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Balfour v. Huxley on Evolutionary Naturalism: A 21st century Perspective

This essay begins by setting forth the conflicting prophecies, in 1895, of Arthur James Balfour and Thomas Henry Huxley concerning the probable course of Western culture in the twentieth century if Huxley's 'scientific naturalism' were to prevail over Balfour's theistic conception of the relations between science and religion. The essay then examines some leading developments in the physical, biological, and social sciences and in philosophy and theology since 1900 to determine which of these prophecies, if either, proved to be truly prophetic. The author concludes that Balfour was the better prophet.

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In 1895, Arthur James Balfour, a philosophically trained Scottish politician-statesman then serving as Chancellor of the Exchequer, published a book entitled *Foundations of Belief, Being Notes Introductory to the Study of Theology* containing a searching criticism of the evolutionary naturalism which Thomas Henry Huxley had labeled 'scientific naturalism'. The naturalism underlying positivism, agnosticism, and empiricism, Balfour argued, rested on two grounds: (1) it reduced human experience to sense perception with the result that the only knowledge available to human beings was knowledge of phenomena, the things that appear to our senses, and the laws connecting them; and (2) it viewed human nature in all its aspects as a product of natural processes – that and nothing more. (Balfour clearly had in mind not evolutionary theories in general but Darwin's attempt in *The Descent of Man* to view the whole of human nature as a product of natural and sexual selection.) The first of these assertions Balfour had dealt with in an earlier book, *A Defence of Philosophic Doubt* (1879), purporting to show that the picture of nature depicted by the physical science of his day – a world of colourless, tasteless, soundless vibrating atoms acted on by forces – could no more be perceived or correctly imagined than the deity represented to humankind by theologians. In both cases, said Balfour, we must content ourselves with symbolic images. 'There is not a single particle of matter that we can perceive or picture to ourselves as it really exists.' The reconciliation of science and religion, therefore, was to be achieved, not by setting up the logic, method and findings of science as the test of religious truth but by recognizing that both science and theology were systems of belief resting ultimately on faith and that both were forced to represent to the human imagination in anthropomorphic language an ultimate

reality transcending the power of human reason to grasp fully.¹

As to naturalism's second assertion – that human nature in all its aspects is a product of natural laws and processes – Balfour argued that this view deprived the basic values of Western civilization, values shared by Darwin, Huxley, and Balfour himself, of any rational justification. Reason became a mere instrument for survival, the passion for truth an emotion with no foundation in the nature of things, art and aesthetics mere by-products of the machinery of nature, morality a matter of natural appetites, self-condemnation, repentance, and remorse emotions without any reasonable foundation.² Huxley might rhapsodise about the liberally educated man as 'one who is full of life and fire, whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to respect others as himself,' but where was there a place for these moral and aesthetic intuitions in Huxley's 'web and woof of matter and force interweaving by slow degrees, without a broken thread, that veil [of sense impressions] which lies between us and the Infinite, that universe which alone we know or can know'?³ The exalted values of the champions of naturalism, Balfour perceived, were derived from conceptions of reality and the place of humans in it which were totally incompatible with the picture of the universe they professed to draw from science.

This 'inner discord' between the values and intuitions associated with traditional conceptions of nature, man, and God and the implications of an evolutionary naturalism claiming the sanction of science, Balfour predicted, would be resolved in one of two ways. Either evolutionary naturalism would be abandoned in favour of a philosophical and religious view of reality that recognised the essential similarity of the scientific and the theological ways of picturing reality and the need to postulate a rational Author of nature as the source of the order, beauty and goodness in the world, or Western culture would descend to a level consistent with Huxley's depiction of nature as 'a realm of matter and law... co-extensive with knowledge, with feeling, and with action'.⁴

Huxley, combating an illness that would end his life in that very year, mustered strength to reply to Balfour's prophecy with his own vision of the future course of Western civilization. In the future as in the past, wrote Huxley, it would involve a 'struggle for mastery' between the scientific spirit originating in Greek philosophy and the opposing spirits of post-prophetic Judaism and the prophetic Judaism transformed by Hellenic speculation into the elaborate

1 Balfour, A.J. *A Defence of Philosophic Doubt, Being an Essay on the Foundations of Belief*, London: Hodder and Stoughton Ltd. (1926), p. 245. Original edition 1879.

2 Balfour, A.J. *Foundations of Belief, Being Notes Introductory to the Study of Theology*, 8th ed. London, New York, Toronto: Longmans, Green and Co. (1933), p. 27. Original edition 1895.

3 Huxley, T.H. 'A Liberal Education' (1878), in Castell, A. (ed.) *Selections from the Essays of Thomas Henry Huxley*, New York: Appleton-Century-Crofts (1948), p. 18; Huxley, 'The Origin of Species' (1860), in Castell, A. *op. cit.*, p. 58.

4 Huxley, T.H. 'The Physical Basis of Life' (1868) in Castell, A. *op. cit.*, p. 21.

complex of dogmatic Christianity. At long last, said Huxley, 'the scientific spirit, freed from its early wrappings, stands in independence of, and, for the most part, in antagonism to, its ancient rivals. Its cosmology, its anthropology, are incompatible with theirs; its ethics are independent of theirs'.⁵ This was a strange utterance coming from the Huxley who, two years earlier in his Romanes lecture, had declared war on the idea that ethical progress depended on imitating the cosmic process and had championed instead the Hebrew prophet Micah's injunction to love mercy, do justly, and walk humbly. Where or how Micah had obtained this knowledge of human duty Huxley did not say. Some men, he observed in a letter to a friend, have 'an innate sense of moral beauty and ugliness', from whence acquired, who could say. Huxley was a humanist at heart, but his head and his heart were at war with each other.⁶

Having introduced the protagonists in the story we are about to tell, let us now review in broad outline some major twentieth-century developments with the idea of determining to what extent the conflicting prophecies of Balfour and Huxley have been fulfilled. In physics and cosmology the scientific spirit achieved notable successes in formulating increasingly abstract mathematical models capable of predicting striking results. The history of these speculative and technological triumphs and reverses, leading from Planck's discovery of the quantum effect to Einstein's special and general theories of relativity, Schroedinger's development of quantum mechanics, Niels Bohr's interpretation of the wave-particle duality, Heisenberg's uncertainty principle, E.O. Lawrence's cyclotron, Hubble's expanding universe and the consequent Big Bang theory of the origin of the universe, and the successive theories of supergravity, supersymmetry, cosmic inflation, and superstring theory – this history has been told with admirable lucidity by physicist David Lindley in his book *The End of Physics: The Myth of a Unified Theory*, published in 1993. What Einstein and Stephen Hawking were seeking, Lindley says, was a theory of everything, a theoretical physics so complete that God would have had no choice in determining the character of the universe. Reason, logic and physics would constitute the unmoved mover, the uncaused effect.

Not surprisingly, Lindley was sceptical of this ambitious scientific dream. The clues these scientists needed to guide them on their search were scarce, Lindley noted. The microworld of particle physics had been exposed by particle accelerators, but further progress was inhibited by the size and cost of the machinery required to test theoretical predictions. The macroworld of cosmology would be explored further as bigger and better telescopes were built, but no amount of technical ingenuity would permit the astronomers to see other

5 Huxley, T.H. 'Mr. Balfour's Attack on Agnosticism', *The Nineteenth Century* (1895) 37, 539. The second half of Huxley's reply to Balfour was published in Houston Peterson's *Huxley, Prophet of Science*, Toronto, New York, London: Longmans Green (1937).

