example) and it is reductionist to conclude that entire organisms remain unchanged over time. Differential evolution of individual body components (mosaic evolution) is a widely recognized phenomenon and there is, for instance, no indication of stasis at the level of the structural gene. Stanley makes little mention of the substantial literature on molecular evolution, which suggests a hiatus between rates of evolution of single proteins and those of whole organisms. It is all too easy to slip into equating fossilized skeletal parts with entire organisms, and this slip is a recurrent feature of the literature of punctuated evolution. Stanley, for example, asserts that *Homo sapiens* has undergone almost no bodily change since appearing in Europe some 40,000 years ago.

The second aspect of the punctuational model is rapid evolution during speciation, which is generally assumed to occur in relatively or very small, peripheral populations. Such rapid evolution must, however, be *inferred* from the fossil record and involves the assumption that the fossil record is sufficiently complete to document this process unequivocally. In a few special cases this may be true, but the fossil record as a whole is pitifully inadequate — there is, for example, only one major fossil site recording the occurrence of mammals in the entire African continent for the first 35 million years of the Tertiary. We really

need to have estimates of the relationship between the likely catchment areas of relevant fossil sites and the geographical ranges of equivalent modern species; in the absence of such estimates a reasonable guess is that fossil sampling is in fact extremely patchy.

Nevertheless, the picture now emerging from the fossil record is unsettling, and our ideas of evolutionary processes must undoubtedly progress to account for long-term stasis, at least in individual body parts, in species populations. The question is whether such progress requires no more than healthy readjustment of basic theory or whether the changes which occur during speciation dictate recognition of a radically new process ("quantum speciation" or "macroevolution"). Stanley is convinced that the latter is the case. Perhaps understandably, he does not fix upon a single basic mechanism of "macroevolution", though he does somewhat vaguely implicate chromosomal reshuffling. Everything really hangs on the rapidity with which speciation takes place. Stanley states that he is prepared to envisage thousands of generations as the time-scale for "quantum speciation", and this could well be accommodated within a traditional model of evolutionary change. Stanley feels that the fossil evidence for human evolution provides us with one of the best illustrations of punctuation, yet "thousands of generations" could occupy a considerable proportion of the average geological duration of the hominid species currently recognized. In any case, the situation is far more complex than Stanley suggests, notably in the existence of intermediate forms (see Cronin *et al.*, *Nature* 292, 113–122). Stanley himself is somewhat unclear about the actual limits of his model as well. He suggests (p.157) that human races ("subspecies") may have arisen by punctuated evolution. Quite apart from the fact that here he is treading on extremely contentious ground in socio-political terms, it is difficult to see what "quantum" differences might define the human races in any context relevant to punctuated evolution.

In the absence of a clear model of the mechanism of "quantum speciation", the case for a radically new paradigm remains somewhat unconvincing, as was the case with continental drift prior to the recognition of sea-floor spreading. Stanley devotes a whole chapter to demonstrating that his doubts about conventional theory do not open the door to creationism; but without a clear concept of the mechanism involved in "punctuated evolution" he is unlikely to convince any creationist! Stanley is right to alert the general reader to the surprising new findings of palaeontologists, but he really goes much farther than the present evidence permits. □

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Two sides of Darwin

A.J. Cain

Darwin. By Jonathan Howard. Pp.101. Hbk ISBN 0-19-287557-4; pbk ISBN 0-19-287556-6. (Oxford University Press: 1982.) Hbk £5.50; pbk £1.25. To be published in the USA later this year.
Darwin. By Wilma George. Pp.160. ISBN 0-00-636502-7. (Fontana: 1982.) £1.75.

It is a sign of Darwin's relevance that Jonathan Howard's book is in the OUP *Past Masters* series, Wilma George's in the Fontana *Modern Masters*. They are nearly identical in their rather nasty format (dirty-coloured paper, undistinguished type-face and over-gorgeous covers, rather like the trash-novels on a railway bookstall), but do not be put off by first appearances — their intellectual content is very good, and both are well worth the money. Both are written by practising zoologists — a refreshing change from so many books on Darwin — but zoologists of very different interests. Jonathan Howard is a Principal Scientific Officer at the ARC Institute of Animal Physiology at Babraham, Wilma George is a University Lecturer in the Department of Zoology, Oxford. There is also a useful difference of sex; some of Wilma George's comments on the acceptability of Darwin's theories of sexual selection and male aggression to Victorian men are particularly enlightening.

Jonathan Howard remarks in his preface that

With the centenary of Darwin's death comes a widespread mood of scepticism and unease about the validity and significance of Darwin's contribution to knowledge. The time is certainly right to try to describe Darwin's scientific work briefly and in plain language.

While fully recognizing the importance of Darwin's work for biology, he says "I hope the book is fair in pointing out aspects of Darwin's thinking which lack consistency or have failed to stand up to critical scrutiny". And he rightly emphasizes that whatever others have made of Darwinism in philosophy or sociology, and however true it is that "human life and human society are to a certain extent biological issues", it is Darwin's contribution to biology on which he must stand or fall. "Darwinian philosophy of Darwinian society are post-hoc constructs that had no place in Darwin's thought".

The chapters take us successively through Darwin's life; the foundations of Darwinism; natural selection and the origin of species; the evidence for evolution by natural selection; sex, variation and heredity; man; perfection and progress; Darwinism and ideology; and Darwin as a scientist — an evaluation. The style is mostly good and the exposition clear. Just occasionally it would have benefited from critical reading — for example I can make no sense out of Howard's comment on

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Feb. 1982. 176 pp., 62 illus. Glossary. \$9.95 (paper), \$16.50 (case). *Science Books International*, 51 Sleeper Street, Boston, Mass. 02210. Write to Jane Wescott for purchase or examination copy, or call (617) 426-2224.

