qualified to read this book. One reason is that the equations used are rather simple. But even simple equations are a barrier for those who have not done much mathematics, and this imposes an unfortunate restriction on the readership. This is a pity, for many worthwhile ideas are expounded here which even a newcomer to physics could understand. I strongly recommend this book. ■

Peter Landsberg is emeritus professor in the Faculty of Mathematical Studies, University of Southampton, Southampton SO17 1BJ, UK. His most recent book is Seeking Ultimates *(Institute of Physics Publishing, 1999).*

The genetic complexity of life

The Misunderstood Gene
by Michel Morange (translated by Matthew Cobb)
Harvard University Press: 2001. 212 pp. $24.95, £16.95

Brian Charlesworth

According to the preface of this book, which is a translation of a work in French originally entitled *La Part des Gènes* (Odile Jacob, 1998), Morange's aim is "to put forward a new vision of genes and their function based on recent results from molecular biology". He goes on to assert that "the concept of the gene that is used both by the general public and by many scientists is completely outmoded". By this, he is referring to the role of genes in determining protein structure.

His statement will come as a surprise to most geneticists, as this concept of primary gene function has long since become a truism. Morange seems to feel, however, that the nature and functions of genes are widely misunderstood (he is excluding professional geneticists, presumably), and that this misunderstanding contributes to a widespread hostility to genetic determinism. At one point, he even refers to "the opponents of molecular biology and genetics". These opponents are vaguely defined as people who attribute the complexity of life to components of organisms other than genes, and their views are not discussed in any detail. I felt, therefore, as though I was listening to only one side of an argument; and it is not very clear with whom the argument is being conducted, and why it started.

Most of what Morange has to say is, however, sensible and instructive, and he does an excellent job of presenting molecular, cellular and developmental aspects of genetics to readers who are not geneticists, but who have a fairly good knowledge of biology. Morange's main point is that the product of a single gene is only one part of a complex web of interacting proteins that results in the structure, functioning and behaviour of an organism. This is, in fact, an old idea, clearly stated in the writings of developmental geneticists such as C. H. Waddington and Sewall Wright in the 1940s and 1950s. The difference now is that molecular genetics has provided detailed evidence about the nature of some of the key players in the game and exactly how they interact with one another. Oddly enough, Morange devotes only a couple of pages to the way in which early embryonic development is controlled by genes, despite the breathtaking advances that have occurred in this field over the past 20 years.

Morange develops various important implications of the broader view of gene action, which he illustrates with concrete examples, mostly from human and mouse genetics. The first is that a change in the structure of a gene, as a result of a mutation or (nowadays) a 'knockout' experiment, may or may not have a drastic effect on the organism, depending on the place of the gene's product in the web of interacting gene products and the ability of the web to compensate for such a change.

Other implications are that multiple, and often surprising, complexes of changes in the organism's characteristics may arise from a single mutation; the nature or even the occurrence of changes may also depend on the nature of the environment, or on the state of other genes. When there is variation in a trait among people, as in their susceptibility to a given disease, a given gene may contribute only a minor part of the variation, and non-genetic factors frequently also contribute to the variability. This applies especially to complex traits, such as behavioural characteristics and lifespan. Again, this all forms part of the stock-in-trade of classical developmental and quantitative genetics.

So genes do not have a one-to-one relation to the characters they affect, and any crude version of genetic determinism fails. This does not undermine the fundamental role of genes in encoding the sequences of amino acids in the polypeptide chains to which they correspond, and which, in turn, determine the three-dimensional structure and biochemical specificities of the folded proteins. Because only the genes are transmissible across generations, only they are subject to the forces of evolution. In a very real sense, therefore, Morange concludes, genes are the ultimate determinants of the development and evolution of organisms.

Little of this is new or controversial, but is probably worth presenting in some detail to show the general reader exactly what is meant by the genetic control of development and behaviour. The book concludes with a discussion of human evolution and eugenics. Morange is rightly cautious about the prospects for widespread genetic manipulation of human genetic material, although positive about limited interventions such as somatic gene therapy and selective abortion of individuals at high risk of genetic disease. Overall, the book is well written and accurate. ■

Brian Charlesworth is at the Institute for Cell, Animal and Population Biology, University of Edinburgh, Edinburgh EH9 3JT, UK.

New in paperback

Mystery of Mysteries: Is Evolution a Social Construction?
by Michael Ruse
Harvard University Press, $19.95, £13.95

Primeval Soup
by Christopher Wills & Jeffrey Bada
Perseus, $17
"The authors provide an excellent and compelling written overview… this book provides a highly readable survey of the historical prelude to the study of the origins of life." William J. Hagan *Nature* **407,** 451–452 (2000)

The Settlement of the Americas: A New Prehistory
by Thomas Dillehay
Basic Books, $18

Cradle of Life: The Discovery of Earth's Earliest Fossils
by J. William Schopf
Princeton University Press, $17.95, £11.95

The Natural Philosophy of James Clerk Maxwell
by Peter M. Harman
Cambridge University Press, £18.95, $29.95

The Sun in the Church: Cathedrals As Solar Observations
by J. L. Heilbron
Harvard University Press, $18.95, £12.95
"… John Heilbron's book tells a gripping story with a splendid literary flair ... Heilbron tells it in a masterfully human way… with his usual brilliant irony." George V. Coyne *Nature* **402,** 579–580 (1999)

You Can't Eat GNP: Economics as if Ecology Mattered
by Eric A. Davidson
Perseus Publishing, $16

Color Vision: From Genes to Perception
edited by Karl R. Gegenfurtner & Lindsay T. Sharpe
Cambridge University Press, £42.95, $59.95