possible, is to be laid on a plate of clean glass; a silk thread is tied round the base of one of the tentacles of an Anthea, and the tentacle snipped off. The mere tentacle separated from the animal to which it belonged is drawn gently across the nerve, or laid upon it, at the upper part: immediately muscular contractions follow in the leg. These contractions cease at once if the portion of the nerve touched by the tentacle be cut off. There can, it seems, no longer be any doubt that the muscular contractions are excited, not by electricity, but by irritant action of the urticating organs of the Anthea, which being more powerful in this respect than other Anemones, has been chosen for experiment, although other varieties give similar results.

I now see I was in error in supposing that the effect produced on the frog's limb by the Actiniæ could be transmitted along a wire. I presume that in preparing the experiment alluded to, which I performed in the open air, at the sea-side, some of the irritant materials of the Anemones, which I had possibly handled, had been brought by my fingers in contact with the nerves, and I was thus deceived.

I am very happy, however, that I am myself the first to perceive and correct this error.

I remain, &c.,

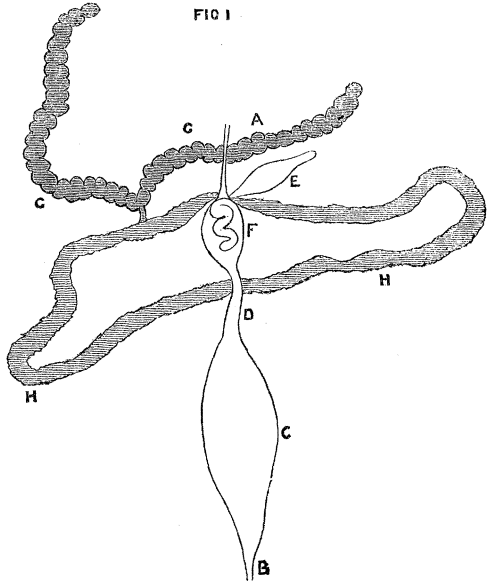
ROBERT M'DONNELL.

W. Bowman, Esq., F.R.S., &c. &c.

III. "On the Digestive and Nervous Systems of *Coccus hesperidum*." By JOHN LUBBOCK, Esq., F.R.S., F.L.S., F.G.S. Received Oct. 4, 1858.

In the early part of last spring I began to investigate the anatomy of this interesting little insect, with the intention of studying only the organs connected with the development of the ova and pseudova. It soon, however, became evident that the structure of the intestinal canal, on the one hand, had been entirely misunderstood by those who had previously examined it; and on the other, that the nervous system, far from being similar in all specimens, varied in the most extraordinary manner. It is therefore proposed in the present communication to give a very brief description of the digestive organs and of the nervous system.

Intestinal Canal.
(Magnified 30 diameters.)



Ramdohr and Leydig are the only two naturalists, so far as I know, who have published any original remarks on this subject.

Ramdohr says, "Die Speiseröhre kurz und enge. Der Magen vorn ein wenig erweitert, lang und völlig durchsichtig, so dass man die dunkeln Contenta darin sieht..... Der Dunndarm ist leer, etwas weiter als der Magen, durchsichtig, bisweilen faltig.... Die Gallgefässe fehlen, wenigstens konnte ich nicht die geringste Spur davon entdecken." This description, however, has reference to *Chermes Alni*.

According to Leydig (Zeitschr. f. Wiss. Zool. V. Tab. I. fig. 1), the canal in *Coccus hesperidum* consists of a short œsophagus, a large stomach, and a long intestine. Into this intestine open four glands. Rather behind the middle of it are situated the two large, yellow hepatic glands, and in front of these open, on one side, a free, slightly curved cæcum, and on the other, a shorter cæcum coiled up and enclosed in a pyriform sac, which is continued into a tube, whose end is attached to the skin. This description is a singular mixture of truth and error, and Professor Leydig is so careful an observer that it

was long before I could convince myself that he had made such a series of mistakes. His descriptions of the separate parts are indeed correct (though in my specimens the hepatic glands (G, G) were proportionally larger than in his figure), but he has entirely misunderstood the relations of the different organs.

The true œsophagus (fig. 1 A) is rather long and extremely narrow. It corresponds, I believe, to the tube *f* in Leydig's figure, which he considers as an appendage to the intestine. Following the œsophagus comes the pear-shaped bag (fig. 1 F), with its remarkable cellular, contorted, internal gland. Then there is a very short intestine (D, ilium) opening into the rectum (C), which Leydig has described as the stomach. The rectum is often found filled with fluid, as Leydig figures it, and varies in shape in different specimens; it contracts at its posterior end into a narrow tube, B (the œsophagus of Leydig), which opens into the vent on the upper side of the body.

