" (Kobeltia) hortensis Ferrussac 1819 (1).
" " 'A'
" " 'B'
" " intermedius Normand 1852

Superfamily Zonitacea

Family Milacidae

Milax Gray 1855 (2).

- Milax (Milax) gagates (Draparnaud 1801)
" " nigricans (Schultz in Phillipi 1836)
" " sowerbyi (Ferrussac 1823)
" " budapestensis (Hazay 1881)

Boettgerilla Simroth 1910

Boettgerilla pallens Simroth 1912

Family Limacidae

Limax Linnaeus 1758

- Limax (Limax) maximus Linnaeus 1758
" " cinereoniger Wolf 1803
" (Limacus) flavus Linnaeus 1758
" " pseudoflavus Evans 1978
" (Malacolimax) tenellus Müller 1774
" (Lehmannia) nyctelius Bourguignat 1861*
" " marginatus Müller 1774
" " valentianus Ferrussac 1823*

Deroceras Rafinesque 1820 (3).

- Deroceras (Deroceras) laeve (Müller 1774)
" (Agriolimax) agreste (Linnaeus 1758)
" " reticulatum (Müller 1774)
" (Malino) caruanae (Pollonera 1891) (4).

* = greenhouse aliens.

Notes: (1) Recent work by S.M.Davies has produced evidence that Arion hortensis is an aggregate of three species. (Not yet named).

(2) Milax is placed in the family Limacidae, subfamily Parmacellinae by Quick (1960) and in the subfamily Milacinae of Limacidae by Germain (1930).

(3) Deroceras Rafinesque has been brought into use for this genus in line with most Continental authors, reducing Agriolimax to subgeneric status.

(4) The name caruanae has been used in this key, as the correct name for this species is not yet certain. Most Continental authors now use the name pollonerai Simroth 1889, but an even earlier name panormitanum Lessona and Pollonera 1882 may prove to have priority; provided it proves to be synonymus with caruanae.

MEANS OF IDENTIFICATION

Although most species are recognizable by external appearance, for some dissection is necessary to confirm identification. While organs such as the radula, intestine and retractor muscles are of diagnostic significance, the genitalia probably afford the most reliable specific characters. The following glossary includes structures which are referred to in this key. The general plan of the reproductive system is illustrated by the drawing of that of Testacella haliotideae; organs not found in Testacella are marked with an asterisk.

GENITALIA: GLOSSARY

*Atrial glands: mass of coiled tubular glands connected with the atrium in Milax; vaginal glands (Quick 1960, p.203).

Atrium: vestibule or chamber into which the genital ducts open, itself opening to the outside by the genital pore near the front of the animal on the right-hand side.

*Epiphallus: in Arionidae and Milax, the dilated part of the vas deferens in which the spermatophore or sperm-packet is secreted.

*Ligula: a structure formed by folds of the lining of either the upper (proximal) chamber of the atrium (Arion ater) or of a dilated section of the oviduct (Arion hortensis, A.subfuscus, A.lusitanicus), which is extruded in copulation to unite the two conjugants.

Oviduct: tube through which eggs pass to the atrium or the vagina; in this key the term refers to that portion (free oviduct) which is separate from the sperm-duct.

Ovotestis: the hermaphrodite gland or gonad, situated on the 'liver' or digestive gland, in which both ova and spermatozoa are

formed.

*Penial appendage: simple or branched hollow outgrowth from the hind (proximal) part of the penis in Deroceras, everted in copulation.

*Penial caecum or diverticulum: conical or cylindrical blind tube projecting from proximal end of penis in some species of Limax.

Penial flagellum: blind tube, to which retractor muscle is attached, arising from proximal end of penis where vas deferens enters, in Testacella haliotidea.

Penis: eversible intromittent organ (absent in Arionidae).

Spermatheca or seminal receptacle: sac for storing spermatozoa received from another individual.

*Spindle: the name given to the swelling found on the vas deferens in Boettgerilla.

*Stimulator: protrusible organ situated either in atrium (corniform body of Milax) or in distal portion of penis-sac (sarcobelum of Deroceras).

Vagina: common duct formed by union of oviduct and spermatheca duct in Testacella and Milax.

vas deferens: narrow tube leading from prostrate (section of sperm-duct united with oviduct) to either penis or epiphallus.

