THE DARWINIAN REVOLUTION, AS SEEN IN 1979 AND AS SEEN TWENTY- FIVE YEARS LATER IN 2004

A convenient and not-entirely-arbitrary starting point is 1959, one hundred years after the publication of the *Origin*. It was around that time that serious professional work started enriching our understanding of the Darwinian revolution. Books by trained historians began to appear, and the rich archives were gathered, systematized, and increasingly made readily available to scholars.[1] Sir Gavin de Beer's publications of the private evolution notebooks of Charles Darwin, although now superceded by a more scholarly edition, were a landmark and an inspiring spur to scholarship.[2] In the twenty years from that date, a growing number of people – many with real training in the arts of historical understanding and writing – helped to make out and elaborate on the events in the middle of the nineteenth century, when people's thinking was changed from a static world picture to one that made evolution central.

Such was the situation when, in 1979, I published my *The Darwinian Revolution: Science Red in Tooth and Claw*, a work that openly and deliberately drew on the scholarship of the previous twenty years, trying to synthesize and make sense of Charles Darwin, his contribution, and the revolution that takes his name. Immodestly, I

think I succeeded fairly well in my aim, and although in the quarter century since there have been major pertinent contributions to our understanding, the picture I was able to sketch has stood up sufficiently well that I felt justified in bringing out a new edition of my book (main text unchanged, with a new *Afterword*) in 1999. Let me start my contribution to this special edition of the *Journal of the History of Biology* by saying what I think I was able to achieve in *The Darwinian Revolution.* To take the sting from my immodesty, let me stress again that mine was a work of synthesis. Then, let me go on to discuss what my researches of the past twenty-five years (since that book's publication) make me want to add to my then analysis.

The Darwinian Revolution

The story I told in my book was straightforward and familiar. The action began in France around 1800, with the very different takes on life's origins by Lamarck and Cuvier, the former an evolutionist and the latter an opponent. It then moved across the Channel to Britain around 1830, the time when Charles Darwin was coming into scientific maturity and when, towards the end of the decade, he took on and conquered the organic origins problem. The key figure here was Charles Lyell, the author of *The Principles of Geology*, whose uniformitarian message was then thought (and by me and most others

is still thought) to be the greatest of all of the influences on Darwin. At the same time, however, it was stressed how science itself was becoming self-consciously professionalized and how this fed into Darwin's thinking and activities. Time out occurred between Darwin's fruitful creative period and the publication of the *Origin* in 1859. It seemed to me then, as it seems to me now, not terribly significant or overwhelmingly interesting why Darwin delayed so long in publishing. Much more significant and interesting was the way in which the very idea of evolution – for or against – started to become a major factor in people's thinking in Britain at the mid-century. Much of this was due to Robert Chambers's anonymously published *Vestiges of the Natural History of Creation* (1844), as well as other works (including Tennyson's *In Memoriam*) published later. By the time Darwin published, and this was important in the *Origin*'s reception, evolution was a much-discussed topic. There was not a huge shock value in the idea as such. Also significant and interesting was the way in which Germanic ideas started to become important in the biological sciences. First there was Richard Owen with his archetypes, and then the work of the younger scholars, including he who was to become Darwin's great defender Thomas Henry Huxley.

By the time I wrote and published my book in 1979, the *Origin* itself was seen as a carefully constructed work, greatly influenced by the day's ideals of proper scientific understanding. It was also seen as a work with an ambiguous and by-no-means-negative relationship to religion. It was clear that the kind of deistic philosophy that underlay Lyell's *Principles* had been very influential on Darwin. So also was the Christian theism of his own education – especially the natural theology that Darwin absorbed from reading Archdeacon William Paley, as well as from his Cambridge mentors like John Henslow, Adam Sedgwick and William Whewell. I saw, following just about every writer of the two decades previously, that natural selection was a mechanism expressly intended to speak to the issue of design. In his *Natural Theology,* Paley had stressed the functional nature of the organic world, the eye is like a telescope, and Darwin had bought into this completely and utterly. That was the starting point of the unique contribution of the *Origin*, to give a natural explanation of apparent organic design – to explain adaptations.

