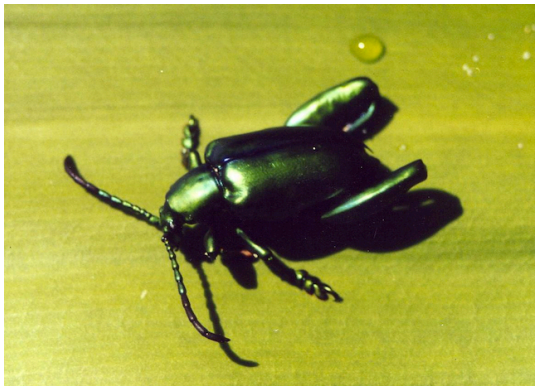
Optical biomimetics

Prof Andrew Parker, Research Leader, Department of Zoology, The Natural History Museum, London, and Green Templeton College, Oxford University
Email: a.parker@nhm.ac.uk.

There exists a diversity of optical devices at the nano-scale (or at least the sub-micron scale) in nature[1]. These include 1D multilayer reflectors, 2D diffraction gratings and 3D liquid crystals. In 2001 the first photonic crystal was identified as such in animals, and since then the scientific effort in this subject has accelerated. Now we know of a variety of 2D[2] and 3D[3] photonic crystals in nature, including some designs not encountered previously in physics.

Some optical biomimetic successes have resulted from the use of conventional (and constantly advancing) engineering methods to make direct analogues of the reflectors and anti-reflectors found in nature[4, 5]. However, recent collaborations between biologists, physicists, engineers, chemists and material scientists have ventured beyond merely mimicking in the laboratory what happens in nature, leading to a thriving new area of research involving biomimetics via cell culture. Here, the nano-engineering efficiency of living cells is harnessed, and nanostructures such as diatom "shells" can be made for commercial applications via culturing the cells themselves.

Additionally, optical devices in nature can be combined with those possessing other functions, such as water management structures. These include the water-collecting structures of beetles and plants in the fog-laden Namibian desert[6], and the Australian "thorny devil" lizards that can suck water from damp soil.



1. Parker, A.R. 515 Million years of structural colour. *J. Opt. A* **2**, R15-28 (2000).
2. Parker, A.R., McPhedran, R.C., McKenzie, D.R., Botten, L.C. and Nicorovici, N.-A.P. Aphrodite's iridescence. *Nature* **409**, 36-37 (2001).
3. Parker, A.R.,Welch, V.L., Driver, D & Martini, N. An opal analogue discovered in a weevil. *Nature* **426**: 786-787 (2003).
4. Parker, A.R., Hegedus, Z. and Watts, R.A. Solar-absorber type antireflector on the eye of an Eocene fly (45Ma) *Proc. R. Soc. Lond. B* **265**, 811-815 (1998).
5. Parker, A.R. & Townley, H. E. 2007. Biomimetics of photonic nanostructures. *Nature Nanotechnology* **2**, 347-353.
6. Parker, A.R. and Lawrence, C.R. Water capture from desert fogs by a Namibian beetle. *Nature* (2001) **414**, 33-34.