KEY TO GENERA

1. Ear-shaped external shell at hind end TESTACELLA
No external shell; mantle near front end 2
2. Mantle granular or shagreened; epiphallus present 3
Mantle concentrically wrinkled (like a thumb-print) 5
3. Mantle with central rhomboidal area bounded by a furrow;
very prominent mid-dorsal keel; atrial glands present MILAX
Mantle without central demarcated area; back not keeled;
no penis 4
4. Spotted or dappled with white; internal shell
present GEOMALACUS
Not maculate; usually banded if only when young; internal
shell represented by chalky granules ARION
5. Size 30-60 mm; body very narrow in relation to length,
rarely more than 5 mm broad. Colour white to bluish-grey,
mantle shield in the form of a slightly rounded V at hind
end; spindle present on vas deferens BOETTGERILLA
Not as above. 6
6. Under 35 mm.; nucleus of mantle wrinkles on right side
above breathing hole; hind end faintly keeled;
obliquely truncated DEROCERAS
Larger; nucleus of mantle ridges median; not truncated LIMAX

Note Limax tenellus is about the size of a large Deroceras.

TESTACELLA

Predacious slugs feeding mainly on earthworms. Body narrowing towards front end; pair of longitudinal dorsal grooves from which arise branching grooves like leaf-veins; tentacles not bulbous at tip; breathing hole and anus near hind end; no jaw; buccal bulb very large with powerful muscles; radular teeth, sharp, barbed on outer side.

Chiefly in gardens; T. maugei mainly in SW, the other two more widely distributed, including central Scotland 'rare'. (The range of all Mollusca which tolerate or even prefer cultivation has been greatly extended by human agency.)

Key to Species of Testacella

1. Shell c.14mm. in length, oblong; hinder part of body very deep and broad; dorsal grooves c.5mm. apart at their origin in front of shell; spermatheca duct long, dilated distally; vas deferens convoluted proximally; penis long, dilated proximally, without a flagellum; vagina short T. maugei
Body more flattened, whitish; shell 7mm. or less, oval triangular; dorsal grooves arising close together; spermatheca duct short; vas deferens not coiled; penis not dilated 2
2. Shell c.7mm. long; penis with flagellum; spermatheca duct short and wide; vagina long T. haliotidea
Shell c.6mm. long, flatter; no penial flagellum; vagina very long; spermatheca duct longer and narrower T. scutulum

ARIONIDAE

Usually a pair of lateral bands, if only in the young; breathing hole in anterior half of mantle; foot-fringe wide; caudal mucus gland; jaw crescentic, ribbed; no stimulator.

Geomalacus maculatus is unique in its spotted colour scheme. The animal is very extensible and can also curl up like some woodlice and caterpillars. Genital atrium with a long backward prolongation or diverticulum. This remarkable slug is confined to rocky hillsides in W. Kerry and north of Bantry Bay, Co. Cork, where it browses on Algae and Bryophytes.

The species of Arion are generally distributed, though the range of the more recently recognized species is as yet imperfectly known; most occur in both cultivated and wild places, including woods; A. hortensis is a common garden pest, as is form 'A' of this species complex; A. ater is even found on moors.

Key to Species of Arion

1. Very small (20mm.), conical tubercles give a prickly appearance; no ligula; spermatheca spherical A.intermedius
Length over 25mm.; not 'prickly' 2
2. Medium size (25-70mm.); fairly smooth 3
Over 70mm.; dorsal rugae prominent 9
3. Length 60-70mm.; orange-brown with darker lateral bands, slime yellow; distal part of oviduct dilated, containing ligula; spermatheca spherical A.subfuscus
Length 25-50mm.; grey (sometimes tinged with yellow) or black 4
4. Black or dark brown, sole yellow or orange; length 25-30mm. sides vertical so that body is hoop or inverted U-shaped in cross section and foot-fringe is invisible from above; hind end narrow (most marked when dead); right mantle band surrounding breathing hole; spermatheca spherical; ligula in dilated part of oviduct A.hortensis egg.
(note; segregates of the three species in the hortensis complex can only be satisfactorily separated by dissection.) 5
Grey or tinged with yellow, sole white; length up to 50mm.; lines of raised tubercles in mid-dorsal line; right mantle band arching above breathing hole; body bell-shaped in cross section so that foot-fringe is visible from above; hind end broad, bluntly rounded; spermatheca conical or flask-shaped; no ligula; oviduct not dilated 7
5. Colour typically brown with distinct bands and greyish sides; dorsal rugae coarse, rather sharply ridged or angled; a crenate structure in the atrium and the spermatophore diagnostic Form 'B'
Colour typically yellowish-grey to black with a blue-black overlaying pigment, body with narrow lateral bands, dorsal rugae rather smooth 6
6. Flap covering the termination of the epiphallus within the atrium; transparent bases of the tentacles cold or greenish-grey; spermatophore diagnostic Form 'A'
Flap projecting between the termination of the epiphallus and the spermatheca duct; transparent bases of tentacles usually show a tinge of red; spermatophore diagnostic A.hortensis
7. Length c.50mm.; sides pale yellow with white zone above foot-fringe; oviduct long, narrow; spermatheca duct long, atrium small A.fasciatus

