Chapter V. THE EXCRETORY SYSTEM
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Malpighian tubules

The specialized tubular projections of the tick midgut, the Malpighian tubules, excrete the final products of nitrogen metabolism. The long, paired slender tubules form several loops in the body cavity; proximally they open into both sides of the rectal sac at the origin of the rectum. Their apices are at the level of the central nerve synganglion. Malpighian tubules are not visibly differentiated externally except for marked apical thickening (Fig. 213). The tubule walls consist of a single layer of epithelial cells which, in the light microscope, do not differ throughout the tubules (Balashov, 1967).

Tick Malpighian tubules are ultrastructurally essentially the same as those of insects (Balashov and Raikhel, 1973, 1975, 1976b; Raikhel, 1975B). Each tubule is surrounded by a connective tissue sheath and muscles. As in insects, the tubule cells have features typical of those involved in active fluid transport. They are characterized by structural asymmetry and highly developed plasma membrane folds. The apical surface facing the tubule lumen is covered by microvilli; the basal zone is separated from the hemolymph by the basal lamina and has a system of plasma membrane infoldings (Figs. 213-217). In H. asiaticum, the microvilli length and density vary depending on the particular region of the tubule, but structurally are like and contain no mitochondria, microfilaments or channels of smooth endoplasmic reticulum (Fig. 213). Microvilli in the Malpighian tubules of an argasid Ornithodoros papillipes (Raikhel, 1975b; Balashov and Raikhel, 1976b) and other terrestrial chelicerate species so far studied (Coons and Axtell, 1971a; Seitz, 1975) are structurally similar. Insect Malpighian tubule microvilli usually contain elongated mitochondria or channels of smooth endoplasmic reticulum and only the microvilli of some specialized cells or tubule regions lack these organelles (Smith, 1968; Maddrell, 1971; Wall et al. 1975).

The microvilli and basal infoldings of plasma membrane characterize cells of transporting epithelia. Both subcellular surface specializations drastically increase the effective surfaces of transporting cells through which molecules move. These specializations form a channel system to provide a structural basis for fluid transport (Maddrell, 1971; Wall et al., 1975). Consequently, the developmental level of these surface specializations may serve as an index of the functional activity level of transporting excretory cells. Electron microscope investigation has demonstrated the important morphophysiological adaptation of ixodid ticks to the hematophagia: the ability of the Malpighian tubule