

1. On the Land-Molluscan Genus *Girasia* of Gray, with Remarks on its Anatomy and on the Form of the Capreolus of Lister (or Spermatophore) as developed in Species of this Genus of Indian Helicidæ. By Lt.-Col. H. H. GODWIN-AUSTEN, F.Z.S., F.R.G.S., &c.

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(Plates XXIV.-XXVII.).

In certain groups of the Mollusca the many forms run so closely one into the other that it is not easy to find differences sufficiently well marked by which to characterize even the genera. The shells (which, as a rule, have alone been described) are often very similar; but in the animal itself, quite if not a more important part, very great diversity may be found in colour and markings, as well as in the complicated generative organs, amongst which the capreolus presents us with another specific point of difference.

This is one reason for my bringing it now more particularly to the notice of conchologists, as well as to show into what curious distinct forms it has been developed. I must state that I have not long taken up this part of the study of Malacology; and I trust that anatomists will deal leniently with any crudeness which must be inseparable from this communication.

When examining a large series of *Helices* which I had collected on the Eastern Frontier of India, I found that the body of many of them had dried up into the shell in a very perfect state. By placing these in cold water and allowing them to soak for 8 or 10 days in winter, I found that the odontophore, and in some cases even the genital organs, came out in a wonderfully perfect state of preservation. It was when examining one of these that I noticed the presence of a very hard chitinous organ (which I had never seen before) bent like a spring, from which projected at the basal end a series of long spinules: it tapered towards the posterior end, and terminated in a trumpet-shaped aperture, here also set with a few short spinules. Taking up the subject, I found that Ferd. Stoliczka had also detected and published the presence of this very peculiar chitinous organ in some species of the Indian *Zonitidæ*, and in two very different genera as regards the shells, viz. *Sesara infrendens* and *Macrochlamys honesta* (J. A. S. B. 1871, p. 242); and had he been spared longer to science, it was his intention to thoroughly examine all the Indian species he could get, and among them some of the slug-like forms hitherto placed in the genus *Helicarion*, which I am about to describe in more detail. Stoliczka suggested that the organ was one of irritation or titillation (p. 243, *l.c.*), also that it might represent the seminal receptacle or the arrow-sac; but Professor Semper afterwards pointed out (with reference to Stoliczka's paper) that it is a spermatophore.



Before describing or making any remarks of my own on this particular organ, it will be as well to refer to the works of other naturalists who have made the anatomy of the Mollusca their especial study, and then to compare and extend their valuable deductions to the Indian species now treated of.

M. A. Moquin-Tandon<sup>1</sup> (1851) and, later, M. P. Fischer have written on this organ of the Pulmoniferous Gastropods. In the 'Annales des Sciences Naturelles,' vol. vii. (1857), M. Fischer refers in terms of admiration and praise to the labours of Lister, who so far back as 1694 described and figured under the name of "capreolus" a curious organ, slender, thread-like, which is to be found in the genital apparatus of *H. pomatia* (Exercit. Anat. p. 115, tab. ii. figs. 4, 5, London). I will quote his own words:—"Nous donnons textuellement en note le assage de Lister relatif au *capreolus*; car il démontre le zèle et la sagacité qu'il apporta dans ses observations, alors que la zoologie comparée était encore à créer." Since Lister's time many naturalists have written on the subject, while some do not mention it at all when treating of the Land-Mollusca. Thus, Cuvier<sup>2</sup> says nothing of this organ in the fine monograph which he published on *Helix pomatia*; and various uses have been assigned to it. Draparnaud took the capreolus for the dart in *Helix vermiculata*.

Nitzsch (1826) notices it in *H. arbustorum* as not united to the genital organs, and had seen it come out a short way from the genital orifice; he did not attempt to explain its use, and called it the "corps énigmatique." Duverney, in *H. aspersa*, thought it condensed sperm. Van Beneden called it "un stylet" in *Parmacella*; Blainville, "un corps styliforme" in *Parmacella palliorum*. Dutrochet noted the spermatophore of *Arion rufus*, but did not interpret its meaning well; but Siebold, according to Fischer, foresaw its use: he says that it is "a slender body, of peculiar form, which in *Helix hortensis* and *H. arbustorum* is seen sticking out near the genital cloaca after fecundation, and which, when drawn in, is rolled up in a spiral at both extremities"<sup>3</sup>. Moquin-Tandon describes two different type forms in *Helix* and *Arion*. It has also been noticed in *Limax*, *Bulimus*, *Pelutella*; and, summing up, we find:—

1. That nearly all naturalists are of opinion that it is only developed at the period of reproduction and has only a temporary existence<sup>4</sup>.

