

The decline of China's environment

The spread of agriculture led to deforestation and the growth of towns.

The Retreat of the Elephants: An Environmental History of China

by Mark Elvin

Yale University Press: 2004. 547 pp.

\$39.95, £25

Crispin Tickell

Pity the poor elephants! Over more than 4,000 years they were gradually forced from living all over China to a few protected enclaves near the border with Burma. The main reason was the destruction of their habitat as humans cut down forests and introduced agriculture. Farmers found the dwindling elephant herds a nuisance, as crops were trampled and plundered. Others came to value elephants for military, transport and ceremonial purposes: their ivory was prized and their trunks became a gourmet delicacy. Elephant numbers shrank until they were little more than a memory for most Chinese. Mark Elvin uses the decline of the elephant as an allegory to illustrate the transformation of the Chinese environment to the end of pre-industrial times. Some of the same story can be seen in Africa today.

Elvin's book is not so much an environmental history of China as a collection of its fragments. With copious quotations from Chinese written sources of all kinds, he shows what happened in different places and why. Even if we can see from archaeology that comparable events took place elsewhere, only in China are there such written records, giving a unique account of how it felt to live through them. It was not always a pleasant or edifying process, and as usual the voices of those worst affected will never be heard.

In broad terms, the transformation of the Chinese environment, which was faster in some areas than others, had certain characteristics. First, deforestation made way for agriculture. There was then a bonanza as resources were exploited, species were lost and human numbers rose. This triggered the growth of towns, cities and states with social stratification, followed by increasing competition between them, with war as the spur and the environment sometimes used as a weapon. Better technology was mitigated by mismanagement of resources. Entrapment in limited local circumstances left people vulnerable to change. Finally, there was a greater risk of social and economic collapse affecting society as a whole. Elvin shows the differences clearly in three areas: Jiaying to the south of the Yangzi river; Guizhou in the south, where the Han people gradually displaced the indigenous Miao; and Zunhua in the mountainous northeast.



Stacking the odds: Chinese farmers shaped the environment to suit them by building rice terraces.

Everywhere, control of water was essential. 'Hydraulic despotism' may tell only part of the story, but communities and even states grew partly out of the need to manage this precious and sometimes capricious resource. The struggle to run irrigation systems, limit marine incursions, maintain banks and walls, undertake dredging, cope with floods and storms, and adapt to ever-changing weather patterns is as difficult today as it ever was. With huge populations dependent on particular systems, any change can become increasingly difficult to cope with.

The complexity of Chinese attempts to manage human effects on the environment is remarkable. Even more special are the Chinese beliefs and attitudes towards the environment that have existed over the millennia. Generalizations are bound to be misleading but, in general terms, the Chinese were driven, in Elvin's words, by a desire for rational mastery of the world. They had little hesitation in uprooting forests, redirecting and polluting rivers, destroying natural landscapes and giving political and military needs absolute priority. They had remarkable powers of organization, and ran projects far beyond European capacities at the time. But in doing so, the Chinese paid scant regard to the environment and unwittingly created many long-term problems.

On the other hand, the Chinese had a particularly sensitive respect for nature and natural beauty in all its forms. Even as forests were destroyed, individual trees were singled out for admiration. Heaven and Earth were closely linked, and the line between the natural and the supernatural was blurred. There was a confluence of matter leading

to energy, and energy leading to life, each a product of Bright Force and Dark Force. Dragons and spirits were sometimes seen above the surface in thunder and lightning, and sometimes below it in earthquakes. They formed part of a living world that sustained and punished humans. They even related the behaviour of the weather to human activity, so there was morality in meteorology.

In such a world, it was crucial to divine what the invisible forces felt or did. This could involve sacrificing animals or humans, or burning cracks in the shoulder blades of mammals or the undershells of turtles. In Shang times, such practices had political significance as the ruler was the intermediary between the visible and the invisible world. This was also true in other epochs when the apparatus of authority was given almost divine attributes.

It is as difficult for us to enter into this mental cosmology as into that of our own ancestors in pre-scientific times. Elvin shows that searching for observable and verifiable facts about the world, and putting them to use in programmes of thought, was almost entirely alien to the Chinese. As a result, the shock of change was more abrupt in China than it was in Europe, where the scientific revolution began earlier. Traces of the old thinking may have survived Mao Zedong and persist in fundamental ways today.

The Retreat of the Elephants is not an easy book to read. Some of the quotations seem scarcely relevant, and the whole text could have been usefully pruned. At the end there is an unilluminating venture into equations, as if sustainability could be reduced to an algorithm. Yet taken as a whole, the book is a fascinating, scholarly miscellany of stories,

poetry and ideas from the history of the longest continuous civilization on Earth. The relationship of that civilization with its fragile and often tortured surroundings contains lessons for others — particularly at a time when industrial society in China, as elsewhere, is pressing harder than ever on the environment. This will be a source book, elephants and all, for generations to come. ■

