main arguments for Williams and Dawkins's position are nowhere explained. The Dawkins paper (on the "extended phenotype") aims to extend, rather than defend, his case, and his critics, although they describe (sometimes even fairly) the theory they oppose, do not pause to expound it.

The argument, in condensed form, is this. The unit of selection will be, in a sense, the unit of heritability, because natural selection cannot act on non-heritable entities. Organisms are not inherited, because they die; "higher genetic levels" are not inherited, because they are broken and recombined: the unit of heritability will be something smaller, which Williams and Dawkins have chosen to call (and *define* as) the gene. If, in the kind of complex situations that Wimsatt, Sober and Lewontin discuss, that unit is longer than a cistron, then the gene (in Williams and Dawkins's sense) is longer than a cistron too.

In practice, however, Williams and Dawkins do not apply their argument to the problems of population genetics, but use it to think about what kind of adaptations will be favoured in particular environments. That application is strictly circumscribed. Williams and Dawkins have not been trying to explain everything in biology solely in terms of genes. Wimsatt, however, directs his criticism against a hopelessly ambitious theory of genic selection, which he has practically pumped up into *ex DNA omnia*:

> T2: (Dynamical thesis): Processes at the genetic level determine (and are the primary and ultimate) explanations for processes at all higher levels.

It is quite easy to make mincemeat of this, especially if "genetic level" is identified with a single genic locus. Wimsatt only needs to argue "that understanding evolutionary processes requires the invocation of causal mechanisms and nomic regularities" concerning things other than genes, for his work of destruction, against T2, to succeed. Against Williams and Dawkins, however, he is rather wide of the mark.

Actually, because genes are propagated in sets by the thousand through organismic agency, the selection of genes often produces organismic adaptations. There is broad agreement that organismal (rather than genic or group) adaptation is common, the disagreement being mainly about whether organismal adaptation is caused by the selection of genes or "higher levels". But either way we can ask how important the theory of natural selection is by asking how well adapted organisms are. If adaptation is uncommon, and imperfect, natural selection may remain its proper explanation, but will be unimportant. The five authors here (Lewontin, Gould, Oster, E.O. Wilson, Maynard Smith) all agree that organisms are only imperfectly adapted, because the range of genetic variation available for selection is limited. The argument is strong, and not (so far as I know) doubted by anyone; which is only unfortunate for Lewontin and Gould, who would discover an orthodoxy of "adaptationists" (all of whom believe organisms to be perfectly adapted), portray them in caricature, and analyse them with Marxist absurdities.

Sober remarks in his preface that it is difficult to distinguish the science from the philosophy in this anthology. For the most part I would agree; but only for the most part. In the sections that discuss whether theories are true, the science is indeed generally indistinguishable from the philosophy, and there are numerous scientific authors. The distinction could be made; but only superficially, by language and style (I could not help noticing the philosophers are more long-winded than scientists, but perhaps that is only the selection). Two sections, however, deal not with the validity, but with the nature, of theories — these are on functional explanation (teleology) and the reduction (or not) of Mendelian principles to molecular genetics — and they are entirely written by philosophers. Only, it would seem, when philosophical argument is used to criticize theories do scientists become seriously interested.

The final section takes leave from the theory of natural selection. Mayr, and Sokal and Crovello, discuss the nature of species — whether reproductively ("biologically") or phenetically defined — and Hennig, Hull, Felsenstein and Farris discuss the three main schools of classification.

I often wonder who buys these anthologies. They are usually too expensive for individuals; but why on earth should a library buy a selection of papers it already possesses? I think *Conceptual Issues in Evolutionary Biology* may be an exception. Most of its contents originally appeared in philosophical journals that are not subscribed to by biological libraries: but they should all interest biologists who enjoy thinking about the theory of evolution. And every biological library in the world, I hope, eagerly serves that species of reader.

Mark Ridley is Astor Junior Research Fellow of New College, University of Oxford, and author of The Explanation of Organic Diversity *(Oxford University Press, 1983).*

Keeping cool

H.M. Rosenberg

Matter at Low Temperatures.
By P.V.E. McClintock, D.J. Meredith and J.K. Wigmore.
Blackie: 1984. Pp.258. Hbk £19.75; pbk £10.25.

IT IS time that we had a new introduction to low temperature physics, and this book fits the bill very satisfactorily. Each of the three authors is well-schooled in the cryo-arts and together they have produced a unified text in decent English, with the occasional felicitous turn of phrase that made me pause and smile.

The book assumes a background of undergraduate physics, but the first three chapters gently remind the older reader of certain essentials. For the final-year undergraduate and the beginning graduate student (by whom the book will probably be most used) they will act as a useful revision.

The authors begin by introducing the general principles of low temperature physics, with particular emphasis on the third law of thermodynamics, the effects of zero point energy and macroscopic quantization. The next two chapters deal with lattice vibrations and electrons, respectively, and in each case the differences between the behaviour of crystalline and of amorphous materials is well brought out. The meat of the book comes next in accounts of superconductivity, liquid helium 4 and liquid helium 3 (including the properties of mixtures of ^{3}He and ^{4}He). In each case a simple phenomenological introduction is given as well as an outline of the current theory—with ample references for those who need a more detailed theoretical treatment. The final section of each of these chapters attempts to bring the reader up to date (to 1983) with developments in the most recent fields of interest—the properties of one-dimensional conductors and the search for other boson and fermion fluids.

The last two chapters cover more practical matters. Chapter 7 gives a good outline of experimental methods — ^{4}He and ^{3}He cryostat design, the dilution refrigerator, magnetic and Pomeranchuk cooling — and there is a helpful discussion on thermometry for various purposes. Finally, the authors turn to the applications of low temperature physics, the major emphasis, of course, being on superconductivity (high field electromagnets, the application of Josephson effects in computer elements, squids and other devices). This concluding chapter ends with a brief account of the uses of liquified gases themselves, including the interesting application of superfluid ^{4}He as a couplant in the acoustic microscope and as a non-reacting surface in the neutron bottle.

All in all, this is a good useful text. Not only that, it is enjoyable to read—an unusual and refreshing attribute. □

H.M. Rosenberg is Reader in Physics at the Clarendon Laboratory, University of Oxford, and a Fellow of St Catherine's College.

New in paperback: Jonathan Slack's *From Egg to Embryo* published by Cambridge University Press, price £9.95, $24.95. For review see *Nature* **306**, 294 (1983).

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