2. That it is a perfectly free body, not attached to the generative organs, and formed partly in the flagellum<sup>5</sup> and partly in the sheath of the penis.

There is only one exception given: in *Parmacella valenciennii*: M. Van Beneden concluded that it was a true organ and always present.

<sup>1</sup> 'Journal de Conchyliologie,' 23rd Dec. 1851, p. 333; and Comptes Rendus, vol. xli. p. 857, (1855).

<sup>2</sup> "Mémoire sur la Limace et le Limaçon," Ann. Mus. vii. (1806), p. 140.

<sup>3</sup> Baudelot, Ann. Sci. Nat. 1863, p. 136, gives a good history of the various papers on the subject of the generative apparatus of the Pulmonifera.

<sup>4</sup> P. Fisher Para, Annales des Sciences Nat. vii. (Zool.), p. 376 (1857).

<sup>5</sup> Moquin-Tandon, Comptes Rendus, 1855, p. 857



3. The capreolus apparently does not exist in some *Helices*; but as it is not always to be detected in *Helix aspersa*, these require more careful examination.

4. The capreolus serves to aid in the intromission of the seminal fluid, or rather the saving of it, and renders copulation more certain and intimate. Lister considered that the spinules of the capreolus retained the body in the female organ.

The more we know of the species of Indian Mollusca which have hitherto been placed in the genus *HELICARION* of Férussac (Tabl. Syst. 1821), of which a form, *H. cuvieri*, Fér., was the type (from Australia), the more certain it is that few of the Indian forms, if any, can be retained in it. Of these, two or three are so very distinct they may safely be separated and also described in more detail.

Nothing is more satisfactory than to get hold of a type specimen of a genus; and acting on a note from my friend Mr. Geoffrey Nevill, and with the kind aid of Mr. Edgar Smith, I have been able to find and examine the type of Dr. J. E. Gray's genus *GIRASIA*, represented by a single specimen in spirit, which was collected by Sir Joseph Hooker in the Khasi Hills. It proves to be my *Helicarion* (*Hoplites*?) *theobaldi*, described in the P. Z. S. 1872, p. 517.

The subgenus *Hoplites* was proposed for these Khasi-Hill slugs by Mr. Theobald in the J. A. S. B. 1864, p. 244. No description of the genus or species is given, save that it was 2 inches long, from Teria Ghat, and was probably my *H. theobaldi*, l. c. p. 517. This group I now propose to start from, and take up first.

*GIRASIA*, J. E. Gray, Cat. Pulm. Brit. Mus. p. 61 (March 1855).

The original description (which I give below) is imperfect; no mention is made of the mucous gland, save in the synopsis of the generic section in which it is placed:—"Body united to the back of the foot, only separated by the convex hinder edges. Shell partly exposed, ovate, expanded, with a solid apex. Back of the neck (under the collar) with three grooves, the central groove between the tentacles double-edged; the lateral one single, bent down on each side to the sides of the head at the back of the lower tentacles<sup>1</sup>; the head is only partly retractile, so that the base of the upper tentacles, which are completely retracted, are exposed on the top of the head like two perforations<sup>2</sup>; the aperture of the generative organs is rather behind the base of the right tentacle. The hinder part of the body attached to the back of the foot nearly to its hinder end, which is separated from the deep concavity on the back of the foot by a deep lunate cross groove. In all these particulars the animal exactly agrees with the Portuguese species of *Drusia*"<sup>3</sup>.

Type *hookeri*, Gray. Khasi Hills.

These species are added:—

*Girasia? rutellum*, Hutton. Kandahar, Kabul. Evidently a *Parmacella*.

*Girasia extranea*, Fér. Habitat? (Hist. Moll. ii. 96.)

"Shell a thin horny pellicle, without any appearance of a spire."

<sup>1</sup> This sentence is not very clear or accurate.

<sup>2</sup> This is merely the description of the state of the spirit-specimen with the eye-tentacles inverted as usual.

<sup>3</sup> Then why was it separated?



*Girasia? problematica*, Fér., Hist. Moll. ii. 96. Habitat?