My account of the reception of the *Origin* also followed a well-trodden path. On the one hand, the idea of evolution itself rapidly became the standard view of educated (and not-so-well-educated) Victorians. Darwin made a strong case for evolution, based on a wide-

ranging survey of the problems of the living world – instinct, paleontology, geographic distribution, morphology, embryology, classification, and more – and people agreed that he had made his case. Evolution became the accepted view. This was so even for many Christians. On the other hand, natural selection was a flop. Few bought into it in any great detail or with much enthusiasm. Huxley's indifference was paradigmatic. Part of what was happening here was that people could see the problems. Without the backing of an adequate theory of heredity, no one could really see how selection could really be effective. Also the physicists (themselves ignorant of the warming effects of radio-active decay) were giving the earth a very short life history – far too short for so leisurely a process as natural selection. Part of the problem here was that people were untouched by selection's virtues. With the coming of German biology, things like homologies loomed as more important than things like adaptations. Homology can be explained by evolution without invoking selection. Hence, the significance of selection was downplayed.

Although my account of the Darwinian revolution ended around the time of Darwin's old age (1875), it looked forward to the twentieth century and to the ways in which the revolution could finally be completed and natural selection could come into its own. Especially, it

anticipated the development of genetics, and then the work of the population geneticists like R. A. Fisher and J. B. S. Haldane in Britain and Sewall Wright in America. It anticipated also the empirical work that would be done by E. B. Ford and his associates in Britain and Theodosius Dobzhansky and his associates in America. It looked forward, in fact, to the *Origin* centenary celebrations of 1959. Given the story of *The Darwinian Revolution*, the surprise would have been had there been no celebrations.

The implicit message

Looking back on this book, I now see that there was an overall message that became explicit only in my *Afterword* of 1999. This was that the Darwinian revolution was no revolution of pure, isolated ideas – pure, isolated, *scientific* ideas. For all that the philosophy of science in which I had been trained made science a thing apart from society – for all that the first book I published (in 1973) made evolution a thing apart from society[1] – my history stressed that the Darwinian revolution was a cultural revolution. Darwin's work came out of the culture of his day; it went back into the culture of his day. He drew on politics, he drew on philosophy, he drew on religion, and much more. He gave back into politics, he gave back into philosophy, he gave back into religion, and much more.

I have mentioned religion already, but there is more that could be said in this and related fields. Very significant was the way in which the traditional churches (in Britain) were themselves wrestling with the decline in faith and the forces for modernism, for instance the Higher Criticism coming from Germany. Darwin's work benefitted from this and in turn helped to speed on its way the transformation (some would say decline) of contemporary Christianity. I have not yet mentioned other areas like social theory and practice. Karl Marx in a letter to Friedrich Engels spoke of how Darwin had taken industrial England and read it into biology. This was the position of *The Darwinian Revolution*. The work of Thomas Robert Malthus was taken to be very important in Darwin's coming to natural selection. Conversely, the importance of Darwin's thinking for the development of later Victorian social philosophies (especially so-called Social Darwinism) was seen as crucial.

One question that has haunted me since I wrote my book is the extent to which the account reflects the way that things really were, and the extent to which the account reflects the way that history of science had evolved. Was my story an objective, fact-controlled reflection of a real, independent world, or was it a subjective construction, making up stories about an expected world? The answer

is that it was both of these things. There is no question but that the Darwinian revolution was much more than an event of pure scientific ideas (assuming that these ever do exist). I simply do not see how, for instance, you could ever take the religious issues out of the revolution. Natural selection without natural theology is meaningless – a solution in search of a non-existent problem. And from this follows such things as Darwin's feeling of triumph at what he had done, and Huxley's indifference towards Darwin's mechanism. If it is a legitimate question for a historian of science to ask why Darwin's chief lieutenant was basically unmoved by Darwin's chief mechanism, then bringing in religious and like questions is not just allowed – it is required. And likewise religion both as theory and as a social prop in Victorian society is required to see why Darwin's mentors like Sedgwick and Whewell could not accept Darwin's theory when it was published, and why younger people – including younger religious people like Charles Kingsley (the author of the *Water Babies*) – were not just able to accept evolution but positively welcomed it.

