ORIGINS

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The Darwin College Lectures

Edited by
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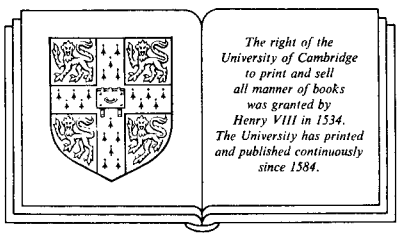

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Preface

University research covers a great range of subjects. To try to comprehend all of them would be foolish: life is too short, and anyway no one is good at everything. But most subjects are to some extent spectator sports. You needn't be a musician to appreciate some modern music – though no doubt it helps – nor a cosmologist to appreciate some modern cosmology. And many spectators have common interests in very different subjects: an interest in their origins, for example. A natural narcissism interests us in our own origins and, by a natural extension, in the origins of the very diverse parts and aspects of the world on which we depend.

There is, therefore, a predictable demand for series of public lectures by leading authorities in interdisciplinary topics such as origins. And not only for lectures: such interests are not confined to Cambridge, nor to one year. So the lectures might profitably be reprinted in a book, to make them available permanently to a wider audience.

But who is to arrange all this? In the nature of the case, it is not the business of any one university department. And although colleges cut across departmental boundaries, the main business of an undergraduate college is still to teach its students their own subjects. But the main business of a graduate college such as Darwin College is research, and especially aspects of it that relate, or are common to, different subjects. Arranging lecture series and books on such topics is a natural activity for a graduate college. Hence the sequence of lecture series and books of which this is the first.

The first Cambridge college to undertake such a project, we at Darwin have been encouraged in part by the example of our counterpart in Oxford, Wolfson College, which has organized several similar series of lectures and books. And in 1982 we organized the Darwin Centenary Conference and arranged the publication of its proceedings by Cambridge University Press under the title *Evolution from Molecules to Man*. The success of that conference and that book has been the main stimulus to our present enterprise. And it seemed especially apt for a College named after Charles Darwin to follow his Centenary Conference, and start our sequence, with a series of lectures and a book on origins. So, too, it clearly seemed to the massive audiences for these lectures,

who throughout the Lent Term of 1986 packed the University's largest lecture theatre week after week to hear them. The demand in fact exceeded all our predictions: and those who were there know how well our lecturers met it. Just how well, readers may now judge for themselves; and we hope they will be encouraged thereby to support with equal enthusiasm the next, equally, apt, 1987 series of Darwin College Lectures, on *Man and the Environment*.

D. H. Mellor

Introduction

In discussing origins, it makes more than conventional sense to begin at the beginning, since the origin of everything is also the origin of all other origins. Hence our first chapter by Martin Rees, which sets us off with a bang: the hot big bang that was probably the origin of our expanding Universe. Not that modern cosmology starts with the big bang. Rather, it works back to it, using our knowledge of gravity and nuclear physics to trace and explain the formation, history and workings of galaxies and stars, including the creation of the matter we are made of. We may never actually reach the big bang, because the nearer we get, the less we know and the more we can only speculate. Still, Rees gets us close, showing how informed speculation can now reach back to the first 10^{-36} or even 10^{-43} seconds. And if we still want the big bang explained, Rees reminds us that cosmology will not explain it anyway, since origins explain what follows them ('things are as they are because they were as they were'), not vice versa.

In chapter 2 we come closer to home, with the origin of the Solar System. This is harder to settle than the origins of stars and galaxies, because we have only one visible specimen to study. David Hughes takes us through the facts and a range of theories. The more or less known facts concern the similar ages of Earth and Sun, and the latter's evolution; the masses and sizes of the planets, and hence their densities and probable composition; their orbits and hence their angular momenta; the prevalence of planets among nearby stars; meteorites; and possible ways of forming planets. The theories include: a spinning cloud flinging off rings that condense into planets, the residue condensing into the Sun; a passing star pulling the matter of the planets from the Sun; the Sun picking it up from interstellar dust and gas. Hughes' favourite is that Sun and planets condensed from a single cloud, a mechanism that would give planets to about one star in five – some 20 billion in our galaxy.

