The Conchological Society of Great Britain and Ireland

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Papers for Students No. 12

# KEY TO BRITISH SLUGS

by

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## 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 Parmacella 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).

Superfamily Oleacinacea

Family Testacellidae

Testacella (Cuvier) Draparnaud

T.maugei Férussac
T.haliotidea Draparnaud
T.scutulum Sowerby

Superfamily Endodontacea

Family Arionidae

Geomalacus Allman

G.maculosus Allman

Arion Férussac

A.intermedius Normand
A.circumscriptus Johnston
A.silvaticus Lohmander
A.fasciatus (Nilsson)
A.hortensis Férussac
A.subfuscus (Draparnaud)
A.lusitanicus Mabille
A.ater ater (L.)
A.ater rufus (L.)

Superfamily Zonitacea

Family Limacidae

Subfamily Parmacellinae

Milax Gray (1)

M.gagates (Draparnaud)
M.insularis (Lessona & Pollonera)
M.sowerbyi (Férussac)
M.budapestensis (Hazay)

Subfamily Limacinae

Agriolimax Mörch (2)

A.agrestis (L.)
A.reticulatus (Müller)
A.caruanae Pollonera
A.Laevis (Müller)

Limax Linnaeus

L.tenellus Müller
L.cinereoniger Wolf
L.maximus L.
L.flavus L.
L.marginatus Müller (3)

Greenhouse Aliens

Limax valentianus Férussac (= L.poirieri Mabille)
L.nyctelius Bourguignat

Notes: (1) Milax is placed in a separate family, Milacidae, by Ellis (1926) and in subfamily Milacinae of Limacidae by Germain (1930).

(2) Deroceras Rafinesque has been brought into use for this genus in some quarters; the objections to this lamentable name have been cogently expressed by Watson (J.Conch.vol.22, p.55).

(3) Placed by some authors in genus Lehmannia Heynemann, which is better ranked as a subgenus.

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 haliotidea: 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 distal 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 Agriolimax, everted in copulation.

*Penial caecum or diverticulum: conical or cylindrical blind tube projecting from promixal 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.

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

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. Under 35mm.; nucleus of mantle wrinkles on right side above breathing hole; hind end faintly keeled; obliquely truncated — AGRIOLIMAX
   Larger (1); nucleus of mantle ridges median; hind end not truncated — LIMAX

Note: (1) Limax tenellus is about the size of a large Agriolimax.

## 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 curved, sharp, barbed on outer side.

Chiefly in gardens; T.maugei mainly in SW, the other two more widely distributed, including central Scotland. (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 maculosus 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; A.ater 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 — 7

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

   Grey or tinged with yellow, sole white; length up to 50mm.; line 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 — 5

5. Length c.50mm.; sides pale yellow with white zone above foot-fringe; oviduct long, narrow; spermatheca duct long; atrium small — A.fasciatus (1)

   Length c.40mm.; grey; oviduct short, wide; atrium large — 6

6. Uniformly dark grey (var.neustriaca Mabille brown); bands inconspicuous; epiphallus pigmented — A.circumscriptus (1)

   Pale grey with white sides; lateral bands broader and more conspicuous; epiphallus not or only slightly pigmented — A.silvaticus (1)

7. Length 70-100mm.; resembling A.subfuscus when young and in the genitalia (oviducal ligula and rudimentary upper atrium), adult more like A.ater rufus; lateral bands often persistent in adult — A.lusitanicus (2)

   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 8

8. Typically black; upper atrium not greatly enlarged; ligula small; vas deferens usually less than 1½ times as long as epiphallus

A.ater ater (2)

Normally red or reddish, foot-fringe orange or red; mantle banded in the young, upper atrium bulky with large bulge on left side; ligula large; vas deferens over 1½ times length of epiphallus A.ater rufus (2)

Notes: (1) I am indebted to Dr. H. W. Walden of Göteborg for summarising the differences between these three species. A.fasciatus could be mistaken for a pale A.subfuscus, but the genitalia are very different.

(2) These largest Arions can only be satisfactorily determined by the distal genitalia, colour being an unreliable guide. The two subspecies of A.ater intergrade, though extreme examples are distinct enough.