"Shell yellow, convex externally, concave internally, like a half eggshell."—Deshayes, from Férussac's figure. This is very unlike the type.

In the Appendix to Adams's Gen. Moll. p. 640, it is stated that Dr. Gray, in a communication to the author, proposed that these two last species should be placed in another new genus, *Rigasia*; and on the same page *G. hookeri* is put into *Cryptella*, a Canary-Island form with which it can have no possible affinity.

#### PARMARION, Fischer<sup>1</sup>.

Dr. Semper, in his fine work, Reis. Arch. Phil. p. 9, places in *Parmarion* two specimens, *pupillaris*, Humbert (*problematica*, Fér.?) from Java, and *extraneus*, Fér., obtained through Herr Pierre, and taken by him in Calcutta. I am in great doubts as to the identification of the latter species, which Semper figures on plate i. fig. 5. Mr. Nevill thinks it is *Helix bensoni* of Lower Bengal. No forms like the Khasi-Hill *G. hookeri* have been taken in Calcutta. If it was found in the Botanical Gardens there, it may have been brought from up the country in baskets of plants. Several imported species have been in this way introduced there from time to time; and some may have become established. I do not think myself it is *H. bensoni*; the shell is too much covered with the mantle, especially for a spirit-specimen.

In Nevill's Hand-list of the Indian Museum, Calcutta, p. 13 (1878), in *Parmarion* he includes two species of typical *Girasia* from the Khasi Hills, *croceus* and *brunneus*, and creates a new sub-genus, *Austenia* (type *Vitrina gigas* of Benson, from the Khasi Hills), to include all those species with better-developed shells, which could not be placed in *Helicarion*, and which I had pointed out were different from Theobald's slug-like forms known to us then as *Hoplites*. He included in this group *Hoplites magnificus*, *resplendens*, *peguensis*, *solidus*, *auriformis*, *heteroconcha*, and two others unnamed from Darjiling.

I had myself brought home from India a good many specimens in spirit; and I have lately received from Mr. Ogle, of the Topographical Survey, to whom my very best thanks are due, another lot

<sup>1</sup> PARMARION, Fischer, Actes Soc. Linn. Bordeaux, 1855. (The paper bears date June 1855, the part 15th March, 1856; so that Mr. Gray's title has priority.)

Fischer places in it the following species:—

*infumatus*, Fér. (Gray, Fig. Moll. plate 286. fig. 1). Hab.? (Placed in *Drusia*, by Gray.)

*extraneus*, Fér. (Gray, Fig. Moll. plate 286. fig. 2). Hab.?

*rangianus*, Fér. Bourbon and Madagascar. (Placed in *Drusia?* by Gray.)

*problematicus*, Fér. (Gray, Fig. Moll. plate 286, fig. 4). Hab.?

From the drawing of *infumatus*, by Férussac, one would be led to suppose that the shell is very rudimentary, and entirely concealed by the mantle-lobes. Unfortunately the habitat of this species and *extraneus* is unknown. I, however, should place in Fischer's genus all those species in which the shell is so little developed, and take as our N.E.-frontier type, *P. rubrum*, G.-A., from the Naga Hills (J. A. S. B. 1875, p. 6, pl. ii. fig. 4), which will require hereafter a close comparison with the Javan forms.



from Shillong, all of typical *Girasia*. These have furnished me with the means of more accurately describing the genus.

*GIRASIA SHILLONGENSIS*, G.-A., J. A. S. B. January 1875, p. 4, pl. ii. f. 1, 1a.

The following will be an emended description of the genus:—

Shell rudimentary, horny, narrow, elongate, of one simple whorl; colour olivaceous, apex white, the central portion of the inside of the shell covered with a milky-white callus. About 1 inch long. (Plate XXIV. fig. 10.)

Animal slug-like, long, mantle largely developed; shell and dorsal lobes are united all round; and the shell is entirely covered by the former, with the exception of a narrow area on the posterior left margin. From the anterior right margin of this area a well-marked cicatrical line runs forward to just above the respiratory and anal orifice, and marks the usual division of the shell-lobes in other species into a left (frontal) and right (posterior). The dorsal lobes are divided diagonally forward from the respiratory orifice into a large left dorsal lobe and (behind and adjacent to the orifices) a smaller right dorsal lobe; on the extreme posterior side a slight beading marks the junction of these lobes with the shell-lobes above. This portion of the animal is sunk into a deep V-shaped depression in the back, where the dorsal ridge of the foot terminates suddenly. Extremity of the foot truncate, with a large linear mucous gland; the pedal line is very distinct.