- Length c.40mm.; grey; oviduct short, wide; atrium large 8
8. Uniformly dark grey (var. neustriaca Mabilie brown); bands inconspicuous; epiphallus pigmented A.circumscriptus
Pale grey with white sides; lateral bands broader and more conspicuous; epiphallus not or only slightly pigmented A.silvaticus
9. Length 70-100mm.; resembling A.subfuscus when young and in the genitalia (oviduct ligula and rudimentary upper atrium), adult more like A.rufus; lateral bands often persistent in adult A.lusitanicus
Length 100-140mm. or more; adult unbanded; breathing hole very large; upper division of atrium well developed containing ligula; oviduct not dilated A.ater sensu lato 10
10. Typically black; upper atrium not greatly enlarged; ligula small; vas deferens usually less than $1\frac{1}{2}$ times as long as epiphallus A.ater
Normally red or reddish, foot-fringe orange or red; mantle banded in the young, upper atrium bulky with large bulb on left side; ligula large; vas deferens over $1\frac{1}{2}$ times length of epiphallus A.rufus

Notes: 1) I am indebted to Dr.H.W.Waldén of Göteborg for summarising the differences between Arion fasciatus, circumscriptus and silvaticus. A.fasciatus could be mistaken for a pale A.subfuscus, but the genitalia are very different.

2) The largest Arions can only be satisfactorily determined by the distal genitalia, colour being an unreliable guide. The two species A.ater and A.rufus intergrade and should perhaps be considered as sub-species, though extreme examples are distinct enough.

Zonitacea

Milacidae - Limacidae

Vestigial shell enclosed by mantle, in hinder half of which is breathing hole; no caudal mucus gland; foot-sole tripartite lengthwise; jaw smooth, with median downward projection.

MILAX

Median strip of sole crossed by chevron-like grooves; atrial stimulator (except M.budapestensis). Mainly in gardens, generally distributed, more sparsely in Scotland; M.gagates in wild places in SW; M.budapestensis sometimes in woods; M.nigricans recorded only from Bexhill, E.Sussex.

1. Length c.70mm.; brown, minutely speckled with orange and black; keel and rim of breathing hole orange; sole uniformly pale; skin very tough; keel not truncated behind, crinkled when the animal is contracted; slime yellow; spermatheca long, conical, bent towards right when containing a spermatophore; epiphallus widest distally; stimulator short, rounded M.sowerbyi
Smaller (c.50mm.); colourless; spermatheca oval 2
2. Sole dark, median strip black; dorsal surface dark grey peppered with black; keel dull yellow; body extensible, not laterally compressed, often curved sideways into a comma or C-shape at rest; no stimulator; spermatheca oblong-oval with long duct M.budapestensis
Sole unicolorous; keel dark, truncated behind; body laterally compressed at rest; stimulator a flattened, curved cone; spermatheca duct short 3
3. Black, gray or drab; sole pale; skin smooth; stimulator smooth; epiphallus widest at proximal end, with lateral bulge; penis with two dilatations at distal end M.gagates
Intensely black; sole dark; stimulator with 4 rows of papillae; epiphallus without proximal bulge; atrial glands with tongue-like backward projection M.nigricans

BOETTGERILLA

Boettgerilla pallens is the only species of this genus found in Britain. First recorded in 1972 in the Lake District, now known from several areas including Northern Ireland and the Channel Islands. Length 30-60mm., breadth 3-5mm.; colour typically bluish-grey; keel sharp, compressed laterally; mantle shield in the form of a slightly rounded V at hind end; foot-sole narrow and pale; mucus colourless; vas deferens with characteristic spindle-shaped swelling.

