Temporary adaptation of the cuticle in *Semibalanus balanoides* (Linnaeus, 1767) (Crustacea, Cirripedia Thoracica)

V. Zheden[1], D. Gruber[1] and W. Klepal[1]

1. Cell Imaging and Ultrastructure Research, University of Vienna, Althanstraße 14, A-1090 Vienna, Austria

vanessa.zheden@univie.ac.at
Keywords: *Semibalanus balanoides*, cuticle adaptation, ultrastructure

Differences in cuticle architecture within one organism are known of several crustaceans (e.g. Amphipoda [1]). In Cirripedia Thoracica the carapace forms a calcified shell, consisting of wall- and opercular plates, in which prosoma and thorax with cirri and penis are enclosed, all covered by uncalcified cuticle. On the cirri, which are regularly extended out of the shell into the surrounding water, an electron-dense upper exo- and a less electron-dense lower endocuticle can be distinguished (Figure 1A). Prosoma, thorax and penis are covered by undifferentiated procuticle (Figure 1B).

Outstanding within the Cirripedia Thoracica is *Semibalanus balanoides* by the annual temporary adaptation of the penis cuticle. This boreo-arctic species reproduces only once a year within one month (November in Scotland). After the copulatory period the penis degenerates and is shed off [2, 3]. In February/March the annulated copulatory organ begins to grow again from the pedicel and it reaches its full length and the maximal number of annulations by October. It is then ready for the next breeding season. In the course of penis development the cuticle changes its appearance. On the growing penis the cuticle is on average 1,3µm wide. The outer cuticular surface of the annuli is fairly smooth, in the depressions between the annuli the outer surface of the cuticle shows ridges (Figure 1C, D). In mature animals a differentiation of the cuticle from tip to basis of the penis is noticeable. The cuticle is smooth only near the tip. In the middle and basal region of the penis the surface of the outer cuticle is highly folded (Figure 1E) and the inner zone of cuticle is smooth (Figure 1F).

The ridges in the depressions between the annuli strengthen the cuticle, increasing its overall thickness by far and serving as special sites for the attachment of the longitudinal muscles which retract the extended penis. The folds, developed in the mature penis only, are supposed to have a double function: they give to the cuticle extra strength combined with high flexibility. By increasing the overall thickness of the cuticle to about three times its original width it is an important and necessary counterpart to the turgor pressure effective during searching movements and copulation of the extended penis. Additionally it allows easy bending of the penis which would be very difficult with a thick and solid packing ring of cuticle around.

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4. The animals used in this study were collected by Dr. M. Barnes and Mr. R. Harvey, whose help is gratefully acknowledged.

DOI: 10.3217/978-3-85125-062-6-271,

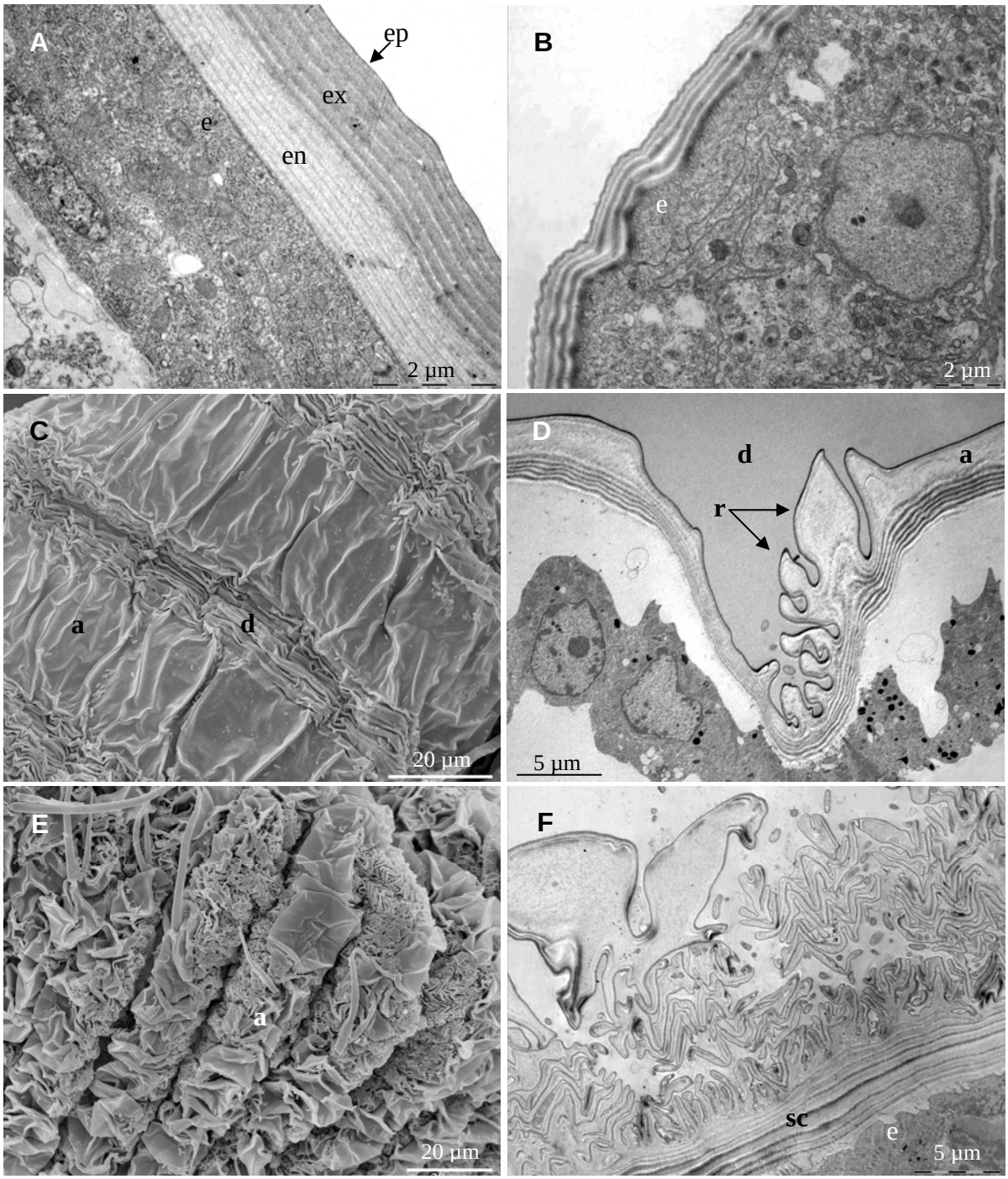

Figure 1. Cuticle of *Semibalanus balanoides* observed by transmission electron microscope **(A,B,D,F)** and scanning electron microscope **(C,E)**. **A** transverse section of the cirral cuticle; the smooth cuticle consists of epi-, exo- and endocuticle, **B** transverse section of the thorax cuticle, **C** middle region of the growing penis with extended depressions between the annuli, **D** longitudinal section of the middle region of the growing penis; annuli with smooth cuticle and depression with ridges, **E** middle region of the mature penis with folded annuli, **F** transverse section of the basis of the mature penis; surface of the outer cuticle highly folded and inner zone smooth. **a** annuli, **d** depressions, **e** epithelium, **en** endocuticle, **ep** epicuticle, **ex** exocuticle, **r** ridges, **sc** smooth cuticle

M.A. Pabst, G. Zellnig (Eds.): MC2009, Vol. 2: Life Sciences,
DOI: 10.3217/978-3-85125-062-6-271, © Verlag der TU Graz 2009