induction, adaptations and other interactions between environmental variation, genetics and plasticity in development; (6) a return to the topics of homology and of the interconnectedness of development and evolution, and the evolutionary mechanisms that shape developmental processes; (7) heterochrony and how embryos measure time; and (8) a summary of the major ideas of the book. Laudably, all chapters have an up-to-date 'endnote' section where ideas are developed further and referenced with the most recent publications. This structure adds a lot to the readability of the book.

In 1992, when the first edition of Hall's book was published, EDB was only a budding new biological discipline. Not least because of Hall's work, it is now an established scientific field with at least three new journals exclusively devoted to it. *Genes, Development and Evolution*, *Molecular Developmental Evolution*, and *Development and Evolution* have all been launched since the publication of the first edition. During the past five years or so, many leading universities have responded to the huge renewed interest in EDB by creating new faculty positions in this area and 'evo-devo' sections in scientific societies; funding agencies also were established.

Brian Hall's scholarly work aims to be the first textbook for this maturing field of EDB. His lucid and scholarly writing, and his most impressive knowledge of the literature and the history of the field, make this book a great pleasure to read and a treasure trove of information. The book is somewhat broader in its scope, and more oriented towards history, than Raff's[1] extremely insightful and influential book *The Shape of Life*. It is also more complete in its selection of topics than Gerhard and Kirschner's[2] recently published *Cells, Embryos and Evolution*, but Hall covers less of his own theories of the evolution of development in his book than they did. Hall's book is a highly authoritative summary of the current state of knowledge and how we got there from an historical perspective –it is less a devo-evo textbook that deals with how developmental biology 'works'. Because of that, in a devo-evo course, this book should be used jointly with Gilbert's[3] *Developmental Biology* textbook. Hall's book would have been much improved if diagrams were presented in two or even in multi-colors. Because development deals with morphologically complex two- or three-dimensional relationships colored graphics are an absolute must, but this was presumably too expensive for the publisher to agree to. Unfortunately, this omission diminishes the value of the book as a textbook of development – prior knowledge of developmental biology or the concurrent usage of a developmental textbook like Gilbert's[3] is required.

Hall is surely one of the foremost historians of the field of devo-evo. Not since Gould's[4] book *Ontogeny and Phylogeny* has the field been reviewed so masterfully. Gould's[4] book can be credited (justifiably) with having single-handedly sparked a rekindled interest in the connections of development and evolution, which lay dormant for almost a century after Ernst Haeckel, Anton Dohrn and others who thought about it then. The book was the major cause for the interest among evolutionary biologists (and less so developmental biologists) in phenotypic plasticity and heterochrony during the 1980s.

Gould's book was published more than 20 years ago and dealt with devo-evo issues almost devoid of a discussion of the molecular basis of development – and that is where most of the progress in the 1990s came from. The new comparative molecular genetic and genomic data on gene expression and gene regulation from various model systems collected by biologists, formally known as developmental biologists but now termed evolutionary developmental biologists, during the past ten years or so is what is at the basis of the reincarnation of devo-evo. Debates that date back more than 100 years, about the ancestry of vertebrates from annelid or ascidian-like ancestors, which then involved people like Geoffroy, Semper, Dohrn, Gegenbaur, Kovalevsky and Haeckel, and that centered around arguments about segmentation and dorsal–ventral axes, have now been re-addressed with novel molecular data. These new molecular developmental data are mostly similar in expression patterns of presumably homologous genes in different regions of developing embryos from different phyla. Among the most exciting new findings are expression patterns of homologous genes that specify ventral and dorsal sides of embryos in protostomes and deuterostomes, respectively, or highly conserved genes that specify the expression of optical sensors in all phyla. The extremely high degree of conservation of developmental control genes, in terms of expression and interactions with other genes during evolution, came as the major biological surprise of the 1990s. The challenge remains to explain how body plans diversify during evolution in spite of this 'laziness of evolution', which keeps genes and their interactions the same. The crucial question is where does novelty come from and how does evolution diversify morphology?