DEROCERAS

No epiphallus nor atrial glands; penis subdivided into two portions, the more distal of which contains a conical sarcobelum, while the proximal bears an appendage or caecum.

D.reticulatum is our commonest and most ubiquitous slug.
D.agreste is known from marshes in E.Norfolk and from high altitude grassland in the north, becoming more common in Scotland. D.caruanae is common in the south and west, elsewhere mainly in gardens.
D.laeve is common in wet places.

Key to Species of Deroceras

1. Small (up to c.22mm.); very soft and slippery; uniformly deep brown; slime watery; penis sinuous with a bifid caecum, often abortive (aphallic) D. laeve
Larger (25-35mm.); penis with a simple or branched appendage 2
2. Resembling D. laeve in appearance; slime clear; very active; penis deeply cleft with two incurved diverticula between which is an appendage with 4-6 slender crenulate branches D. caruanae
Slime milky; penis not cleft or lobed 3
3. Pale flesh-coloured unicolorous or mottled; penial appendage papillate, normally trifid but very variable; ovotestis near hind end of visceral mass D. reticulatum
Pale tawny, unicolorous; penial appendage small, simple; ovotestis situated near middle of visceral mass D. agreste
Note: D. reticulatum and D. agreste were formerly confused under the name D. agreste.

LIMAX

This genus includes the largest species of the family (up to 200mm.); no epiphallus, atrial glands, stimulator nor penial appendage (penial caecum present in some species).

Diet mainly fungi; L. tenellus and L. cinereoniger occur in old woodland, the latter sometimes on rocks, and are widely distributed but local (L. tenellus absent from Ireland); other species generally distributed; L. flavus, which is rare in N. Scotland, mainly in domestic habitats; L. pseudoflavus has recently been described from wooded habitats in Ireland; it has also been found in Great Britain, particularly in the Liverpool area; L. maximus and L. marginatus are frequent in woods, the latter also on rocks and walls. No Limax is a pest in gardens.

Key to Species of Limax

1. Length 25-35mm.; uniformly clear yellow, head black; penis short L. tenellus
Length over 70mm. 2
2. Length 70-100mm.; dull or greenish yellow to olive, mottled, unbanded; tentacles blue or grey; long rectal caecum; penis long 3
Not yellow or greenish yellow; often banded; no rectal caecum 4

3. Tentacles blue; usually dull to pale greenish yellow
Spermatheca duct joined to the oviduct; usually in
or near human habitation L.flavus
- Tentacles grey; usually greenish yellow to olive with
more contrast between the ground colour and the greenish
mottling; spermatheca duct inserted at the base of the penis,
usually in wild situations; common in Ireland L.pseudoflavus
4. Length c.75mm.; very smooth and gelatinous; typically two
pairs of lateral bands; mantle bands lyre-shaped; penis very
short with a conical caecum L.marginatus
- Length 100-200mm.; penis long 5
5. Grey or brown with 2 or 3 pairs of lateral bands (often
interrupted or obscure); sole uniformly pale; penis long,
tapering distally L.maximus
- The largest species; black; mid-sole and conspicuous dorsal
keel white; tentacles speckled; dorsal tubercles coarse;
penis very long, of even diameter L.cinereoniger

GREENHOUSE ALIENS

Limax valentianus: length 60mm.; resembles L.marginatus but is
yellowish and paler, the bands nearer the middle line; penial caecum
cylindrical (not conical); radula like that of Deroceras and very
different from that of L.marginatus.

L.nyctelius: similar to L.valentianus in appearance and radula,
but resembles L.flavus in the long rectal caecum and long penis
without a caecum.

COLLECTING SLUGS

Slugs are active at night in mild, damp weather, when they can be
collected by torchlight. During daylight they lurk amongst leaf litter,
under bark, in holes and crevices, and beneath any object lying on the
surface of the ground, such as clods, turves, logs, boards, stones,
tiles, pots, seed boxes and garden rubbish, or underground. In woods
they tend to congregate, especially in autumn, on or near toadstools.
Slug traps can be set by laying planks, card-board or folded news-
paper on the soil where slugs abound. A mixture of metaldehyde (the
toxic ingredient of proprietary slug pellets) and bran or oatmeal is
an irresistible though lethal bait. Some kinds of slug can be found
at all times of the year, while others reach maturity at a definite
season: autumn on the whole is the most favourable period for slugging.
Some species can only be identified with confidence when the genitalia
are fully developed: if only young individuals are to be found, they
can be brought home and reared to maturity - provided they neither
escape nor die.

