

to find host individuals but stay small enough to fit, as a juvenile, inside the host's body. The host must be reproductively prolific enough to cope with suites of such parasites taking their share of its reproductive output.

Simple models in ecology often take the form of a pair of coupled dynamic equations; one equation for each of the interacting species. Yet species interactions in nature are often much less species-specific. This tends to create a mismatch between our simple models for pairs of interacting species and the more web-like interaction networks that are the norm. For host-parasitoid interactions, this mismatch between theory and reality is less extreme. It is typical for a parasitoid species to be restricted to a single host species. And, for the most part, a single egg laid in a host translates into one less survivor for the host population and one more recruit to the parasite population. Host-parasitoid systems are thus the ground zero for theoretical ecology. If we can't get it right for these specialized interactions, we are probably not going to get it right anywhere.

There is another very practical reason why host-parasitoid interactions are central to ecology and why this book should be broadly read. The specialization of these species makes them prime candidates for use as biological control agents. The more specialized the predator or parasite, the fewer non-target side effects. Most insect pests are exotic species to an area, introduced by accident. Once freed from their native enemies, they can grow to pest levels. The challenge is to find a suitable parasitoid in their homeland. It must be deadly enough to reduce the pest populations radically, but not so efficient that they crash too low to support the parasite population, since that would return us to our starting point. We'd like to be able to identify characteristics that will lead to stable control at low host levels for each particular pest.

It would be hard to think of anyone better suited than Michael Hassell to review this field. His new book is a well-organized compendium of the myriad features that make or detract from stability in these tight interactions. Hassell last summarized the field in a monograph published in 1978. Since then, there have been major new developments.

Hassell details the important role spatial heterogeneity plays in coexistence and control. Also new is a growing list of theoretical studies that include webs of interactions among several host-parasite combinations. He is careful throughout to point out current deficiencies in both our theoretical and empirical understanding of these systems.

This book is a must-have for anyone interested in the theory of host-parasite interactions, and for those who just want to know more about ecological dynamics. ■

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## Science in culture

### Colouring it true

#### Origins of the art of colour reproduction

Philip Ball

Art is most often viewed at one remove: as a reproduction in a book or on a poster. Usually without acknowledging it, we entrust our experience of the colours of Renaissance Venice or Impressionistic Paris to the skill and diligence of the printer. But a comparison of the same image in different books is often a sober reminder of the vagaries of colour reproduction.

Capturing colour on the printed page is one of the themes of "More Than Meets The Eye", an exhibition at the Victoria and Albert Museum in London that explores the science in art and design, ending on 3 November (see *Nature* **407**, 20; 2000). As this part of the exhibition shows, a knowledge of colour theory is of only limited help in overcoming the infidelities imposed by shortcomings in the technology and materials of printing.

Printing in many colours did not become commonplace until the nineteenth century. Some of the most glorious colour prints of this period were a technical *tour de force*, for each individual colour was typically applied by a separate printing plate. William Savage, appointed by the Royal Institution in London to improve printing technology, laboured for eight years on an illustrated book, *Practical Hints on Decorative Printing*, finally published in 1823, in which some of the images bore the imprint of no fewer than 29 separate woodblocks.

But a technique that was in principle more economical of materials and labour had been developed 100 years earlier. By the start of the eighteenth century artists and scientists had reached a consensus that there were but three primary colours, as well as the white and black needed to lighten or darken them. Said Robert Boyle in 1664: "There are but few Simple and Primary Colours (if I may so call them) from whose various compositions all the rest do as it were Result ... I have not yet found, that to exhibit this strange Variety [painters] need employ any more than *White and Black, and Red, and Blew, and Yellow.*"

To the French artist and engraver Jacob Christoph Le Blon (1667–1741), this suggested a way to create full-colour prints using just the three primary inks. If they were translucent, their superposition could generate the secondary colours (orange, green, purple), as well as tertiaries and more complex shades. Black, thought Le Blon, should arise from superimposing red, yellow and blue.

To capture tonal variations, Le Blon used the half-tone technique of mezzotinting. A metal plate was burred all over with a sharp implement, and then smoothed back down by hand to a degree proportional to the lightness of the image: smoother areas retained less colour when inked. But to prepare the three 'colour separation' plates



A colour print by Le Blon, from around 1722.

in the pre-photographic era, Le Blon had to pull off the astonishing feat of decomposing a full-colour image into the three primaries by eye.

He began to use this method in the early 1700s, but failed to find a sponsor until he came to Britain in 1719. Here, in collaboration with the wealthy dignitary Colonel Sir John Guise, he set up a company called The Picture Office in 1720. With the permission of King George I, the partners made several thousand copies of pictures from Kensington Palace.

They were impressive, by some accounts. Sir James Percival said of one of Le Blon's prints in 1721, "Our modern painters can't come near it with their colours, and if they attempt a copy make us pay as many guineas as we now give shillings." This, however, was the opinion of someone unused to seeing reproductions in anything but monochrome. In reality the method had several shortcomings. Because the inks were not pure primaries, their mixtures produced somewhat dirty colours — which time has only muddled further. The three primaries did not mix to black but to murky brown, so Le Blon was forced to add black laboriously by hand. And the plates lost their crispness after many impressions.

Le Blon's biggest handicap, however, was a poor business sense. The writer Horace Walpole considered him "either a dupe or a cheat, I think the former". Forced to flee England to escape his debts, he died in poverty. His three-colour process was abandoned until photolithography, combined with James Clerk Maxwell's invention of colour photography, made it practical in the 1860s. ■

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"not science AND art", a closing talk for the "More Than Meets The Eye" exhibition, will be given by art historian Martin Kemp at the Victoria and Albert Museum on 3 November (7 pm). Entry free.