Genital aperture near the lower and outer base of the right tentacle.

The foot is divided longitudinally into three subequal median and lateral areas, and is distinctly segmented, the major divisions on the pallial edge of the foot being continued in V-shape from one side to the other, the angle being directed backwards in the spirit-specimen; but they are no doubt straight when the animal is alive.

*Generative organs of G. shillongensis*.—In every way similar to *G. gigas*, Bs. The ovo-testis consists of five separate bunches or lobes of very minute globular follicles, each lobe having a separate duct leading to the main hermaphrodite duct; this gradually widens, and becomes much thickened, with several sharp convolutions; it then suddenly contracts again, leading to the junction of the albumen-gland. Here a short pear-shaped cæcum is conspicuous (only seen in one specimen).

The albumen-gland was not perfect, but appeared as if formed of two lobes (from above specimen).

The prostate was wide, ribbon-like; the oviduct with three or four great folds, which extend to the posterior termination of the spermatheca, which is not so long as to be infolded by it. The vas deferens is given off a very short distance below the end of spermatheca, high up the oviduct; and it extends backwards to near the base of the penis and amatory organ, in a loop, to join the former close behind a cæcum-like appendage rounded at the end (the cæcum calciferum). The penis is bent on itself, where a long process is given off, to which the retractor muscle is attached. The ama-



tory organ (dart-sac) is a long cylindrical body, becoming finer towards the posterior end; its retractor muscle has its attachment with that of the penis, close below the apex of the shell, in the body-cavity.

The spermatheca is of the same size as the latter, and in this specimen presents a swollen sac below, terminating in a short, thin, cylindrical point, which is buried and attached where the convolutions of the ovo-testis commence.

The spermatophore is similar to that of *Austenia gigas*, but rather shorter, the sac being 0.3 inch long. The cervicorn processes at the base are strong and numerous, much branched above (see Plate XXVII. fig. 8). The basal duct is 0.2 in length. Three of these were found in the spermatheca examined.

*List of species of Girasia.*

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| 1. <i>hookeri</i> , Gray (Plate XXVII. figs. 2, 3), = <i>G. theobaldi</i> , G.-A., Khasi. | 5. <i>nagaensis</i> , G.-A., Naga.   |
| 2. <i>crocea</i> , G.-A., Khasi.  | 6. <i>magnifica</i> , Nev. & G.-A. (Plate XXIV. figs. 1, 2), Upper Burmah. |
| 3. <i>shillongensis</i> , G.-A., Khasi.   | 7. <i>radha</i> , G.-A.?, Assam.   |
| 4. —, var. <i>brunnea</i> , G.-A. (Plate XXVII. fig. 1), Khasi.                           | 8. <i>burtii</i> , G.-A.?, Assam.  |
|   | 9. <i>peguensis</i> , Th.?, Pegu.  |

*AUSTENIA GIGAS.* (Plate XXIV. fig. 8, shell.)

*Vitrina gigas*, Benson, J. A. S. B. vol. v. (1836), p. 350.

*Helicarion gigas*, Godwin-Austen, J. A. S. B., vol. xlv. (1875), plate iii. (animal).

*Vitrina gigas*, Theobald & Hanley, Conch. Ind. pl. lxvi. figs. 2, 3.

*Helicarion* (sec. B.) *gigas*, Theobald, Cat. L. & F.W. Shells of B. India, p. 23, 1876.

*Helicarion gigas*, var. *minor*, J. A. S. B. vol. xlv. 1875, pl. iii. (animal).

*Austenia gigas*, G. Nevill, Hand List Indian Museum, 1878, p. 16 (no description).

Shell ovate, broad, whorls about  $1\frac{1}{2}$ ; apex depressed; body-whorl large and flatly expanded, with a shining lustre; colour olivaceous, with sienna-brown, pale at apex, somewhat nacreous within. One specimen is all sienna-brown and milky-white within (Plate XXIV. fig. 9).

Typical from Teria Ghat, Khasi Hills. Largest example: major diam. 1.7 inch, minor diam. 1.2 inch. Another: major diam. 1.53 (=38.5 m.), minor diam. 0.95 (=24.5 m.).

