Making evolution clear

What evolution is. 2002. Ernst Mayr. Weidenfeld & Nicolson, London. 318 pp. Hardback £14.99. ISBN 0 297 60741 3

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Mayr, the long-time grand master of modern evolutionary biology, has prepared a surprisingly short book that is both erudite and concentrated. He presents clear statements and explanations of virtually every aspect of the evolution of life on earth. What an accomplishment! He deals with the vast literature in a series of twelve intensely written chapters. Evolution, which is simply descent with genetic change, is quickly accepted as a fact that he proceeds to defend with great skill and thoroughness.

The author states that this book is written for "... anyone, biologist or not, who simply wants to know more about evolution". The general reader, however, will soon find it necessary to have had considerable prior exposure to the many intricacies of biological processes. These range from mating systems in local populations to the detailed nature of the genetical coding system and what happens to it when it is forced, by wholly natural forces, through the amazing egg/sperm bottleneck in each generation.

Over the years, Mayr's primary area of expertise has been with natural populations, encouraging the perceptive observer to draw conclusions based directly on natural-history observations. In this, he follows very closely in the steps of Darwin. Thus, the strongest parts of this book deal with his enthusiastic endorsement of Darwinian natural selection in all its aspects, as the primary cause of evolutionary change and the building of specific adaptedness in populations. Few professional biologists will disagree with this presentation.

A major "natural-history" contribution of Mayr is his long-term advocacy of "population thinking". Mayr is a "pan-selectionist", championing the powerful idea that the object of selection is ultimately the sexually produced individual. Indeed, each such individual is monitored by selection from the time that it originates as a fertilized egg carrying a unique genetic code. After braving the many challenges that natural selection poses to survival, some small proportion may finally reach sexual maturity. This is when the code-bearer faces the new game of sexual selection, which is perhaps the hardest test of all. Mayr's point stresses the realization that the causes of evolutionary change can be profitably analyzed at the level of the small, local interbreeding population of present-day organisms. This view of the growing point of evolutionary change has had a wide influence among modern experimental population geneticists. There are, of course, the dissenters, who hold that to produce an innovative character, selection must be carried out within large out-breeding populations, which hold maximum genetic variability.

In biology, the 20th was the century of genetics. This fact imposes daunting difficulties for the popular writer in the 21st century. The influence of this hugely documented, quantitative, molecular, statistical and highly technical modern science has reached into every corner of biology, including medicine. The discovery in 1953 of the precise nature of the hereditary material as coded molecular information that goes from parent to offspring, seized the imagination of biologists. Molecular genetics was born as an exciting new research adventure that required novel modes of investigation. Curiously, the science developed quite separately from the study of evolution. Nowhere has the influence of genetics been greater than in evolutionary biology. It has fallen to traditional evolutionists, like Mayr, to connect Darwinian natural selection with genetics.

In this book, genetical properties of organisms relevant to evolution are dealt with in a complex thirty-two page chapter called "Variational Evolution". The account goes from one technically difficult genetic topic to another, barely getting to the central molecular aspects. Mayr tackles this difficult task boldly but I feel that the job is too big for a book intended for a broad audience. Indeed, for example, it has never been possible to successfully present nuclear physics to a general reader. Biology has now reached the stage that to really understand it requires extensive specialized furniture for the mind. There is no easy road.

In discussing the various patterns of descent with change, Mayr has long ago made up his mind where the evidence leads on many topics and he is not hesitant to make declamatory statements of his view. An example is his conclusion that the individual, not the gene, is the major object of natural selection. I happen to agree with him on this, but there are certain contexts, as in clonal selection, where single-gene selection can be cogently argued.

