

# EVOLUTION FROM MOLECULES TO MEN

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Edited by D. S. Bendall  
*on behalf of Darwin College, Cambridge*

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I. Bendall, D. S.

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## Contributors

- Ms S. M. Adams, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK
- Professor G. E. Allen, Washington University, St Louis, Missouri 63130, USA
- Professor F. J. Ayala, Department of Genetics, University of California at Davis, Davis, CA 95616, USA
- Dr P. A. Barrie, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK
- Dr P. P. G. Bateson, Sub-Department of Animal Behaviour, High Street, Madingley, Cambridge CB3 8AA, UK
- Dr A. Blanchetot, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK
- Dr W. F. Bodmer, Imperial Cancer Research Fund Laboratories, Lincoln's Inn Fields, London WC2A 3PX, UK
- Professor R. W. Burkhardt, Department of History, University of Illinois, Urbana, ILL 61801, USA
- Professor P. H. Clarke, Department of Biochemistry, University College London, Gower Street, London WC1E 6ET, UK
- Dr T. H. Clutton-Brock, Large Animal Research Group, Department of Zoology, 34a Storey's Way, Cambridge CB3 0DT, UK
- Dr R. Dawkins, Department of Zoology, South Parks Road, Oxford OX1 3PS, UK
- Professor Dr M. Eigen, Max-Planck Institut für biophysikalische Chemie, Am Fassberg, D-3400 Göttingen, W. Germany
- Professor S. J. Gould, Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, USA
- Professor A. Hallam, Department of Geological Sciences, University of Birmingham, Birmingham B15 2TT, UK
- Professor J. L. Harper, School of Plant Biology, University College of North Wales, Bangor, Wales
- Mr S. Harris, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK
- Dr M. J. S. Hodge, Department of Philosophy, University of Leeds, Leeds LS2 9JT, UK

- Professor D. L. Hull*, University of Wisconsin, Milwaukee, Wisconsin 53201, USA
- Professor Sir Andrew Huxley*, Department of Physiology, University College London, Gower Street, London WC1E 6BT, UK
- Professor G. Isaac*, Department of Anthropology, University of California at Berkeley, Berkeley, CA 94720, USA
- Dr F. Jacob*, Institut Pasteur, 25 rue du Dr Roux, 75017 Paris, France
- Dr A. Jeffreys*, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK
- Professor R. C. Lewontin*, Museum of Comparative Zoology, Harvard University, Cambridge MA 02138, USA
- Professor J. Maynard Smith*, School of Biological Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QG, UK
- Professor E. Mayr*, Museum of Comparative Zoology, Harvard University, Cambridge, Mass 02138, USA
- Professor E. Nevo*, Institute of Evolution, Haifa University, Haifa, Israel
- Professor J. Passmore*, Department of Philosophy, Australian National University, History of Ideas Unit, Research School of Social Sciences, P.O. Box 4, Canberra ACT 2600, Australia
- Professor Sir David Phillips*, Molecular Biophysics Laboratory, Zoology Department, South Parks Road, Oxford OX1 3PS, UK
- Professor J. Shapiro*, Department of Microbiology, University of Chicago, 920 E 38 Street, Chicago, Ill 60637, USA
- Dr M. J. E. Sternberg*, Molecular Biophysics Laboratory, Zoology Department, South Parks Road, Oxford OX1 3PS, UK
- Dr B. J. Sutton*, Molecular Biophysics Laboratory, Zoology Department, South Parks Road, Oxford, OX1 3PS, UK
- Dr B. A. O. Williams*, King's College, Cambridge CB2 1ST, UK
- Professor E. O. Wilson*, Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, USA
- Professor C. R. Woese*, Department of Genetics and Development, University of Illinois, Urbana, Illinois 61801, USA
- Mr D. Wood*, Department of Genetics, University of Leicester, Leicester LE1 7RH, UK

## Preface

The conference, entitled *Evolution of Molecules and Men*, which Darwin College organised from 27 June until 2 July 1982 has been called in *Science* 'the most official of the multiplicity of conferences to commemorate the centenary of Darwin's death'. Although there is, of course, no body with the authority to declare a conference on Darwin official, there is an obvious sense in which the label is not unjustified. No other conference took as wide-ranging a view of the present state of Darwinism, as this volume shows. This is not a volume of conference proceedings in the strict sense. However, with the exception of Sir Andrew Huxley's prologue, every contribution started as a paper at the conference, which has been more or less revised for publication. Only three participants felt that they preferred not to join in the publication for one reason or another.

A brief explanation of how the conference came about may be of interest to readers of this volume. The explanation actually goes back almost two decades. Darwin College was founded by three other Cambridge colleges – Gonville & Caius College, St John's College and Trinity College – to be the first exclusively postgraduate college in Cambridge. The move was taken soon after the death at the end of 1962 of Sir Charles Darwin, grandson of the Charles Darwin. After some negotiation, the family agreed to make their property available to the new college – a considerable site on an arm of the river acquired by Charles' son George in 1885, that included the family home, Newnham Grange, and the Old Granary. The college was also given permission to take the name Darwin. Although it was never the intention that the college should concentrate on biological studies, the name has inevitably created a special association, and it is a fact that research in biology occupies a large proportion of the research students and Fellows of the college.

