for the reader to accept the veracity of the observers, even though why one should believe them is unclear.

In Chapter 9, Shackley hypothesizes that the Mongolian "wildmen", the Almas, are a surviving Neanderthal population. This is one of the more interesting parts of the book, since the Neanderthals are a well-known biological group. It therefore provides an opportunity to evaluate the thoroughness of Shackley's scholarship and hence a framework against which to judge her evaluations of "wildmen" stories. What, then, is her "evidence" that the Almas of Mongolia are Neanderthals? It consists entirely of Middle Palaeolithic-like tools in areas of Mongolia (none illustrated or described in detail), which local people say are made by "wildmen" in the nearby mountains. Not only is this shaky evidence upon which to base such an hypothesis, but it bespeaks ignorance of the associations of Upper Pleistocene lithic industries with human biological forms. Shackley is apparently unaware that anatomically modern human beings, as well as Neanderthals, are associated with Middle Palaeolithic industries in the Crimea and the Near East. The presence of such lithics in Mongolia, therefore, does not document the existence of Neanderthals, whatever the geological ages of the implements might be.

In addition, the density of misinformation on the Neanderthals is appalling. It appears that Shackley does not realize that two adult Neanderthal partial skeletons were found at Spy, not one (p.141), that they were excavated in 1886, not about 1866 (p.141), that Boule estimated the cranial capacity of La Chapelle-aux-Saints 1 to be 1,620 cc, not 1,450 cc (p.143), that there is no evidence for rickets or other specific dietary deficiencies in any of the known Neanderthal specimens (p.146), that Neanderthal halluces were of the same relative length as ours (p.148), and that Skhul 5 is not a Neanderthal but a robust, early anatomically modern human (p.159). These may appear to be detailed points of little importance, but they illustrate Shackley's disregard for factual accuracy. All are easily verifiable, unlike her claims about "wildmen".

Shackley's lack of competence in human palaeontology and palaeolithic archaeology does not lead one to have much confidence in her other opinions. Thus, this book is merely another contribution by an individual already convinced that "wildmen" exist. □

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Flora of Australia. The second volume in this series to be released (Vol. 8, *Lecythidales to Batales*) has recently been issued. Price is hbk $A34, pbk $A29; postage is $A5. For review of Vol. 1 in the series and details of the publisher see *Nature* **296**, 275; 1982.

Protein in the picture

Wayne A. Hendrickson

Hemoglobin: Structure, Function, Evolution, and Pathology.
By Richard E. Dickerson and Irving Geis.
Benjamin/Cummings: 1983. Pp.176. $34.95, £22.45.

MAX PERUTZ describes haemoglobin as the hydrogen atom of biology. Indeed, this protein does serve as the model for a broad reach of biological sciences and has also been the proving ground for countless techniques. Because haemoglobin plays such a central role in science and in life, Dickerson and Geis quite naturally chose it to illustrate principles of protein structure, function and evolution when they set out to revise their first book, *The Structure and Action of Proteins* (Benjamin, 1969). The example became the subject, and the planned revision evolved into *Hemoglobin.*

Readers of the previous book will recognize much of the material in the early stages of this one. However, nearly everything in the last three quarters is fresh, including a beautifully illustrated description of the mechanism of allosteric action in haemoglobin as well as outstanding sections on globin evolution and on abnormal human haemoglobins. In general, the clear exposition and wonderfully comprehensible views here of the three-dimensional structures of haemoglobins and myoglobins provide an excellent complement to the stereographic details in the Fermi and Perutz's *Atlas* (for review see *Nature* **302**, 362; 1983).

Molecular evolution is one of Dickerson's major interests and the corresponding section is probably the strongest in the book. Thorough coverage of sequence variability in the globins is backed up by a lucid discussion of mutation rates and evolutionary theory. (It is a pity that Perutz's recent work on species adaptation came too late to be included.) One also finds a fascinating description of haemoglobin gene structure and its relationship to changes in expression during pre- and post-natal development. There is, however, a failing with respect to invertebrate haemoglobins. One gains the impression that the cited monomeric examples are typical when, in fact, giant extracellular haemoglobins are commonplace.

The mutant haemoglobins, a subject closely related to evolution, are also admirably covered. This part of the book flows from the aetiology of thalassaemias to a comprehensive table of known point mutations in human haemoglobin. But the highlight is sickle-cell anaemia. Here Geis's talents as an illustrator again come to the fore. Both the text and the figures convey a marvellous picture of the molecular basis of this disease and the hope for a cure.

The metaphor that likens haemoglobin to the hydrogen atom is apt, in large measure, because so much is known about the molecular structure of this protein. But the wealth of information in a three-dimensional structure must be comprehended for it to have an impact. This book makes that possible for haemoglobin. Dickerson's enviable ease with words and Geis's word-saving pictures clear away the clutter and focus our attention on essentials. Consequently, we see fields ranging from evolution to medicine illuminated by the structure of haemoglobin. We await more in the same vein from this outstanding partnership when they reach the original goal of updating their 1969 book. □

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After Waterman

E. Naylor

The Biology of Crustacea. Vols 1–3 of a projected ten-volume series.
Editor-in-chief Dorothy E. Bliss.
Academic: 1982/1983. Vol. 1 pp.318, $38.50, £25.60; Vol.2 pp.440, $49.50, £32.80; Vol.3 pp.480, $59, £39.

A LITTLE over 20 years ago *The Physiology of Crustacea,* edited by T. H. Waterman, was published by Academic Press. It was a two-volume work which synthesized and stimulated the study of crustacean biology in a manner which has been of fundamental importance for the development of the subject. Now, as a measure of the success of that publication, it is argued that to produce an up-dated review under the broader title of *The Biology of Crustacea,* it is necessary to plan for ten volumes, with almost a hundred contributors and eight editors.

The past two decades have undoubtedly witnessed a remarkable growth of knowledge in many areas of crustacean biology. The study of interrelationships through comparisons of living forms has been advanced by fuller evaluation of the Class Cephalocarida, discovered only a few years before *The Physiology of Crustacea* was published in 1960, and the recent discovery of the Class Remipedia in 1980. Evidence from the fossil record has also increased markedly with new fossil finds of late Palaeozoic forms and the application of X-ray techniques to the head and limb structure of trilobites, thus clarifying their relationships with Crustacea. Significant advances have been made in the study of crustacean embryology, with evidence emerging of modified spiral cleavage and of constancy in the fate map of the blastula