## 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.insularis recorded so far only from Bexhill, E.Sussex.

### Key to species of Milax

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.); slime colourless; spermatheca oval 2

2. Sole dark, median strip black; dorsal surface dark grey peppered with black; keel dull yellow; body very 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, grey 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.insularis

## AGRIOLIMAX

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.

A.reticulatus is our commonest and most ubiquitous slug; A.agrestis is known from marshes in E. Norfolk and from not particularly moist habitats in parts of Scotland; A.caruanae is common in SW, elsewhere mainly in gardens and seems to be spreading. A.laevis is common in wet places.

### Key to Species of Agriolimax

1. Small (up to c.22mm.); very soft and slippery; uniformly deep brown; slime watery; penis sinuous with a bifid caecum, often abortive (aphallic) — A.laevis

   Larger (25-35mm.); penis with a simple or branched appendage — 2

2. Resembling A.laevis in appearance; slime clear; very active; penis deeply cleft with two incurved diverticula between which is an appendage with 4-6 slender, crenulate branches — A.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 — A.reticulatus (1)

   Pale tawny, unicolorous; penial appendage small, simple; ovotestis situated near middle of visceral mass — A.agrestis (1)

Note: (1) These two species were formerly confused under the name Agriolimax agrestis.

## 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.maximus and L. marginatus 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, mottled, unbanded; tentacles blue; long rectal caecum; penis long — L.flavus

   Not yellow; often banded; no rectal caecum — 3

3. 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 4

4. 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 Agriolimax and very different from that of L.marginatus. Reading and Swansea.

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. Edinburgh and Glasgow.

## 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, bricks, 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, cardboard or folded newspaper 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 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 mandarin 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 the 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.

CLAUGHER, D., 1965. Preparation of the radula. Ibid. No. 5.

QUICK, H.E., 1949. Synopses of the British Fauna No. 8. Slugs. Linnean Society of London, Burlington House, Piccadilly, London, W.1. Price 7/6d.

QUICK, H.E., 1960. British Slugs. Bulletin of the British Museum (Natural History), vol. 6, No. 3. Price £2.5.0d.
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., 1902-07. Monograph of the Land and Freshwater Mollusca of the British Isles, parts 8-13 (bound as vol.2). Taylor Bro., Leeds.
The most splendid work on slugs ever published, though now of course somewhat out of date and very expensive: in a recent catalogue the entire Monograph is priced at £36.




