Contributions to the Knowledge of the Antennary Sense-Organs of Insects. By C. M. Child, of the Zoological Institute, Leipzig University.

After being occupied for some months in studying the larvæ and pupæ of *Mochlonyx* [*Corethra*] *culiciformis*, Deg., and *Corethra plumicornis*, F., in the laboratory of Privy Councillor Leuckart, my attention was directed to a singular organ at the base of the antenna in these insects. Upon further investigation it has been found that the structure in question is a highly developed sense-organ, an organ which, as I gradually learnt, is not only present in the Nematocera, but is also of fairly frequent, if not of universal, occurrence in the most widely different orders of insects.

The literature upon the subject I found to be very scanty, and for the most part out of date and incomplete. On account of its structure and position the organ was regarded by Johnston * as having an auditory function. Mayer † performed certain experiments with living gnats, which confirm rather than refute this view. Weismann ‡ has studied the development of the organ, but leaves the question as to its function entirely undecided. Hurst § gives a very inexact and partly incorrect description of the structure of the organ, and agrees with Johnston and Mayer in regarding it as auditory.

Moreover, as I convinced myself in the course of my investigations, the organ in question is possessed not only by the gnats, but also by all Diptera, so far as I have examined them. This general occurrence among the Diptera induced me to investigate other orders of insects, and here also I have found a similar structure in a corresponding position.

With reference to this a few words may be said as to the structure of the organ in the case of a common wasp (*Vespa vulgaris*), which perhaps may serve as an introduction to the knowledge of the other forms. In the wasp the structure lies in the small second joint of the antenna, through the middle of which run the main antennary nerve and a tracheal stem. At the end of the first joint the nerve gives off fibrils on all sides, which run obliquely towards the periphery of the second joint, there to enter into connexion with ganglion-cells. These ganglion-cells are also connected with long rod-like structures, which run as far as the arthrodial membrane between the second and third joints, where they apparently enter into small pores in the membrane and there end. Into each of these pores or small tubes enters a little group of these structures, which I will here term rodlets (Stäbchen).

* Johnston, "Auditory Apparatus of the *Culex* Mosquito," Journal of Microscopical Science (Old Series), vol. iii. 1855.

† Mayer, "Researches in Acoustics: Paper no. 5," 'Philosophical Magazine' for December 1874, p. 513.

‡ Weismann, "Die Metamorphose von *Corethra plumicornis*," Zeitschr. f. wiss. Zool. xvi. Bd.

§ Hurst, "The Pupal Stage of *Culex*," Inaug. Dissertat. Leipzig, 1890.—"On the Life-History and Development of a Gnat," Transactions of the Manchester Microscopical Society, 1890.—"The Post-embryonic Development of *Culex*," Proceedings of the Liverpool Biological Society, vol. iv.

Between the rodlets in their course towards the arthrodial membrane lie here and there small bodies, which contain chromatin; these are probably nuclei, but whether they belong to supporting cells or to other cells of a nervous nature is a question which for the present may be left undecided. On the outside of the antenna there is neither a sensory seta nor any other appendage corresponding to the ends of the rodlets, and the pores appear to be closed at their outer ends. In no other joint of the antenna of the wasp have I been able to find a trace of this structure or of one resembling it. I at first thought that perhaps some relation might exist between this organ and the rod-bearing sense-organs, or scolopophores, which (according to the statements of Graber, von Leydig, and others) occur in the antennæ. A closer investigation, however, proved this supposition to be erroneous.

In the genera *Melolontha* (Coleoptera), *Epinephele* (Lepidoptera), *Bombus* (Hymenoptera), *Pachyrhina*, *Tabanus*, *Syrphus*, *Helophilus*, *Musca*, *Sarcophaga* (Diptera), *Sialis*, *Panorpa*, *Phryganea* (Neuroptera), and *Libellula* (Pseudoneuroptera) the organ exhibits on the whole the same structure as in the case of the wasp.