As the centenary of Charles Darwin's death approached, the college felt that it wished to do something substantial to commemorate it. After considerable preliminary discussion with officers of the Royal Society and others, the college decided that the only really appropriate celebration would be one that looked at the whole field in order to assess the current status and prospects of Darwinian theory. The response was overwhelming, not only from various societies and institutions that helped with the finance, but from biologists all over the western world. The range of the papers, selected by a small college committee after very extensive discussion with experts in various fields, reflects the fact that Darwinian theory has implications for all aspects of biology and also for sociology and philosophy.

An early decision was taken to restrict the conference to about 300 participants in order to allow for serious formal and informal discussion. This was a difficult decision to make, and a harder one to enforce. It became increasingly obvious that a large number of people other than specialists have a serious interest in the subject and this volume is directed to them as much, or perhaps more, than to professional evolutionists and molecular biologists. Although the papers were all written by professionals in the strict sense of the word, they proved to appeal to a wider audience as well. That, we like to think, is a measure of the range and breadth of Darwinism, of Darwin's own work and of the avenues of inquiry that he opened up. As Professor Passmore said in his 'epilogue', a remarkable tour de force in summation: if the authors, 'active scientists' in most cases, 'usually begin with a bow in Darwin's direction, and an appropriate quotation, ... they are not, in general, talking *about* Darwin. Rather, they are presenting us with independent investigation conducted in a Darwinian spirit, testimonies to the fact that Darwin is still a living force... There is something very special about a scientist who is commemorated in that way.'

The prologue by Sir Andrew Huxley actually results from a different activity of the college, which in 1977 initiated a series of annual public lectures to be given to a large academic audience by distinguished figures in all branches of the world of learning. This lecture was given on 4 May 1982 by Sir Andrew Huxley, currently the President of the Royal Society, on the subject of Charles Darwin. The committee felt that it would make an appropriate prologue to this volume and we thank Sir Andrew for agreeing to revise it for this purpose.

The college was able to run the conference with its own limited personnel and I believe it is not invidious if I single out for special thanks three people - Dr D. H. Mellor who acted as Conference Secretary, Dr D. S. Bendall

who played a major role in the planning stage and has taken the responsibility for this volume, and my secretary Mrs Joyce Graham who was responsible for the administrative side.

*September 1982*

Moses Finley  
*Master of Darwin College*



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## PROLOGUE



## How far will Darwin take us?

ANDREW HUXLEY

*The Origin of Species* worked a revolution by bringing a very wide range of biological phenomena within the scope of natural explanation. In the nature of things, evolution, which has to do with events millions or hundreds of millions of years ago, is an area where detailed certainty is unattainable and will remain so. But a centenary of this kind is a suitable occasion not only for taking stock and asking ourselves how successful Darwin's ideas now appear to have been within the range to which he devoted himself, but also for going further and asking what are the prospects for extending natural explanations to aspects of living things to which Darwin did not address himself because in his time they were completely out of range.

Darwin was, of course, not the originator of the idea of evolution. If you mention evolution to a Frenchman the first name that will come to his lips is not Darwin but Lamarck, who lived and wrote half a century or so before Darwin. In Britain there was Darwin's own grandfather Erasmus Darwin. In the nineteenth century, Herbert Spencer (1852) was an ardent evolutionist well before the publication of the *Origin*, as was Robert Chambers, author of the *Vestiges of Creation*, published anonymously in 1844. The chief grounds in those days for thinking of evolution, or transmutation as it was commonly called, were the obvious resemblances between animals of any one group, and the fact that organisms could be classified in a hierarchical system – species within genera, genera within families and so on – so that it was possible to draw an evolutionary tree in which each branch point might correspond to the splitting into two of an ancestral species.

In the first half of the nineteenth century almost all biologists remained unconvinced, and fixity of species was the standard and orthodox position.

My grandfather, Thomas Henry Huxley, adopted an agnostic position, as he did in many things, and writing much later (1888) he describes his discussions in the 1850s with Herbert Spencer in the following words: 'I took my stand upon two grounds: firstly, that up to that time, the evidence in favour of transmutation was wholly insufficient; and, secondly, that no suggestion respecting the causes of the transmutation assumed, which had been made, was in any way adequate to explain the phenomena. Looking back at the state of knowledge at that time, I really do not see that any other conclusion was justifiable... So I took refuge in that 'thätige Skepsis', which Goethe has so well defined; and reversing the apostolic precept to be all things to all men, I usually defended the tenability of the received doctrines, when I had to do with the transmutationists; and stood up for the possibility of transmutation among the orthodox – thereby, no doubt, increasing an already current, but quite undeserved, reputation for needless combativeness.'

