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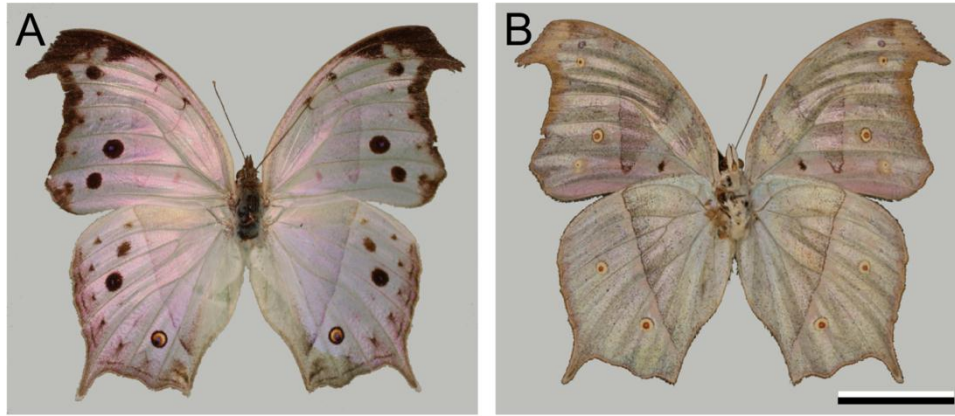


Fig. 1. The Mother of pearl, *Protogoniomorpha parhassus*. **A** Dorsal wing side. **B** Ventral wing side; scale bar: 2 cm.

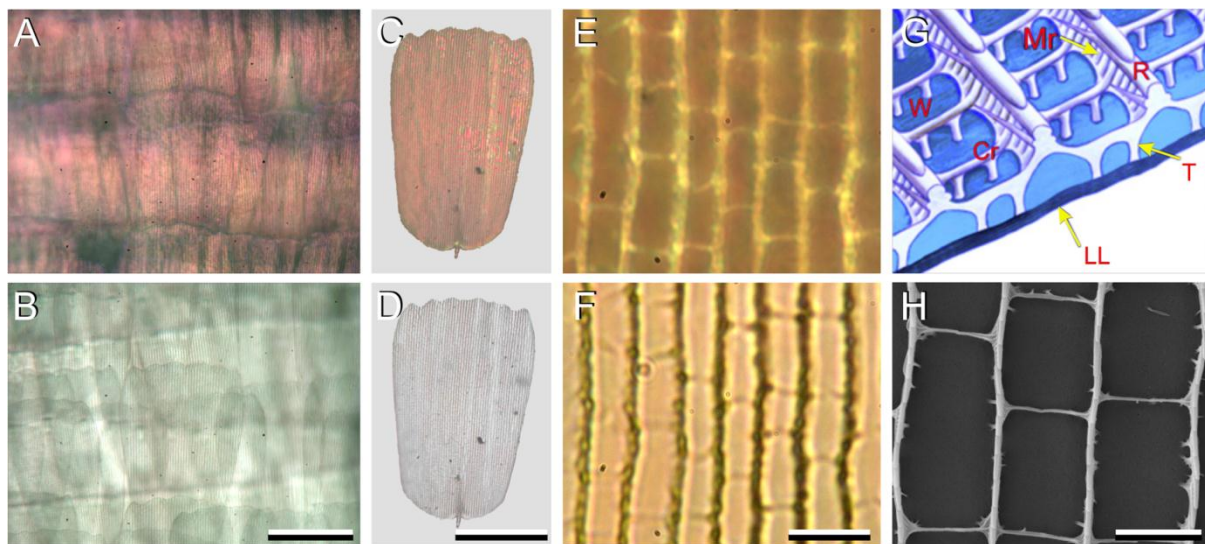


Fig. 2. Wing scales of the dorsal wings of *P. parhassus*. **A** Epi-illumination of the dorsal forewing. **B** Same location in transmitted light. **C** Epi-illumination of an isolated scale in air on a microscope slide. **D** The same scale in transmitted light. **E** Close-up view; epi-illumination. **F** Close-up view; transmitted light. **G** Diagram of a basic nymphalid wing scale (adapted from Wasik et al., 2014). R, ridge; Mr, microrib; Cr, crossrib; T, trabecula; LL, lower lamina; W, window. **H** FIB-SEM Scanning electron micrograph. Scalebar: A-D, 100 μm ; E, F, 10 μm ; H, 3 μm .

