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External Structure

1. Introduction

The extreme variety of external form seen in the Insecta is the most obvious manifestation of this group's adaptability. To the taxonomist who thrives on morphological differences, this variety is manna from Heaven; to the morphologist who likes to refer everything back to a basic type or ground plan, it can be a nightmare! Paralleling this variety is, unfortunately, a massive terminology, even the basics of which an elementary student may find difficult to absorb. Some consolation may be derived from the fact that "form reflects function." In other words, seemingly minor differences in structure may reflect important differences in functional capabilities. It is impossible to deal in a text of this kind with all of the variation in form that exists, and only the basic structure of an insect and its most important modifications will be described.

2. General Body Plan

Like other arthropods insects are segmented animals whose bodies are covered with cuticle. Over most regions of the body the outer layer of the cuticle becomes hardened (tanned) and forms the exocuticle (see Chapter 11, Section 3.3). These regions are separated by areas (joints) in which the exocuticular layer is missing, and the cuticle therefore remains membranous, flexible, and often folded. The presence of these cuticular membranes facilitates movement between adjacent hard parts (*sclerites*). The degree of movement at a joint depends on the extent of the cuticular membrane. In the case of intersegmental membranes there is complete separation of adjacent sclerites, and therefore movement is unrestricted. Usually, however, especially at appendage joints, movement is restricted by the development of one or two contiguous points between adjacent sclerites; that is, specific articulations are produced. A *monocondylic* joint has only one articulatory surface, and at this joint movement may be partially rotary (e.g., the articulation of the antennae with the head). In *dicondylic* joints (e.g., most leg joints) there are two articulations, and the joint operates like a hinge. The articulations may be either *intrinsic*, where the contiguous points lie within the membrane (Figure 3.1A), or *extrinsic*, in which case the articulating surfaces lie outside the skeletal parts (Figure 3.lB).

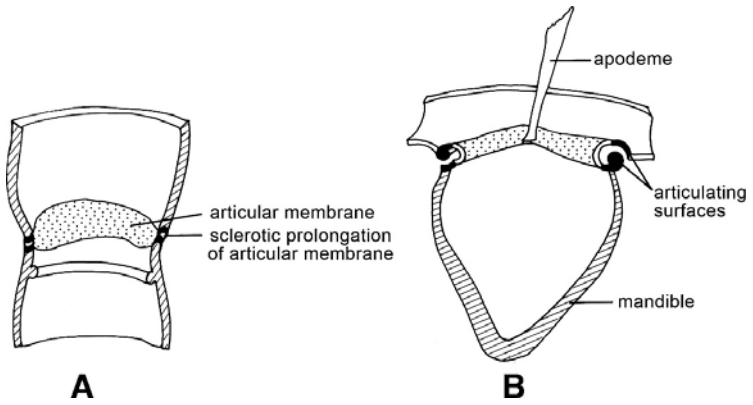

FIGURE 3.1. Articulations. (A) Intrinsic (leg joint); and (B) extrinsic (articulation of mandible with cranium). [From R. E. Snodgrass, *Principles of Insect Morphology.* Copyright 1935 by McGraw-Hill, Inc. Used with permission of McGraw-Hill Book Company.]

In many larval insects (as in annelids) the entire cuticle is thin and flexible, and segments are separated by invaginations of the integument (*intersegmental folds*) to which longitudinal muscles are attached (Figure 3.2A). Animals possessing this arrangement (known as *primary segmentation*) have almost unlimited freedom of body movement. In the majority of insects, however, there is heavy sclerotization of the cuticle to form a series of dorsal and ventral plates, the *terga* and *sterna*, respectively. As shown in Figure 3.2B,

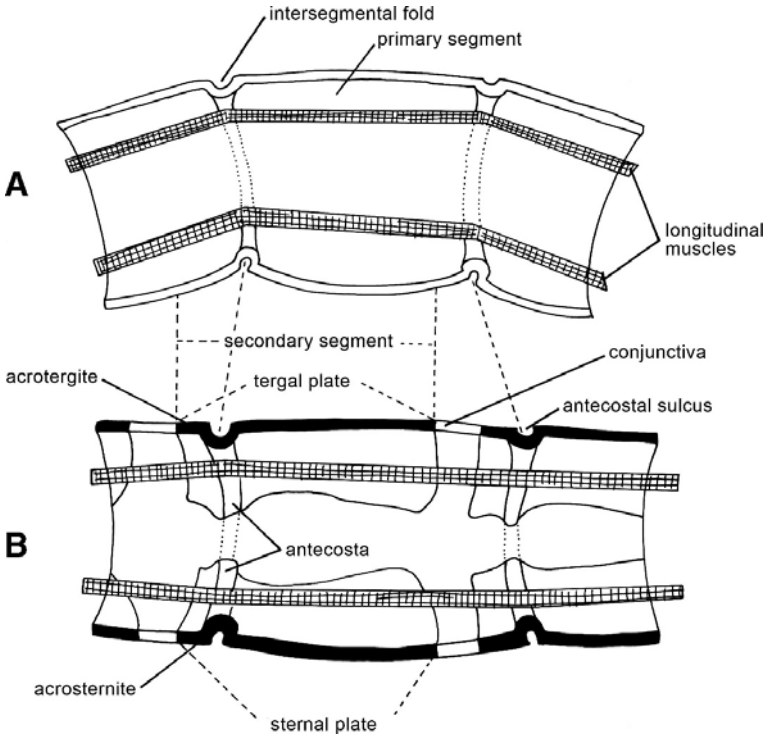

FIGURE 3.2. Types of body segmentation. (A) Primary; and (B) secondary. [From R. E. Snodgrass, *Principles of Insect Morphology.* Copyright 1935 by McGraw-Hill, Inc. Used with permission of McGraw-Hill Book Company.]