6 Huxley, T.H. *Evolution and Ethics and Other Essays*, New York: Macmillan (1895), p. 109. See also Huxley, L. *Life and Letters of Thomas Henry Huxley*, London: Macmillan (1900), pp. 223–4 and Huxley, T.H. *Science and Hebrew Tradition: Essays*, New York: D. Appleton (1898), pp. 160–1.

universes, or our own universe at any other time than the present. What the searchers for a final theory were trying to find, Lindley concluded, was something that could be grasped by reason alone, urged on by a passionate faith in a universal order of nature discoverable by human reason.⁷

In the same year in which Lindley published his book, 1993, Sylvan Schweber, a physicist and historian of physics and of evolutionary biology as well, published in the journal *Physics Today* an article announcing that: 'The reductionist approach that has been the hallmark of theoretical physics in the twentieth century is being superseded by the study of emergent phenomena.' Einstein's dream of arriving at a unified theory of universal elementary laws from which the cosmos can be built up by pure deduction has given way, says Schweber, to a realization that the sciences of nature are arranged hierarchically, each level – particle physics, solid state physics, chemistry, biology, and the like – having its own emergent laws which cannot be reduced to the laws governing lower levels. This realization, says Schweber, has produced a sense of crisis in the physics community and a fear that this challenge to the privileged status of high energy physics may diminish Congressional support for the high-cost equipment needed in pursuing the dream of a unified theory still further.⁸

Turning now to the life sciences, and especially to evolutionary biology, we see Darwin's theory of evolution by natural selection, long neglected by the founders of experimental Mendelian genetics and by paleontologists with evolutionary theories of their own, emerging triumphant in the 1930s and 1940s as three mathematical population geneticists, R.A. Fisher, J.B.S. Haldane, and Sewall Wright, joined hands with geneticist-naturalist Theodosius Dobzhansky, field naturalists and systematists E.B. Ford, Ernst Mayr and Ledyard Stebbins, paleontologist George Gaylord Simpson, and T.H. Huxley's grandson Julian to produce a neo-Darwinian evolutionary synthesis based on changes in population gene frequencies brought about by natural selection operating on the organisms produced by those genes. No common world-view united these men. Fisher was an Anglican, Haldane a Communist sympathizer, Wright and Julian Huxley panpsychists; Simpson was an agnostic, Dobzhansky a Christian of Russian Orthodox background, Mayr and Huxley atheists. But all subscribed to traditional Western values, and all looked to Darwin's theory of natural selection to unify biology and cast light on human duty and destiny. Their efforts reached a grand climax when the devotees of the neo-Darwinian synthesis assembled at the American Philosophical Society in Philadelphia, the University of Chicago, and elsewhere to celebrate the one hundredth anniversary of the publication of Charles Darwin's *On the Origin of Species*.

7 Lindley, D. *The End of Physics. The Myth of a Unified Theory*, New York: Basic Books (1993), p. 209. See also Horgan, J. *The End of Science: Facing the Limits of Science in the Twilight of the Scientific Age*, Reading, Mass.: Addison-Wesley Publishing Co., Inc.(1996) for a collection of interviews with leading scientists on the future of science.

8 Schweber, S. 'Physics, Community and the Crisis in Physical Theory', *Physics Today* (November, 1993), 36–9.

At this point my narrative of events becomes more personal, for it was in 1959 that I attended the Darwin centennial celebrations in Philadelphia and Chicago, where I began a friendship with Theodosius Dobzhansky and saw Julian Huxley, Sir Charles Galton Darwin, and other notables in action. In that same year the Iowa State University Press published my first book, melodramatically titled *The Death of Adam: Evolution and Its Impact on Western Thought*, in which I took issue with Theodosius Dobzhansky's suggestion that man, as the most progressive animal on earth, was now in a position, if he so chose, to take conscious control of his own evolution and thus become, as Julian Huxley predicted, 'business manager for the cosmic process of evolution'. As a free, intelligent agent, I observed, man could plan all sorts of things, himself included. But who was to plan the planners? Who was to prevent them from establishing a tyranny of mind and body over their fellow human beings? Was man, in truth, a Prometheus unbound, ready to assume control of his own and cosmic destiny? Or was he, as the Bible represented him, a God-like creature who, having denied his creatureliness and arrogated to himself the role of Creator, now contemplated his handiwork with fear and trembling lest he reap the wages of sin, namely death? The planned society, I noted, looked less inviting in its grim reality than it did when still a dream. The conflict of nations and races, far from raising mankind to ever higher levels of freedom, virtue, and culture, threatened to accomplish the destruction of the human species. Science and technology, which were to have led the way to a bright new future, were now increasingly preoccupied with devising new and more dreadful weapons of obliteration. The historical Adam was dead, a casualty of scientific progress, but the Adam in whom all men die was alive and well, a moral being whose every intellectual triumph was at once a temptation to evil and a power for good.⁹ When Dobzhansky saw me in Chicago after having read this closing passage in my book he exclaimed, 'Professor Greene, why are you so pessimistic'?

My dialogue with Dobzhansky, which continued through the sixties, turned mostly on the question of whether the creativity of the evolutionary process, conceived as a continuum linking cosmic, biological and human evolution, and conveyed to the public in value-laden figures of speech such as progress, trial and error, blind alleys, opportunism, success and failure, and the like, could be reconciled with the mechanistic view of nature inherited from the seventeenth century. I argued that it could not, that biologists must *either* discard these teleological, value-laden figures of speech and the notion of progress associated with them, *or* they must revise their conceptions of science and nature to make sense of a natural, creative process, perhaps along the lines suggested by Alfred North Whitehead. Dobzhansky disagreed. 'I refuse,' he said, 'to believe in "direction" in any other sense than that the Alpha and Omega of evolution are simultaneously present in God's eyes (like Laplace's universal intelli-

⁹ Greene, J. C. *The Death of Adam: Evolution and Its Impact on Western Thought*, Ames: Iowa State University Press (1959), pp. 338–9.

gence)... I cannot believe that God from time to time becomes a particularly powerful enzyme'.¹⁰

In many ways the Darwin centennial celebrations marked the apogee of the neo-Darwinian synthesis launched in the 1930s. Among biologists the synthesis had no significant challenger, although there were internal disputes among its advocates. Among the anthropologists, represented at Chicago by Alfred Kroeber, Clyde Kluckhohn, and Sol Tax among others, human nature was still conceived as shaped by nurture and culture, not by nature, and grand theories of cosmic-biological-social evolution in the manner of Herbert Spencer were out of fashion. On the religious front the Catholic Church, under Pius XII, had given Catholic scholars permission to discuss evolution as an hypothesis and to take account of ancient Near Eastern literary forms in interpreting the Bible, and the long-suppressed writings of Pierre Teilhard de Chardin appeared in print, notably his book *The Phenomenon of Man* which so enchanted both Julian Huxley and Dobzhansky. In the Protestant world new interpretations of the doctrines of revelation and inspiration issued from Anglican and neo-orthodox spokesmen and even from some self-styled 'conservative Christian' members of the American Scientific Affiliation in a volume edited by Russell Mixter of Wheaton College.¹¹

