DIVINE ACTION AND EVOLUTION BY NATURAL SELECTION

A possible and necessary dialogue

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Introduction

This volume deals with the question of faith and reason concerning specifically the emergence and evolution of life on Earth, one of the important topics of the new science of astrobiology. The same subject is the main aspect of Genesis, the first book of the Bible. From the point of view of faith this common objective - to reflect on the emergence of life on Earth from two different cultural points of view - has led in the past to a fecund dialogue between faith and reason. In this work we enquire how to interpret the holy books of the main monotheistic religions against the background of modern science.

We face the dialogue between science and theology with the conviction that it will be fruitful, because the search for the truth is a common objective of both of these aspects of culture. We are also convinced of the unity of knowledge and consider that a fractured unity is due to the current excessive specialization that puts a barrier to the eventual integration of science and religion in our society, as well as interfering with an appropriate popularization of science by practicing scientists. Narrow expertise may distance contemporary culture from the bigger picture that is relevant for unified knowledge that is of vital importance for discussing the question of faith and reason, especially regarding divine action and evolution by natural selection.

Profound changes have taken place in the understanding the constraints imposed by philosophy and natural theology on our view of life. They mostly favor a special place of man in the universe. Neoplatonism is a modern philosophical doctrine. Plotinus, who died in 270 AD, is often considered to be its founder and an expositor of the doctrines of Plato. This philosophic school drew not only upon the Platonic canon, but also upon Pre-Socratic literature. With Marsilio Ficino (1433-1499) we may say that Platonism achieved a brief moment of ancient renewal, when this philosopher advocated a special place of man in the universe. On the other hand, within the boundaries of science with its characteristic experimental and observational methods, a different outlook has been inferred. The general laws of science do not assign humans any special position in our galaxy. Science gives our nearest star, the Sun, an insignificant position in the cosmos.

Lord Russell's frontiers of philosophy, science and theology

Science has made enormous progress since Galileo's epoch-making strict adoption of the experimental approach for understanding nature. Modern science since Galileo, recognizes that scientific ideas must be provisional and capable of being overturned by evidence from experimentation and by observation, which is its most robust and strong feature. There appears to exist a misunderstanding in relation with a universe evolving for 13.7 billion years since the Big Bang. In the cosmos, beginning at about 3 to 4 billion years before the present life evolved, in its most primitive forms, through a process of random genetic mutations and natural selection. Science is neutral with respect to philosophical or theological implications that may be drawn from its conclusions. Those conclusions are always subject to improvement. Indeed, the National Academy of Sciences has expressed this key issue that is significant for scientists that are also believers, in very clear terms (NAS, 1999):

Many religious persons, including many scientists, hold that God created the universe and the various processes driving physical and biological evolution and that these processes then resulted in the creation of galaxies, our solar system, and life on Earth. This belief, which sometimes is termed "theistic evolution," is not in disagreement with scientific explanations of evolution. Indeed, it reflects the remarkable and inspiring character of the physical universe revealed by cosmology, paleontology, molecular biology, and many other scientific disciplines.

Religion has come a long way in its natural-theologic approach to deeper philosophical questions, always basing its considerations on revelation and tradition. Both scientists and humanists are well represented in this book with their worthy reflections. It is understandable that in addressing the phenomenon of the origin and evolution of life in the universe, the ensuing dialogue has not always excluded mutual contradictions. These discussions are necessary to delineate clearly the frontiers of each contribution. In this respect we should not forget Galileo's statement that the Book of Scripture and the Book of Nature speak of the same God. In a modest effort towards aiming at the unity of knowledge we have included many contributions in the following pages. We have brought together multiple points of view. Heterogeneous in their approaches from either humanities or science, the chapters have been brought together, even if some of them may have ignored the strict frontiers of either theology or science.

In the present context, one of the most distinguished philosophers of modern times, Bertrand Russell, explained this point particularly well. Lord Russell (1872-1970) was an English logician and philosopher, whose seminal work in mathematical logic was published in the early 20th century. Russell collaborated with Alfred North Whitehead on "Principia Mathematica" (1910-13). He received the Nobel Prize for Literature in 1950.

