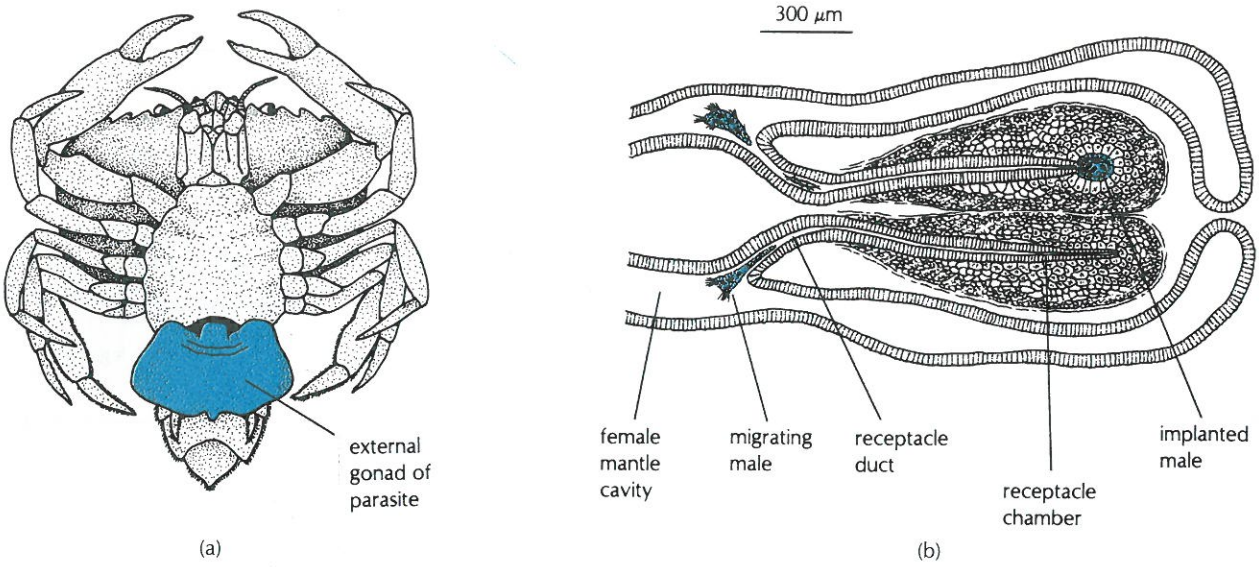

Figure 18.36

(a) External gonad of the rhizocephalan *Sacculina carcini,* parasitic on (and in) the green crab *Carcinus maenas.* The crab is shown in ventral view. Internally, the parasite ramifies throughout the crab's tissues. (b) Diagrammatic cross section through a portion of the external gonad of a female rhizocephalan barnacle, *Sacculina carcini.* As shown, the female has two narrow receptacle ducts opening into the mantle chamber. A dwarf male, expelled through one antenna of a cyprid larva, is shown entering the lower of the two ducts. The upper duct already houses one male at its distal end; another male, shown about to enter this upper duct, will never reach the end: The passageway is blocked by the cuticle shed previously by the first male to enter. (a) *From K. Rhode, 1982.* Ecology of Marine Parasites. *New York: Queensland Press; after Boas.* (b) *From J. T. Høeg,* Philosophical Transactions of the Royal Society, *317:47–63, 1987.*

The fertilized eggs of terrestrial species require some form of protection, especially from desiccation, and are often provided with sufficient food to fuel most or all of their prejuvenile development. The nutritional requirements of the fertilized eggs of terrestrial species can often be met only if the female has access to a high-protein diet during the period of egg formation, or **oogenesis** (*oo* = G: egg; *genesis* = G: birth). Hence, many female insects require a blood meal to mature their eggs prior to **oviposition** (i.e., discharge and placement of eggs). A number of insects, notably the wasps, meet the nutritional needs of their larvae by placing their eggs in or adjacent to the eggs of other insect species or within the bodies of other adult insects, which are then devoured by the developing young from the inside out (Research Focus Box 18.1).[10] Some insects deposit their eggs in plants, which respond by forming protective galls. The eggs are inserted into these various substrates through a long tube, called an **ovipositor,** typically protruding from the abdomen. Harvestmen (class Arachnida) are similarly equipped, and for a similar purpose. In some insects (e.g., bees), the ovipositor has been modified to form a stinger.

During development, insects pass through several larval stages, called **instars.** This is conspicuously true for insect species that undergo a **metamorphosis** from a larval to a distinctly different adult body plan. In some species, this transition is gradual, and the different instars are called **nymphs** (Fig. 18.37a,b). Aquatic nymphs are sometimes referred to as **naiads.** Dragonflies, grasshoppers, and cockroaches, for example, develop in this manner and are said to be **hemimetabolous** (*hemi* = G: half; *metabolo* = G: change) (Fig. 18.38a). In most other insect species, the change to adult form is radical and abrupt, and termed **holometabolous** (*holo* = G: whole; *metabolo* = G: change). The feeding, immature stages are termed **larvae** (Fig. 18.37c,d). After passing through several larval instars of ever-increasing size, a morphologically distinct, nonfeeding pupal stage is formed. The **pupa** then undergoes extensive internal and external reorganization to form the adult morph. Butterflies provide what is probably the most familiar example of holometabolous development (Fig. 18.38b). Wasps and ants are other noteworthy examples, with the adults laboriously tending the helpless larvae and pupae. Holometabolous development characterizes about 88% of all extant insect genera, as opposed to less than 50% of insect genera known from 250 million year old fossils; life histories with ecologically distinct larval stages and a dramatic transition to adulthood clearly have had a selective advantage over those exhibiting more gradual development to the adult stage.

Adults of **apterygote** species, such as silverfish, lack wings (*a* = G: without; *ptero* = G: wing), and in fact are believed to be direct descendants of wingless ancestors; thus,

10. See *Topics for Further Discussion and Investigation,* no. 4.