Var. *minor*<sup>1</sup>. Naga Hills. Shell: major diam. .84 inch (21.5 m.), minor diam. .55 inch. (18 m.). Of same form as *gigas*, but with a fine glassy lustre and olivaceous brown. Animal spotted.

Small var. North Khasi. Shell: major diam. 1.0 inch (25.5 m.), minor diam. 0.68. Animal brown.

Pale grey (dissected) var. Burmah? from G. Nevill. Shell: major diam. 0.95 inch (25.5 m.), minor diam. 0.75 (19.0 m.).

<sup>1</sup> May be *Helicarion resplendens*, Nevill, J. A. S. B. 1877, p. 23.



*Animal*.—The left dorsal lobe (*l.d.l.* Plate XXIV. figs. 3, 4, 5) is large in front, and extends from the respiratory orifice to the left margin. The right dorsal lobe (*r.d.l.*) extends from the same part to the posterior right margin. The shell-lobes are connected all round the periphery of the mantle-zone, but are reduced in size, and present two distinct right and left contractile lobes; the right extends to and covers the apex of the shell, while the left extends over the edge of the body-whorl for a distance of 0·3 to 0·5 inch, leaving the posterior and the greater portion of the upper surface of the shell uncovered (we have here a true approach to what is seen in the subgenus *Macrochlamys*). The posterior margin of the shell is not sunk in a depression of the hinder part of the foot, but the upper surface of the foot extends in an unbroken ridge to the mantle-zone.

Extremity of the foot truncate, with a large linear mucous gland, the pedal line very distinct, as well as the lateral markings on the surface of the body.

Genital aperture at the lower and outer base of the right tentacle.

Animal reaches quite 4 inches in length.

*Description of Genital Organs of A. gigas*. Small var., Khasi Hills (Plate XXV. fig. 1).—The ovo-testis was not seen; the hermaphrodite duct (*h.d.*) is much convoluted at the anterior end, where it divides; the shape of the albumen-gland was also unobserved, and had apparently not been preserved in the spirit. The oviduct (*ov.*) was very closely convolute, and arranged in four sharp folds upon the posterior portion of the spermatheca (*sp.*), to which it is apparently held by muscular tissue. The prostate is wide, regular, and ribbon-like, much and closely convolute, giving off the vas deferens not far above the junction of the spermatheca with the oviduct; this is very long, extending forward between the inverted eye-tentacles, forming a loop among the muscles of the buccal mass.

The penis is bent on itself at the point where the retractor muscle is given off (*Pc.* fig. 4); and a short, blunt, rounded portion extends beyond the insertion of the vas deferens (*pd.*), corresponding to the flagellum in some species, or the Kalksack of Semper (the *cæcum calciferum vasis deferentis*).

The retractor muscle of the penis has its attachment, together with the eye-tentacles, in the usual position, close below the apex of the shell, near the posterior margin of the body-cavity (Plate XXIV. fig. 3 *m*).

*Detailed Anatomy of Penis of G. gigas* (Plate XXVI. figs. 2, 3). On the removal of the outer muscular sheath, the anterior end is of a hollow cone-shape (*a*), which, on being cut away, presented within a cup-shaped depression (*a'*), and exposed the duct of the penis. It contracts suddenly, and continues as a smooth stout tube of equal size for about 0·25 inch, where it expands again (*b*) into a stouter portion of cylindrical form, which is 0·55 inch long, and continues, with gradually lessening thickness, up to the part where it is turned suddenly backwards, and close to where the retractor muscle is given off (*c*). On removing the outer layer a chitinous sheath was exposed lying



against the thin membrane beneath (*b' b*); and following this down, it was found to be the basal end of the spermatophore, with the peculiar cervicorn processes at the base, *in situ* where developed. On opening the membranous sac, it was found to consist of one continuous thread coiled down on itself (fig. 3), and pressed closely together, and was in such good preservation as to be easily unravelled. I drew out and measured a portion  $\frac{1}{10}$  inch in length, and found it to contain 15.1 inches; the whole length of this part being .55 inch in length, would give nearly 7 feet for the total contents of the sac. It is, in fact, a spermathecal thread of hardened spermatozoa, poured out from the vas deferens<sup>1</sup>.