Having said this, there is also no question but that, by the end of the 1970s, the history of science had become very much (what in the old days we used to call) "externalist" explanation-favouring rather than "internalist" explanation-favouring (and my sense is that in the

years following it has become even more so). For a number of reasons, the thirty years previously (during which time history of science had professionalized as a discipline) had seen a dramatic move from pure history of ideas to a history that made crucial a socially and culturally contextual approach, that made central the influence of extra-scientific factors like religion, politics, literature, and just plain human personalities. Although it is not really my job here to dig into them too deeply, there were a number of reasons for this. Clearly, the very training of people as historians was an important factor, especially when the trainees often did not come from a lifetime in hard science but from undergraduate backgrounds in the humanities or social sciences. Historians take context seriously. Scientists tell themselves that context is irrelevant. Clearly, also, going to the archives was important. When you find that a scientist is other than he pretends to be – that he is a crypto-fascist or that he has rather peculiar private sexual habits – then it is overwhelmingly tempting to make these facts relevant to your tale. And clearly the modified, pro-context philosophies then appearing (part cause, part effect) were significant. Thomas Kuhn' s *The Structure of Scientific Revolutions* was the key work here. Actually, this work itself is pretty conservative on social factors, but it opened the door for non-pure-science factors, and

they streamed in. Then came Michel Foucault, and the flood gates were opened.

Actually, in my case, although Kuhn was crucial (I wrote *The Darwinian Revolution* in conscious imitation of his *The Copernican Revolution*, and in the first draft had forty concluding pages on Kuhn – tedious material I am glad I dropped before the book saw the light of day), I could never get on with Foucault, then or now. Flashy, French, philosophical brilliance without the genius of Descartes. But I was (as I remember, to my good friend David Hull's great dismay) greatly influenced by the Marxist historian, American-born but Cambridge-based, Robert Young. I spent my first sabbatical tooling up as a historian in his unit, others associated members of which were Martin Rudwick (simply the best historian of geology, ever) and Roy Porter (then still a grad student, but about to begin his dizzying rise upwards). I have never been a Marxist – like most English socialists I cannot follow him and find him too germanically boring to want to make the effort (and, as if to prove a point, spent the next sabbatical in the lab of Edward O. Wilson at Harvard, the American Marxists' favourite hate object) – but Young was overwhelmingly influential on my approach. (He still is, even though I suspect he would approve of nothing I ever write!) I bought into the social approach – one that also

stressed such things as the significance of culture-based metaphors – and although I did not then intend a constructivist analysis, it did reflect my background and inclinations.[4] (For the record, I do not think that *The Darwinian Revolution* does give a constructivist analysis – making science just an epiphenomenon on society. It is far too respectful of empirical fact for that. However I have spent much of the last twenty-five years trying to show how one can have a social account, taking metaphor seriously, and yet allow that science does achieve some level of objectivity.[5])

The Darwinian revolution seen twenty-five years later

So much then for the unoriginality of my methodological approach to the Darwinian revolution and the unoriginality of the content of my discussion of the Darwinian revolution. Although I might trim and tuck a bit, here and there, as I have said I really do not want to alter significantly what I said back in 1979.[6] But I have been thinking about these issues in the twenty five years since that book, and there are a number of new things that I would now want to say. These are to be claimed as my own. (Which lays me open to the teacher's comment on the student's paper: "Ruse's analysis of the Darwinian revolution is both original and true. Unfortunately, those

parts which are original are not true and those parts which are true are not original.")

