hunter–gatherers subsisted on terrestrial plants and animals almost to the exclusion of fish and aquatic mammals. Comparison of the two hypothetical samples thus provides clues about changes in the hunter–gatherer diet as population increased and traditional resources came under pressure. As the Pleistocene model excludes aquatic mammals and fish, their use naturally emerges as one signature of intensification, especially in Europe, where the postulated change is often from terrestrial animals to aquatic resources. In South America and Africa, on the other hand, the postulated change is mainly from terrestrial animals to terrestrial plants.

Binford draws several interesting insights from these comparisons, especially about the spread of agriculture into Europe, which he suspects was largely not the result of migration but rather a subsistence shift — one that occurred almost instantaneously in those places where hunter–gatherer populations had reached a critical point and needed to intensify, but lacked the wild resources to do so.

In the remaining chapters, Binford pursues hunter–gatherer intensification and the shift to agriculture in depth, repeatedly searching for patterns that reveal critical points, or thresholds, where a directional trend in population density, group size, or the like, is reversed. For him, these signal trajectories of intensification in which hunter–gatherer systems restructure radically from within, and are likely to produce archaeological signatures of discontinuity that Binford thinks are too often attributed to migration and ethnic replacement.

He is clearly not afraid to speculate and take risks, and constantly pushes the edge of his interpretive envelope, never more so than near the end of the book. There he takes the climatic algorithms developed to project his hypothetical Late Pleistocene and ethnographic hunter–gatherer samples, applies them to detailed palaeoclimatic information for the Near East and North Africa, and uses the results to interpret the changes in behaviour, including the origin of agriculture, that took place in the terminal Pleistocene and the early Holocene that followed it.

This approach assumes, of course, that hunter–gatherers not only adapt to changes in climate (which seems reasonable), but that this adaptive readjustment more or less keeps pace with climate change. This is altogether more problematic, especially in light of ice-core records of wild and rapid climatic shifts, from full glacial to full interglacial conditions within the span of a few decades, during most of the Pleistocene — including the Late Pleistocene interval that interests Binford here. Abrupt termination of this chaotic pattern of climate change with the onset of the Holocene 10,000 years ago raises the further spectre of a potentially significant behavioural gulf in the range and scope of responses to climate change separating hunter–gatherers before and after this.

It is important to understand what this book is and is not. It is an important landmark work, but it is not for the general reader. Although it contains things of potential interest to geographers, ecologists and biologists, it is a technical volume written mainly for students of hunter–gatherers and will challenge the patience of even the most quantitatively inclined of them. This is largely because Binford is less interested in using quantitative data to demonstrate statistically significant relationships than in using them to discover interesting and unsuspected patterns, which may or may not be convincing to readers without his predilections.

In contrast to many of Binford's earlier works, *Constructing Frames of Reference* contains very few simple take-home lessons. In compensation, he gives much greater attention than he has in the past to hunter–gatherer social and political organization and the ways in which they might be manipulated to facilitate intensification. The environmental and behavioural information Binford compiles for his sample of 339 hunter–gatherer groups will certainly be one of this book's most lasting contributions. Its theoretical and interpretive impact, although sure to be large, is harder to judge, simply because of the sheer scope of what is attempted, the wide subject matter covered and the data presented, all of which will take time to sort out. ■

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Lost to the world

Only two whole specimens of Australia's short-tailed hopping-mouse (*Notomys amplus*) were found before the species became extinct in 1896. *A Gap in Nature: Discovering the World's Extinct Animals* by Tim Flannery and artist Peter Schouten (Atlantic Monthly Press, $34.95) catalogues the 103 species of mammal, bird or reptile known to have become extinct between 1500 and 1999.

Biographical biology

Darwin & Co.: Eine Geschichte der Biologie in Portraits (in German)
edited by Ilse Jahn & Michael Schmitt
C. H. Beck: 2001. Volume 1: 552 pp. DM68. Volume 2: 574 pp. DM68

Claus Wedekind

Who still believes that the theory of evolution was developed by Charles Darwin alone, uninfluenced by other ingenious thinkers? Progress is not made like this, only myths. But who can remember the names of those other biologists or their contributions to evolutionary theory, let alone any biographical details? This is now remedied in the more than 1,000 pages of the two volumes of *Darwin & Co.*, which contain 51 biographies of researchers who have shaped biology over the past three centuries. Given the title and the weight, one might fear that the result would be a tiresome account of errors and corrections, of misunderstandings and clarifications, around a single theory. But these fears are unjustified.