But this relatively calm situation could not long withstand the powerful forces, military, social and intellectual, that were transforming the character of science in the Western world. The rise of Hitler to power in the world's leading scientific nation, the outbreak of World War II, the Japanese attack on Pearl Harbour and the ensuing Korean war and cold war had changed the scientific scene dramatically, giving rise to Big Science, the Manhattan Project, and the military-industrial-academic complex and bringing scores of refugee scientists to English and American laboratories. Physicists and biochemists, spurred on by Erwin Schroedinger's book *What Is Life?*, entered the biological sciences, pushing aside the founders of the evolutionary synthesis in the competition for government funding and bringing with them the experimental, reductionist point of view that produced the Watson-Crick discovery of the structure of DNA, soon to be conceived as nature's secret code containing information and instructions for building organisms.¹²

As Howard L. Kaye, Professor of Sociology and the History of Social Thought at Franklin and Marshall College, has shown in his searching criticism enti-

10 Greene, J. C. *Debating Darwin: Adventures of a Scholar*, Claremont, California: Regina Books (1999), p.98.

11 See *Proceedings of the American Philosophical Society* (April, 1959), 103 and Tax, S. (ed.) *Evolution After Darwin: The Evolution of Man*, Chicago: University of Chicago Press (1960); also Greene, J. C. *Darwin and the Modern World View*, Baton Rouge, Louisiana: Louisiana State University Press (1961), lectures given at Rice University in the wake of the Darwin centennial celebrations.

12 See Kay, L. E. *Who Wrote the Book of Life? A History of the Genetic Code*, Stanford, California: Stanford University Press (2000) for a full account of the rise of molecular biology.

tled *The Social Meaning of Modern Biology*, the molecular biologists were much less respectful of the traditional values of Western civilization than the founders of the evolutionary synthesis had been. The soul, said Francis Crick, was a figment of the human imagination, the mind simply a way of talking about the functions of the brain. Morality was a biological phenomenon. It was time, said Robert Sinsheimer, Chancellor of the University of California at Santa Cruz, for man to take charge of his own evolution and move toward a 'higher state' through the systematic practice of eugenics. To this end he suggested in 1985 the idea of sequencing the human genome to discover the entire set of instructions for producing a human being. Professor Walter Gilbert of Harvard University was sceptical of the project at first but eventually declared it to be the 'Holy Grail' of biology. James Watson of double helix fame agreed. 'We used to think our fate was in our stars,' he said. 'Now we know in large measure our fate is in our genes.' Since human genetic instructions were designed by natural selection to adapt human beings to conditions in the Stone Age, conditions which no longer prevail, why should we not make ourselves a little better suited for survival? 'That's what I think we'll do. We'll make ourselves a little better.' Here at last was Julian Huxley's dream of 'a rational applied biology' teetering on the brink of realization.¹³

The successes of the molecular biologists, the renewed interest in Darwin's long neglected *Descent of Man*, and William Hamilton's mathematical demonstration of the validity of the concept of kin selection inspired evolutionary theorists to stake a biological claim to the social sciences under such titles as sociobiology, ethology, bioanthropology, evolutionary psychology, cognitive psychology, and the like. Human nature and behaviour, it was claimed, were shaped, not by culture, imitation, and learning, but by random genetic variation and natural selection of those types of brain structure best suited to promote survival of the hominids inhabiting the savannas of Africa in the Stone Age – the so-called 'ancestral environment' of the species *Homo sapiens*. Since that time, it was said, the human species had spread over the whole earth and then, about 10,000 years ago, had invented entirely new social and cultural environments involving farming, city life, and empire. But the human brain and the genetic predispositions to behave in certain ways remained the same, driving this now badly adapted species to uncontrolled population growth and genocidal warfare endangering not only the survival of the human species but that of millions of other species as well. This grim saga was conveyed to the public in anthropomorphic figures of speech portraying hordes of selfish genes selfishly manipulating the behaviour of the robot humans they had created for one purpose only, namely, to ensure the passage of the genes themselves into succeeding generations by hook or by crook.

Commenting on these grim portrayals of the human situation, Howard Kaye

13 Kaye, H. L. *The Social Meaning of Modern Biology: From Social Darwinism to Sociobiology*, 2nd edn., New Brunswick and London: Transaction Publishers (1997), p. 184.

writes:

From Spencer's inflation of evolution into a 'total theory of existence'... and a 'scientific morality', to Julian Huxley's 'Religion Without Revelation' and 'Evolutionary Ethics', to E. O. Wilson's sociobiological quest for life's 'ultimate meaning' and a 'biology of ethics', the search for moral certainty, individual meaning, and communal purpose within a scientifically comprehensible universe has been central. Burdened with such metaphysical baggage, the science of evolutionary biology passes over into myth despite the avowed materialism or even reductionism of its leading theorists.¹⁴

Howard Kaye's critique made sense to me, for I had expressed similar views a few years earlier in the final essay of my book of essays entitled *Science, Ideology and World View*. There I described the books by Julian Huxley, George Gaylord Simpson, and Edward O. Wilson on the meaning of evolution as the Bridgewater treatises of the twentieth century in that they sought to find in science answers to questions of ultimate meaning and value, answers which would take the place of what Simpson called 'the lower and higher superstitions' which had hitherto served as answers to these questions. These writers, I suggested, were caught on the scientific horn of the positivist dilemma.

Whoever regards science as man's sole means of acquiring reliable knowledge must eventually confront that dilemma. If science and the scientific method are defined narrowly so as to exclude value judgments and all non-logico-experimental statements... it then becomes impossible to say why anything, science included, is important or valuable, why the passion for truth is to be inculcated and respected, or why human beings have any more inherent dignity than starfish or stones. But if, on the contrary, science is declared competent to discover human duty and destiny, as those who choose the other horn of the dilemma assert, one is soon confronted with the conflicting claims of Huxleian science, Freudian science, Marxian science, Comtean science, and a host of other scientisms. In the ensuing struggle the central idea of science as an enterprise in which all qualified observers can agree as to what the evidence proves vanishes from sight. Thus, whichever horn of the positivist dilemma one takes, science is the loser.¹⁵

These opinions, and others like them, had already brought me into correspondence with Ernst Mayr, a founding father of the evolutionary synthesis. Mayr had responded to the invasion of biology by reductionist physicists and biochemists by turning his attention to the history and philosophy of science in order to refute the reigning philosophers of physics, to develop an autonomous philosophy of biology, and to vindicate the concepts and methods of the sys-

¹⁴ *ibid.*, p. 157.

¹⁵ Greene, J. C. *Science, Ideology and World View: Essays in the History of Evolutionary Ideas*, Berkeley, Los Angeles, London: University of California Press (1981), pp. 162–3, 188.

tematist-naturalist against those of the supposedly more scientific mathematical and experimental biologists. Our correspondence ranged over topics in the history and philosophy of science as well as the bearing of science on questions of meaning and value, of human duty and destiny. As a historian I found Mayr's idea that the development of evolutionary ideas in the Western world had been impeded by the successive 'false ideologies' of Platonic essentialism, Christian dogmatism, and Cartesian-Newtonian 'physicalism' not only ahistorical but anti-evolutionary. It ignored the interweaving of all three of these world-views, and of ancient Greek atomism as well, in the transition from Aristotle to Darwin and the influence on Darwin himself of the Christian doctrine of creation and the mechanical view of nature inherited from the seventeenth century.¹⁶