Progress

First, we need to take analysis of the Darwinian revolution back before 1800. You must start somewhere, and I do not apologize for starting *The Darwinian Revolution* at 1800. For its *genre*, the book is quite long enough as it is. But we know that there were evolutionists before Lamarck. Charles Darwin's grandfather, Erasmus, for a start. Denis Diderot, if you want to go back more in time – although no one previously produced a full system like Lamarck. More important is the issue of why the idea of evolution arose in the first place. Obviously, in part, this is because people wanted to give an alternative to the Judaeo-Christian account of origins. But why did people want to give an alterative account, and why did this need arise in the eighteenth century, and why an evolutionary account?

The answer lies in the crisis of faith that marks the beginning of the Enlightenment at the beginning of the century (around 1700).[7] The Protestant Reformation was important for religion but not all-important. People went on believing that Jesus Christ was the son of God who died on the cross for our sins. Two centuries later, however,

thanks to such things as the growing acquaintance with sophisticated heathen religions, the rise of science and the critical acid of philosophy, the move to urban living and away from the traditions of the village and the farm, people were starting to wonder if it was all true. There were two responses. One was to reaffirm Christianity, making it an affaire of the heart. Pietism and Methodism fall into this category. The other was to go the direction of reason and evidence, and to jettison traditional beliefs. People who went this way, notoriously the French *philosophes*, had their own ideology, opposing the Providential ideology of Christianity. Instead of a god of grace, they held to the belief that we humans ourselves can improve our lot, through science, through education, through social reform and more. They subscribed to the ideology of *progress*.

The significance of this ideology cannot be overestimated, especially for our story. Evolution was progress read into the living world. People believed in social and cultural progress, they claimed to find it among animals and plants in the rise up from blobs to Britons, and then generally they read it right back into culture as evidence for their social beliefs!

Imperious man, who rules the bestial crowd,
Of language, reason, and reflection proud,

With brow erect who scorns this earthy sod,

And styles himself the image of his God;

Arose from rudiments of form and sense,

An embryon point, or microscopic ens![4]

In *The Darwinian Revolution*, I certainly was aware of the issue of biological progress, and recognized that Darwin himself wrestled with the issue and in respects was a progressionist. I did not then see how important the issue of progress was right through the Darwinian revolution, and beyond (I would say) to this day.[5] I believe now that this is a crucial insight and that it is something that throws much light on such issues as the opposition to evolution by religious people – often Genesis was irrelevant, but the Providence/progress dispute was crucial – as well as much of the appeal of evolution both to pre-*Origin* writers like Robert Chambers as well as to post-*Origin* writers, above all to the evolutionist who had even more public appeal than Darwin, Herbert Spencer. The latter was open in his enthusiasm for progress – or what he would call the rise upwards from the homogeneous to the heterogeneous – and many followed him in this. One should not think of evolution as something always challenging people's (especially Victorian people's) beliefs. Often, thanks to progress, it supported them. My own favourite example – if that is the right predicate – is how, once people became evolutionists, they could justify all of their

racial prejudices. Here at last was solid proof of the inferiority of the Irish, whom cartoonists inevitably portrayed as being first cousins to the Neanderthals. Paddy and Biddy from the Stone Age.

Professionalism

The second point picks up on the issue of professionalism. Although, as noted above, I was aware that the early Victorians took the matter of scientific professionalism increasingly seriously – and that this was something that influenced Darwin's work – I did not see that progress and professionalism are entwined, almost like Siamese twins. Or, perhaps, like a man and woman caught in a mutually rewarding but very difficult marriage. Early evolutionism was truly an epiphenomenon of culture – a construction built on the back of the ideology of social and other kinds of progress. The move to professionalism in science entailed, in major part, the elimination of cultural values from one's work. Since progress is cultural through and through (and a value that the early evolutionists cherished), inasmuch as the Darwinian revolution meant the potential professionalization of a significant part of biology, there was bound to be tension if not a clash. Progress and professionalism had to come into conflict.