PRESERVING SLUGS

Slugs intended for preservation or dissection should be drowned in water for about 24 hours, then placed in 30% alcohol (industrial methylated spirit) for a further day. For permanent preservation they are then transferred to 50% and finally 70% alcohol, to which a little glycerol may be added. Other preservatives which have been recommended are 10% zinc chloride solution, and 1% paopylene phenoxetol in 10% glycerol; formalin is not advised. Labels should be written in Indian ink or manderin black and placed inside the specimen tubes. Tubes, plugged with cottonwool and placed mouth downwards, can be stored in stoppered or screw-top jars filled with preservative. The internal shell can be extracted by slitting open the mantle and preserved dry in a specimen tube; if the rest of the slug is not wanted, it can be killed by boiling water or any crude method.

For dissection, the body cavity is opened up by a median or lateral incision through the integument. If it is desired to examine the anterior genitalia only, the alimentary canal with its associated glands can be removed by severing the oesophagus and rectum. Papers for Students No. 8 applies equally to slugs, with appropriate modifications. Instructions for preparing the radula are given in Papers for Students No. 5; the jaw can be mounted unstained.

LITERATURE

- Block, M.R., 1967, Dissecting Snails. Conch. Soc. Papers for Students No. 8.
- Chatfield, J.E., 1976, Limax grossui Lupu 1970, a slug new to the British Isles, J.Conch, Lond. 29:1-4.
- Colville, B., Lloyd-Evans, L., & Norris, A., 1974, Boettgerilla pallens Simroth, A New British Species, J.Conch. Lond, 28:203-208.
- Davies, S.M., 1977, The Arion hortensis complex, with notes on A.intermedius Normand (Pulmonata: Arionidae) J.Conch. Lond. 29:173-187.
- Evans, N.J., 1978, Limax pseudoflavus Evans: a critical description and comparison with related species, Ir. Nat. J. 19:231-236.
- Kerney, M.P., 1976, Atlas of the Non-marine Mollusca of the British Isles, Cambridge
- Quick, H.E., 1949, Synopsis of the British Fauna No. 8. Slugs. Linnean Society of London, Burlington House, Piccadilly, London W.1.
- Quick, H.E., 1960, British Slugs. Bulletin of the British Museum (Nat. Hist.), vol.6. No.3.
A much fuller account than the Synopsis and includes descriptions of anatomy, distribution maps and extensive bibliography. (The author of this key is under great obligation to this work of Quick's.)

- Taylor, J.W., 1902-7 Monograph of the Land and Freshwater Mollusca of the British Isles, parts 8-13 (bound as vol. 2.), Taylor Brothers, Leeds.
- Waldén, H.W., 1976, A nomenclatural list of the land Mollusca of the British Isles, J.Conch. Lond. 29:21-25.

c The Conchological Society of Great Britain
and Ireland.