At the anterior end of the pear-shaped crop or stomach are attached, besides the œsophagus, the two ends of the recurrent intestine (H), and the cæcum (E), which is generally swollen at its base, and is perhaps the equivalent of the sucking stomach.

The recurrent intestine is considered by Burmeister and Lacordaire to be part of the ventriculus, but in all insects the Malpighian vessels open into the duodenum, or, when this is wanting, into the ilium, close behind the pylorus; and as in the Homoptera they are attached to the recurrent intestine, it seems improper to consider this as part of the ventriculus. If the recurrent intestine be cut, a number of large cells, some with daughter-cells, exude from it.

According to Burmeister, the Malpighian vessels are never less than four in number; and according to Lacordaire, when there are only two, they are always attached by both ends; but in *C. hesperidum* there are but two, and they are attached only at one end.

It seems to me evident that M. Leydig must have detached the whole canal from the skin, and, in doing so, ruptured the recurrent intestine. In this case it would be very natural for him to regard the free end of the longer part as the anus. The large rectum he has evidently mistaken for the stomach, and the vent for the mouth. There would then remain the œsophagus, which he has correctly described as going to the skin.

I have repeatedly dissected out the intestinal canal without rupturing the recurrent intestine; and it may be observed that the structure of the whole digestive organs, as now described, is in accordance with that of the other Homoptera, which would not be the case if M. Leydig is correct.

M. Ramdohr examined *C. Alni*, but his description can hardly be correct, since it is scarcely possible that nearly allied species can differ so entirely in the arrangement of such important organs. Unless *Coccus Alni* does differ very much from *C. hesperidum*, he has made the same mistakes as M. Leydig, with the addition of having misunderstood or overlooked the hepatic glands, which perhaps he may have mistaken for ovaries.

The intestinal canal of *C. persicæ* is formed on the same type as that of *C. hesperidum*.

Nervous System.

I do not propose to give a detailed account of the nervous system, and only allude to it in order to mention the great variations observed in different specimens. Figs. 2–9 represent different forms of the nervous system in *C. hesperidum*, and fig. 10 that of *C. persicæ*: in all the objects are magnified 60 diameters.

Leydig rightly describes the subœsophageal portion of the ganglionic column as being reduced to a large mass (fig. 2, &c. A), situated close behind the mouth. This ganglion generally emits, besides the commissure, three large nerves on each side, and its hinder extremity is continued into a still larger nervous column (C), which passes backward for rather more than ·014 of an inch without throwing off any branches. It then divides, and after a while each of the divisions again subdivides, so as to give off a rich plexus of nerves to the posterior part of the body.

The posterior pair of nerves (fig. 2, &c.) always throws off on its inner side, and not very far from its origin, a nerve (F) which I once traced and found to unite with one of the nerves derived from the main central chord. This nerve (F) is always present, but the point at which it leaves the main nerve (B) is very variable, being sometimes as much as ·014 of an inch from the subœsophageal ganglion, sometimes quite close to it. Indeed, in more than one instance it arose from the ganglion itself, and not from the nerve B (fig. 3).