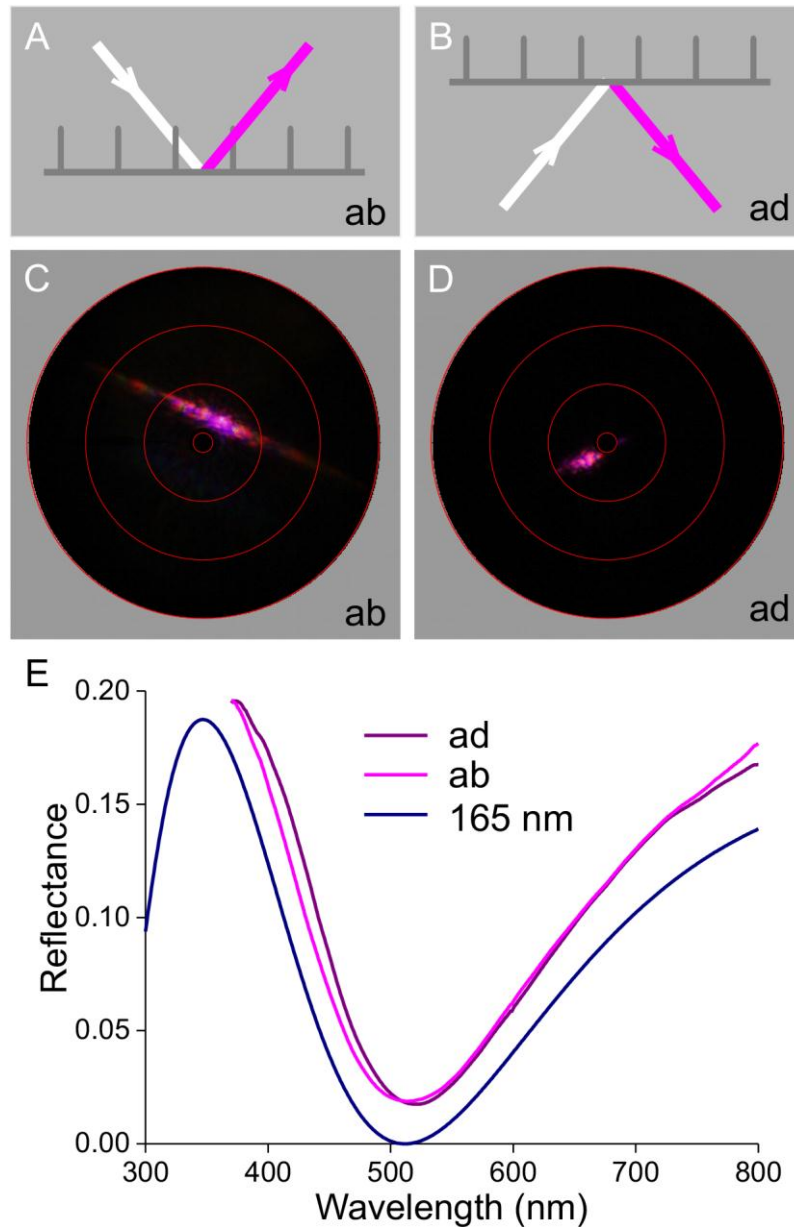


Fig. 3. **Scatterometry and microspectrophotometry on single wing scales of *P. parhassus*.** **A** Diagram of the abwing (the upper side of the scale) illumination of a wing scale. **B** Diagram of the adwing (the scale side facing the wing) illumination. **C** Abwing scatterogram. **D** Adwing scatterogram. The circles in **C** and **D** represent angular directions of 5°, 30°, 60°, and 90°. **E** Reflectance spectra measured with a microspectrophotometer from the ad- and abwing sides of the scales compared with the spectrum of an ideal chitinous thin film with 165 nm thickness.