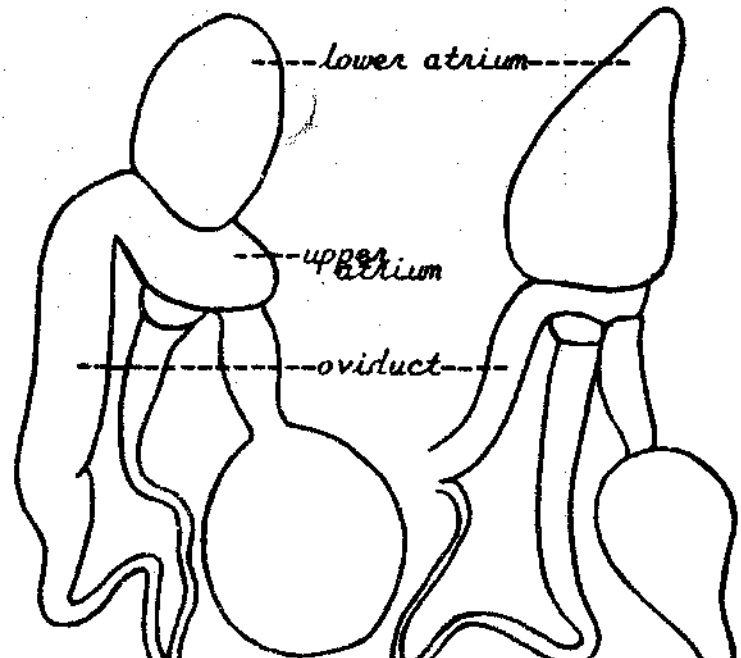
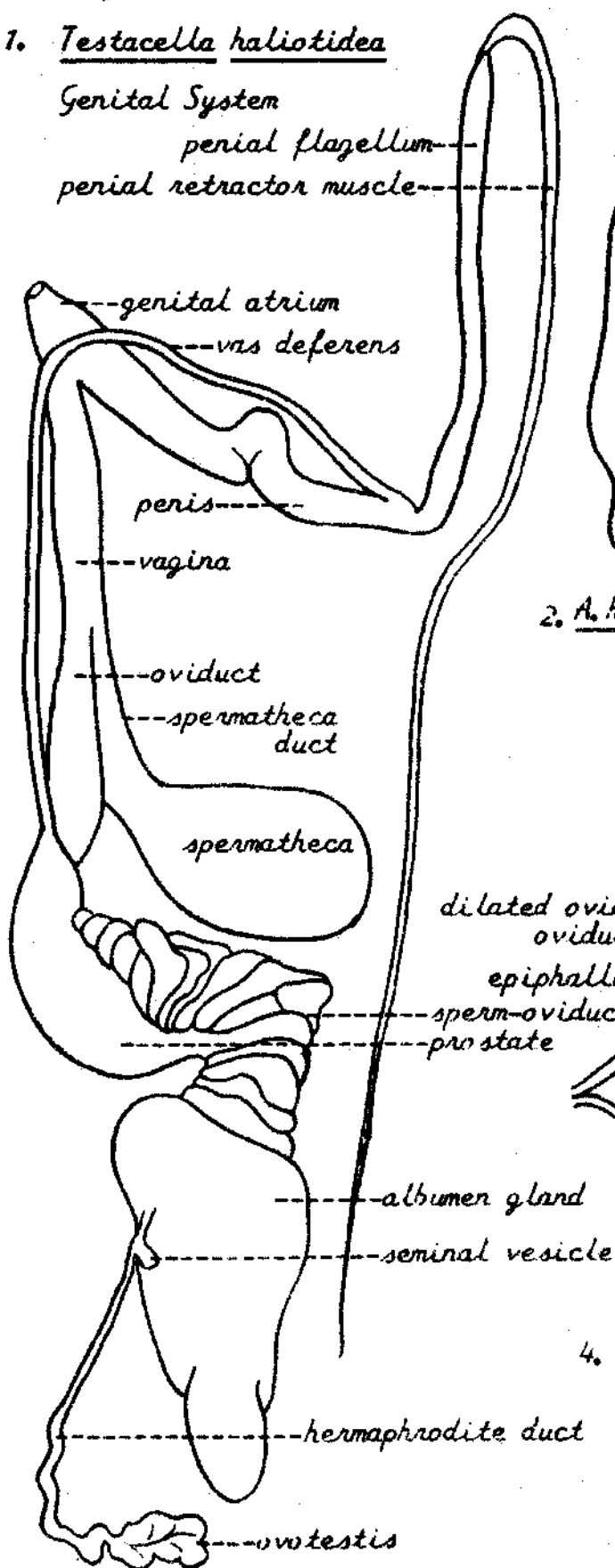
First published 1st August, 1969.

New edition 1st February, 1979.