These developments, of the Universe and of the Solar System, involve irreversible change and increasing complexity. In chapter 3 Ilya Prigogine asks how complexity can arise and increase. He ascribes it to instability in dynamical systems, which can make even deterministic ones – e.g. the orbits of comets – unpredictable and irreversible. He also finds these effects in the non-

equilibrium thermodynamics of chemical and other processes, where the interplay of a few variables may 'attract' a system like the atmosphere to many stable states, but with much fluctuation. Prigogine finally speculates that such irreversible processes might have produced the whole material Universe by the bifurcation of a primordial vacuum into matter and gravity.

Chapter 4 brings us to human life in particular. When and how we evolved depends on what it took to become human: a complex question. David Pilbeam takes major stages to be: bipedal hominids appearing about 5 million years (my) ago; their diversifying between 5 and 1.5 my ago; the use of stone-flakes, greater brain size and more meat-eating in *Homo* over 2 my ago; a non-ape-like omnivorous scavenging and/or hunting phase with stone tools and probably speech; modern humans and perhaps modern language capacity by 40 or more millennia ago; and a shift in the last 10 millennia from gathering food to producing it. He sketches a range of current theories about when, why, how and by what steps these changes occurred; the relevant fossil, genetic, behavioural and other evidence; and how much it may ultimately tell us about our ancestry.

After matter and life there comes the still greater complexity of society – animal and human. In chapter 5 John Maynard Smith asks how the co-operative behaviour which animal societies require could evolve. He answers that co-operation is often synergistic and thus evolutionarily stable, and gets going because animal societies are composed of relatives, who will spread 'co-operative' genes. Co-operation with non-relatives can also spread by reciprocal altruism on a tit-for-tat basis. Human society, being self-conscious, needn't evolve genetically; but our capacity for it, Maynard Smith argues, probably did, because of its synergistic effects on evolutionary fitness. Finally, Maynard Smith considers in a range of cases how far loyalty to a human group may make it, or depend on its being, a breeding group.

In chapter 6 Ernest Gellner considers specifically the origins of our own societies. He starts from their diversity. It isn't genetic: children can be socialized into any society. The diversity of our societies thus implies that each one severely – and differently – restricts our possible behaviour. How is that done? Ritual, says Gellner; but ritual alone won't explain our contractual and coercive social structure. The origin of that, he thinks, lies in our starting to produce and store food and so needing to distribute and defend it. That in turn needed language and then writing: hence the production, storage and distribution of concepts and doctrines as well as food. But that allows people to envisage new ways of behaving: it strengthens logical but weakens social coherence. So to preserve society we then needed a shift from ritual to doctrine: gods to enforce, but also to be bound by, systems of social concepts. But then the concepts became debatable, if only among their clerical articulators, and our loyalty eventually gets transferred from specific doctrines to our modern social systems for deciding and enforcing them.

All this, of course, demands language, perhaps our most distinctive and important social trait, whose origins John Lyons looks at in our last chapter. He distinguishes the origins of particular languages from the origins of language

itself. Knowing the former is no help with the latter, because earlier languages, and those of so-called primitive people, are no simpler or less highly evolved than ours. Nor does Lyons think in the case of language that 'ontogeny recapitulates phylogeny', though neither is yet understood. But in both, he distinguishes language from speech. He thinks human language was probably gestural in origin, like the rudimentary languages taught to chimpanzees, which compare in complexity with the 'telegraphic' utterances of two-year-old children. But the grammatical and descriptive complexity of adult language, which *is* associated with speech, requires capacities beyond those of other terrestrial species, capacities we may have acquired in only the last 40–100 millennia.

All our lecturers emphasize how far we are from knowing all about our origins. But between them they also show clearly how far we have come already, and where we now stand. The lectures in this book, we venture to hope, will provide as good an origin for new work on origins as they already have for our new sequence of Darwin College lecture series.

D. H. Mellor