On further examining the part near *c*, this cylindrical portion was found to end in a conical cap, which again gave off a thin rod, which bending sharply back, is evidently in communication with the extension of the vas deferens towards *d*. Behind the junction of this last is a short gland rounded at the end (*e*), which contained some very microscopic transparent crystalline bodies of oval form (fig. 2, *a*). This is the Kalksack mentioned above, and secretes the material for the formation of the spermatophore.

This spermatophore, which is an organ of a very complicated and curious form, may be thus described:—The basal or anterior end consists of a chitinous strap about 0.4 inch long, with the sides more or less turned over, forming a sort of trough or long spout, which, after it has passed into the spermatheca of the other individual, will be found opening into the lower part of the oviduct. At the other end the sides at last meet and form a tube; it then thickens and widens, giving off several strong cervicorn or more or less branched processes, which are directed backwards; they serve, I think, to aid in the expulsion of the spermatophore from the penis, and, when once within the spermatheca or vagina, serve as holding-hooks to prevent its withdrawal. The part above this consists of a very long thin membranous bag 0.4 inch long, terminating in a hard conical cap, from which proceeds a thin rod, which is found to extend to the hard rounded apex of the spermathecal sac, where it bends over or ends in a few separate filaments within the tube of the vas deferens. In one specimen of this species (*gigas*) no less than seven perfect spermatophores were counted, closely packed together side by side within the spermatheca. (Van Beneden observed two in a *Parma-cella*, Ann. Sci. Nat. 1857, p. 371.)

It would appear that in these creatures even one act of copulation would fertilize for a very considerable period; for it would be some time before the contents of a spermatophore became exhausted.

This organ, as situated in the penis, presents the character of a perfect spring (*vide* Plate XXVI. figs. 2, 3); and it can be imagined that when it enters the wider and very elastic sac of the spermatheca, and is then gradually released, it will tend to become quite straight, and that, the recurved processes holding it at one point, the longer portion will bend round to the long axis of the sac, bringing the end

<sup>1</sup> This thread is similarly described by M. Baudelot, *l.c.* p. 165, in his description of the capreolus of *Arion rufus*.



of the shorter portion (Plate XXVI. fig. 3, *a*) to the aperture within the vagina and ovo-testis (Plate XXVI. fig. 4, *j. sp.*).

*Macrochlamys decussata*, of which I have a drawing, taken when the animals were *in coitu*, protruded a large white bladder-like sac, which expanded and contracted from time to time as if inflated with air; this I now think may have been the spermatheca drawn out and receiving the penis and capreolus.

In the two specimens I examined, the spermatheca (*sp.*) was elongate, smooth, lying close to and partly enveloped by the convolutions of the oviduct &c., with its posterior end near the junction of the hermaphrodite duct and albumen-gland. This posterior termination is bent over on itself, presenting a smooth rounded end (Plate XXV. figs. 2 & 4), which, coiling round, terminated, and was covered with what was apparently muscular tissue buried in the prostate and oviduct. The form of the spermatheca is due to its contents; and the rounded end is produced by the bending-over of the flagellum-like terminations of the enclosed spermatophores.

In one specimen of *G. hookeri* which I examined, probably taken in the cold weather, all the generative organs are small and contracted, the spermatheca only represented by an attenuate sac.

The amatorial organ or dart-sac (*D*)<sup>1</sup> is a long cylindrical body narrowing towards the genital aperture, and again swelling there into a large orifice; it has a very thick and muscular structure, and in these spirit-specimens is very hard and unyielding. When cut open longitudinally, the dart or *spiculum amoris* was found to be a simple cylindrical rod, sharply pointed (Plate XXVI. fig. 7). This organ has a strong retractor muscle, with its attachment near that of the penis.

*Relative Position of the different Parts in G. gigas.*—On cutting through the skin of the upper side of the back, commencing from between the eye-tentacles, the penis is seen lying in the middle line between the inverted eye-tentacles (Plate XXV. fig. 2); on the proper left of it are seen three large convolutions of the intestine (*i*); and on laying it over to the right side the salivary glands of flattened form are seen spreading over these, and a distinct connexion with the central convolution was very clearly made out (fig. 5, *a*). Proceeding from the sides of the buccal mass will be noticed two strong muscles, which have their attachment on the frontal margin of the body-cavity, at the point (Plate XXIV. fig. 3) *m*; these are the retractor muscles of the head and buccal mass.

The spermatheca lies on the right side of the animal, covered partly by the oviduct; and a large expansion of the intestine occupies the posterior portion of the cavity, narrowing suddenly to enter that of the shell above.