ISSN 0141 - 4593

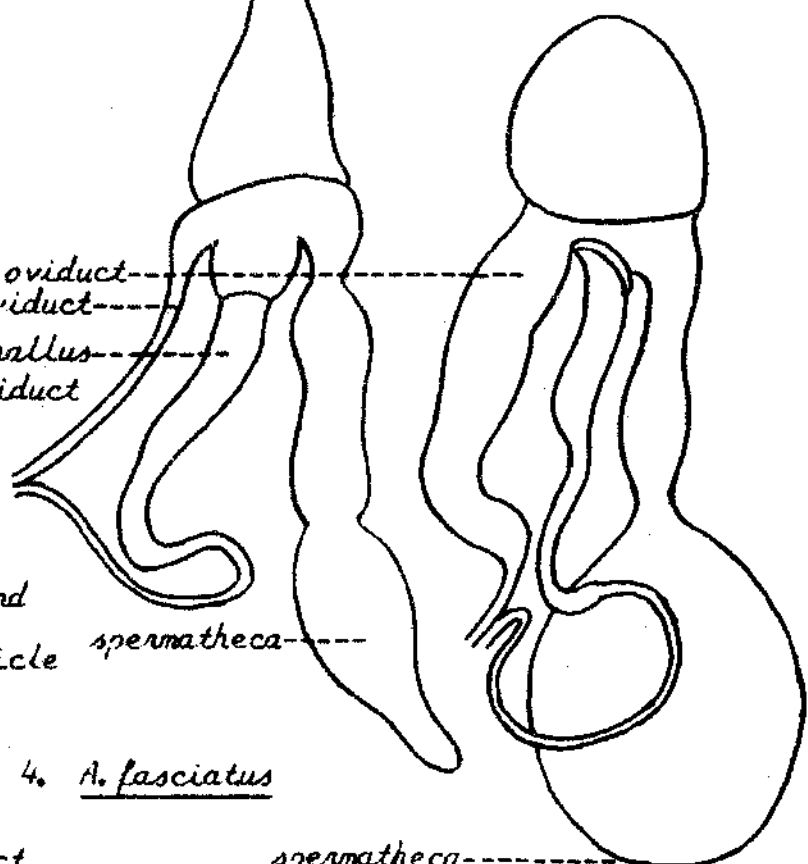
1. Testacella haliotideae

Genital System



2. A. hortensis agg

3. A. circumscriptus

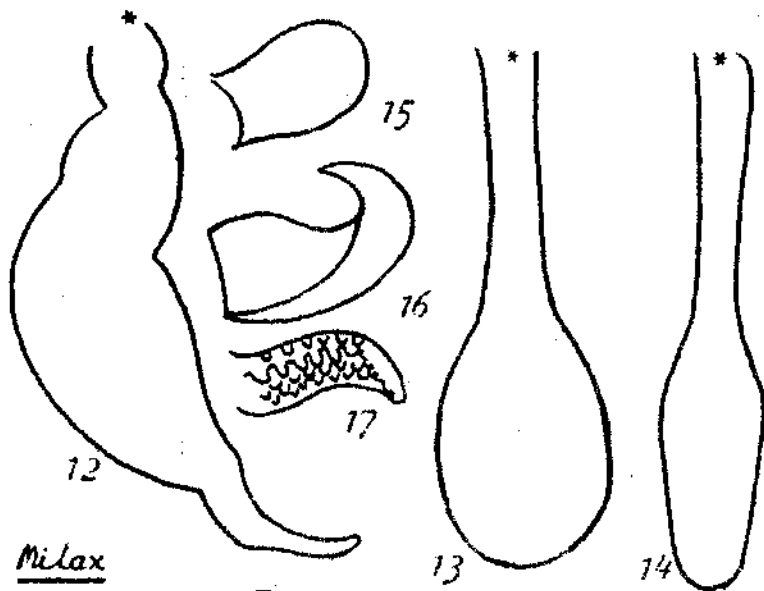


4. A. fasciatus

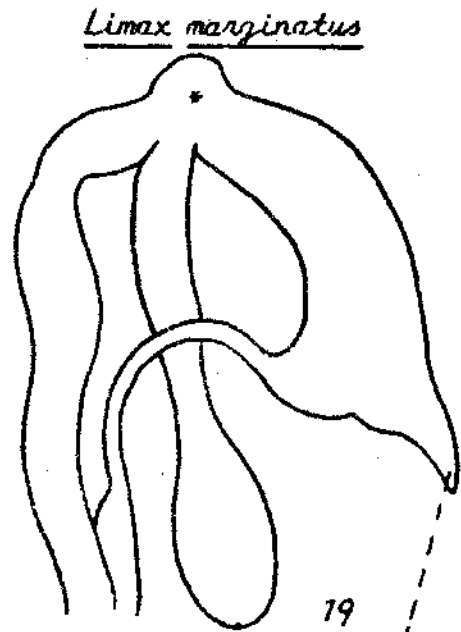
spermatheca

5. A. subfuscus

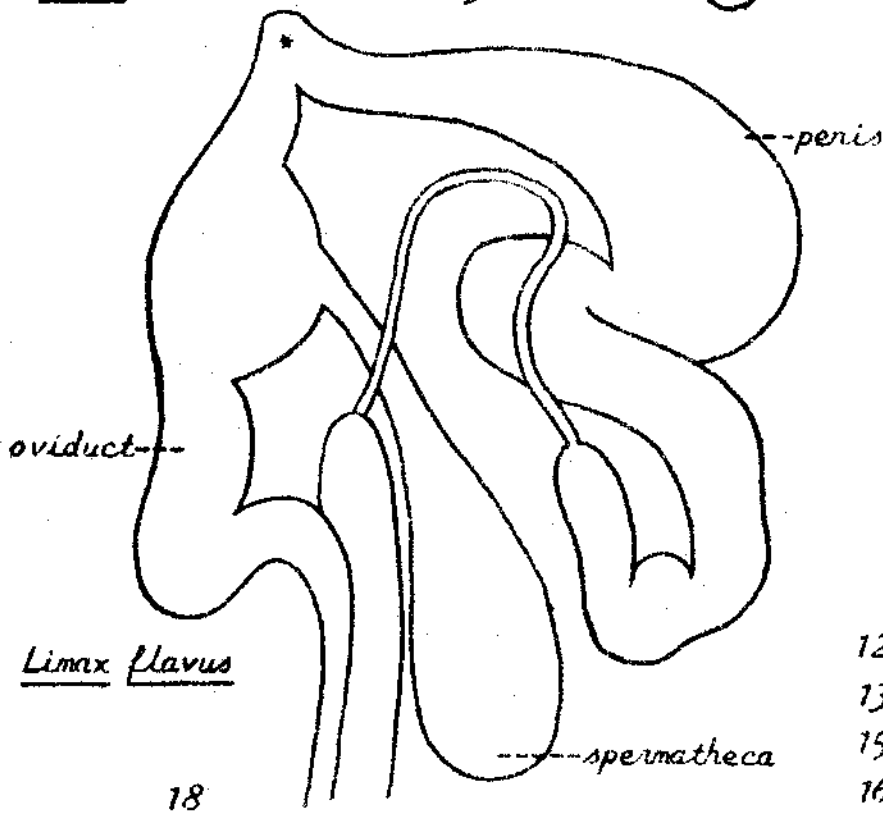
Arion: distal genitalia



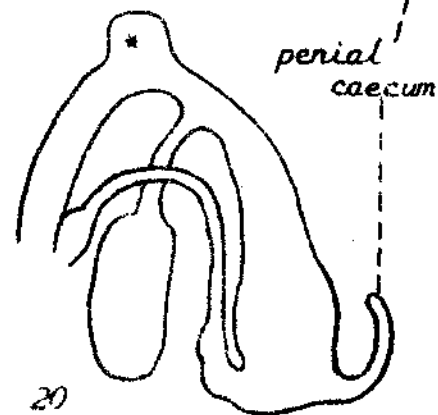