In the philosophy of science Mayr tries to define a middle ground between the reductionism of the physicists and biochemists and the holistic perspective of the vitalists and the believers in Aristotle's final causes. He does this by conceding the biology of proximate causes (physiology and embryology) to the reductionists while reserving the realm of ultimate causes for the evolutionary biologists with their 'organic-historical' conception of nature's progress from monad to man. To me, however, Mayr's version of evolution as a natural creative process (which Mayr describes in the usual anthropomorphic, teleological figures of speech) seemed subject to the same difficulties encountered by Dobzhansky and Julian Huxley but without the benefit of either Dobzhansky's Alpha and Omega or Huxley's panpsychism. For Mayr the key to evolutionary progress is the concept of emergence: 'the emergence of unanticipated properties at higher hierarchical levels'. What the underlying nature of reality must be to give rise to emergences like these Mayr does not say. Somehow or other all these properties and capacities of what Mayr calls the 'substrate' of the world are perpetually there in potency, waiting for the law-bound transformations of mindless, valueless, purposeless matter-energy to actualize them in its random combinations. The vast, unthinking, value-blind complex of matter-energy euphemistically called a 'universe' by the only beings capable of conceiving it as such has become aware of itself, so to speak, in that peculiar form of human consciousness known as 'science,' and it has done so by what Mayr calls 'a sequence of improbabilities'. 'It is,' he declares, 'a miracle that man ever happened.'¹⁷

But what could be more implausible than this emergentist scenario? In one breath Mayr dismisses the biblical miracles and tells his readers that Darwin, Ernst Haeckel, and T.H. Huxley exploded 'the traditional anthropocentrism of the Bible and the philosophers'. In the next, he pictures the evolution of mankind as unique, unrepeatable, and unpredictable and warns that the future of mankind is not something dictated by the laws of nature; rather 'it is

16 Greene, J. C. 'Reflections on Ernst Mayr's *This Is Biology*', *Biology and Philosophy* (1999) 14, 113–16.

17 Mayr, E. *Toward a New Philosophy of Biology*, Cambridge, Mass. and London: Harvard University Press (1988), pp. 12, 5, 21.

we ourselves who hold the fate of our species in our hands'.¹⁸ What a paradoxical situation for the chance product of a sequence of improbabilities!

As the twentieth century drew to a close and the twenty-first dawned, both gene-based reductionism and the evolutionary synthesis defended by Mayr were subjected to trenchant criticism by biologists and others. In a little book entitled *The Triple Helix: Gene, Organism and Environment* Richard Lewontin mounted an all-out attack on the machine metaphor that had dominated biology ever since Descartes first introduced it and on the development metaphor, of equally ancient origin, which pictured embryological development as preformed in the egg or, in modern terms, in the genes. In an opening passage reminiscent of Arthur James Balfour's ideas Lewontin wrote:

It is not possible to do the work of science without using a language that is filled with metaphors. Virtually the entire body of modern science is an attempt to explain phenomena that cannot be experienced directly by human beings, by reference to forces and processes that cannot be perceived directly because they are too small, like molecules, or too vast, like the entire known universe, or the result of forces that our senses cannot detect, like electromagnetism, or the outcome of extremely complex interactions, like the coming into being of an individual organism from its conception as a fertilized egg.

In biology, Lewontin argued, it was time to stop conceiving the organism as the passive nexus of independent environmental and genetic forces, the changing environment generating problems for the organism in its struggle to survive and random genetic mutation providing solutions to those problems. Instead of conceiving the organism as adapting to a randomly changing environment in this random fashion biologists should recognize that the organism *constructs* its environment by its activities, and that the effective environment consists of those aspects of the external world that are relevant to those constructive activities. As for embryological development, it was best conceived, not as preformed in a genetic blueprint, but as the outcome of a unique interaction between the organism's genes, the temporal sequence of external environments through which the organism passes in its life cycle, and random events of molecular interaction in individual cells. Evolution, Lewontin concludes, is 'an historically contingent wandering pathway through the space of possibilities'.¹⁹ As a convinced Marxist, however, Lewontin might be hard pressed to explain how such a 'wandering pathway' could produce a being capable of writing *The Triple Helix*.

In a more recent book entitled *Acquiring Genomes. A Theory of the Origins of Species*, Lynn Margulis and Dorion Sagan agree with Lewontin's view that

¹⁸ *ibid.*, pp. 176, 293–4.

¹⁹ Lewontin, R. *The Triple Helix: Gene, Organism, and Environment*, Cambridge, Mass. and London: Harvard University Press (2000), pp. 3–4, 47–8, 88.

evolution is an historically contingent wandering pathway, but they reject the neo-Darwinian thesis, essential to Lewontin's work in population genetics, that the evolution of new species results from the gradual accumulation of mutations favourable to survival and reproduction in particular circumstances. Genuine novelty, they argue, arises spasmodically from stress-induced occasional symbiotic mergers of unlike organisms, especially (but not only) microbes.

The hegemony of R. A. Fisher, J.B.S. Haldane, and Sewall Wright [they assert] is gone forever.... The language of evolutionary change is neither mathematics nor computer-generated morphology [nor] statistics. Natural history, ecology, genetics, and metabolism must be supplemented with accurate knowledge of microbes.²⁰

Like Lewontin, Margulis and Sagan 'feel no need for the supernatural'. Their God, or rather goddess, is Gaia, 'the interactive system on the surface of the Earth, supplied with solar and geothermal energy gradients, that maintains the temperature close to 18 degrees Centigrade'. Professing complete agnosticism as to the origin of the Big Bang, the resultant cosmic expansion, and the laws of thermodynamics, they find in Nietzsche's 'will to power' and the operation of thermodynamic laws ('nature abhors a gradient') a full explanation of the apparent purposefulness and emergent novelty in nature. 'The key point,' they write, 'is that living and non-living "selves" come into being to reduce gradients naturally.' As for such novelties as human beings, with their inflated self-esteem, they are Johnny-come-latelys whom Gaia can dispose of with a shrug of her shoulders, leaving Earth to the creative microbes that gave them birth.

Another trenchant critique of the evolutionary synthesis owes its origins to developmental geneticist Stuart Kauffman, creator of computer models of the dynamics of complex systems. 'Living systems,' Kauffman writes, 'are not deeply entrenched in an ordered regime.... They are actually very close to the edge of chaos transition, where things are much looser and more fluid. And natural selection is not the antagonist of self-organization. It is more like a law of motion, a force that is constantly pushing emergent, self-organizing systems toward the edge of chaos.' This approach to emergent phenomena in evolution has been warmly endorsed by David Depew and Bruce Weber in their masterful survey of the history of Darwinian theories entitled *Darwinism Evolving*. Kauffman's ideas, Depew and Weber believe, suggest the mutual dependence and interpenetration of chance, selection, and self-organization in evolution, a dependence and interpenetration revealed by nonlinear dynamic models of complex systems, thereby giving the Darwinian tradition a new lease of life. The same models, these authors suggest, indicate that scientific naturalism is not only expanding to deal with complex systems but is also poised to achieve a reconciliation between the natural and the human sciences, a reconciliation

²⁰ Margulis, L. and Sagan, D., *Acquiring Genomes: A Theory of the Origins of Species*, New York: Basic Books (2002), pp. 201–2. See also pp. 44–50, 68–9, 134–5.

outlined at some length in Depew and Weber's long essay 'Evolution, Ethics, and the Complexity Revolution' in a volume entitled *Evolution and Human Values*, edited by Robert Wesson and Patricia Williams.²¹

If ethics is to be reconciled with scientific naturalism, say Depew and Weber, it must break loose from old philosophical debates stemming from Plato and study instead what modern 'interpretive' social scientists have discovered about the moral practices of human societies. Evolutionists, for their part, must embrace the complexity models that are revolutionizing all science. The natural scientists must abandon the scientific myth that progress in the human sciences requires branding much of human culture, and especially religious beliefs, as illusion. The humanists, in turn, must stop thinking that any culture worth having must transcend nature, natural science, and philosophical naturalism. Only in this way, conclude Depew and Weber, can the perennial battle between naturalism and transcendence be transcended.