A very large mucous gland lies next the sole of the foot along the whole length of the body-cavity; and two large pedal nerves are conspicuous and traverse it, throwing off nerves to the epidermis, and extend onto the caudal gland.

<sup>1</sup> Glandula mucosa cum sagittâ amatoriâ.



*List of species of AUSTENIA.*

<i>gigas</i> , Bs., Khasi.	<i>cinerea</i> , G.-A., Dafla.
<i>gigas</i> , var. <i>minor</i> , Naga.	<i>salia</i> , Bs., Khasi.
<i>gigas</i> , small var., Khasi.	<i>venusta</i> , Theob.?, Burmah.
<i>solida</i> , G.-A., Khasi.	<i>resplendens</i> , Nevill, Upper
<i>minutu</i> , G.-A., Dafla.	Burmah.

Still retained provisionally in *HELICARION*.

<i>verrucosum</i> , G.-A., Dafla.	<i>cassida</i> , Hutt. & Bs., W. Hima-
<i>ovatum</i> , Hy. Blf., Darjiling.	laya.
<i>bensoni</i> , Pfr., Calcutta.	<i>birmanicum</i> , Phil., Mergui.
<i>planospira</i> , Bs. (= <i>succina</i> , Reeves?), Darjiling.	<i>heteroconcha</i> , Hy. Blf., Darjiling.
<i>scutella</i> , Bs., Kashmir.	<i>membranaceum</i> , Bs., Ceylon.
<i>flemingianum</i> , Pfr., Sindh.	<i>edgarianum</i> , Bs., Ceylon.
<i>christianæ</i> , Theob., Anda- man.	<i>layardi</i> , Bs., Ceylon.
<i>irradians</i> , Pfr., Ceylon.	<i>extraneum</i> , Fér., Calcutta?
<i>monticola</i> , Bs., W. Hima- laya.	<i>tennentii</i> , Temp.?, Ceylon.
	<i>præstans</i> , Gould?, Tenasserim.
	<i>auriforme</i> , W. Blf., Nilgiri Hills.

## EXPLANATION OF THE PLATES.

## PLATE XXIV.

- Fig. 1 & 2. Animal of *Girasia magnifica*, nat. size. Specimen in Indian Museum, Calcutta. *G.ap*, genital aperture, showing the end of the amatorial organ projecting from it.
3. *Austenia gigas*, small var. View of right side, showing the respiratory and anal orifices. *r.d.l.*, right dorsal lobe; *l.d.l.*, left dorsal lobe; *r.s.l.*, right shell-lobe; *l.s.l.*, left shell-lobe.
4. The same. View of left side.
5. The same. Viewed from the back, apical portion cut off. *h.d.*, position of the hermaphrodite duct.
6. Portion of capreolus of *A. gigas*, small var. *a*, strap-like basal portion; *b'*, base of sac, with cervicorn processes; *b''*, the membranous sac.
7. Jaw of *A. gigas*. *a*, cleft in which the muscles of the upper lip are inserted; *b*, lower free edge.
8. Shell of *A. gigas*, Bs., nat. size.
9. *A. gigas*, var. *minor*, G.-A., nat. size.
10. *Girasia shillongensis*, G.-A., nat. size.