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The body-plan explosion

On the Origin of Phyla

by James W. Valentine

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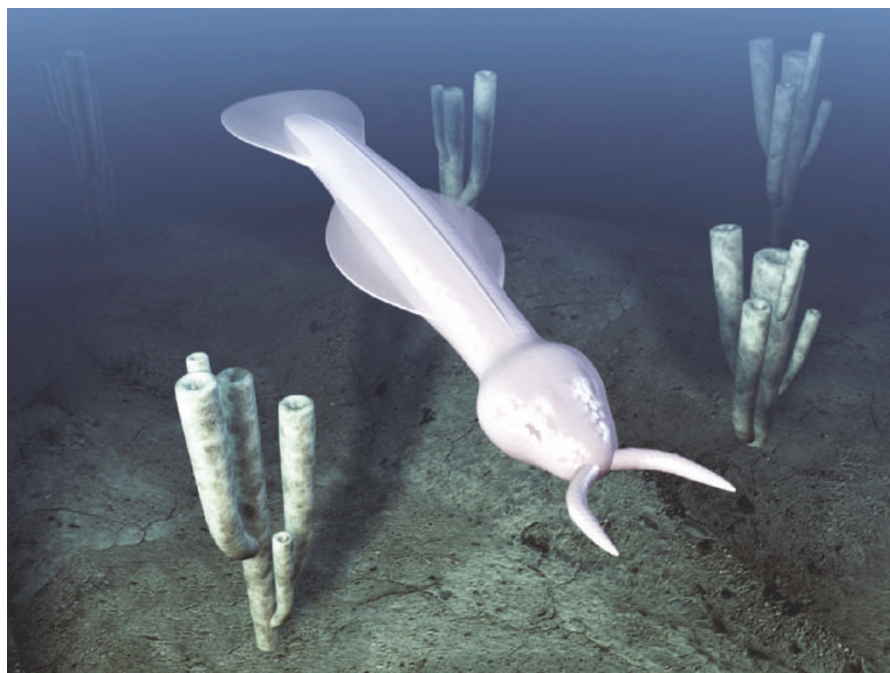
Stefan Bengtson

More than 30 years ago, palaeontologist James W. Valentine's highly acclaimed book *Evolutionary Paleocology of the Marine Biosphere* sought to integrate ecological and environmental studies within a framework of evolution over geological time. He has now written a book on one of the most significant revolutions in the history of life, the Cambrian explosion.

The Cambrian explosion is the transition half-a-billion years ago from a fundamentally microbial biosphere to one in which various multicellular creatures expanded the food web to dimensions and shapes never before realized. It saw the appearance of just about all the major groups of animals that we today recognize as (fossilizable) phyla. Yet Valentine's new book of more than 600 pages contains little about ecology and almost nothing about the physical environment. What has changed since 1973?

For one thing, Valentine, one of the renaissance minds of our times, has further expanded his vision to take in new fields of science, notably developmental genetics, molecular systematics and the evolutionary development (evo-devo) melting pot. Even so, the decision to downplay environmental aspects of early animal evolution must be understood as a deliberate one.

Darwin wisely called his best-known work *On The Origin of Species*; the origin of phyla is an even stickier problem, and Valentine deserves credit for tackling it at such breadth. The first problem is defining the concept of the phylum in an evolutionary context. Historically, phyla have been recognized as groups of extant animals with a characteristic body plan and uncertain relationships to other such groups. Fossils have generally been assigned to the least dissimilar of the living phyla, a practice that pre-empts



In a phylum of its own? Fossils of *Amiskwia* suggest that it was unlike any other known animal.

the possibility of extinct phyla. From a cladistic point of view, it is easy to argue that two extant sister phyla arose at the point of branching from the last common ancestor, and that anything that branched off later should be included in the respective phylum. A distinction can then be made between the crown group (the descendants of the last common ancestor of all the living members of the phylum, including this ancestor) and the stem group (everything else). This avoids the question of how body plans arise and whether there may be others not represented by living forms.

Defining a body plan isn't easy, however. Valentine's definition, for example, is dangerously circular: "an assemblage of morphological features shared among members of a phylum-level group". What does that mean, except that when we define a phylum we also define its body plan, or vice versa? Valentine proposes to define the origin of a phylum by the acquisition of a key apomorphy — a unique derived trait. This may be more subjective and less convenient than letting the total (stem and crown) group or the crown group define the phylum, but it gives due priority to biological significance over methodological convenience. After all, we want to know how different kinds of organism evolve by natural selection, and how they interact with each other and with the environment. They do that with their phenotypes, not their pedigrees.

A key question, then, is whether the body plans of the recognized phyla represent more or less the total number of possible solutions to the problem of being an animal, or whether there were numerous other possibilities that came into being but became extinct because of bad luck or bad design.

Valentine argues that the Cambrian explosion initially produced great disparity in design, but that this was subsequently diminished by extinctions. The pattern of diminishing evolutionary novelty subsequent to this event, he says, may have been due less to developmental constraints than to a saturation effect (candidates for new adaptive radiations were already available among existing body plans). He also believes that the Cambrian explosion produced a lot more homoplasies (similar characters with independent origins) than most phylogenetic analyses suggest — in my view an extremely important point that calls for much more careful character evaluation than is commonly done. He is clearly not impressed, then, by some recent attempts to use fossils to bridge gaps between phyla.

Valentine seems most happy with intrinsic biological mechanisms for the rapid appearance of phyla. Large parts of the book deal with developmental prerequisites (such as cell-type numbers and gene regulation) for the event. Ecological interactions, such as predation, are given more cursory treatment. As for the physical environment, he merely concludes, somewhat apologetically, that although physical environmental factors were "supremely important", he does not see any evidence that extraordinary environmental events were causally connected with the Cambrian explosion. Given that extraordinary environmental events did indeed occur shortly before the explosion, I would give the jury just a little more time to ponder the question. But first I would make sure they had read this magnificent book. ■

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