Russell's interests ranged over a wide spectrum including philosophy, mathematics, science, ethics, sociology, education, history. And most significantly from the point of view of this book his interests also extended to the area of religion. He had a personal gift in explaining philosophical and scientific arguments, an unusual ability that led to his 1950 Nobel Prize in literature (Russell, 1991). His main point is that philosophy is something intermediate between theology and science. Like theology it consists of speculations on matters as to which definite knowledge has, so far, been unascertainable. But Russell clarifies that like science, philosophy appeals to reason,

rather than tradition, or revelation. He underlines that philosophy is like a 'no-man's land' that is approachable from science, and also from theology. A common denominator amongst the disagreements demonstrated by authors in the following chapters is still missing a clear demarcation of the frontiers of science. In other words, the three areas demarcated by Russell are not always maintained. To a large extent these disagreements reflect present-day uncertainties.

Saint Augustine's reading of the Holy Books

The other important topic of faith and reason that is pertinent to our arguments concerns a certain caution of theologians with respect to the questions on which we have dwelt at some length. In the fourth century AD, Saint Augustine of Hippo, (354-430) discussed faith and reason in *The City of God.* Augustine raised the point of possible conflicts that may arise from a literal reading of the Bible (Augustine, 1984). The Bible is not a single book, but rather a library with texts of different nature, but uniformly displaying a deep theological content revealing some aspects of God and his divine action. Today, bearing in mind the significant progress in the space sciences, especially in astronomy, Augustine's point can be clearly illustrated with a quotation from the Book of Daniel

The Book of Daniel is a book in both the Hebrew Bible (Tanakh) and the Christian Old Testament. The book may have been written during Daniel's lifetime in the sixth century BC or it may have come to us from a version written later. An inspiring poetical analogy with the stars in the firmament comes from Chapter 12; 1-3:

> *And those who are wise shall shine like the brightness of the firmament;*
> *and those who turn many to righteousness, like the stars forever and ever*.

According to Augustine's view (and ours), this quotation should be taken strictly as an analogy, and not as scientific information on the longevity of stars, since we know today from a considerable amount of data on supernovas that stars are not eternal, but once their nuclear fuel runs out several scenarios are possible, including the supernova explosions. But the message in the Book of Daniel is not only valid today, but it still retains its usefulness after well over two millennia since the prophet's words were written. Daniel's main point is not one of accuracy in astronomy, but rather it is a point that emphasizes the importance of good living and good behavior.

To such questions pertaining to the philosophical area of ethics, no answer can be found in the laboratory, and the prophet's comments are relevant even today. Some additional discussions on the question of faith and reason are available (Barbour, 1995; Chela-Flores, 1998; Coyne, 1998; Haught, 1998, 2005; McMullin, 2000; Peacock, 1988; Polkinghorne, 1996; Russell, 1995). Besides, previous books of this series have also contributed to these discussions (Seckbach, 2004, 2006; Seckbach et al. 2004). Still today the subject of faith and reason has captured the attention of the general public. We illustrate this assertion with the wide publicity given to the frontier of science and religion in the special issues of leading newspaper and magazines (Editorial, 2005; News, 2006; Spiegel, 2005; Time Magazine, 2005; 2006).

Einstein's views on faith and reason

Albert Einstein, who together with Charles Darwin, Isaac Newton, and Nicholas Copernicus are amongst a handful of scientists who have radically transformed our view of the world, considered that a conflict arises when a religious community insists on the absolute truthfulness of all statements recorded in the Bible (Einstein, 1950). He had an impersonal Spinozan view of God:

Spinoza believed that everything that exists is God (a doctrine known as pantheism). But he opposed the view that God is no more than the sum of what exists, since He had infinite qualities. Only two, thought and extension can be perceived by human intelligence. Hence God must also exist in dimensions far beyond those of the visible world (Spinoza, 2002).

Indeed, the literal interpretation of the Bible means an intervention on the part of religion into the sphere of science. What is most significant over half a century after Einstein wrote these words are Einstein's comments on the relation between faith and reason. He often spoke about trying to understand how the Lord shaped the universe, and not surprisingly he reminds us that science can only be created by those who are thoroughly steeped with the aspirations towards truth and understanding, a feeling that according to him arises from the sphere of religion. Scientists have an analogous faith that the world is comprehensible to reason in terms of a mathematical description of the physical sciences. Einstein concludes this part of his reflections in *Out of my later years* with the statement that he cannot conceive of a genuine scientist without that profound faith. It is at this stage that Einstein inserted his often-quoted:

Science without religion is lame, religion without science is blind.