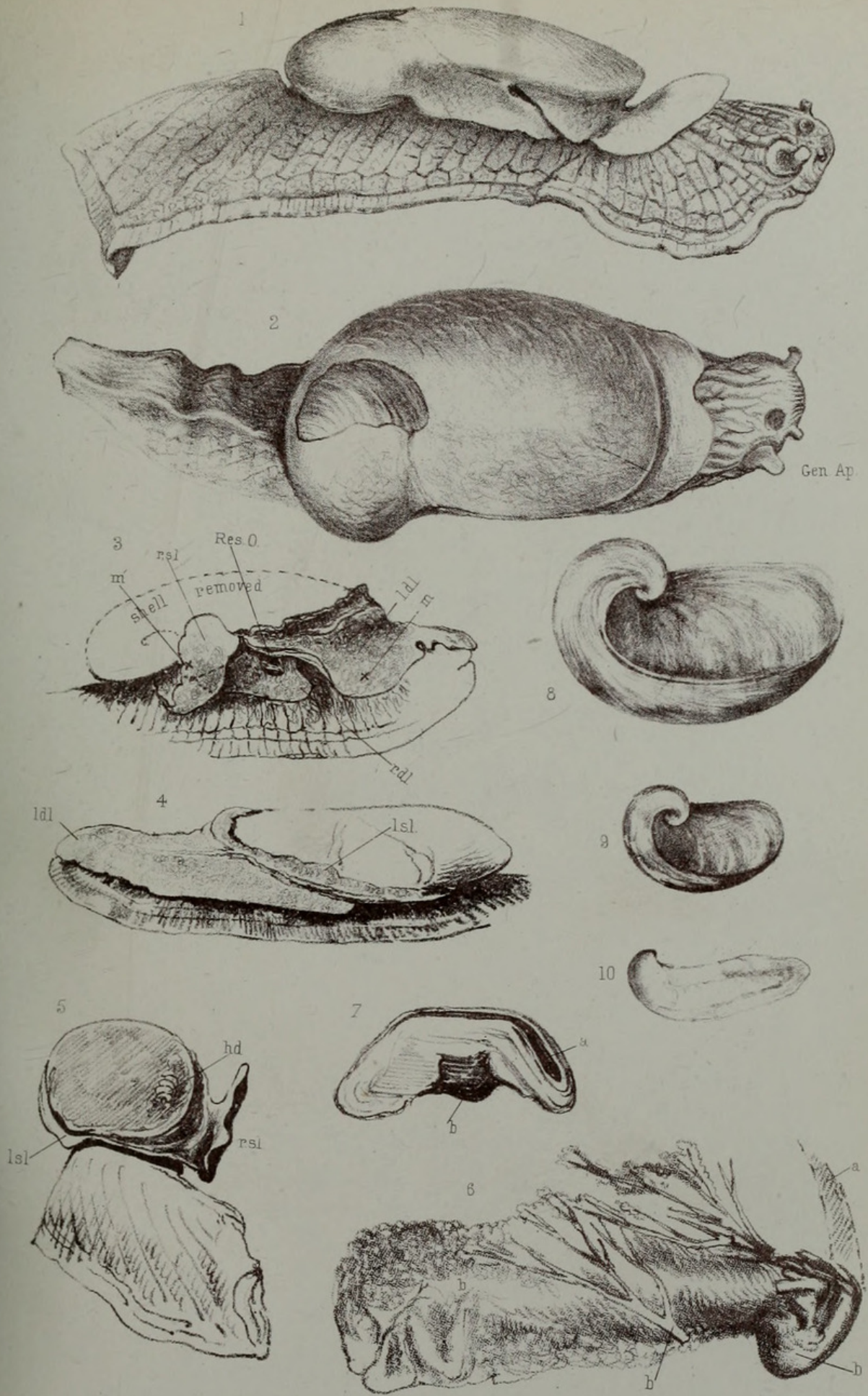
## PLATE XXV.

- Fig. 1. Genital organs of *Austenia gigas*, small var. Khasi Hills. Side view.
2. The same, seen from above.
3. Intestine, salivary gland, &c., viewed from above.
4. Genital organs removed from the animal.
5. Basal portion of the spermatheca.
- j.sp.*, point of attachment to oviduct; *a*, strap-like portion of the capreolus; *h.d.*, hermaphrodite duct; *al.gld.*, albumen-gland; *ov.*, oviduct; *v.d.*, vas deferens; *D*, dart-sac; *P*, penis; *Pe.*, cæcum calciferum; *Sp.*, spermatheca; *r.m.p.*, retractor muscle of penis; *mu.gld.*, mucous gland; *i.*, intestine; *m.*, retractor muscle of head and buccal mass.

## PLATE XXVI.

- Fig. 1. Shell and neck-lobes of *Austenia gigas*, var. *minor*, G.-A.
2. Penis of *A. gigas*, Bs., showing the position of the capreolus or spermatophore during the period of development,  $\times 3$ . 2*a*. Concretions from calciferous gland or Kalksack.





Gen Ap





Godwin-Austen, Henry Haversham. 1880. "1. On the Land-Molluscan Genus Girasia of Gray, with Remarks on its Anatomy and on the Form of the Capreolus of Lister (or Spermatophore) as developed in Species of this Genus of Indian Helicidse." *Proceedings of the Zoological Society of London* 1880, 289–299. <https://doi.org/10.1111/j.1469-7998.1880.tb06561.x>.

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