And herein lies a story. As noted, we knew back in 1979 that although evolution succeeded after the *Origin*, natural selection did not. And, as noted, we had lots of good reasons to explain this. But back then we were missing one vital piece of the puzzle. As I was then aware (and I do still take pride in having spotted), not only was Darwin keen on the professionalization of his science, he gathered around him a group of men of science – Huxley, the botanist Joseph Hooker, and others – who were also keen on professionalization. But what I did not then grasp was that these men (unlike Darwin) really could not see that evolution as such was a science that could be properly professionalized. Unlike physiology that could be sold to doctors and morphology sold to the teaching profession (as a substitute for classics), evolution does not put bread on the table and in any case has a whiff of unorthodoxy. Added to this was the fact that, with the indifference to selection, there was no great urge to professionalize.[10]

But riding on the back of progress, evolution could continue to play the role of a Christianity alternative. And in the hands of Thomas Henry Huxley, this is what it became. Something with which to bash bishops, something to be preached from the podia of working men's clubs, something to fill the new secular cathedrals (a.k.a. natural

history museums), something suitable as a kind of secular religion for the new age into which the Victorian scientists were directing their society. Peter Bowler has labeled the rejection of natural selection as the "non-Darwinian revolution."[11] I agree that there was a non-Darwinian revolution, in the sense that there was something that occurred that Darwin did not want and that it did involve the rejection of natural selection. But the really important fact was that discussion of evolution was kept out of the halls of quality science – or as today's evolutionary biologists might say, kept from the high table of science – and that evolution took off as a kind of secular religion, to substitute for what many scientists judged the moribund religion of Christianity.

Things changed only in the 1930s when the population geneticists got their hands on evolution. Then, they and the empiricists after them made a conscious effort to upgrade their subject from quasi-religion to professional science, a major part of which effort was eliminating thoughts of progress from the discussions. But this – an effort that succeeded only in part – takes the story out of our time frame here, and so can be ignored. The important point is that the Darwinian revolution judged as science was only partly successful. This was not simply a negative matter of failure as science. It was only partly successful because Darwin's followers – notably Huxley – had

ends in view other than simply moving science forward. They wanted to reform society, and so from their perspective the Darwinian revolution judged as a tool of reform was brilliantly successful.

Form versus function

Third and finally, I turn to a somewhat different matter, although still connected. As I hinted above, a major reason for my getting so interested in the Darwinian revolution was because of Thomas Kuhn's exciting book. Indeed, the first paper I ever had accepted for publication – a paper so bad that I will decline to reference it – was a refutation of Kuhn's theory using the Darwinian revolution as a counter example. I still think that Kuhn's analysis taken head on fails on the Darwinian example. His key notion is of a paradigm, and a crucial feature of paradigms is incommesurability – if you change paradigms, the facts change. It always seems to me that Darwin's genius is that he was not the Christian God, making things from nothing. Rather he was like a kaleidoscope, taking so much from his past and his training, shaking it up and making an entirely new picture. The facts do not change. The interpretation and meaning does. But this said, I now think that matters are rather more complex and interesting than simple refutation.

I have remarked above on the tension between Darwin's emphasis on adaptation and Huxley's emphasis on homology – isomorphisms. It is an emphasis rather than a complete and exclusive commitment. Darwin recognized homology, he called it "Unity of Type" and thought it important proof of evolution as such. Huxley recognized some adaptation, even though he thought it a pain for one such as he working out relationships (because it concealed underlying more fundamental similarities). But these are important emphases, and in respects the homology/adaptation dichotomy (often known as the form/function dichotomy) does remind me of a paradigm divide. You have the same not-entirely-rational commitment to a viewpoint and a feeling of real discomfort with the viewpoint of the opposition.