FIG. 2

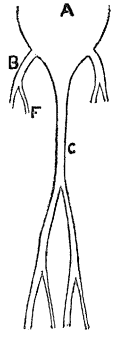


FIG. 3

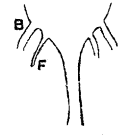


FIG. 4

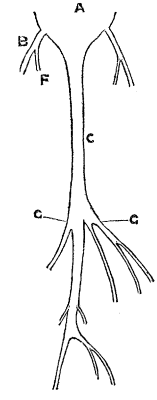


FIG. 6

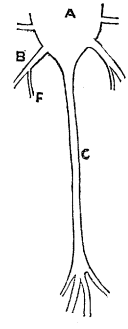


FIG. 5

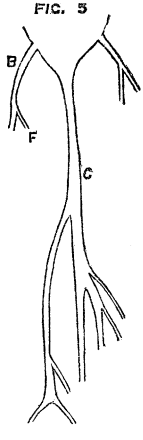


FIG. 7

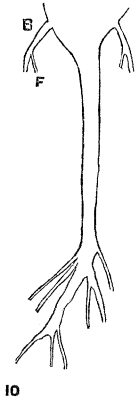


FIG. 9

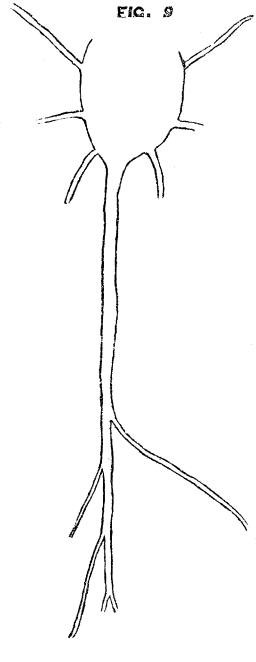


FIG. 8

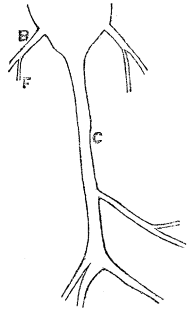


FIG. 10

In the divisions also of the central stem there are very great variations, which it would be endless to describe in detail. Perhaps the arrangement most generally met with, and that which I am inclined to regard as the type, on account of its presenting the nearest approach to symmetry, is that the main central chord separates, at about ·014 from its origin, into two equal branches, and these again, after a course of about ·01, divide dichotomously (fig. 2). In such a case the division of F from B generally takes place at a considerable distance from the ganglion.

I have, however, not met with many specimens presenting even this very limited amount of symmetry and regularity.

In fig. 4 we see the two divisions (G, G) of the central chord C divide almost immediately and yet not symmetrically. In fig. 5 the chord C divides into two unequal divisions, the smaller of which passes along for more than ·014 before it redivides, while the larger branch divides into three at a point only ·006 from its origin. In fig. 6 the central chord, just before its division into two branches, throws off on each side a small branchlet; in fig. 7 this happens only on one side. Finally, figs. 4 and 7 present us with some instances in which more than four branches are given off close to the first division of the great chord C.

But even in the case which I have above described as most typical, the symmetry is not in fact so great as it would at first sight appear to be, because the nerves on the two sides are frequently not of the same size. Thus, in fig. 2 each of the two branches of the main central stem divides, it is true, into two secondary branches, one of which is smaller than the other, but the two lesser branches are both upon the right side. If then, as is probable, we are justified in concluding that in each animal the ultimate nervous fibrils are of somewhat equal size, that they compose the greater part of the nerve, and that the corresponding organs of the two sides of the body receive an equal amount of nerves, it is evident that some of the parts which on the left side are supplied by the large outer branch must on the right side be connected with the median branch.

We see, therefore, that not only is the branching of the nerves absolutely irregular, and that of the two sides entirely unsymmetrical, but even the number of main stems proceeding from the

ganglion is not always the same. This result has surprised me very much, since if any organs might have been expected to be almost invariable, I should have thought it would have been the nervous system. I believe that no parallel case has been described, nor do I even remember to have seen a description of any variation occurring in the larger nerves of any animal whatsoever. Considering, however, how great are the variations which occur here in the same species, it is evident that differences in the distribution of the nerves in nearly allied forms are in themselves no *proof* that such species were separately created.

Around the ganglionic masses are several large spherical bodies. These appear to be homologous with the "Zellenkörper," described by Leuckart as surrounding the supraœsophageal ganglion in the larva of *Melophagus*. He considers them also as homologous with similar organs which have been observed in the embryos of other insects by Heroldt and Kölliker*.

Dujardin (Ann. des Sci. Nat. 1850, 3rd sér. vol. xiv. p. 202) describes the supraœsophageal ganglion of the worker-ants as consisting of several isolated parts, and I was at first inclined to consider these spherical bodies as also merely isolated parts of the ganglionic mass, in favour of which view it may be urged that fewer nerves than usual appear to proceed from this mass. The contents of the spherical bodies, however, under the influence of reagents, present an appearance different from that of the supraœsophageal mass.

The subœsophageal ganglion is very richly supplied with tracheæ, derived from two large stems which are attached to the front angles, and ramify from thence all over the mass.

The supraœsophageal ganglion is a triangular mass with its apex behind. The two front corners terminate in large nerves.

The nervous system of *C. persicæ* differs but little from that of *C. hesperidum*, and offers the same extraordinary amount of variation. The two species, however, could be at once distinguished by the superior size of the subœsophageal ganglion in *C. persicæ*, in which species also the last pair of nerves (fig. 10) is given off more posteriorly, while both they and the central stem are considerably swollen at their origin, so as to give the hind margin of the ganglion a three-pronged outline.

* Die Fortpflanzung und Entwickelung der Pupiparen. Halle, 1858.