5 Summary

The integument is the morphologic unit that has received the most attention in discussions on the evolution of the seed plants. There are several theories and hypotheses about the origin of the integument were presented in the history. However, the development and function of the ovule envelopes are not so clear until now. We selected the basal gymnosperms, *Cycas* L. and *Zamia* L., and basal angiosperms, *Magnolia* L., and relatively derived Celastraceae to investigate the development of the ovule, especially of the integument to complement the existing knowledge in seed plants. The development of ovules of seed plant is documented with morphological and anatomical techniques using LM and SEM.

The nucellar beak found in *Zamia* is a structure that has not been recorded previously. It protrudes from the micropyle at pollination and may be the primary acceptor for pollen. There are striking similarities to the lagenostom or salpinx in Lyginopteridatae. There may be an evolutionary way to interpret the pollination drop existing in the Lyginopteridatae. Probably the nucellar beak of Cycads, even Ginkgoales, have the same function as the lagenostom or salpinx of the Lyginopteridatea. Unfortunately, pollen and transport inside the pollination chambers have not been observed. Further analysis of this unusual structure seems to be very important.

The development of *Magnolia* L. shows that the outer integument differentiates into two layers, an outer fleshy one well filled with oil receptacles, and an inner stony layer of bony hardness. The inner integument forms only a thin layer. This supports the results of Boer and Bouman (1972).

The developmental studies of three species of Celastraceae, however, turned out that the structure termed aril in this family does not originate from the funiculus or the hilum, but from the exostomatic micropyle. As a consequence, the micropyle is not inside the aril, but at the base of the fleshy structure which is thus better referred to as a caruncula. The fleshy part of seeds in Celastraceae differs thus markedly from those seed appendages usually referred to as an aril. The seed wing of *Catha edulis* (Vahl) Endl. (Celastraceae) has been described as an aril derived from the funiculus, while the aril of other Celastraceae is considered arising from the micropyle instead of the funiculus. The wing is a modified caruncula derived from the micropylar region.
Thus, seed wings are not only interesting in respect to function, but may carry also interesting and important evolutionary signals. The evolution of different micropylar appendages within Celastraceae is discussed.

Seed appendages are structures of rich diversity which have different biological functions and can show different evolutionary pathways. However, a description of these structures without a developmental study would be incomplete or even contradictory. *Homalanthus populifolius* Graham (Euphorbiaceae) and *Passiflora citrina* J. M. MacDougal were selected to study the processes of carpel, ovule and seed appendage development in order to compare different models of caruncula and aril. A caruncula is confirmed to exist in *Homalanthus populifolius* Graham. The presence of the stomata on the outer integument is a new discovery in this genus. The stomata on the outer integument are compared with those on the leaf, and the evolutionary implications are discussed.