

staff for producing such a handsome and stimulating volume. But will this gratitude extend to lending the new museum their Nobel objects? ■

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Life and times of a pioneering polymath

George Perkins Marsh: Prophet of Conservation

by David Lowenthal

University of Washington Press: 2000. 650 pp. \$40, £26.95

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Thomas R. Dunlap

George Perkins Marsh is not a household name, except perhaps in the households of environmental historians. There he is remembered for *Man and Nature* (1864), the first study of humans as a worldwide agent of geological and biological change. In nineteenth-century America he was moderately well known in higher political, social and intellectual circles. He was a scholar, lawyer, congressman and for two decades a US diplomat in the Levant and the Italian states. David Lowenthal's book, which started as a revision of his earlier biography, *George Perkins Marsh: Versatile Vermonter* (1958), blossomed into a fresh attempt to understand Marsh and his influence.

Lowenthal is perhaps the ideal biographer for Marsh. He is a geographer, and so shares Marsh's environmental interests. And he has been interested in Marsh for many years. This interest sustained him as he tracked his man through libraries and archives and followed in his footsteps across various landscapes.

Knowledge and enthusiasm are necessary, for formidable obstacles are placed in the biographer's path by the very diversity of Marsh's life. He was a polymath. He knew many languages and wrote on a wide variety of topics. His interests included the English language and several others, philology in general, agriculture, soil erosion, the influence of the Goths on European civilization, political economy, public affairs and camels.

Marsh's public career was equally diverse. He made one of the first studies of the environmental effects of the fishing industry and forest clearance, investigated Vermont's railroad companies, designed the Vermont State House, represented that state in Congress, and served as an American consul and minister. He was a lawyer, invested in railroads, and was partner in a marble quarry — among other ventures.

The obvious approach for a biography would be to focus on what Marsh is remembered for, his ideas about humans and their

relation to nature. The book's subtitle suggests this tack, but the book is actually a more ambitious 'life-and-times'.

There are, in fact, two books here. One is the story of an American scholar, the other the record of Marsh as a prophet of environmental thought. Both are worthwhile, but for different reasons. The first puts Marsh in the context of his times. It was quite a context. Marsh lived through American politics from the anti-Masonic agitation around 1830 through to the end of Reconstruction (although he was out of the country for many of the later events). He saw American business expand from the shaky financing of the early nineteenth-century railroads to the industrial progress after the Civil War. He was involved in American scholarship and science in ways as different as the political manoeuvring that established the Smithsonian Institution and the 'dictionary battles' over American versus English usage and spelling.

Then there were the political events in Europe and the Ottoman Empire, the background to Marsh's diplomatic efforts. In addition, Lowenthal describes Marsh's family life, his travels, financial troubles and political problems: it is easy to see how Marsh's career was related to events. He could not have written with authority on so many topics even a generation later. His career as diplomat and wandering scholar was equally a product of American and European involvement in the countries where he was stationed. The profusion of events and ideas in the book and the detail on Marsh's travels and studies will discourage some readers, but the result is a vivid portrait of Marsh against his intellectual and social background.

The second story is the more important. As Lowenthal admits, "it is above all for his crucial role in environmental history that Marsh's life warranted retelling here". Most of that is described in the two chapters in which Lowenthal discusses *Man and Nature* and the final one on Marsh's ideas. But the environmental aspect runs throughout the text, for Lowenthal believes Marsh's circumstances and experiences shaped his ideas on conservation. He had seen the forests of his native Vermont fall to the axe and travelled over the eroded landscapes of the Middle East.

Experiences such as these, as much as formal knowledge of geology, made *Man and Nature* what it was. Lowenthal's assessments are judicious, usually more solid than startling, but occasionally bold. His comparison of Marsh and his contemporary Henry Thoreau should stir some thought. He rejects as a "latter-day construct" the idea that there was a division between biocentric and anthropocentric views, as represented respectively by Thoreau and Marsh, and finds many points of agreement between the two men. Then there is his view that, next "to Darwin's *On the Origin of Species*, Marsh's *Man and Nature* was the most influential text of its time to link



Advance guard: Marsh was a century ahead of his time in recognizing environmental concerns.

culture with nature, science with society, landscape with history". Well, maybe, but wasn't second place in this race a long way back?

There is something here for everyone. General readers will get a picture of Marsh and his times, American and European. Environmental historians and geographers will appreciate Lowenthal's discussion of Marsh as an environmental thinker, the fate of his ideas since 1864, and their relevance today. Everyone should come away with a better appreciation of a man who was a century ahead of the general run of scientists in recognizing many of our environmental concerns and who addressed them at a fundamental level. This is a useful study of an important figure. ■

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Parasites at the heart of ecology

The Spatial and Temporal Dynamics of Host-Parasitoid Interactions

by M. P. Hassell

Oxford University Press: 2000. 208 pp. £39.50, \$70 (hbk); £19.95, \$34.95 (pbk)

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Ted J. Case

About 10% of the world's animal species make their living by laying eggs inside another insect or arthropod. This parasitoid lifestyle presents challenging problems for host and parasite alike. The parasite must avoid the immune responses of the host and synchronize its life history and habitat selection to match the host. It must have dispersal powers

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 muddied 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.