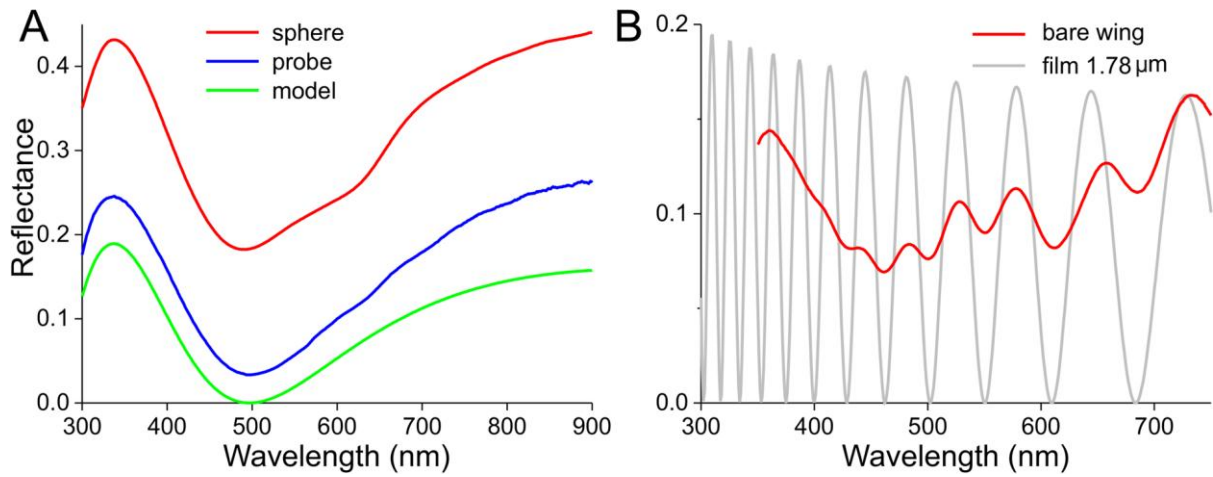


Fig. 4. Reflectance spectra of the dorsal forewing of *P. parhassus*. **A** Spectra measured with an integrating sphere and a bifurcated reflection probe, compared with the reflectance spectrum calculated for a chitinous thin film with thickness 160 nm. **B** Reflectance spectrum of a bare wing substrate measured with a microspectrophotometer, compared with the reflectance spectrum calculated for a thin film with thickness 1.78 μm .