A long-term interest of Mayr's has been the mode of origin of new species. In the 1940s, he advocated that species arise through gradual change in geographically partly separated populations that slowly, through selection, have acquired reproductive isolation from one another. Mayr has always made "isolation" an integral part of his definition of the species. Dissenters from this view look at the evolutionary process as a continuous accumulation of genetic differences over time in a gradual manner. This process is considered to proceed in a manner unrelated to any final human-conceived, idealized

"goal" such as the reproductive closure of a group of organisms. Many flowering plant species, for example, retain extensive out-crossing possibilities that do not degrade their adaptive integrity. The "isolation" concept of the species ignores the power of other strong selective forces, working within populations. An example is non-random mating due to mate choice, which has now been very widely observed. I was glad to see (on page 100) that Mayr now admits that this may occur in cichlid fishes of certain African lakes as well as in some insects. Accordingly, the much-maligned theory of "sympatric speciation" may yet survive and with new data may even be accorded favorable attention more widely in nature. Although Darwinian selection surely is paramount everywhere, a major modern research challenge is to find out the details of precisely what is being selected in natural populations.

For one who has followed Mayr through his many books on evolution, it is with pleasure that I find myself agreeing that, in most cases, he is right in his strong emphases. Despite not being for the general reader, this book turns out to be an admirable, in fact masterful, summation of the details of evolutionary principles. There is probably no other contemporary professional evolutionist who could articulate them as well as Mayr does.

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The Quantum Brain

The Quantum Brain. The search for freedom and the next generation of man. (2001). Jeffrey Satinover. Wiley, New York. pp. £11.50(pb) £17.50(hc). ISBN 0-471-44153-8

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The writing of books about consciousness and intelligence has become a cottage industry in recent years, and books on the brain are now a glut on the market. In the face of such competition, many authors feel obliged to make extravagant claims for their products, and some of them are driven to hype up their work out of all proportion. The upshot is frequently material of little value, hardly worth the bother of reading.

When I first saw the cover of Jeffrey Satinover's latest book, I frankly found it off-putting. The title itself revealed that he favours the quantum view of the brain most famously championed by Sir Roger Penrose, which has had a chequered career to say the least, though Satinover cannot be faulted merely because he has chosen to favour one particular theory—most of us do the same thing. I was more put off by the subtitle: *The search for freedom and the next generation of man.* My goodness, what a mouthful! And as if that were not enough, the front cover also boasts a peer endorsement, to the tune of "The first definitively 21st century book." If that is not enough to put backs up I don't know what is.

But as conventional wisdom would have it, one shouldn't judge a book by its cover, and this is particularly true of the present effort. Much of it is, in fact, a fairly pedestrian review of neural network theory and, although there is the brief coverage of real neurons that has become mandatory in such books, the focus quickly shifts toward neural networks of the artificial type. This is a richer vein for the popularising author, given that the bulk of theoretical effort has been directed toward such networks over the past two decades.

What is usually glossed over is the far greater complexity of the real brain's anatomy and physiology and, in this respect, Satinover is no exception. It takes an enormous act of faith to submerge oneself in the seemingly endless amount of biological detail one finds in neuroscientific texts, given that there is no guarantee that this will bring one closer to the heart of the mystery. But the hard grind of studying the appropriate level of structure can point to illustrious antecedents. It paid off at the macroscopic level, with elucidation of the function of the heart and the liver, for example, and it paid off just as handsomely at the molecular level, with the astounding discovery of the molecular basis of hereditary half a century ago. Indeed, one could do worse than follow Francis Crick himself, who latterly has turned from matters molecular to matters mental, and continues to stress that the story is all in the structure. You wouldn't find him getting hot under the collar about artificial neural networks. Indeed, his views on that subject are on record; he calls such activity rather low-brow.

In default of getting down to the arduous task of studying the genuine article, people with physics backgrounds who become interested in the brain invariably end up trying to force that 'noblest part of us' into the standard physical template, and Satinover is regrettably no exception, despite the fact that he writes eminently readable prose. So after the first flush of excitement over neural networks, he launches into a veritable smorgasbord of cute bits of modern physics—buzz words and sound bites with only the most tenuous of connections to anything biological. We've all laughed at the tale of the