Hab. Pretoria. In coll. Edward Collier, Esq.

A transparent shining little species, with regularly costulate whorls, ventricose, seven in number; the shell is cylindriform in shape; peristome shining white, somewhat translucent, as is the rest of the shell, furnished with a prominent acute parietal fold and an internal broad plica behind the columellar margin of the peristome. There is also one simple labial tooth.

Two specimens, one of which is slightly more elongate than the other.

EXPLANATION OF PLATE III.

Fig. 1. *Helix strobilodes.*
Fig. 2. —— *somersetensis.*
Fig. 3. *Pupa tabularis.*
Fig. 4. —— *dysorata.*
Fig. 5. —— *quantula.*
Fig. 6. —— *Sykesii.*
Fig. 7. —— *haploa.*
Fig. 8. *Pupa pretoriensis.*
Fig. 9. —— *griqualandica.*
Fig. 10. *Ennea distincta.*
Fig. 11. —— *regularis.*
Fig. 12. —— *perspicua.*
Fig. 13. —— *Collieri.*

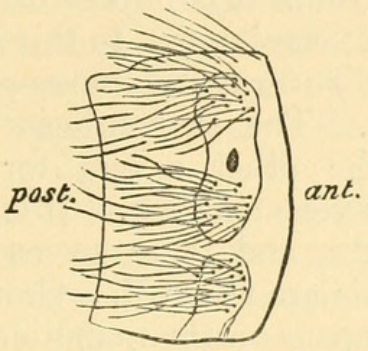
III.—*Additional Notes on the Origin of the Tracheæ from Setiparous Glands.* By Henry M. Bernard, M.A. Cantab. (from the Huxley Research Laboratory).

In the last issue of the 'Zoologische Jahrbücher' (Bd. v.) I brought forward some evidence in favour of the derivation of the Arthropodan tracheæ from setiparous glands, and pointed out how this derivation might be made to explain many of the difficulties which at present beset this subject. I propose here to bring forward a few more arguments tending in the same direction.

(1) I endeavoured to show that in the Myriapoda, while we could deduce the tracheæ from the notopodial acicular glands, the stink-glands which occur dorsally to the stigmata might be the glands of the original parapodial setæ. Mr. Pocock, of the British Museum, kindly informs me that in the Chordeumidæ, which appear in many respects to be intermediate forms between the Iulidæ and the Polydesmidæ, the foramina repugnatoria of these latter are not to be found, but setæ develop apparently exactly on the spot where these glands ought to occur, and, further, that in the Polyxenidæ a great tuft of setæ grows in the same spot, apparently in place of the stink-glands which are wanting, and, again, a still more important fact, that in *Scolopendrella*, in which animal the

stigmata are confined to the head, large setæ spring from the sides of the segments in the place where stigmata occur in all the Chilopoda and Hexapoda. This curious retention of so many primitive Annelidan characteristics on the part of the Myriapods is after all what one might expect from animals so clearly Annelidan in their rich segmentation.

(2) The arrangement of the stigmata, hairs, and pigment in the pupa of the vapourer moth (*Orgyia antiqua*) is very suggestive. The deep black pigment of the skin is relieved at the sides of the abdominal segments by clear white or whitish patches, running dorso-ventrally and nearly meeting in the ventral middle line. The arrangement is shown in the woodcut. On each side of the stigma is a very definite, more



Lateral view of an abdominal segment of a pupa of a female Vapourer Moth, showing the "parapodial scars."

or less circular field covered with long setæ. It is true that the greater part of the dorsal surface is covered with long setæ, but no one can examine these setigerous areas under the microscope without being convinced that they are distinct regions. If this arrangement is compared with an Annelidan parapodium, the similarity in the position and arrangement of the setæ is very striking. The stigma corresponds to the opening of the acicular gland and the setigerous areas to the setigerous regions of the parapodium on each side of the aciculum. It was especially the aciculum of the dorsal parapodium to which I referred the stigmata of the Hexapoda. We have here, then, traces of a complete dorsal parapodium, as shown in the figure, while beneath it is seen the dorsal part of the ventral parapodium with a similar setigerous area well marked off. More ventrally (not shown in the figure) the white patch is continued, but without setæ, almost to the median line. It is the ventral parapodium which I have suggested formed the leg of the Hexapoda.

Why these extraordinary "parapodial scars," as I propose to call them, should suddenly appear on the pupa is a problem

I cannot pretend to solve. It may perhaps be referred to the force of heredity coming into action as soon as the animal is more or less withdrawn from the struggle for existence, as a pupa may almost be said to be when encased in a cocoon.

(3) In order to get more light on the homologies of the ventral row of structures in the Arachnids which I propose also to refer to a row of setiparous glands, I have naturally turned my attention to some of the less known orders. A small Chernetid, apparently an *Obisium*, has yielded me unexpected results.