What is fascinating about the Darwinian case, showing that we do not have a straight paradigm shift or replacement, is that the form/function dichotomy holds right across the Darwinian revolution.[12] Before Darwin, there were non-evolutionists who were formalists, emphasizing homology. Many, early-nineteenth-century Germans, *Naturphilosophen*, fall into this category. Goethe probably (although he may have become an evolutionist before his long life ended). Then Richard Owen (who may also have become an evolutionist before the end). And, most obviously, the Swiss-American Louis Agassiz (who

always rejected evolution, even after the *Origin*). Before Darwin there were functionalists, emphasizing adaptation. Paley has already been mentioned. And Cuvier very much falls into this tradition. After the *Origin* there is Huxley who is a formalist, and Darwin himself as a functionalist. This division persists to this day. The late Stephen Jay Gould was an ardent formalist, forever criticizing natural selection. His counterpart in England, the popular-science writer Richard Dawkins is no less sincerely a Darwinian functionalist.

As it happens, I am myself a pretty keen Darwinian functionalist.[11] But that is not quite the point here. What I am saying – what I recognized in *The Darwinian Revolution* but did not really stress enough – is that we have this divide in biology between formalists and functionalists, and the way this played out is an important part of understanding the Darwinian revolution. Aside from anything else, it adds to our understanding of why Darwin's followers did not do exactly what he wanted and made something of his work other than he intended. Paradoxically, understood in the rather modified sense mooted above, I would now say that Huxley was always in a different paradigm.

Concluding thoughts

In a way, I find this all a little troublesome. I came to the Darwinian revolution nearly forty years ago, thinking it one of the great events in the intellectual history of humankind. I still think this – except I would now say as well that it was one of the great events in the social history of humankind. Yet, I have now admitted that scientifically Darwin did not do what he wanted. Others may have done so later, but Darwin did not – either convincing people of his mechanism or making a professional science out of evolutionary studies. I have also admitted that at a metaphysical level, if we might so call it, Darwin did not run the opposition out of town. He left the same squabbles as before for biologists to fret about. All of this seems to belittle Darwin's contributions, especially when you add that (rather like me!) Darwin got just about all of his good ideas – deism, design, and so forth – from others.

I console myself, cherishing and praising Darwin's contributions, because in the end his aims were realized – a professional, natural-selection-based discipline of evolutionary biology and (what is for me) an entirely convincing natural explanation of the most important aspect of the organic world, its design-like nature. As is the case with paradigm-difference, I belittle the opposition and sneer at its wrong-headedness. The pertinent point of conclusion here is that the more

you learn about something, the more you learn that things are not quite as simple and straightforward as when you first set out on your inquiry. That is the joy of scholarship and that is the reason why – whatever my doubts and hesitations – I will never regret having spent so much of my life trying to understand and write about the Darwinian revolution.

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1 Much criticized at the time, because of its hostility to Darwin and his achievements, was Gertrude Himmelfarb's *Darwin and the Darwinian Revolution* (1959). She was in a Marxist phase at the time, so was putting the boot into one who was seen as the epitome of running-dog capitalism. Nevertheless, historiographically speaking, the book was a quantum leap beyond all that had gone before.

2 De Beer 1960a, b, c, d, 1961, 1967; Barrett, et. al. 1987.

3 Ruse 1973

4 His essays were finally collected and published as Young 1985.

5 My most sustained analysis comes towards the end of Ruse 1999.

6 I do not mean that no important books have appeared since. I would single out three for especial praise: Ospovat 1981, that makes major contributions to the understanding of Darwin between conception and publication; Richards 1987, that digs into the evolution-and-humans issue deeper than anyone before or since; and Desmond 1989, whose brilliant discoveries more than balance his provocative constructivism. I survey the more recent Darwin literature in Ruse 1996a.

7 Ruse 2005

8 Darwin 1803, 1, 295-314

9 Ruse 1996b

10 I discuss this all in great detail in Ruse 1996b, returning to the problems in Ruse 1999 and 2005, giving a more popular discussion in Ruse 2000

11 Bowler 1988

12 The classical and still extremely valuable discussion of the form/function dichotomy is Russell 1916. I give a full analysis from a contemporary perspective in Ruse 2003

13 Ruse 1982, 2001, 2006