Darwin was surely a most influential biologist. Much has been written about him, his life, his family, the struggle with his contemporaries and, of course, his achievements. But in this book, he gets only the 21 or so pages allotted to each of the other personalities. The biographies are arranged chronologically, are not centred around evolutionary theory and can be read in any order.

BETTMANN/CORBIS

Strong ideas: the Comte de Buffon believed variation within a species was due to a *force pénétrante*.

Some of the authors are professional historians of science; others are biologists, often now retired, who happen to have an interest in the person. Despite this diverse authorship, the editors have managed to achieve a consistent structure for the portraits. Each contains a section on the subject's life story, embedded in the circumstances of the respective period and location, and often spiced up with subjective assessments of personality. The rest is a summary of the scientific achievements, largely well explained for non-specialists.

The collection starts with Carl Linnaeus (1707–78), who introduced a still-valid nomenclature for classifying organisms. As well as enormous productivity, Linnaeus possessed an ingenious imagination. As a physician, he suggested that infectious diseases such as smallpox, measles, dysentery, syphilis and plague might be caused by very small organisms. This was long before microscopes enabled us to see these pathogens. The idea must have sounded quite bold to his contemporaries, who used fragrances as protection against infection.

It was perhaps as bold as some other early biologists' ideas sound to us now. Georges-Louis Leclerc, Comte de Buffon (1707–88), another polymath of impressive productivity, explained variation within a species by what he called the *force pénétrante* and the following model. Organic particles that are transported by the blood system to the different organs are either used for growth and maintenance, or, if they do not spontaneously get assembled into gut worms, get imprinted by these organs under the influence of the *force pénétrante*. They are then collected in seminal fluids. At coition, male and female seminal fluids are mixed and form offspring. These offspring resemble their parents because they are formed by imprinted organic particles. Later, the offspring's own organic particles will be modified as a result of different habits and environments. Hence — variation in time and space. It seemed as if you only had to explain the *force pénétrante* to complete the model.

Biologists of the twentieth century are, of course, 'just' specialists. But even if you are not that interested in agronomy, you would find the story of the botanist Nicolai Vavilov remarkable. He and some of his colleagues did not bow to lysenkoism and the threats of the stalinistic reign of terror in the Soviet Union of the 1930s and 1940s, and continued to discuss mendelian genetics and plant breeding. Because their opponents had political influence, Vavilov and his colleagues knew they risked arrest and death, and eventually paid this high price for their ideals.

Equally, even if you know little about ethology, you might be curious to learn how one of its founders, Konrad Lorenz, stood by his membership of the National Socialist Party of Nazi Germany, and how, as a scientist, he arrived at his ideas about the preservation of pure races. Another example of free speech in science?

The biographical portraits end with the American geneticist Barbara McClintock, who died nine years ago. In passing, we learn that this excellent student and later Nobel prizewinner was not accepted for a PhD position at the Institute of Genetics at Cornell University in the 1920s because, at that time, this degree was not open to women.

Talent and diligence alone never guaranteed professional success. The stories in this book tell us that biologists have always needed influential supporters, and this is where scientists who have reached positions of authority can do some good. But who will remember those enthusiastic and talented students who came to grief against the pride or morbid ambition of some of these authorities? With this in mind, one might take a sceptical view of overly laudatory exaltations of the 'great man'. Indeed, some of the portraits have rather too many unnecessary superlatives. Nevertheless, what biologist would not be curious to read about the lives of their successful predecessors? I certainly enjoyed dipping here and there into these biographies, which are of such an easily digestible length. ■

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More on Darwin

Charles Darwin: Interviews and Recollections
edited by Harold Orel
St Martin's Press, $55

Darwin's Mentor: John Stevens Henslow, 1796–1861
by S. M. Walters & E. A. Stow
Cambridge University Press, £40

Benefactors of mankind

Cultures of Creativity: The Centennial Exhibition of the Nobel Prize
edited by Ulf Larsson
Science History Publications: 2001. 228 pp. $40

The Nobel Prize: The First 100 Years
edited by Agneta Wallin Levinovitz & Nils Ringertz
Imperial College Press/World Scientific Publishing: 2001. 236 pp. £18, $26 (pbk)

Alison Abbott

Alfred Nobel was a tormented genius in his own right. A brilliant entrepreneur, by the age of 40 he was already making a fortune