This view of what Depew and Weber call the 'interpretive' social sciences does not agree with the views I set forth in my lectures at Rice University, published under the title *Darwin and the Modern World View*, where I wrote:

In the effort to deal with man by the methods of natural science, we must perforce overlook those aspects of human nature and culture that do not readily lend themselves to formulation in scientific terms. We concentrate on those aspects of the subject matter that are amenable to our method – man's animal organism, his social needs, and the stabilizing influence of religious and moral beliefs. After a while we forget what we have left out.... Culture becomes simply a mode of adaptation to the environment, morality simply a matter of preserving social solidarity, religion nothing but a way of discharging individual and social tensions, and so on. This goes along very well until we are recalled to the concrete world by the necessity of action. Then we can no longer evade such questions as whether there are dimensions of reality inaccessible to science, whether some truths can be known only from the point of view of a responsible moral agent, whether religious beliefs relate to a reality which is more than social. If there are such truths, such dimensions of reality, the apprehension of them may be a cause of action. But how can science hope to calculate the influence of such causes on the total action situation?

The attempt of modern social science to avoid questions of this kind, I argued, is fraught with danger because there is no neutral ground with respect to them. The assertion that science can neither verify nor disprove them gives rise imperceptibly to a conviction that there is *no way* in which their validity can be tested. But where there are no tests of validity, there is no truth or fal-

21 Depew, D. and Weber, B. 'Natural Selection and Self-Organization', *Biology and Philosophy* (1996) 11, 54–5; Depew and Weber, 'Evolution, Ethics, and the Complexity Revolution', in Wesson, R. and Williams, P. (eds.) *Evolution and Human Values*, Atlanta, Georgia: Rodopi (1995), p. 63.

sity. There is only the bare fact of belief. If the ultimate ends of action have no basis in the structure of reality, there is little point to science. The passion for science then becomes an odd preference for a certain kind of activity. This is precisely the situation in which Darwin found himself at the end of his spiritual evolution. Science had become his passion, the only thing that made life bearable, but its larger significance was no longer clear to him. He was sure he had been right in devoting his life to science, but he could not say why.²²

What shall we say, then, concerning the conflicting prophecies of Balfour and Huxley as to the probable course of Western culture in the twentieth century? Without doubt the spirit of science extolled by Huxley has achieved notable successes in the physical and biological sciences, and in applied science as well. In so doing, however, it has developed a severe case of hubris, overweening pride. Some of its devotees claim the whole field of rational inquiry, from physics to the humanities, as their legitimate bailiwick. Science aspires, says Ernst Mayr, to understand and explain 'everything known to exist or happen in the universe'. Next to art and music, say Mayr and Karl Popper, science is 'greatest, the most beautiful, the most enlightening achievement of the human spirit'.²³ But there are other equally or more qualified contenders for this honour. What about Chartres cathedral and the other medieval cathedrals built by the labour of thousands? What about the achievements of the black peoples of Africa brought to North America as chattel slaves yet maintaining their human dignity and dream of freedom and equality through pain and suffering and, at the same time, contributing priceless art and music, scholarship and leadership despite the slings and arrows of discrimination and outright violence? Science is indeed a noble achievement of the human spirit, but scientific theory, as such, has no room for the concept of spirit. The human spirit cannot be weighed, quantified, predicted, or genetically engineered. It is, in short, spiritual, a word which some spokespeople for science seem to want to banish from our vocabulary.

I conclude, then, that science needs to be seen in a wider philosophical and religious context that can make sense of the human spirit scientists love to talk about. A first step in this direction would be to discard T.H. Huxley's notion that 'there is but one kind of knowledge and one way of acquiring it'.²⁴ There are many kinds of knowledge – the scientist's, the artist's, the craftsman's, the philosopher's, the seer's – each with its own way of acquiring it. And there are truths, important truths, which can be tested only by faith-inspired experiments in living, doing, and dying, as the lives of Ghandi, Martin Luther King, Jr, and a host of other non-violent revolutionaries testify. Science yields a kind of knowledge, but not this kind.

22 Greene, J. C. *op.cit.* (11), pp. 126-128.

23 Mayr, E. *This is Biology: The Science of the Living World*, Cambridge, Mass.: Harvard University Press (1997), p.41.

24 Huxley, T. H., 'The Advisableness of Improving Natural Knowledge'(1860), in Castell, A. *op.cit.* (3), p. 15.

Balfour had hoped that the twentieth century would produce a philosophy of nature and science that would reject evolutionary naturalism and recognize the essential similarity of the scientific and the theological ways of picturing reality. His hope in this respect has been partially realized, but to a very limited extent. The philosophy of science was dominated for six decades by the reductionist logic of physics. Ernst Mayr then led the way in claiming autonomy for the philosophy of biology on the basis of emergent phenomena, but without granting a similar autonomy to the philosophy of human nature on the same basis. By the end of the century the position of many philosophers was aptly summed up by the title of Werner Callebaut's book *Taking the Naturalistic Turn: How Real Philosophy of Science Is Done*.²⁵

There were a few dissenting voices, however. Instead of attempting to derive the complex nature of humans from the law-bound transformations of matter-energy, these writers argued, we should look for clues as to the general character of the evolutionary process by examining our own experience, of which we have first-hand knowledge. This was the method adopted by the mathematician-logician-philosopher Alfred North Whitehead. Whitehead extended the concept of experience to embrace all natural entities down to the level of atoms and molecules, each entity prehending (taking into its own being) in some degree the rest of the universe in its successive occasions of experience. As I wrote to Ernst Mayr in response to his statement that he believed that man was 'somehow' higher than the chimpanzee: 'I think Whitehead would say that man is higher because he prehends the universe more fully than the lower animals or plants. The knower is higher than the known unless the known is also a knower. That is why I think that all science is anthropocentric. We may not be physically at the center of the universe, but *mentally* we grasp the galaxies, the dinosaurs, and the like into our own being, and that being transcends the objects known in thus knowing them.'²⁶

The population geneticist Sewall Wright adopted an approach similar in many ways to Whitehead's. In his view, the primary reality for human beings was 'the kind of knowledge provided to each person by his own stream of consciousness'. The scientist's knowledge of the external world, said Wright, was wholly derived from bits of the streams of consciousness of many observers and was restricted to those aspects which could be communicated in terms of the so-called primary properties of matter, a restriction which stripped the stream of consciousness of its original richness. Moreover, all of the common knowledge of these 'primary properties' was based on units of measurement – centimetre, gram, second – with operational definitions which were recipes for *voluntary* actions. 'Reality,' Wright concluded, 'clearly consists primarily of streams of consciousness. This fact must take precedence over the laws of nature of physical science, even though it must be largely ignored in science itself.'

25 Callebaut, W. *Taking the Naturalistic Turn: How Real Philosophy of Science is Done*, Chicago: University of Chicago Press (1993).