Astrobiology and rational bases for evolution beyond Darwin

The new science of Astrobiology covers research in the field of biological aspects of the subjects of the origin, evolution and distribution of life in the universe. Astrobiology is currently in a period of fast development due to the many space missions that are in their planning stages, or indeed already in operation (Chela-Flores, 2004).

Amongst its pioneers a place of honor is undoubtedly assigned to Stanley Miller (1930-), and other distinguished organic chemists, including Sidney Fox (1912-1998), John Oro (1923-2004) and Cyril Ponnamperuma (1923-1994). They were pioneers in demonstrating the feasibility of the synthesis amino acids (which are the building blocks of proteins) in an atmosphere that simulated prebiotic conditions that may have reigned on Earth soon after its formation over four billion years before the present. Miller was only a second year graduate student at the University of Chicago, when he published a remarkable paper in 1953 on the generation of amino acids. It was a simple experiment that attempted to reproduce conditions similar to those in the early Earth, when life first originated. As a subject of his doctoral thesis Miller demonstrated experimentally that amino acids, the building blocks of the proteins, could be formed without the intervention of man in environmental conditions, which we have called prebiotic - similar to those that presumably were valid at the earliest stages in the evolution of the Earth itself. The corresponding geologic period was the Archean. Miller's work was an

important step in the growth of the subject of chemical evolution. The 50th anniversary of the 1953 paper was celebrated with a scientific event in Trieste (Seckbach et al, 2004), where there is further information on the relevance of this singular contribution to the development of astrobiology.

However, even though no single living cell has been formed as yet in the test tube, chemical evolution continues to be a solid scientific pursuit that has been reviewed extensively over the last decade in the Trieste and Caracas series of conferences (Ponnamperuma and Chela-Flores, 1993, 1995; Chela-Flores et al, 2000; 2001; Seckbach et al. 2004).

Going beyond Darwinism strictly within the life sciences, including astrobiology is not new. One illustration is provided by adaptive radiation. This is a process in which one species gives rise to multiple species that exploit different habitats that they may occupy. This is an evolutionary process driven by mutation and natural selection. A well-known example of adaptive radiation as the result of an environmental change is the relatively rapid spread and development of mammalian species after the extinction of the dinosaurs. The speed of the adaptation is measured in time scales that are familiar to geologists. For example, the periods of time that are relevant for adaptive radiation are measured in millions of years. Darwin understood such a phenomenon. By studying the work of his contemporaries he brought this phenomenon to the attention of science in his seminal work *The origin of Species* (Darwin, 1859).

What is new to us, at the present time when we are approaching the year 2009, the second centenary of Charles Darwin's birth, is a phenomenon observed in, for example, fish. A small population of Trinidadian guppies was scooped from a waterfall pool, where predators were abundant. Later they were released upstream in a pool in the presence of only one enemy species. The guppies adjusted to the new environment with few predators by growing bigger, living longer, and having fewer and bigger offspring. Although natural selection was assumed by Darwin to be a slow process, it was found that natural selection is able to act speedily, not in the span of millions of years as in the case of the mammalian radiation that took place about 65 million years ago (Reznick et al., 1997). On the contrary, the guppies adapted to their new environment in a mere 4 years, which is a rate of change some 10,000 to 10 million times faster than the average rates determined from the fossil record (cf., Morell,1997).

If Darwinian theory is thought of as being incomplete and we do keep within the boundaries of science, as pointed out above by Einstein, then the evident avenue to follow is to replace the theory by another one that may explain some of the data better. One significant example is already provided by the well-known theory of evolution by 'punctuated' equilibria'. This theory suggests that species are fixed most of the time, and only change when new opportunities open up, usually following the extinction of other species. Darwin on the other hand, appreciated the evidence suggesting that species are fairly stable entities with distinct beginnings and ends. His discovery of natural selection led him to believe that evolution must be slow and gradual (Eldredge, 2006). To sum up, if neither Darwinism, nor punctuated equilibrium eventually were shown to satisfy in the future all the data that will be available in the life sciences, then science will show its traditional strength by challenging biologists to produce a more refined theory for the evolution of life on Earth.