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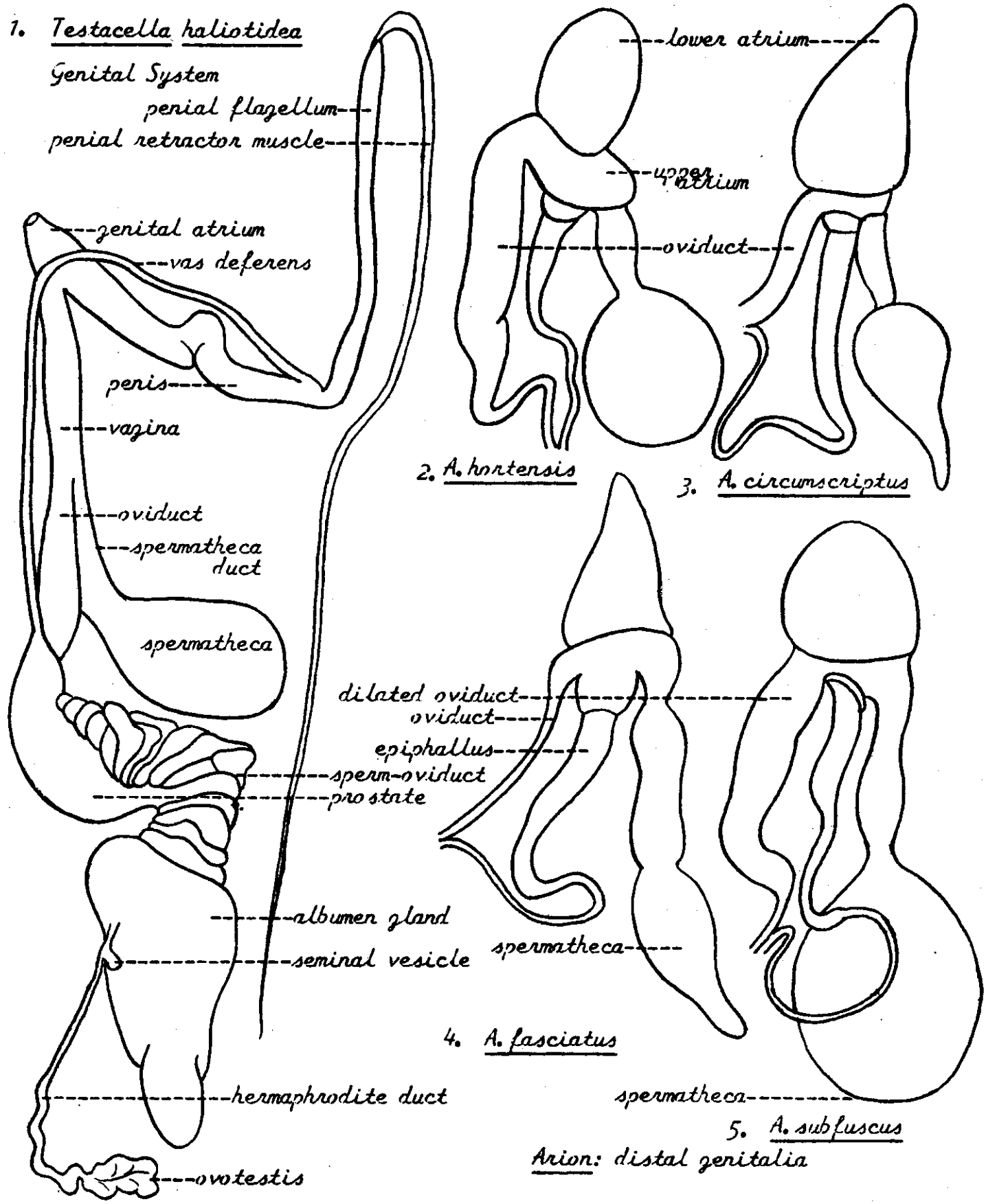