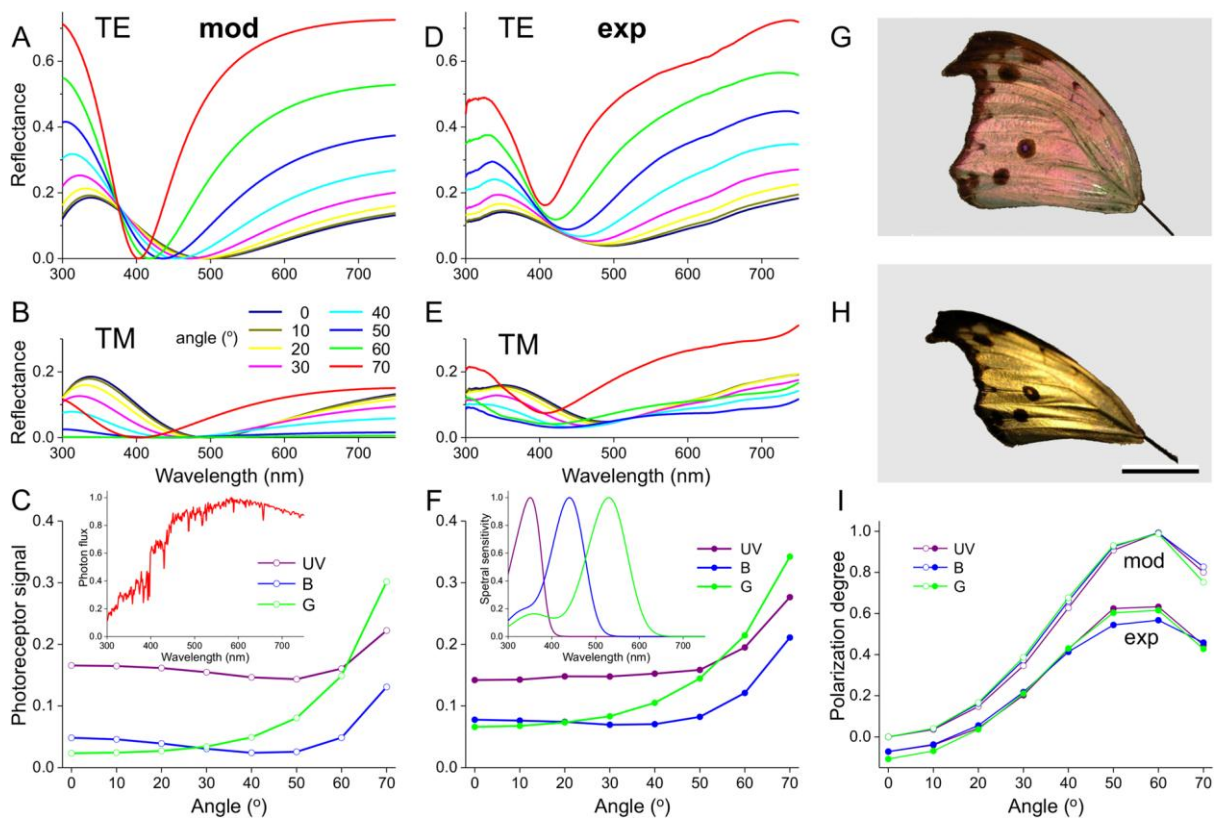


Fig. 5. Angle-dependent reflectance spectra and degree of polarization. **A** TE-reflectance spectra of a 160 nm thick thin film as a function of the angle of light incidence. **B** The corresponding TM-reflectance spectra. **C** Signals generated in UV-, B- and G-photoreceptors (spectral sensitivities inset panel F) by unpolarized sunlight (normalized spectrum inset panel C) illuminating the model thin film of panels A and B as a function of angle of light incidence. **D** Reflectance spectra of an intact forewing of *P. parhassus* for TE-polarized incident light. **E** Reflectance spectra of the forewing for TM-polarized light. **F** Signals generated in UV-, B- and G-photoreceptors (spectral sensitivities inset panel F) by unpolarized sunlight (normalized spectrum inset panel C) illuminating the forewing of panels D and E as a function of angle of light incidence. **G** A dorsal forewing under normal illumination and view. **H** The dorsal forewing illuminated with unpolarised light at angle of incidence 50° and viewed from the mirror angle; scale bar 1 cm. **I** Angle-dependence of the degree of polarisation derived from panels A and B (mod) and panels D and E (exp).