26 Greene, J. C. *op.cit.* (10), p. 244.

We must acknowledge the necessity of dealing with the universe as the world of mind, within which all subordinate minds must be included in some sense.... The question is... whether the mind of the universe is all knowing and omnipotent, or... merely that which is superimposed on the point-to-point interactions of the minds of the components as the integrating factor.... As one concerned with the philosophy of science rather than philosophy in general, I must take the latter view, recognizing that there is a great deal that science does not and probably never can know.²⁷

Other writers, too, followed Whitehead's lead. The Catholic philosopher Bernard Lonergan sought insight into the common human experience of obtaining a sudden insight into the solution of a problem (the 'Eureka!' experience). His analysis led him from mathematical physics to evolutionary biology and the concept of 'emergent probabilities', and eventually to a philosophy of nature supplying a basis for theology.²⁸ The Catholic theologian John Haught views the religious experience of being grasped by 'that which is yet to come' in the context of Whitehead's process philosophy. This experience, says Haught, cannot be expressed in scientifically specifiable concepts because science attributes efficacy only to the causal past.

Nevertheless, if we follow Whitehead's great insight that human experience may be the source of metaphysical categories that by analogy we can assume to characterize the experiential events that make up the rest of nature, then theology can infer that the same 'power of the future' that grasps us in faith must also be effective and persuasively present throughout the entire cosmos. If biologists are permitted to resort to metaphor and analogy, as biologists from Aristotle to Darwin to Dawkins have done, why should not theologians be granted the same privilege? 'By employing metaphors for God's influence such as 'Ground of Being' or 'Absolute Future', theology can in principle account for the fact of evolutionary novelty at a deeper if less precise level of explanation than the scientific. And such metaphorical explanation would not contradict or compete with evolutionary biology any more than evolutionary biology's own metaphorical 'explanations' at its own level conflict with the chemical or physical explanations at another'.²⁹

Returning now to the conflicting prophecies of Balfour and Huxley concerning the future of Western culture, it might seem that Huxley's vision of a struggle for mastery between the spirit of science and the Judaeo-Christian tradi-

27 Wright, S. 'Panpsychism and Science', in Cobb, J. B. and Griffin, D. R. (eds.) *Mind in Nature: Essays on the Interface Between Science and Philosophy*, Washington, D. C.: University Press of America (1977), pp. 79–80.

28 Lonergan, B. *Insight (Collected Works of Bernard Lonergan, III)*, Toronto, Buffalo, London: University of Toronto Press (1997).

29 Haught, J. 'Darwin's Gift to Theology', in Russell, R. J., Stoeger, W. S., Ayala, F. (eds.) *Evolution and Molecular Biology: Scientific Perspectives on Divine Action*, Rome: Vatican Observatory Publications (1998), p. 411.

tion has been realized in the evolution-versus-creationism wars which have dominated the public press in the United States from the Scopes trial onward. From the Balfourian point of view informing this essay, however, these wars seem a sideshow to the main issue in the dialogue between the scientific spirit and the religious spirit. I can agree with Philip Johnson and his colleagues that the writings of many evolutionary scientists are deeply impregnated with implicit materialistic metaphysics and dubious epistemological claims as to the all-sufficiency of science and scientific ways of knowing. But I disagree strongly with Johnson's view that evolutionary science is nothing but that. And I disagree equally strongly with attempts to present William Paley's natural theology as creation science and to picture the Bible as a textbook of science. On the other hand, I am equally critical of those scientists who regard scientific explanations as total explanations and the scientific way of seeking truth as the only acceptable way. If the critics of evolutionary science are misguided in trying to convert William Paley's natural theology into science and the Bible into a textbook of science, the partisans of the all-sufficiency of science are equally misguided in presenting the Bible as a compilation of outdated folklore and in seeking to convert evolutionary science into ethics and natural religion, as Edward O. Wilson and many others do. Here we have the strange spectacle of the advocates of religion presenting themselves as scientists and the champions of science presenting themselves as ethicists and purveyors of natural religion.

I am happy to say that Niles Eldredge, a paleontologist and ecologist at the American Museum of Natural History, agrees with me in finding this spectacle distressing. 'The tired old creationism debate,' he writes, '... simply has not prepared us for the kind of positive interaction that I see as eminently possible as we enter the new millennium and grapple with tough environmental issues.'³⁰ In speaking engagements at colleges and universities across the United States, Eldredge has discovered among the younger members of conservative Christian communities a growing realisation that, if we do not address our environmental problems effectively, there won't be much of Creation over which to enjoy dominion. Environmentalists, Eldredge notes, have frequently disparaged the biblical passage in which God promises the Israelites dominion over the beasts of the field as justifying the rape of the earth. But, says Eldredge, the concept of dominion yields easily to that of stewardship, and this is what Eldredge is hearing from many conservative Christian students as they reinterpret the biblical passage in the light of ecological research on the global ecosystem. Eldredge himself interprets concepts of God as reflections of the way different peoples at different times have interpreted their ecological situation. Thus, he interprets the 'dominion' passage in Genesis as a reflection of

³⁰ Eldredge, N. *The Triumph of Evolution and the Failure of Creationism*, New York: W. H. Freeman and Co. (2000), pp. 167–9. For a comprehensive, well-balanced, sociologically informed account of American theories of origins, creationist and otherwise, see Giberson, K.W. and Yerxa, D.A., *Species of Origins: America's Search for a Creation Story*, Lanham, Boulder, New York, Oxford: Rowman & Littlefield (2002).

the early agriculturist's sense of new-found human freedom to step outside the confines of the local ecosystem, but he concedes that the apparent correlation between views of the spirit world and the viewers' ecological situation does not invalidate any particular concept of God.

For my part, I think this is a meagre and inadequate notion of concepts of God. A deeper and more adequate concept is developed by Colorado State University philosopher Holmes Rolston in his book *Genes, Genesis and God: Values and Their Origin in Natural and Human History*. Rolston writes:

Ours is an age of many doubts but no one doubts that there has been a remarkable genesis on our planet... [T]here are in broadest outline two complementary or competing explanations of this genesis: a scientific account, for which we take the title word 'genes,' and a religious account for which the symbolic word is God. The term 'genesis' mediates between the dual accounts in dialogue with other philosophical and metaphysical possibilities for the explanation of Earthen fertility.

Evolutionary history is interpreted as the generating, conserving and enrichment of value and its eventual appreciation in human terms, philosophical and religious as well as scientific. 'The questions here become ultimate ones, though they are born in the phenomena of natural history and human culture,' Rolston explains.

The religions, including those of the monotheistic West... have steadily thought to detect a Beyond in the midst of the here and now. They have found neither nature nor history in and of itself final or fully self-explanatory. They have claimed a Presence immanent and transcendent, stirring in Earth history. The evidence for such transcendence is the striking emergence, or genesis, of information and value. There are genes, there is genesis, but explanations are not over until one has reckoned with the question of God.³¹

On that great question the scientific jury is still out. Physicist Steven Weinberg, no friend of religion, still cherishes the dream of a final theory of everything, 'an understanding of all the regularities that we see in nature, based on a few simple principles, laws of nature, from which all other regularities can be deduced.' He concedes, however, that science can never explain any moral principle. "There seems to be an unbridgeable gulf between "is" questions and "ought" questions. We can perhaps explain why... the human race has evolved to think that certain things should be done, but it remains open to us to transcend these biologically based moral rules."³² How we are able to transcend these rules Weinberg does not say.