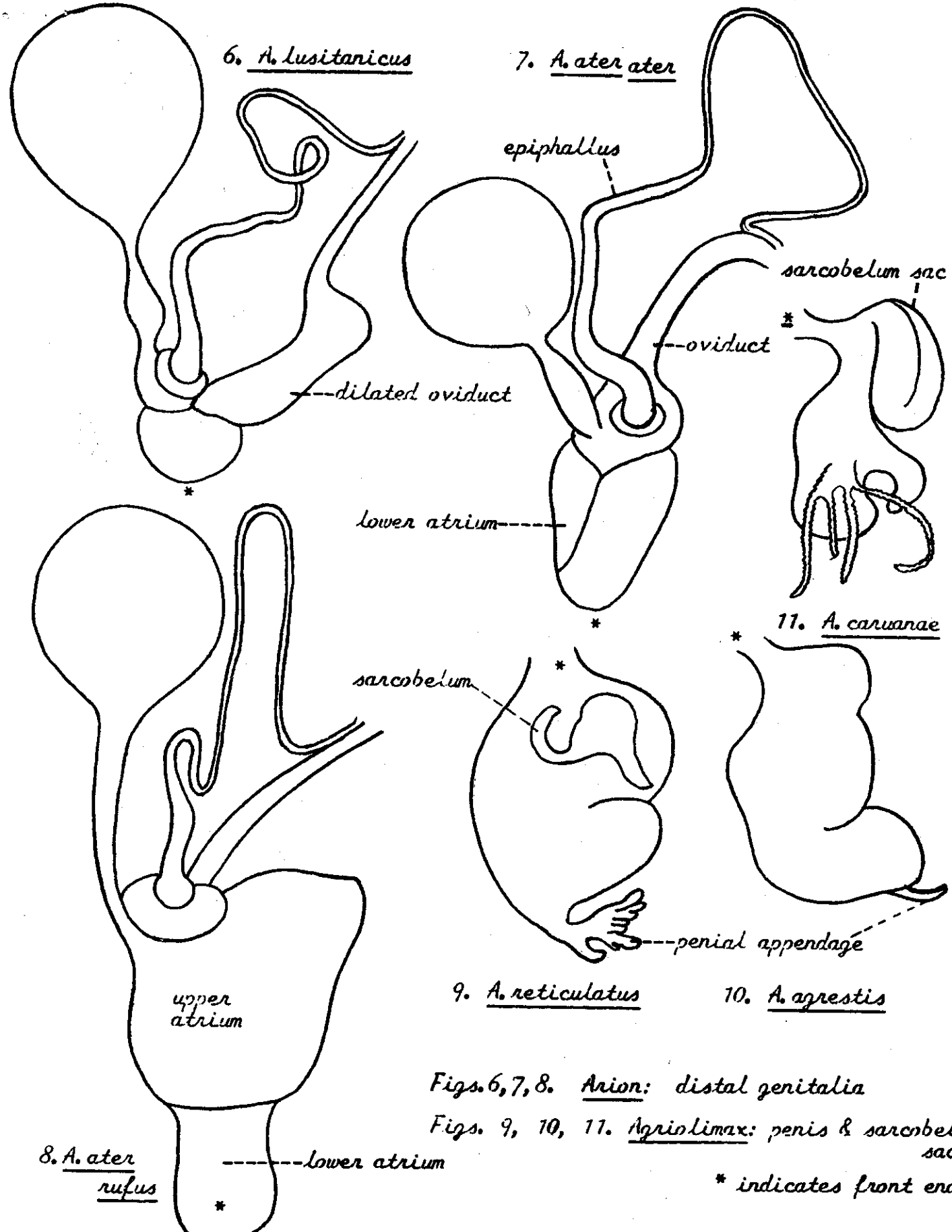
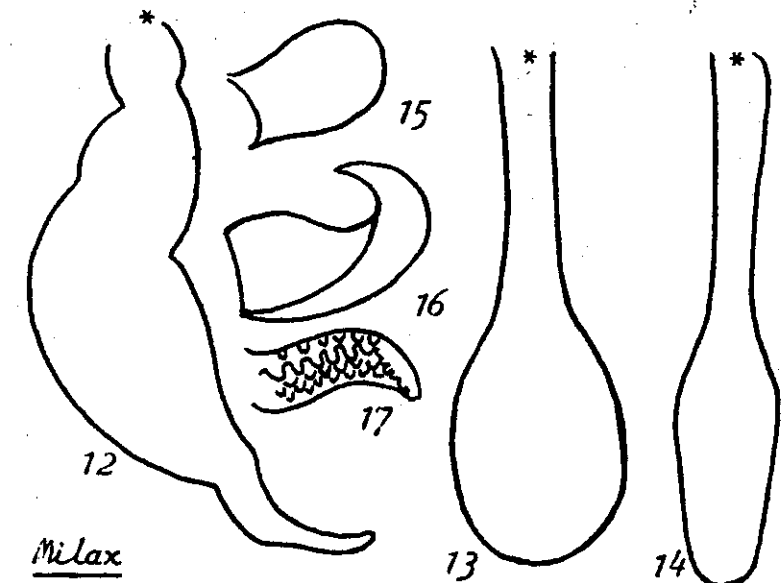