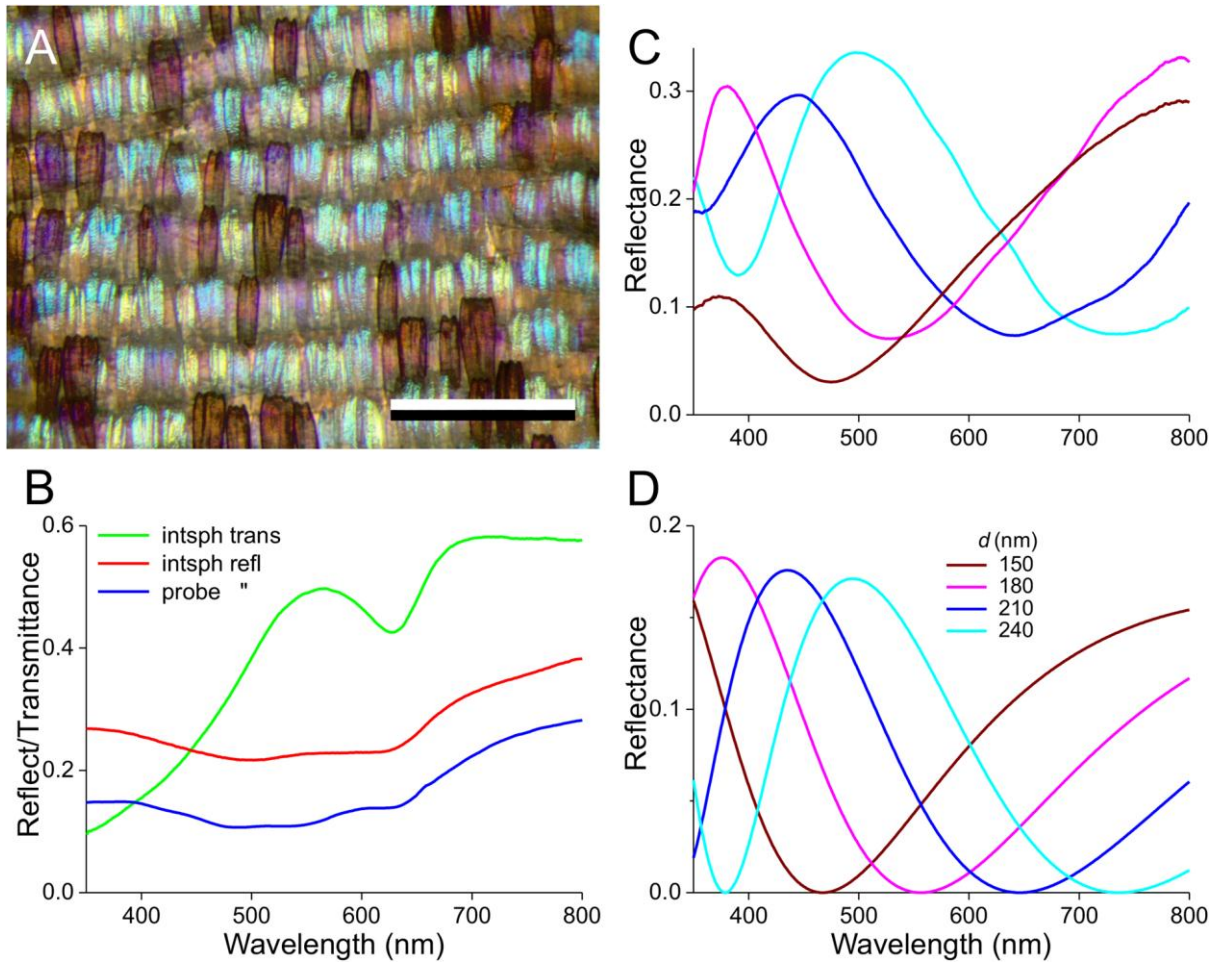


Fig. 6. **Spectral characteristics of the ventral wing.** **A** The multicoloured lattice of scales at the ventral wing, observed with epi-illumination; scale bar: 0.5 mm. **B** Reflectance and transmittance spectra measured with an integrating sphere and bifurcated probe with illumination incident on the ventral forewing. **C** Reflectance spectra measured with a microspectrophotometer of individual ventral wing scales (line colour similar to the scale colour). **D** Reflectance spectra of chitinous thin films with thickness 150, 180, 210, and 240 nm.