Towards an understanding of Darwinism within natural theology

Religion has had great difficulty in assimilating the real significance of Darwinism. From the point of view of theology the difficulty focuses on how to reconcile evolution with the idea of divine action. It is possible to look at the natural world for explanations with scientific ideas that by the very definition of science must be provisional, namely capable of being discarded by evidence from experiments and observation. This approach to science is in sharp contrast intelligent design that will be considered in the next section.

Some scientists say simply that science and religion are two separate realms, "nonoverlapping magisteria," (Gould, 1999). In this view, science is relevant in the realm of "what the universe is made of (fact) and why does it work this way (theory)", while religion concerns itself with "questions of ultimate meaning and moral value." As the careful reader will notice, this position is compatible with the above-mentioned Russellian statement on the distinction of the different components of culture.

Besides Gould's book, there are various other efforts along the lines of trying to understand the significance of Darwinism in the context of natural theology. In another chapter of this book we have brought to the attention of the reader examples of such theologies. For this purpose the concept of kenosis is taken to mean self-emptying and voluntary sacrifice on behalf of others, based on genuine and freely given love for others, and resulting in generosity and respect that flow from it. This approach to the natural theology explains the world in terms of Darwinism. It focuses on features of process thought (cf., Glossary, Chela-Flores, 2007). This philosophical system is considered to be particularly helpful in the task of constructing an evolutionary theology that may throw some further insights on Darwinism (Haught, 2005).

Another approach along these lines points out that theologians already have the concept of God's continuous creation with which to explore the implications of modern science for religious belief Coyne (2005). In this view God is working with the universe. The universe has a certain vitality of its own like a child does. It has the ability to respond to words of endearment and encouragement. You discipline a child but you try to preserve and enrich the individual character of the child and its own passion for life. A parent must allow the child to grow into adulthood, to come to make its own choices, to go on its own way in life. Words that give life are richer than mere commands or information. In such wise ways we might imagine that God deals with the universe.

Along the above lines it is possible that evolution may also provide a way in which the tradition of natural theology may undergo a renewal. Instead of focusing design without a designer, which can be accounted for scientifically in terms of Darwinism (Ayala, 1998), a revived natural theology may take place if we interpret correctly the origin and evolution of life on Earth.

Religion, Science and Creationism

In spite of the significant opinions expressed by the theologian Saint Augustine, the philosopher Lord Russell and the scientist Albert Einstein that we have mentioned in this chapter, the literal biblical interpretation of the emergence of life on Earth by a

Divine Designer has emerged in recent times. This isolated approach to the emergence of natural events has been called Intelligent Design (ID). The advocates of ID, as opposed the science of biology, dispute the idea that natural selection fully explains the complexity of life. This represents an unprecedented metaphysical basis for denying the validity of natural selection without providing any significant new data. Besides, ID proponents say that life is so intricate that only a powerful guiding force, or intelligent designer, could have created it. (In fact, science is neutral with respect to this theological statement.) ID does not identify the designer, but ID is one interpretation for God and its divine action in the universe that lies well beyond the realm of science and, most significantly, ID also lies well beyond natural theology, as natural theology is, strictly speaking, the body of knowledge about religion that can be obtained by human *reason* alone, *without* appealing to revelation. It is especially relevant to highlight the fact that ID is in no way whatsoever the only possible approach to gaining insights into divine action in a theological context (cf., the above section: "Towards an understanding of Darwinism within natural theology).

The ongoing debate between Darwinism and ID has been taken back to the school curricula, where it has caused once again an embroiled hostility analogous to the 1925 Scopes evolution trial. It was also called the "monkey trial" as a reference to the second aspect of the theory of evolution, besides natural selection, namely the descent from a common ancestor, which at the time of the publication of *The Origin of Species,* was emphasizing the evolution of primates (and the popular press singled out 'monkeys'). The general dialogue at the time did not refer to a last common ancestor that astrobiology has traced back to a microbial organism (by careful arguments from molecular biology). The scientific and religious, questions that the Scopes trial raised unfortunately have not disappeared, as we are constantly reminded by leading journals (News, 2006).

We believe that there should not be a real conflict between the holy books and science. Disagreements can only be apparent through lack of appreciation of the real limits of science and the true nature of natural theology. Judaism and other monotheistic religions may accept natural selection (cf., Halperin in this volume). In this case one interpretation of the holy books is that God may have used the mechanism of evolution to create everything from microorganisms to human beings. Jewish traditions also maintain that God renews and guides his original creation as stated in the Jewish morning prayers (cf., Psalm 136, 4-9; Nehemiah 9, 6).