Everyone now agrees that developmental processes affect evolutionary change just as evolution selects, canalizes and directs development, but how exactly this happens (e.g. through what kind of mutation or change in regulation of genes interacting or freeing up functions of genes through duplications of genes or genomes) is unclear. We are still in the more undirected and observing 'natural history' phase of the discipline of EDB; a coherent set of theories of development, which would permit predictions to be made, is still required. However, I am confident that it will emerge, not least because of the large amounts of data that are being collected currently on all kinds of genes and gene pathways in all kinds of model systems. Obviously, the ongoing genome projects are going to do their significant part in permitting the elucidation of homology relationships among genes and gene families, which are at the basis of being able to compare developmental mechanisms across species and phyla in an established phylogenetic framework. Without gene and species trees, comparative developmental data cannot be interpreted properly.

Axel Meyer

Dept of Biology, University of Konstanz, 78457 Konstanz, Germany
(axel.meyer@uni-konstanz.de)

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Tower of Babel

Linguistic Diversity

by Daniel Nettle

Oxford University Press, 1999.
£35.00 hbk, £12.99 pbk (xi + 168 pages)
ISBN 0 19 823 8584/0 19 823 8576

Different human communities speak different and, for the most part, not mutually understandable languages. This fact is a mighty challenge to all naive functionalist and adaptationist explanations of the origins and structure of language. Had language been the result of the need to communicate, then linguistic diversity should not have been possible. Whether less naive approaches might succeed is an open question. Another elementary fact about language defies extreme innatist explanations. Because every human newborn can learn any human language, it is inconceivable that linguistic diversity might have been caused by some sort of cumulative allelic

segregation of slightly different linguistic capacities (whatever that might have meant concretely).

These two sure facts about the linguistic capacity of the human species are still separately in need of an explanation and their stupefying co-occurrence even more so. Daniel Nettle, a British anthropologist and presently a member of the faculty of the University of California in Los Angeles, has bravely and competently attempted to meet this challenge but has, in my opinion, like all before him, failed. Unlike his many distinguished predecessors, Nettle has summoned the modern methods of evolutionary biology – computer-assisted trait analysis and multiple regression – rather than those of historical linguistics. Not being satisfied with an attempt to reconstruct *how* languages have come to differ, he avowedly aims to explain *why* they have (his emphasis). His ambitious plan is to link 'the distribution and evolution of languages to facts about social organization, and facts about social organization to the economic necessity of procuring subsistence in different environments'.

A panoply of possible microprocesses of language variation are explored painstakingly and with great ingenuity by the author, who blends fundamental insights from biological evolution (neutral mutations followed by reproductive isolation, à la Motoo Kimura, sexual selection and functional selection) and from ethology (social selection for birdsongs), with certified phenomena observed in language acquisition (over-regularization, phonological simplification, thresholds of sensitivity to rare variants, preservation of the local dialect in spite of the presence of immigrants, and so on).

This short book is a mine of geolinguistic and sociolinguistic data, presented in a plain and captivating style. Great care is taken to identify the essential global traits of the different languages, of the language families, and of the families of families. Shifting similarities and contrasts among vowels, syllables, words, phrasal constituents and typical word orders in the sentence are charted across languages, continents and centuries. This search for similarities and differences is paired constantly with a search for individual and social mechanisms generating, maintaining and amplifying linguistic diversity; this is inspired largely by genetics and evolutionary biology. But, such choices are always difficult and heavily theory-laden.

