Book reviews

Homology (Novartic Foundation Symposium 222). Gregory R. Bock and Gail Cardew (eds). John Wiley and Sons, Chichester. 1999. Pp. 256. Price £75.00, hardback. ISBN 0 471 98493 0.

We all know that homology is a central concept in biology and we all feel that somewhere out there is an expert who could tell us exactly what it is. The main conclusion of this book is that there is no such person. At school textbook level, the term 'homology' has normally been applied to morphological parts of animals and plants. If a structure is similar in two different organisms, it is said to be *homologous* where it has been retained during evolution from a common ancestor. Conversely, two similar structures are said to be *analogous* if they have evolved independently in the two lineages.

So far this seems simple enough. But the more we read, the less we believe. The first chapter deals with the history of the concept and it turns out that none of the great zoological luminaries of the past actually did supply a satisfactory definition. Following this, many chapters debate the relationship between the visible structure and the underlying gene network that produced it. Primary sequence analysis has made it relatively straightforward to establish whether genes themselves are homologous. So if the same gene is expressed in two structures in different organisms, does this make the structures homologous? Not necessarily. There is general agreement that the nested expression of the Hox gene cluster does define a homologous anterioposterior axis for all animals. However, we should not be tempted to say that the isthmus of the vertebrate brain is homologous to a *Drosophila* segment boundary just because both of them express the gene *engrailed*. This is because most developmental control genes are expressed in several domains and contribute to the development of several structures. An intermediate situation is provided by the eye. The gene *pax6* is needed for eye development in creatures as far apart as *Drosophila* and mouse, and, although the functional information is not available, it is also expressed in the developing eye of planarians and cephalopods. The eyes of these various creatures have long been regarded as analogous because their structure is so totally different, but the new evidence tempts us to call them homologous. However, it is unlikely to be the eye itself but rather a photoreceptive organ-forming territory of the head that is homologous.

An insistence on the importance of the *level* of homology is a theme running through the book. This is because whole genetic pathways may be preserved as functioning units and used for new purposes. In such a case the pathways are homologous but the structures need not be. For example the hedgehog-patched-decapentaplegic pathway in the *Drosophila* wing disc is very similar to the sonic hedgehog-patched-BMP2 pathway in the chick wing bud. Here both the genes and their regulationary relationships seem homologous, but the final structures cannot be. At least they cannot be as *wings*, as we can be quite sure that the Precambrian common ancestor of the chicken and the fruit fly was a marine organism without wings, whatever other appendages it possessed.

Although there is considerable discussion of levels, I feel that more could have been said about cell types and about serial homology. Cell types such as neurons or muscle cells seem clearly homologous in different animals, although the CNS parts or named muscles to which they contribute need not be homologous. Serial homology refers to reiterated structures within an organism. To call these homologous involves an implicit admission that a common mechanism of formation is an essential attribute of homology, something whose necessity between organisms continues to be controversial, and is hotly debated in these pages.

So does all this mean that the concept of homology is actually useless because it cannot be defined, or is its richness precisely that it cannot be defined and so it continues to generate discussion and new research? The book is a stimulating contribution to this debate, and it is regrettable that its high price seems guaranteed to confine its sale to a handful of libraries.

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Eukaryotic DNA Replication — A Practical Approach. S. Cotterill (ed.). Oxford University Press, Oxford. 1999. Pp. 281. Price £29.95, paperback. ISBN 0 19 963680 X.

The basic principle of DNA replication is one of those beautifully simple concepts in biology that could be taught in elementary school, but the actual details have turned out to be surprisingly complex. Around fifty proteins have so far been discovered which function to catalyse replication steps or control the process so that it occurs appropriately with respect to other events in the cell cycle. In eukaryotic chromosomes, initiation occurs just once per cell cycle at a myriad of origins, but only recently have we begun to understand how this process is regulated. Many of the important proteins that function in DNA replication have been discovered, but there is much to be learned about their biochemical functions and how they are co-ordinated to achieve high fidelity duplication of chromosomes.

This book provides an eclectic collection of protocols from eleven replication laboratories. Two chapters deal with the yeast *Saccharomyces cerevisiae*, which has been of singular importance for the investigation of replication proteins and origins. General methods for the use of budding yeast are provided (Plevani) as well as procedures for the biochemical purification of replication complexes such as the origin recognition complex (Diffley). *Xenopus* has also been invaluable, in many ways complementing yeast work, and one chapter provides protocols for preparing and using various egg extracts to allow replication analysis *in vitro* (Walter & Newport). Several chapters discuss purification and assay of factors involved in the elongation step of replication, such as DNA polymerases (Wang), polymerase accessory proteins (Hübscher), DNA helicases (Bean & Matson) and lagging-strand activities (Bauer & Melendy). Procedures for mapping replication origins are provided (Gerbi) as are methods for the detailed probing of interactions between replication proteins and DNA (Borowiec). Additional chapters give details of the SV40 replication system (Bullock) and telomerase purification (Harrington).

This book should be very useful for any group interested in DNA replication. The protocols (over 120 in total) are clearly written and provide a level of detail that tends to be left out of the primary literature. It is worth mentioning that the protocols are set in context with background reviews, but these do not constitute the main attraction of the book, given that the field is hardly under-reviewed. Considering the rate of progress in replication work at the moment, it is difficult for a book like this to be comprehensive and some aspects are under-represented. So while there is good coverage of biochemical methods relating to individual replication proteins, there is rather less emphasis on cell biological and genetic methods relevant to replication work. In any case, with current developments there will soon be a case for a second volume, but perhaps next time the publishers can provide a spiral binding for a book to be used at the bench!

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Books received

Protein Evolution. László Patthy. Blackwell Science, Oxford. 1999. Pp. 228. Price £24.95, paperback. ISBN 0 632 04774 7.

Endless Forms — Species and Speciation. Daniel J. Howard and Stewart H. Berlocher (eds). Oxford University Press, Oxford. 1998. Pp. 470. Price £23.50, paperback. ISBN 0 19 510901 5.

Microsatellites — Evolution and Applications. Daniel B. Goldstein and Christian Schlötterer (eds). Oxford University Press, Oxford. 1999. Pp. 352. Price £27.50, paperback. ISBN 0 19 850407 1.

A Means to an End — The Biological Basis of Aging and Death. William R. Clark. Oxford University Press, New York. 1999. Pp. 234. Price £18.99, hardback. ISBN 0 19 512593 2.