Milax



Limax marginatus

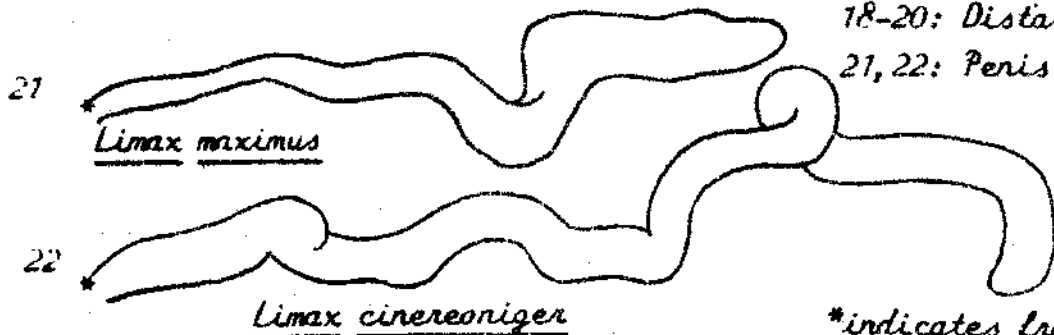


Limax flavus



Limax valentianus

12-14: Spermatheca. 12 M. sowerbyi
 13 M. gagates; 14 M. budapestensis
 15-17: Stimulator. 15 M. sowerbyi
 16 M. gagates; 17 M. nigricans.
 18-20: Distal genitalia.
 21, 22: Peris (fig. 17 & 20 after Quick)



Limax maximus

Limax cinereoniger

*indicates front (distal) end