But are Fridlund's 'behavioural ecology view' and the diverse set of perspectives that he labels the 'emotions view' really in opposition? They might simply operate at different levels of organization. His view is in principle reconcilable with certain types of facial expression consistently appearing when people are in certain emotional states. Fridlund's critics have argued that the face can signal emotions that in turn imply intended actions, thereby allowing it to signal both states and actions. Fridlund argues that "this solution, though diplomatic, is problematic", primarily because he believes there are no adequate criteria for evaluating emotions. But there are features of emotional response — the covariation among behavioural, experiential and physiological systems — that are too coherent and too organized to have arisen by chance, and there is measurable linkage among systems. Emotions themselves may be adaptations, with facial behaviour merely one part of a complex response package. These facial behaviours are indeed involved in communication, yet this does not preclude their role in the organized emotional response.

Photographic plate from Charles Darwin's *The Expression of the Emotions in Man and Animals* (1872).

Fridlund fails to entertain the possibility that there is selection pressure on humans to predict other people's internal states. Understanding emotions from faces provides information about how people may be feeling, what they may be thinking and how they might act. The remarkable consistency in our judgement of facial expression of emotion attests to the presence of such adaptations. □

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Evolving together

Brian Charlesworth

The Coevolutionary Process. By John N. Thompson. *University of Chicago Press: 1994. Pp. 376. $49, £39.25 (hbk); $19.95, £15.95 (pbk).*

EVOLUTIONARY change resulting from interactions between two or more species is a topic that has attracted the interest of evolutionary biologists since the publication of the *Origin of Species*. Indeed, much of the thinking in this field can be traced back to Darwin himself. For example, his famous discussion of the causes of evolutionary divergence between species, in Chapter 4 of the *Origin*, laid great emphasis on the selective advantage of being different from competitors. His book on the *Various Contrivances by which Orchids are Fertilised by Insects* documented the intricate and intimate relationships between the behaviour and structure of insect pollinators and the structure of the flowers that they pollinate. It was the first detailed study of mutualism in the context of the theory of natural selection. Darwin noted that the Madagascar orchid *Angraecum arachnites* had nectaries that were 11 inches long and proposed that its pollinator must be a moth with a correspondingly long proboscis. This prediction was confirmed 125 years later by Anders Nilsson's discovery that the orchid is pollinated by a moth with an extraordinarily long proboscis, *Panogena lingens*. This must be one of the longest delays in the verification of a prediction in the history of science.

The first chapter of John Thompson's *The Coevolutionary Process* makes it admirably clear how great a debt the field of coevolution owes to Darwin's work. This is probably the most ambitious attempt so far to provide a general survey of coevolution. It contains an impressive array of fascinating case studies and examples, which will be of great value to researchers, teachers and students in evolutionary biology. Topics such as the evolution of host-plant specialization by insect herbivores, parasitism and mutualism are all covered in detail. The strength of the book is much more in the details of natural history than in the conceptual framework that Thompson develops to interpret it. Much of this framework is descriptive rather than causal. He argues at some length for the "geographic mosaic theory of coevolution" according to which local populations of a given species often evolve independently to engage in different kinds of interactions with other species. Apparently diffuse interactions of a species with several other species may in this way result from one-to-one interactions that involve different partners in different places. A major thrust of the early chapters is that species (especially parasites) are often highly specialized with respect to the nature of their ecological interactions with other species, yet there is little hard phylogenetic evidence that specialization represents an evolutionary dead-end, as has often been argued.

Not a single equation to describe an evolutionary or ecological model is presented in this book, in sharp contrast to most recent books dealing with evolutionary ecology. Many biologists will probably feel this to be their gain rather than loss. But modelling helps to clarify the nature of the processes underlying observed patterns. Neglect of the predictions of models, however oversimplified they are, tends to lead to the substitution of vague generalizations for genuine theorizing. This is particularly evident in Thompson's discussion of the evolution of specialization. Despite devoting more than a hundred pages to this topic, he givens no clear account of *why* two competing species should diverge with respect to characters that influence their mutual competitive ability, and only one relevant theoretical study is mentioned. Similarly, the extensive theoretical literature on the coevolution of predator and prey species is given only a brief mention.

This book contains an immense quantity of useful and thought-provoking information and certainly deserves to be read by all evolutionary biologists. But it would have been a more stimulating work if the author had tried harder to define a clear set of hypotheses about the mechanisms of coevolution and to test them against the data that he obviously knows so well. □

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Physical ambition

Eörs Szathmáry

Physical Approaches to Biological Evolution. By Mikhail V. Volkenstein. Translated by Artavaz Beknazarov. *Springer: 1994. Pp. 399. DM98, $67, £42.50.*

THE late M. V. Volkenstein trained as a physicist and moved into biology from the area of polymer science. He was apparently willing to get his hands dirty and probe into established parts of 'real' biology. On the basis of this book, it would seem that his adventure was not entirely successful.

He covers three main areas: 'classical' biological evolution, molecular evolution and so-called physical approaches to evolution. His evolutionary heroes are