Structure and Development of the Tracheal Organ in the Mesothoracic Leg of the Cricket

*Teleogryllus commodus* (Walker)

David Young and Eldon Ball

Department of Neurobiology, Research School of Biological Sciences, Australian National University, Canberra City, A.C.T., Australia

Received November 12, 1973

**Summary.** The tracheal organ of the mesothoracic tibia of *Teleogryllus* is located in a corresponding position to the tympanal organ of the prothoracic tibia. The mesothoracic organ contains an average of only 12 scolopidia, the location of which corresponds to that of the proximal group A and proximal main group in the prothoracic tympanal organ. There are no scolopidia corresponding to the distal group of the tympanal organ. The variability in number of scolopidia is much greater in the mesothoracic organ than in the prothoracic organ. The adult tracheal system of the mesothoracic leg resembles the early nymphal tracheal system in both pro- and meso-thoracic legs. The development of the tracheal organ is usually complete by the sixth instar. The mesothoracic tracheal organ of the adult is broadly equivalent to the prothoracic tympanal organ of a fifth instar animal.

**Key words:** Chordotonal (Tracheal) organ — *Teleogryllus commodus* (Orthoptera) — Hearing — Development — Structure.

**Introduction**

In the preceding papers we have analyzed the adult structure and development of the auditory system in the prothoracic leg of the cricket, *Teleogryllus commodus* (Walker). The mesothoracic tibia contains a chordotonal organ in a location corresponding to that of the prothoracic tympanal organ. However, since this organ lacks an associated tympanum we will call it the “tracheal organ” following Friederich (1929).

The homologous chordotonal organs which are present in the prothoracic and mesothoracic legs are commonly regarded as being sensitive to air-borne sound and substrate vibration, respectively. In some ways such a separation is artificial since some units in the prothoracic leg of *Gryllus campestris* respond to both air-borne sound and substrate vibration (Nocke, 1972) and there are units in the mesothoracic leg which respond to both air-borne sound and vibrational stimuli over the range from 0.1–15 kHz (Nocke, 1972). However, as judged by relative thresholds and the presence of a tympanum on the prothoracic leg it is certainly valid to say that the receptors of the prothoracic leg are specialized for the reception of air-borne sound.

We hope to use the information in this and the two preceding papers as the basis for comparative physiological studies. For example, the morphological information here presented, when combined with physiological measurements, may help us to recognize those units which respond to high frequency sound (high pitch) in the prothoracic leg. Once such units have been identified it may
Fig. 1. Left mesothoracic tibia seen in anterior view; projection reconstruction from serial 10 μm sections. The tibia is drawn as if the anterior cuticle and hypodermis were removed and all else left intact except for muscle which is omitted. This drawing is directly comparable with Fig. 3b of the first paper in this series. CM, covering membrane; CS, campaniform sensilla; LN, leg nerve; Sc, scolopales; SN, subgenual nerve; SO, subgenual organ; SSN, subgenual sensory neurons; TB, tracheal branch; TN, tracheal nerve; TS N, tracheal sensory neurons; TT, tracheal trunk

then be possible to meaningfully relate their structure and function. Autrum (1941) has previously utilized a somewhat similar approach to study hearing and vibration sense in the tettigonids Tettigonia (Locusta) cantans and Decticus verrucivorus and his paper contains a good discussion of the limitations of such a comparative approach.

The only previous comparable morphological investigation is that of Friedrich (1927, 1928) on the tettigonids Pholidoptera griseoptera (Deg.) (Thamnotrizon cinerea L.) and Tettigonia (Locusta) viridissima. The first of these papers (1927) points out that organs homologous to the tympanal organ are present in the meso- and metathoracic legs while the second (1928) describes the histological details of these organs and the ways in which they differ. Friedrich's findings will be considered in greater detail following presentation of the results of the present study.

Materials and Methods

Histological techniques and terminology are as presented in the first paper of this series. All observations were made on the same population of freshly moulted animals used for studying the development of prothoracic tympanal organ. However, since perfect series of sections were not always obtained, the individuals from which final counts were made were not necessarily identical for the two legs.

Results

Adult Structure. The tracheal system of the mesothoracic tibia consists of two tubes which are similar to those present in the early developmental stages of the