The stigmata of the tubular tracheæ on the second and third abdominal segments are followed by a *complete row of segmental apertures running along each side to the end of the abdomen*. Their position corresponds exactly with those of the stigmata, and I think it is impossible to doubt that they are homologous with these latter. In this interesting Arachnid, then, there are *nine pairs of apertures on the nine posterior abdominal segments*. The two anterior pairs are stigmata. The function of the other seven, for want of sufficient material, I have not yet made out. It is well known that the Chernetidæ spin webs, and there seems to be no very clear idea where the glands are situated. Croneberg's claim * that the spinning-gland opens on the mandibles is probably correct. I find a very distinct aperture on a small prominence behind the point of the movable piece of the mandibles. In that case these "stigmata" may be purely rudimentary and functionless. If, on the other hand, these seven pairs of apertures following on, and evidently homologous with, stigmata prove to be the openings of spinning-glands (a point I hope soon to investigate), we should have a remarkable confirmation of my suggestion that the lung-books or tracheæ and the spinning-glands of the Araneids are homologous structures as common derivatives from setiparous glands. We learn also from these *nine* pairs of abdominal apertures in *Obisium* that the limitation of the number of stigmata in *Scorpio* is not original, *i. e.* inherited from a *Limulus* ancestor, but is due to a secondary reduction of what were originally segmental structures along the whole abdomen.

(4) The coxal gland of *Galeodes* opens, as Sturany † suspected, between the third and fourth appendages, *i. e.* on the coxa of the first leg. Dufour, who mistook it for a sali-

* "Beitrag zur Kenntniss des Baues der Pseudoscorpione," Bull. Soc. Imp. Nat. de Moscou, t. ii. (1888).

† "Die Coxaldrusen der Arachnoiden," Arb. Zool. Inst. Wien, t. ix. (1891).

vary gland, nevertheless correctly described its different appearance in different Galeodidæ. In some it is a simple long tube commencing in the region of the second leg, running backward to form a tangled coil between the nerve-cords in the region of the third and fourth legs. It then bends forward again to open in the above-mentioned spot. In others the proximal end of the gland divides up into a sponge-like mass of anastomosing tubules, which, uniting with those of the gland on the opposite side, form an amorphous mass arching over the mid-gut. The course of the duct and the position of the aperture agree almost exactly with that described by Sturany for the coxal gland of *Atypus*.

The points which especially interest us here, however, are the following. The aperture of the gland on the coxa of the first leg agrees almost exactly in position with the aperture of the tracheæ on the coxa of the second leg, which suggests their being homologous structures. The duct shows the characteristic striped appearance, as if its wall were pitted by countless pores. It stains very badly, and although it will not stand boiling in caustic potash, resists the action of cold caustic potash. There seems to me to be little doubt that chitin is present in its walls, although it nowhere forms a definite lining to the tube. The retention of the gland in *Galeodes* as an important functional excretory organ, while it has degenerated in the Araneidæ, although once well developed in these latter, suggests a correlation between these coxal glands and the spinning-glands. The development of the spinning-glands to utilize and carry off excretory products renders the coxal glands unnecessary. This correlation is the more probable if both glands can be referred back to setiparous glands. The same may be said of the mandibular poison-glands, which are well developed in the Araneids, but absent in *Galeodes*.

Besides the fact mentioned in my first contribution on this subject, that no difference can be discovered between the tracheæ of the thorax and of the abdomen, it also remains to be stated (what indeed has been known since 1848 *) that the tracheæ of the two regions communicate freely with one another. The assumption that the abdominal tracheæ are developed from lung-books while the thoracic tracheæ are independent developments† from ectodermal invaginations, and therefore not in any way homologous with the former, seems

* Kittary, "Anatomische Untersuchungen der gemeinen *Galeodes* und der furchtlosen *Solpuga*," Soc. Imp. Moscou, vol. xxi.

† Korschelt and Heider, 'Vergleichende Entwickelungsgeschichte,' p. 638.

to me to ignore the fact that both structures arise in similar positions, viz. at the bases of the limbs. The thoracic tracheæ of *Galeodes* open posteriorly on the coxa of the second pair of legs. In addition, then, to the extreme improbability of the same structure—tracheæ—having had two independent origins in the same animal, we have the further improbability that the openings of the assumed independently developed thoracic tracheæ should bear apparently the same relation to the thoracic limbs as the lungs do to the embryonic abdominal limbs.

These arguments, I think, lend considerable support to my attempt to deduce tracheæ from setiparous glands. The first two points seem to show that the lateral row of stigmata, spinning-glands, &c. found in the Myriapoda and Hexapoda have actually been deduced from the acicular glands of dorsal parapodia, the ventral parapodia forming the legs. Such a confirmation of this part of my original suggestion leads us almost naturally to conclude that the ventral row of tracheæ, spinning-glands, &c. in the Arachnida have been developed from the setiparous glands of the ventral parapodia. If so, the legs of the Arachnids have been most probably developed from the dorsal parapodia, while the ventral parapodia have disappeared in the coxal joints, their setiparous glands, however, persisting as tracheæ &c. This origin of the limb in the Arachnids is exactly what I have elsewhere endeavoured to show must have been the origin of the legs of the Crustacea. This would account for the great similarity between the legs of *Limulus* and those of the Arachnids, and also for their common possession of coxal glands. It would also account for the traces of Crustacean characters found by Jaworowski * in the developing limbs in the embryo of *Trochosa singoriensis* †.

IV.—*On the Terminal Organ of the Pedipalp of* Galeodes *and the Discovery of a Homologous Organ on the Pedipalp of* Phrynus.

By Henry M. Bernard, M.A. Cantab. (from the Huxley Research Laboratory).

The remarkable protrusible organ at the tip of the pedipalp of *Galeodes* has, since Dufour's discovery, received but little

* "Ueber die Extremitaten, deren Drüsen, und Kopfsegmentirung bei *Trochosa singoriensis*," Zool. Anz., May 1892.

† I regret to have omitted to mention in my former paper what had been a very valuable work of reference to me, viz. Palmén's 'Zur Morphologie des Tracheensystems,' Leipzig, 1877.