1. Testacella haliotidea
Genital System
penial flagellum
penial retractor muscle
genital atrium
vas deferens
penis
vagina
oviduct
spermatheca duct
spermatheca
albumen gland
seminal vesicle
hermaphrodite duct
ovotestis
lower atrium
upper atrium
oviduct
2. A. hortensis
3. A. circumscriptus
dilated oviduct
oviduct
epiphallus
sperm-oviduct
prostate
spermatheca
4. A. fasciatus
spermatheca
5. A. subfuscus
Arion: distal genitalia



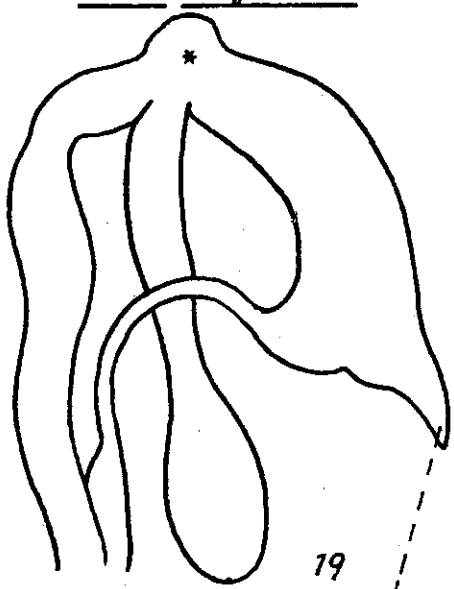

Figs. 6, 7, 8. Arion: distal genitalia

Figs. 9, 10, 11. Agriolimax: penis & sarcobelum sac

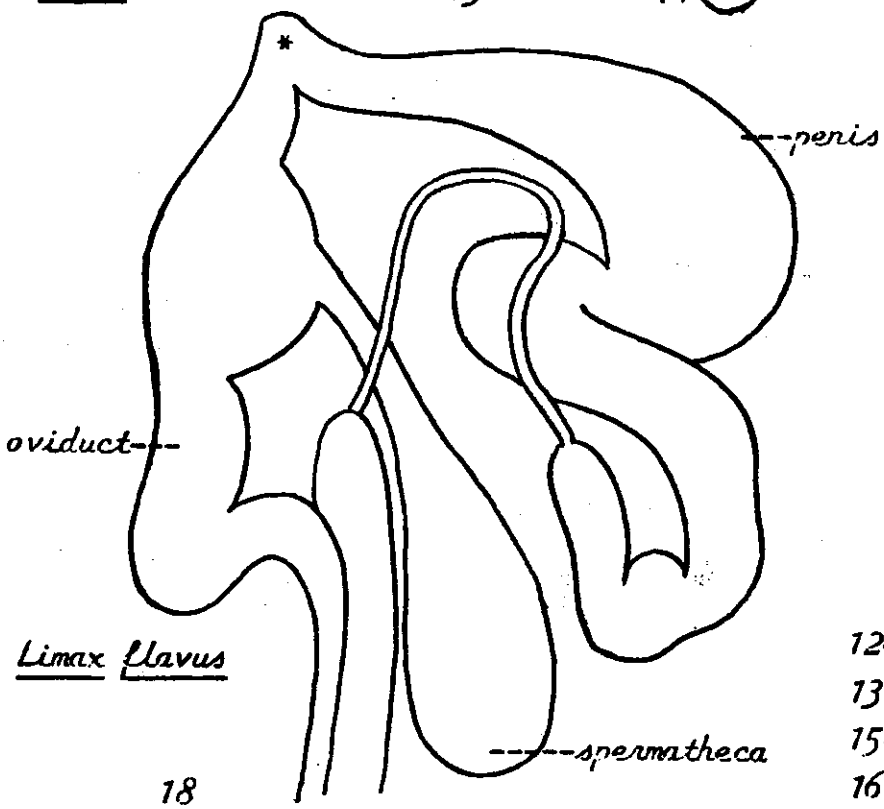
* indicates front end



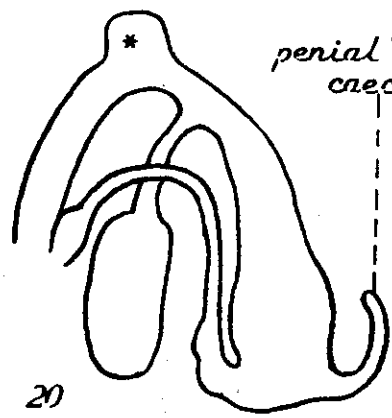

Milax




Limax marginatus

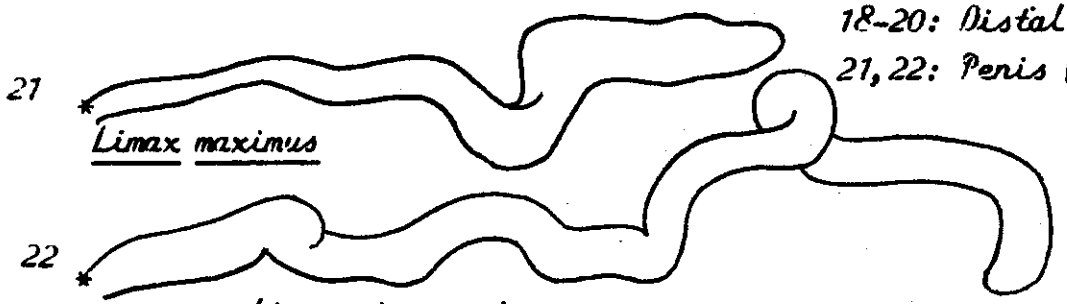



Limax flavus




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. insularis.
18-20: Distal genitalia.
21, 22: Penis (fig. 17 & 20 after Quick)




Limax maximus

Limax cinereoniger

*indicates front (distal) end