Darwin's rejection of Christianity (p.9):

Darwin reserved this uncompromising expression of his religious views for the private autobiography that he wrote for his family. Had he not done so it is inconceivable that T.H. Huxley could have abandoned his war against hypocrisy and helped to carry Darwin's coffin into Westminster Abbey in 1882.

It is inconceivable that Huxley did not know Darwin's views on religion — Darwin was not reticent about them to correspondents — and that he should not have applauded them. Where was the hypocrisy?

Howard's book is essentially a careful exposition and critique of Darwin's arguments in the *Origin* (and in the *Descent of Man* for the evolution of man). It is in the structure of the arguments that he is principally interested. Of course he does not neglect the factual evidence, but produces usually only the minimum of it — for example his comments on the cogency of geological, geographical, taxonomic and embryological information in establishing that evolution had occurred (pp.37–49). Similarly, in summarizing the modern position on natural selection he merely remarks (p.87),

Natural selection and the evolution of natural populations have been observed directly, even in man. There is now no doubt that natural selection is a mechanism of evolutionary change. Whether it is the exclusive mechanism of evolutionary change is still occasionally debated.

And he accepts Darwin's own belief that he had spent too much time on barnacles (p.5) without analysing what he had got from them.

Howard's exposition of ideas and their inter-relatedness is much more full, and he

seems especially interested in predictability and unpredictability and their role in the evolutionary debate. He remarks (p.24):

If mutual competition between organisms was a more important selective influence than mere climatic or geographic change, then the direction of evolution of a species or of an interacting group of species, became effectively impossible to determine.

And, after a supporting quotation from the *Origin*,

It is important to recognise this instance for what it is, namely a hypothetical scenario for fluctuations in frequency of different kinds of organisms that are all subtly related to each other, initiated by introducing into a dynamic equilibrium a single small change

Here is the physiologist pre-adapted for seizing the complexities of a dynamic system and comprehending the modes (and pitfalls) of its analysis — a valuable approach.

Wilma George's book, written in a particularly attractive and lively style, inevitably covers much of the same ground but is effectively complementary to Howard's in its mode of treatment. She has travelled extensively, realizing the facts of natural history, adaptation and biogeography at first hand — an equally valuable approach. She uses all of Darwin's works very effectively, showing how his interests grew on a wide front, and provides the best short account that I know of just why he was so interested in barnacles, what he got from them and how the ideas acquired led on to later interests (polymorphism, sexuality, insectivorous plants and the fertilization of orchids, for example). Her insight into the development of his ideas on coral reefs in relation to other geological ideas is particularly clearly expressed, and she relates Darwin most effectively to other workers before, at the time, and after. She gives a more concrete exposition of subsequent work in population genetics, natural selection and speciation, than does Howard.

Either book can be read with pleasure by itself; the two combined make a first-class introduction to the subject. Both authors make suggestions for further reading, to which should be added Dorothy Nelkin's spine-chiller *Science Textbook Controversies and the Politics of Equal Time*, published by MIT Press in 1977. Both glance at the present situation in evolutionary thought, and both expatiate on the forces of unreason, but neither, it seems to me, appreciates just how powerful and dangerous they are. Nelkin's book is a necessary addition. □

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One foot in sea, and one on shore . . .

D.R. Newth

The Aquatic Ape: A Theory of Human Evolution. By Elaine Morgan. Pp.168. ISBN 0-285-62509-8. (Souvenir Press, London: 1982.) £7.95. To be published in the USA later this year by Stein & Day.

*Sigh no more, ladies, sigh no more,
Men were deceivers ever;
One foot in sea, and one on shore,
To one thing constant never.*

ONE of the few changes made by Darwin in preparing the second edition of the *Origin of Species* was the exclusion, in obedience to Lyell, of any reference to the "secondary whale". The evolution of aquatic mammals still presents troubling problems, but at least, for the most part, those mammals taking to water do not appear to have had second thoughts. It was, therefore, brave of Alister Hardy to

suggest, nearly a quarter of a century ago, that mankind had passed through a semi-aquatic phase and that some of our less easily explained biological features were its legacy.

Hardy laid stress upon our relative hairlessness — and upon the orientation of the hairs that we do possess, upon bipedalism, upon subcutaneous fat, upon our ability to swim, and upon the form and sensitivity of the human hand. All seemed to make sense as adaptations to littoral life, less aquatic than that of present-day otters, but one sufficiently dependent upon shallow waters to make the transition to bipedal locomotion easier to envisage in view of the buoyancy enjoyed by the wading anthropoid. Although Hardy did not attract much support for his idea he was content to wait for the matter to be decided by the fossil precursors of the australopithecines when their discovery should fill the late

Miocene-early Pliocene gap in the story.

In bringing us, with Sir Alister's blessing, an extended statement of the case for his ideas, Mrs Morgan adds arguments of her own. She sees in face-to-face copulation an important behaviour pattern shared by mankind and many aquatic mammals, but not seen in infra-human primates. Emotional weeping is another such behaviour. She also believes that speech as a mode of communication may have evolved as the limitations of smell and sight in an aquatic environment made themselves felt. In this, and in the suggestion that underwater childbirth may once have been the norm, she seems to envisage a more completely aquatic phase than Hardy originally did.

The additional arguments do not, I think, greatly strengthen the case. Mrs Morgan herself sees face-to-face copulation in mankind as a consequence of bipedalism and hence, at most, as a secondary consequence of an aquatic phase. On the shedding of tears the position is not simple. While seals and sea