Among the Hemiptera I have so far only examined the Homoptera. Here the organ is but slightly developed. The ganglion-cells and rodlets are present in small numbers, and are also situated at the end of the second joint, which is not materially different from the other joints.

Among the Orthoptera the genera *Periplaneta*, *Locusta*, and *Stenobothrus* have in the second joint of the antenna a structure which is provided with ganglion-cells and long fibre-like rodlets.

I have hitherto had no opportunity of examining the Thysanura.

The organ undergoes a further development in the Culicidæ and Chironomidæ (Diptera), in which, as is well known, the antennæ are different in the two sexes. At the base of the antenna is an almost spherical joint, which is larger in the male than in the female. Within this joint is a very complicated organ of a nervous nature, in the structure of which, especially in the case of the female, an unmistakable similarity to the organ above described is recognizable. In the female the rodlets, instead of entering into pores, terminate towards a plate of chitin, upon the centre of which stands the long antenna. The very large antennary nerve runs chiefly into the ganglion-cells of the organ, but gives off two relatively small cords, which run through the centre of the large joint into the other segments. The ganglion-cells pass without a sharp division into those of the brain. The rodlets are delicate and provided with small nuclei, which are rich in chromatin. In the male the structure is very complicated, and, moreover, different in the Culicidæ and Chironomidæ. It does not easily lend itself to description in a few words and without figures, but I would here remark that this form is also readily traceable to the general type.

The organogeny I have so far studied only in the Culicidæ and Chironomidæ. For the general development of the antennæ in these insects I would refer the reader to the papers of Weismann and Hurst, already quoted. I will merely add that the entire organ is formed from a fold at the base of the invaginated sac of hypodermis,

and that the differentiation of the rodlet- and ganglion-cells takes place very early.

With reference to the function of this organ in general I am firmly convinced that it does not belong to the category of the so-called olfactory organs of the antenna. I think that my investigations prove that the nerve-endings are situated in such a way that each movement of the distal portion of the antenna, whether in consequence of pressure or tension (Zerrung), must cause a stimulus to be imparted to them. As has been determined by numerous observations and experiments, many insects exhibit with their antennæ a reaction to sound.

It is true that in many instances these observations are not free from error; but in spite of this it appears to be very probable that, at any rate in the case of many insects, an auditory organ is connected with the antenna. In my opinion the organ which I have investigated may be the auditory organ in question. It was, moreover, years ago regarded as such in the case of the Nematocera.

The presence of an organ of this nature in the Orthoptera might perhaps tell against this view, since these insects besides these structures also possess others, the tympanic organs, which are usually regarded as an auditory apparatus. Nevertheless I will here merely recall the experiments of Graber*, who found that Orthoptera, even after the excision of the tympanic organs, were still sensitive to sound, and moreover exhibited the reaction with their antennæ, in certain cases also with the legs.

It appears to me that this organ, if susceptible to very small sound-movements, is also stimulated by coarser shocks, *e.g.* by contact of the antenna with a solid object; in short, that in this case there is no sharp distinction between auditory and tactile sensation.

Since it was impossible for me to foresee that the investigation would extend so far, I collected but little fresh material during the past summer, and was later on prevented from acquiring more in consequence of the advanced season of the year. I intend, however, to ascertain precisely the range of this organ, and to determine its function if possible by experiment. The results of these investigations I purpose to treat in greater detail in a subsequent paper.—*Zoologischer Anzeiger*, xvii. Jahrg., No. 439, February 5, 1894, pp. 35–38.

Researches on the Structure, Organization, and Classification of the Fossil Reptilia.—Part IX. Section 1. *On the Therosuchia.* By H. G. Seeley, F.R.S.

This paper discusses the classification of reputed Permian and Triassic Reptilia which have been referred to the Anomodontia as Theriodonts.

Lycosaurus, as the genus placed first on Sir R. Owen's list, is accepted as the type of the Theriodontia. The species *Lycosaurus*

* Graber, "Ueber die Tympanalsinnesorgane der Orthopteren," Denkschr. der k. Akad. zu Wien, nat.-wiss. Theil, 1876; and other papers.