Concluding remarks

Science and theology must be close to their very beginnings. It is sufficient to remember that stellar evolution predicts that the lifetime of the Sun will continue for a few billion years, while the science of anthropology suggests that humans are a fairly recent addition to an Earth biota, whose origins must be traced back to microorganisms that emerged on the early Earth from 3 to 4 billion years before the present. We expect that theology will continue its independent search for a deeper understanding of God and the meaning of his divine action. Science will be confronted with ever increasing mysteries, as our scientific instruments become better and more accurate to allow confrontation of theory with experiment. The questions of how the universe and life in it were formed

will reveal new insights. Some questions escape the scope of science. We expect that future developments in philosophy and theology will gradually give us better insights into the question that was raised by the philosopher Gottfried Wilhelm Leibniz (1646-1716):

> *'Why is there something rather than nothing?'.... Further, assuming that things must exist, it must be possible to give a reason why they should exist as they do and not otherwise.*

(Leibniz, 1714). We are convinced that in the future the question of the proper place of Darwinism in science, and its teaching in colleges, will be settled to the satisfaction of society in general. This will take place without excluding the questions of faith in God that many scientists accept, including both authors of this chapter. It is of paramount importance for non-scientists to understand that we do not consider science as the ultimate truth, or a cultural sector that has the monopoly of wisdom. Indeed, we have aimed at stressing that science is an activity whose main strength is that it invites arguments to prove that current theories may be inaccurate; but such proofs are not implemented by acts of faith, or by authority. Progress is encouraged by science being continually corrected with new, relevant data, and by observation with instruments that the vertiginous progress of modern technology has put in our hands.

References

Augustine of Hippo (1984) *Concerning the City of God against the Pagans,* Penguin Classics, London (cf. Book XVII, p. 4).

Ayala, F.J. (1998) Darwin's Devolution: Design without Designer, in *Evolutionary and Molecular Biology: Scientific Perspectives on Divine Action***,** Robert John Russell, William R. Stoeger, S.J. and Francisco J. Ayala, Editors, Vatican City State/Berkeley, California: Vatican Observatory and the Center for Theology and the Natural Sciences. pp. 101-116.

Barbour, I. G. (1995) Ways of relating science and theology, in R. J. Russell, W. R. Stoeger, SJ and G. V. Coyne, SJ (eds.), *Physics, Philosophy and Theology. A common quest for understanding,* 2nd. ed., Vatican Observatory Foundation, Vatican City State, pp. 21-48.

Chela-Flores, J. (1998) The Phenomenon of the Eukaryotic Cell, In Russell, R.J., William R. Stoeger, S.J. and Francisco J. Ayala, (eds) *Evolutionary and Molecular Biology: Scientific Perspectives on Divine Action*, Vatican City State/Berkeley, California: Vatican Observatory and CTNS, pp. 79-99. http://www.ictp.trieste.it/~chelaf/ss20.html

Chela-Flores, J. (2004) *The New Science of Astrobiology From Genesis of the Living Cell to Evolution of Intelligent Behavior in the Universe.* Series : Cellular Origin, Life in Extreme Habitats and Astrobiology , Band 3 Kluwer Academic Publishers: Dordrecht, The Netherlands, 251 p., Softcover edition of the 2001 book, ISBN: 1-4020-2229-8 http://www.springeronline.com/sgw/cda/frontpage/0,11855,5-198-72-33595256-0,00.html

Chela-Flores, J. (2007) *Astrobiological reflections on faith and reason The issues of agnosticism, relativism and natural selection*. (In this volume.)

Chela-Flores, J., Lemarchand, G.A. and Oro, J. (2000*). Astrobiology: Origins from the Big Bang to Civilisation*. Kluwer Academic Publishers: Dordrecht, The Netherlands.

Chela-Flores, J, Owen, T. and Raulin, F. (2001). *The First Steps of Life in the Universe.* Kluwer Academic Publishers: Dordrecht, The Netherlands.

Coyne, SJ, G. V. (1998) *The concept of matter and materialism in the origin and evolution of life* in Chela-Flores, J. and Raulin, F. (Eds.), *Chemical Evolution: Exobiology. Matter, Energy, and Information in the Origin and Evolution of Life in the Universe,* Kluwer Academic Publishers, Dordrecht, pp. 71-80.