The situation was transformed by the joint publication in July 1858 of the papers of Darwin and Alfred Russel Wallace proposing natural selection as a mechanism for the transmutation of species. My grandfather (1888) records that his reaction was: 'How extremely stupid not to have thought of that'. Darwin then got down with extraordinary speed to writing *The Origin of Species*, which he described as an abstract of the much longer work that he had already begun, and the *Origin* was actually published in November 1859.

Darwin had for twenty years been amassing evidence both for the general proposition that the diversity of present-day living organisms had been generated by 'descent with modification' from one or perhaps a few primeval forms, and for the efficacy of natural selection as the principal mechanism by which this modification had been brought about. He presented this evidence in so persuasive and readable a form in the *Origin* that the violent opposition which it generated lasted only for a few years, at least among the educated public in Britain. In the *Origin*, Darwin held back from explicitly applying his ideas to Man, and went no further than saying in his concluding chapter that 'Light will be thrown on the origin of man and his history', but by 1871 the climate of opinion had changed so much that he felt able to publish *The Descent of Man*.

But even in *The Descent of Man*, Darwin (1871) excludes two great areas of biology. He says 'In what manner the mental powers were first developed in the lowest organisms, is as hopeless an enquiry as how life itself first originated. These are problems for the distant future, if they are ever to be solved by man'. So, in asking 'How far will Darwin

take us?' we ask in the first place whether we can now accept the two propositions to which he addressed himself – descent with modification, and modification by natural selection. In the second place, we ask what prospect there now is of solving the problems of the origin of life and of the nature of consciousness.

### Descent with modification

The first sentence of *The Origin of Species* reads: 'When on board H.M.S. "Beagle", as naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent'. As regards extinct forms, the point which directly suggested common ancestry was that many South American fossils were clearly related to present-day species which are found only in South America: for example, *Megatherium*, the giant ground-sloth, was related to present-day sloths, the giant armadillo *Glyptodon* was related to present-day armadillos, and fossil rodents resembled present-day South American rodents rather than those of North America or the Old World. As regards living organisms, the most striking instances were in the Galapagos Islands, where, for example, there are thirteen species of ground finches, closely related to one another, adapted to different ways of feeding, and none found anywhere else in the world – just the situation to be expected if they had been derived by descent with modification from a few individuals of a single species which had found their way to the islands. Most of Darwin's evidence is morphological but in *The Descent of Man* he also emphasizes the resemblance of the behaviour of the higher mammals to that of Man. He draws his examples equally from the plant and animal kingdoms, from developing as well as adult forms, and from fossils as well as recent organisms.

Darwin readily admitted the gaps that existed in sequences of fossils, but many of these gaps have since his time been at least partially filled, and this is especially true in the case of Man. When the *Origin* was published, the only known human fossil was the Neanderthal skeleton, whereas now there must, I suppose, be fossil remains as old as or older than the Neanderthal skeleton from thousands of individuals intermediate between present-day apes and man. The closeness of relationship between animals of widely different sorts has been immensely strengthened by the discoveries of biochemistry, the community of biochemical systems and indeed of the genetic system between widely different kinds of animals and plants. Finally, the relationships between animals traced by recent methods such



as protein sequencing agree closely with the relationships traced by methods available in Darwin's time.

Among scientists, the proposition that existing species have arisen by descent with modification is now agreed practically universally. There is, however, vigorous opposition by creationists, especially in the United States. I do not regard this as a scientific disagreement: almost all creationists base themselves on authority which is not admitted by scientists, and they are attacking not so much evolution as science itself. From a scientific point of view one does not need to take them seriously, though from a sociological point of view, and from the point of view of the harm their doctrines may do, one does indeed have to take them seriously. One has to admit, of course, that there are still major gaps in the fossil record, notably between the different invertebrate phyla which seem to appear as distinct entities in the early Palaeozoic, but all biologists suppose that the fossil record is incomplete at that point because the missing organisms were soft-bodied, and have not been preserved; however, this is something that we have to bear in mind.

### Natural selection

It is often forgotten that Darwin himself made no claim that natural selection is the only mechanism in evolution. In a letter to *Nature* in 1880 he asks whether it is possible to 'name any one who has said that the evolution of species depends only on natural selection? As far as concerns myself, I believe that no one has brought forward so many observations on the effects of the use and disuse of parts, as I have done in my "Variation of Animals and Plants under Domestication"; and these observations were made for this special object. I have likewise there adduced a considerable body of facts, showing the direct action of external conditions on organisms...'. Passages like this, which is not by any means unique, read oddly to the present-day biologist, but the reason for this is that we have all become accustomed to Mendelian inheritance, and we forget that a great difficulty facing the idea of natural selection in Darwin's time was the complete ignorance of the laws of heredity and the general assumption that most inherited differences were subject to some degree of blending inheritance or 'regression towards the mean', so that the variability that is obvious within any species would disappear in a few generations unless restored by external influences.

Darwin's own hypothesis (1868) for the mechanism of inheritance, which he called pangenesis, was conceived about 1840. It is a mechanism