31 Rolston, H. *Genes, Genesis and God: Values and Their Origin in Natural and Human History*, Cambridge and New York: Cambridge University Press (1999), pp. x, xiii.

32 Weinberg, S. 'Can Science Explain Everything? Anything?', *New York Review of Books* (May 31, 2001), 50.

Among evolutionary biologists the question of God raised by Holmes Rolston has been a subject of serious discussion by some writers, but not in sufficient numbers to alter the dominant ethos of the biological research community taken as a whole. As we have seen, Ernst Mayr claimed autonomy for the philosophy of biology on the basis of emergent phenomena but refused to grant a similar autonomy to the philosophy of human nature on the same grounds. As for theology, Mayr views it as totally different from science. Theologians, he says, 'invoke the supernatural to explain how the natural world works'. Unlike scientists they never abandon or modify their dogmas when a better interpretation is offered, and they believe in a 'metaphysical or supernatural realm inhabited by souls, spirits, angels, or gods', a realm totally outside the scope of science. By contrast, virtually all scientists known to Mayr 'have religion in the best sense of the word'. Moreover, they bring to the study of nature a 'set of first principles': that there is a real world independent of human perceptions, that this world is structured in such a way as to yield to scientific investigation and explanation, 'that there is a historical and causal continuity among all phenomena in the material universe', that the 'legitimate domain' of scientific study includes 'everything known to exist or happen in this universe'.³³

A quite different picture of scientific first principles informs cell biologist Kenneth R. Miller's book *Finding Darwin's God: A Scientist's Search for a Common Ground Between God and Evolution*. Quantum mechanics, says Miller, has discredited the idea of an objective world existing independently of human perception. It has also rendered untenable the idea of an unbroken causal continuity linking all events in the material universe. 'What matters,' Miller writes, 'is the straightforward, factual recognition that matter in the universe behaves in such a way that we can never achieve complete knowledge of any fragment of it, and that life itself is structured in a way that allows biological history to pivot directly on these tiny uncertainties. That ought to allow even the most critical scientist to admit that the breaks in causality at the atomic level make it fundamentally *impossible* to exclude the idea that what we have really caught a glimpse of might indeed reflect the mind of God.'³⁴ Despite Einstein's dislike of giving chance a real role in physical events, says Miller, the indeterminate nature of quantum reality won out, leading Niels Bohr to comment: 'Who is Einstein to tell God what to do?'

Obviously, Miller does not share Mayr's view that a dialogue between science and theology is impossible. Having established the quantum nature of the material world, he goes on to discuss at length how this discovery affects the basic theological doctrines shared by Jews, Christians, and Muslims concerning miracles, the problem of evil, the nature of God, and the like. Whether the God Miller believes in as a Catholic is, as he tells his students, 'Darwin's God'

³³ Mayr, E. *op.cit.* (23) pp. 33–5.

³⁴ Miller, K. *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution*, New York: Harper Collins (1999), 213–14.

is doubtful. The God of Darwin's *On the Origin of Species* is a deistic God operating through 'laws impressed on matter by the Creator', a God he lost faith in when, after writing *The Descent of Man*, he experienced the 'horrid doubt' as to whether his 'inward conviction' that the universe was not the result of mere chance had any validity in view of man's shared ancestry with the apes.

Kenneth Miller's belief that theology must engage in dialogue with modern science is shared by the biochemist Arthur Peacocke, who is also an Anglican priest and until recently Director of the Ian Ramsay Centre (Oxford) for the study of religion in relation to the sciences. But Peacocke's conception of that dialogue is quite different from the one Arthur James Balfour had in mind. In Peacocke's view, science provides the model and the findings to which theology must conform if Christianity is to have relevance for modern life. 'This is one world,' Peacocke writes in his essay 'New Wineskins for Old Wine: A Credible Theology for a Scientific World'. 'A monistic naturalism is overwhelmingly indicated by the sciences. This need not be reductive about the many levels of the world, and in human beings; but the only dualism now defensible appears to be the distinction between the Being of God and everything else. Talk of the "spirit" or the "soul" as distinct entities appears to be precluded.' Likewise, says Peacocke, the doctrines of original sin, the Fall of Man, the 'new heaven and a new earth', and traditional ideas of eternity and God's timelessness must be discarded as inconsistent with modern science. 'So what is left? The belief that God is merciful Love and has, through the resurrection of Jesus, taken at least one human being fully open to God's presence into the divine life.'³⁵ However unlikely it seems that Peacocke's proposal for a revised theology will prove acceptable to his fellow theologians, it certainly gives the lie to Ernst Mayr's view that theologians never revise their ideas in the light of new evidence.

In contrast to Peacocke's views stands a long tradition among British evolutionary biologists working within a framework of traditional Christian theology. The late neuroscientist Donald MacKay interpreted the evolutionary process within a strongly providentialist framework that emphasized God's sovereignty over all events.³⁶ The historians James Moore³⁷ and David Livingstone³⁸ have drawn attention to the way in which such a theology has often provided a congenial world-view for evolutionary theory. Other evolutionary biologists, such as R.J. Berry, Professor of Genetics at London University and a previous President of the Linnean Society,³⁹ Ghilleen Prance, for many years

35 Peacocke, A. 'New Wineskins for Old Wine: A Credible Theology for a Scientific World', *Science and Spirit* (1999) 10: No. 2 (pp.1-4). See also Polkinghorne, J. (ed.) *The Work of Love: Creation as Kenosis*, Grand Rapids, Michigan and London: Wm. B. Eerdmans Publishing Co. and Society for Promoting Christian Knowledge (2001).

36 MacKay, D.M. *The Open Mind and Other Essays*, Leicester: IVP, (1988).

37 Moore, J. *The Post-Darwinian Controversies – a Study of the Protestant struggle to come to terms with Darwin in Great Britain and America, 1870-1900*, Cambridge: CUP, (1979).

38 Livingstone, D. *Darwin's Forgotten Defenders*, Edinburgh: Scottish Academic Press, (1987).

39 Berry, R.J. *God and the Biologist*, Leicester: Apollos, (1996).

Director of the Royal Botanic Gardens at Kew,⁴⁰ Prof. Malcolm Jeeves, formerly President of the Royal Society of Edinburgh,⁴¹ Denis Alexander, Chairman of the Molecular Immunology Programme at The Babraham Institute, Cambridge,⁴² and many others that space does not allow to list, provide a significant ensemble of scientists who have seen little problem in baptizing Darwinism into a robust Christian theism. It is intriguing that in Darwin's own 'backyard', the tendency to absorb Darwinism into a conservative Christian theology has been most pronounced. The correlation may not be accidental. For a sampling of theological responses to modern science on the continent of Europe, Mayr might begin with Niels Gregersen's *Rethinking Theology and Science: Six Models for the Current Dialogue*.⁴³