Coyne, G., SJ (2005) *God's chance creation,* The Tablet, 6 August. http://www.thetablet.co.uk/cgi-bin/register.cgi/tablet-01063

Darwin, C. (1859) *The origin of species by means of natural selection or the preservation of favored races in the struggle for life,* John Murray/Penguin Books, London, 1968, p. 455.

Editorial (2005) Keeping religion out of science class, Nature **436**, 753

Einstein, A. (1950). *Out of my later years*. Philosophical Library, New York., p. 25

Eldredge, N. (2006) Darwin Discovering the tree of life. Norton, New York.

Gould, S. J. (1999) *Rocks of Ages*, Ballantine, New York.

Haught, J. F. (1998). Darwin's gift to theology, in R.J. Russell, W. R. Stoeger, S. J. and F. J. Ayala, (eds.) *Evolutionary and Molecular Biology: Scientific Perspectives on Divine Action*, Vatican City State/Berkeley, California: Vatican Observatory and CTNS, pp. 393-418.

Haught, J. F. (2005). The Boyle Lecture 2003: Darwin, Design and the Promise of Nature, Science & Christian Belief, **17** (1), 5-20.

Leibniz, G. (1714*) The Principles of Nature and Grace, based on Reason*, in L. Loemker, ed., Philosophical Papers and Letters, 1969, Dordrecht: D. Reidel, pp. 636-42.

McMullin, E. (2000) *Life and Intelligence Far From Earth: Formulating Theological Issues,* Dick, S. (ed) In Many Worlds: The New Universe, Extraterrestrial Life and the Theological Implications, Philadelphia: Templeton Foundation Press .

Morell, V. (1997) Evolution: Predator-Free Guppies Take an Evolutionary Leap Forward, Science Vol. 275. no. 5308, p. 1880.

NAS (1999) *Science and Creationism: A View from the National Academy of Sciences*, Second Edition, National Academy of Sciences, pp. 35.

News **(**2006) Anti-evolutionists raise their profile in Europe, Nature 444, 406-407.

Russell, B. (1991) *History of Western Philosophy and its Connection with Political and Social Circumstances from the Earliest Times to the Present Day,* Routledge, London, p.13.

Russell, B. (1995) *Religion and Science*, New York: Dover

Peacocke, A. (1988) Biological evolution - a positive theological appraisal, in *Evolutionary and Molecular Biology: Scientific Perspectives on Divine Action.* R. J. Russell, W. R. Stoeger and F. J. Ayala, Editors. Vatican City State/Berkeley, California: Vatican Observatory and the Center for Theology and the Natural Sciences, pp. 357-376.

Polkinghorne. J. (1996) *Scientists as theologians.* SPCK: London

Ponnamperuma, C. and Chela-Flores, J. (eds.). (1993) *Chemical Evolution: Origin of Life* A. Deepak Publishing, Vol. **135**: Hampton, Virginia, USA.

Ponnamperuma, C. and Chela-Flores, J. (eds.). (1995). *Chemical Evolution: The Structure and Model of the First Cell.* Kluwer Academic Publishers: Dordrecht, The Netherlands.

Reznick, D. N., Shaw, F. H., Rodd, F.H., and Shaw, R. G. (1997) Evaluation of the Rate of Evolution in Natural Populations of Guppies (Poecilia reticulata), Science 275 1934-1937.

Seckbach, J. (ed.) (2004) "Origins: Genesis, Evolution and the Biodiversity of Life ", *Cellular Origin, Life in Extreme Habitats and Astrobiology*, **6,** Springer, Dordrecht, The Netherlands,.

Seckbach, J. (ed.) (2006) *"Life as we know it"*. Cellular Origins, Life in Extreme Habitats and Astrobiology, Springer: Dordrecht, The Netherlands,

Seckbach, J., Chela-Flores, J., Owen, T. and Raulin F. (eds.) (2004) Life in the Universe. From Miller experiment to the Search for Life in other Worlds. Kluwer, Dordrecht.

Spiegel Magazine (2005) *Darwinism Completely Refutes Intelligent Design*, December 26, http://www.spiegel.de/international/spiegel/0,1518,392319,00.html

Spinoza (2002) *Ethics.* Everyman, London.

Time (2005) *Evolution Wars*, August 15, volume 166 (7). 26-35.

Time (2006) *God vs. Science,* 13 November 2006.