LETTER

High levels of reflectivity and pointillist structural color in fish, cephalopods, and beetles

Vignolini et al. (1) reported the discovery of a multilayer structural reflector in the fruit of the herbaceous perennial *Pollia condensata*. The structural mechanism is remarkable, with a combination of different cells reflecting left-handed or right-handed circularly polarized light.

However, several other significant contributions to the field of structural color deserve to be highlighted alongside this work. Although Vignolini et al. (1) stated that the reflectivity of the berries is the highest measured from a multilayer mechanism in any biological organism, many structural reflectors in animals are known to surpass these levels. One example are the guanine/cytoplasm broadband reflectors in silvery fish such as *Clupea harengus* (Atlantic herring) or *Sardina pilchardus* (European sardine). Over many years, Sir Eric Denton FRS showed typical reflectivities of fish to be around 70–80% (2), far higher than the *Pollia* berries. Iridophores of the squid, *Loligo pealeii*, have also been measured to provide reflectivities of more than 50% (3).

Furthermore, structural pointillist color mixing is a common mechanism of coloration, and is well-documented throughout the animal kingdom. It is again evident in many guanine/cytoplasm reflectors in fish (2), the dynamically controlled iridophore multilayer reflectors in squid and cuttlefish (4), and, in a letter to *Nature* in 1989, Schultz and Bernard discovered "pointillistic mixing of interference colours in cryptic tiger beetles" (5).

In summary, Vignolini et al. (1) reported an extremely interesting mechanism of structural reflection. Their work is an excellent addition to the many examples of pointillistic and highly reflective multilayer structures that occur in nature.

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