One last question remains in our consideration of the prophecies of Balfour and Huxley as to the future course of Western civilization. What shall we say of Balfour's prediction that if evolutionary naturalism should prevail it would deprive the traditional values of that civilization of any rational basis and thereby change the character of that civilization for the worse? At first blush, the traditional values Balfour feared for seem to have survived unblemished despite secularizing tendencies in society and the trend toward evolutionary naturalism in science and philosophy. Concern for human rights, not to mention animal rights, has never been more widespread. Biologists and nature lovers spend hours, days, months and years working to counteract the devastating effect of population growth, urbanization, and science-based technology on the global ecosystem, partly from concern for human survival but also from love of nature in all its varied forms. Enlightenment values of individual liberty, representative government and freedom of speech, press and religion are trumpeted abroad in the war on terrorism. At the same time, however, there is widespread anxiety about the impact of gene-based technology – genetic engineering, stem cell research, cloning, and the like – on the institution of the family and on basic conceptions of human nature and dignity. Howard Kaye discusses this phenomenon from the point of view of a sociologist and historian of social thought in an article 'Anxiety and Genetic Manipulation' in the journal *Perspectives in Biology and Medicine* (Summer, 1998). He concedes that many scientists and others – Francis Crick, Edward O. Wilson, Richard Lewontin, Isaiah Berlin, Willard Van Quine, and the National Bioethics Advisory Commission – have dismissed public anxiety on this score as a passing phenomenon that will subside when the public is better informed about the scientific merit and potential medical benefits of these techniques. Unconvinced by the arguments of these writers, Kaye turns to Kierkegaard and Freud for light on the subject of generalized anxiety. He finds them in basic agreement, despite

40 Prance, G. *Real Science, Real Faith*, Monarch, (1991).

41 Jeeves, M. and Berry, R.J. *Science, Life and Christian Belief*, Leicester: Apollos (1998).

42 Alexander, D.R. *Rebuilding the Matrix – Science and Faith in the 21st Century*, Oxford: Lion (2001).

43 Grand Rapids: Eerdmans, (1998).

differences in their analyses, on what Kaye calls ‘the terrifying ambivalence at the core of anxiety: the fear of what we desire and the desire of what we fear’.

Regardless of the motives for its use – therapeutic, eugenic, or narcissistic – human cloning does indeed raise traumatic possibilities worthy of our anxiety. As many critics have noted, asexual reproduction removes the last biological basis for marriage and the family, and, like incest, confuses relations within the family and between generations, which may then affect its stability and the well-being of its members.... For over 40 years, we have been living in the midst of a biological and cultural revolution of which innovations such as artificial insemination, in vitro fertilization, surrogacy, genetic manipulation, and cloning are merely technological offshoots. In both aim and impact, the end of this revolution is a fundamental transformation in how we conceive of ourselves as human beings and how we understand the nature and purpose of human life rightly lived.⁴⁴

To dismiss public anxiety on this score as a reaction springing entirely from ignorance of scientific principles, Kaye argues, is to risk committing cultural suicide. ‘By challenging the conception of ourselves as unique, precious, free, and responsible beings worthy of respect because of our special nature,’ Kaye concludes, ‘we are undermining the beliefs embodied in our laws, customs, and institutions, and even in our everyday experience and social interaction.’

Oxford University geneticist Richard Dawkins presents a quite different view of human cloning in his ‘Foreword’ to Amnesty International’s lecture series entitled *The Genetic Revolution and Human Rights*. In the light of man’s scientifically established cousinship with the so-called lower animals, Dawkins is sceptical of any conception of human rights based on the presumed special status and dignity of human beings in the animal kingdom. This said, he proceeds to assign humans a special status in that kingdom in virtue of their ability to direct the course of evolution by intelligent planning. ‘This has actually been going on for some centuries in the form of eugenic selective breeding,’ he writes. ‘Now, the genetic revolution offers the opportunity for humans to plan the mutational phase of the Darwinian process, as well as the selectional phase. Pigs might fly – if we plan the Darwinian manoeuvre sufficiently far ahead. Future historians may look back on the twenty-first century as a watershed in evolutionary history.’⁴⁵ What the application of the newly acquired genetic technology to human beings will bring and how these intelligently designed ‘manoeuvres’ will change human self-conceptions Dawkins does not say. He leaves us to ponder the question of how the ‘blind watchmaker’, natural selection, managed to produce a being capable of directing human and non-

44 Kaye, H. L. ‘Anxiety and Genetic Manipulation’, *Perspectives in Biology and Medicine* (Summer, 1998), 486–90.

45 Dawkins, R. ‘Foreword’ in *The Genetic Revolution and Human Rights*, Oxford and New York: Oxford University Press (1999), pp. xv–xvi. See also Dawkins, R. ‘The Word Made Flesh’, *Guardian* (February, 2002), 36–41.

human evolution according to his own fancy.

Strange as it may seem, the Christian philosopher Balfour and the agnostic scientist-humanist Huxley may both have sided with Howard Kaye rather than with Dawkins on the cloning issue if confronted with it. Huxley was aware of Francis Galton's proposal to improve the human species by eugenic legislation, but he recoiled from it. No one, Huxley declared, had sufficient intelligence and moral judgment to decide which human beings were fittest to survive and propagate their kind. 'I do not see how such selection could be practised without a serious weakening, it may be the destruction, of the bonds which hold society together.' Like Dawkins, Huxley had brought himself face to face with an insoluble problem: how could an evolutionary process devoid of intelligence, aim or direction have managed to produce a being endowed with intelligence, purpose and the capacity to redirect that process to his own ends, or, as Huxley proposed, to build the state of art and civil society in defiance of the state of nature? Despite his talk of a struggle for mastery between science and religion, Huxley the ethicist fell back in the end on the prophetic tradition of Judaism, especially as enshrined in Micah's injunction to do justly, love mercy, and walk humbly with God. To Huxley, the prophet's words seemed 'a wonderful inspiration of genius'. 'But what extent of knowledge, what acuteness of scientific criticism, can touch this?' he asked. 'Will the progress of research prove that justice is worthless and mercy hateful; will it ever soften the bitter contrast between our actions and our aspirations, or show us the bounds of the universe and bid us say, Go to, now we comprehend the infinite?' Having thus paid tribute to the insights of moral genius and the inscrutability of the Infinite, Huxley returns to his home base of agnostic, 'scientific' naturalism, declaring that 'science takes for its province only that which is capable of clear comprehension' and consigning all other forms of inquiry and belief to the realm of 'imagination, hope, and ignorance'.⁴⁶

As we have seen, however, in this search for clear comprehension of natural causes science strips nature of everything – so-called 'secondary' qualities, value, meaning, purpose, human freedom and spirituality – not amenable to its methods of investigation and creates its own specialised world of particles, forces, genes and the like, described metaphorically and related mathematically and presented as the real world which somehow or other produces the apparent world of meaning, value and purpose inhabited by human beings. So conceived, science renders incomprehensible its own discovery of the emergence of new levels of being, exhibiting new laws and properties irreducible to the laws and properties of lower levels. Equally incomprehensible is the scientist's passion for truth, her love of nature for its beauty, diversity and majesty, and her sense of moral obligation as a scientist.

Faced with these incomprehensibilities, what shall we conclude? Shall we

46 Huxley, T. H. *Evolution and Ethics and Other Essays*, New York: Macmillan (1895), p. 36; Huxley, T. H. *Science and Hebrew Tradition*, New York: D. Appleton (1898), pp. 161–2.

conclude with Einstein that the most incomprehensible thing about the universe is that it is comprehensible? Or shall we conclude with Johannes Kepler that 'God who founded everything in the world according to the norm of quantity, also has endowed man with a mind which can comprehend these norms'? Or shall we conclude with the absurdist existentialists that the world makes no sense at all or, alternatively, whatever sense we decide to give it? Or, finally, shall we conclude with Balfour that science and theology are enterprises based ultimately on faith and struggling mightily to comprehend and portray in human figures of speech a reality that transcends the power of human thought to grasp fully? On the evidence herein presented, Balfour's view of these issues seems to have been truly prophetic.

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