Chapter IV
Muscular System and Locomotion

ANATOMY AND HISTOLOGY

Anatomy—The muscles of insects fall into two groups; the skeletal muscle forming bands stretched across the articulations of the body wall, which serve to move one segment on another, and the visceral muscles which invest the internal organs. The skeletal muscles are made up of elongated contractile fibres lying parallel with one another or converging upon the point of insertion. They are often exceedingly numerous (Lyonet described 1,647 muscles in the goat-moth caterpillar as compared with 529 in man) and their arrangement differs greatly from one group of insects to another. The visceral muscles may form a regular lattice of longitudinal and circular fibres, as around the gut of some insects, the circular fibres being exaggerated at places to form occlusive sphincters; or they may form an irregular feltwork of branching and anastomozing fibres, as in the wall of the crop (Fig. 82), in the ventral diaphragm or in the 'peritoneal' covering of the ovaries, where these fibres appear to merge imperceptibly into strands of connective tissue. In some insects, such as the bee, branching and anastomozing fibres of this kind may compose some of the muscle coats of the stomach wall.

Histology—All insect muscles seem to be made up of striated fibres; although in some of the visceral muscles the striations may be difficult to detect. Each fibre consists always of a number of parallel fibrillae or sarcostyles laid down in a nucleated plasma or sarcoplasm more or less laden with glycogen (Fig. 341, p. 596). But the degree of differentiation of the fibrillae, and their arrangement within the fibre, differs widely in various insects and in the different muscles of the same insect.

In some of the muscles of the honey-bee larva and in the larvae of many Diptera the fibrils are minute threads with little visible differentiation; and they are invested by a thick layer of superficial plasma devoid of fibrillae (Fig. 83, A).

In adult insects three principal types of skeletal muscle are recognized:

(i) In the adults of all the higher Hymenoptera and Diptera, and in adult...
Dytiscus, the nuclei are arranged in a row through an axial core of sarcoplasm extending the entire length of the fibre, and the fibrillae, as seen in transverse section, are arranged in flat bundles or lamellae radiating from the centre. These are sometimes called 'tubular muscles' or 'lamellar muscles' (Fig. 83, C).45, 74 The flight muscles of Odonata, Blattidae and Mantidae are of this type.

(ii) 'Microfibrillar muscles' with closely packed cylindrical fibrils of 1·1-1·5μ diamater. Each fibre is ensheathed in a relatively tough structureless membrane, the sarcolemma, and the nuclei of the sarcoplasm are either scattered throughout the substance of the fibre or disposed immediately beneath the sarcolemma (Fig. 83, B).

(iii) The indirect flight muscles in the thorax of Apis, Vespa, &c., and many Diptera and Coleoptera, and in the tymbal muscles of Cicadas, are sometimes called 'fibrous' or 'fibrillar muscles' (Fig. 83, D). Unlike the preceding types, which are always white in colour, these are yellowish or brownish. They consist of bundles of very large fibrils, 2·5-3μ in diameter, which presumably correspond with the sarcostyles of the other types. In the wing muscles of the bee, which are of this type, there is no sarcolemma; the fibrils are loosely bound together by the tracheal endings. The entire fibre bundle is polygonal in cross section and 90-160μ in diameter.62

In all these types each sarcostyle or myofibril consists of alternating isotropic and anisotropic segments; these more or less correspond with the pale and dark-staining discs visible in the fixed tissue. In a given fibre these discs are at approximately the same level in neighbouring fibrils, so that the entire fibre has a banded or striated appearance. The details of this striation vary in complexity in different muscles. In its most elaborate form (Fig. 84) the light disc is traversed by a membrane, the Z line, (telophragma or Krause's membrane) attached all round the fibre to the sarcolemma, the compartment between adjacent membranes being termed a sarcomere. In the light disc, on either side of the telophragma, there may be a narrow row of dark dots, the accessory disc. And in the middle of the main dark disc there may be a pale stripe, the median