Two examples of problems not considered by Nettle might suffice. The French possessive pronouns (mon, ma, ton, ta, son and sa) are similar to their Italian counterparts (mio, mia, tuo, tua, suo and sua); they are all phylogenetic cognates of their Latin ancestors and quite dissimilar from the English equivalents (my, your, his and her). However, in Italian it is perfectly acceptable to say 'il mio libro' and 'la sua auto', although the equivalent expressions in English and French give 'goosepimples' ('The my book', 'The his car', 'Le mon livre' and 'La sa voiture'). Where do the truly relevant similarities lie? Are we to privilege sounds or structures, phonology or syntax? The French and Italian weather verbs are again cognates ('piovere', 'plevoir', 'nevicare' and 'neiger'); in Italian you say 'piove' and 'nevica', but in French and English the impersonal pronoun has to be added ('It rains', 'it snows', 'il pleut' and 'il neige'). However, certain dialects of Italian are like English and French, not like standard Italian, because the impersonal pronoun is added mandatorily ('e' pioe' in Tuscany and 'l' fioca' in Lombardy).

A satisfactory classification of languages turns out to be a problematic task. History and geography are far from offering a 'natural' or obvious basis. Languages of human communities separated by tens of thousands of miles, and with no historical record of any contact, group together quite naturally with respect to some deep structural traits, although languages of populations just one valley away, with a long historical record of mutual cooperation, part company on other equally deep structural traits. The ecological constraints explored by Nettle are cute, but arbitrary and inconclusive. Syntacticians have explained these structural differences in terms of a different setting of few binary 'parameters'. There are several heavily constrained options, freely open to any language or dialect, and the resulting binary choices are disconnected totally from any geographical, social or functional motivation. I am one of those who do not think it conceivable (*pace* Nettle) that linguistic differences might be explained in terms of ecological constraints, through '…the economic necessity of procuring subsistence in different environments'. This interesting book leaves my conviction unscathed. The author's systematic computer-aided exploration of the analogies (and disanalogies) with genetics and evolutionary biology do not, in the end, offer a new powerful key. It is a tribute to the multidisciplinary competence, creativity and clarity of Daniel Nettle to infer that, because he has failed to carry out this task, the task itself is indeed guilty as charged.

Massimo Piattelli-Palmarini

Dept of Linguistics, University of Arizona, Tucson, AZ 85721-0025, USA
(piattelli.massimo@hsr.it)

Eco-hydrology

Eco-hydrology: Plants and Water in Terrestrial and Aquatic Environments

edited by A.J. Baird and R.L. Wilby

Routledge, 1999.
£18.99 pbk (xviii + 402 pages)
ISBN 0 415 162 734

What is meant by eco-hydrology? This question is not answered in this book, although one of the editors argues this question in the introduction. He refers to Hatton *et al.*[1] who ' … have used the term to describe plant–water interactions in general …'. He also states that ' … while this book tends to focus on hydrological processes, it also considers how these processes affect plant growth'. The editor is also familiar with the fact that the term eco-hydrology is used to describe the study of the two-way linkage between plant growth and survival, and hydrological processes in wetlands; the term has been in use by wetland ecologists for at least two decades. What strikes me is that both editors still feel that earlier definitions of eco-hydrology given by Wassen and Grootjans[2], and Grootjans *et al.*[3] are focussed too narrowly on wet ecosystems.

In the present book, eco-hydrological processes are considered in drylands, wetlands, forests, streams and rivers, and lakes. Only marine ecosystems are not considered in any detail. This wide scope would not necessarily have been a problem if two-way plant–water relationships had been considered in a true sense. However, most of the book deals with the effect of plants or vegetation on hydrological processes, such as evapotranspiration, throughfall, overland flow, infiltration, runoff, sediment movement and channel flow, and how to measure or model these hydrological processes. Thus, core issues in eco-hydrology largely are ignored: water chemistry, and the impact of the water regime and water chemistry on vegetation composition, structure, distribution and succession. Exceptions are the chapter about freshwater wetlands written by Bryan Wheeler, the chapter on streams and rivers by Andrew Large and Karel Prach, and to some extent the chapter on lakes written by Robert Wetzel. These authors pay specific attention to both the effect of hydrology on plants and how plants affect hydrological processes. Apart from such chapters discussing a specific ecosystem type, the editors also have included three generic chapters: namely, one about water relations in plants written by Melvyn Tyree, one about spatial and temporal scales in

