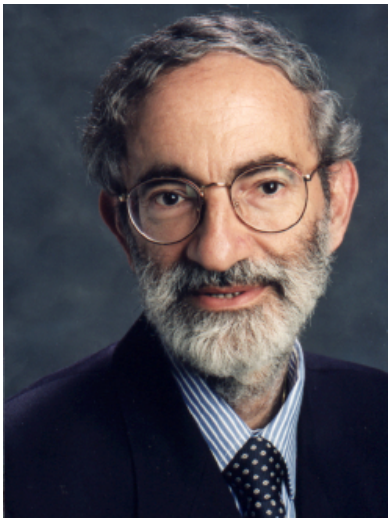
Biography



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4

Astrobiological Reflections on Faith and Reason

The Issues of Agnosticism, Relativism and Natural Selection[1]

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1. Is There a Crisis in the Dialogue Between Faith and Reason?

At a time when agnosticism is widespread in large sectors of society, it is relevant and timely to evaluate those insights into our origins that the science of astrobiology has given us, keeping in mind other sectors of culture. There are both philosophical and theological issues to discuss. First of all, is it conceivable to reject with scientific methods concepts that are of a theological nature? It should be emphasized that the scientific method is itself self-correcting. In spite of this remark, currently it seems to be a widely spread attitude to attempt going beyond the rational boundaries of science, a discipline that should restrict its statements only to hypothesis that can be verified by experiment, in a tradition that goes back to Galileo Galilei. The fact that science is based on a research process that makes it continually and permanently susceptible to improvements

[1]The text has been expanded in a forthcoming book: *A Second Genesis: Stepping Stones Towards the Intelligibility of Nature*. World Scientific Publishers, Singapore.

and corrections is indeed the main strength of the scientific method. Extending such a boundary into the domain of theology has the difficulty that theology is based on tradition and revelation, both concepts lying strictly beyond the scope of science. We argue that such debates are sterile even in the reverse direction. Our faith in divine action is independent of experiments and rational hypothesis.

At present we are faced with two new aspects of postmodernism that have not always characterized Western thought, namely relativism and agnosticism (St. Augustine, 417-427). We may distinguish two forms of relativism: cultural relativism means that a given culture should be understood on its own merits. Morality for one culture could be considered immoral in a different culture. Ethical relativism implies that what is ethical for a person is not an absolute concept but depends on circumstances, or the given society to which the individual belongs. On the other hand, agnosticism proclaims that humans cannot know the existence of anything beyond the phenomena of their experience. The roots of this doctrine can be traced back as far as the Enlightenment (cf., Sec. 4). The term is sometimes used loosely implying skepticism about religious matters, especially rejecting traditional religious beliefs. The growth of science is assumed to have influenced this doctrine.

The dialogue between faith and reason has been prominent since classical times in ancient Greece. An early example is expressed in the defense of the Christian Church that had to survive in a secular Roman world. “The City of God” should be seen in the broad perspective of all the Abrahamic traditions, including Judaism, Christianity and Islam (St. Augustine, 417-427 CE).

Indeed, Augustine advocated the worship of one true God and the rejection of all false gods. He completed Chapter XVII by the year 427 CE. Section 3 of that Chapter has the title: “The threefold meanings of the prophets, referring sometimes to the earthly Jerusalem, sometimes to the Heavenly City, sometimes to both at once”. At the end of the section he dwelt on a problem that has reached our own times: *Is it erroneous to suppose that the Holy Scriptures have any significance beyond the purely historical record?* But he also denied that every statement is a complex of allegorical meanings. The creation narrative of the book of Genesis is a recurring theme. His *De genesi ad litteram* was the result of many years of work, from the late 390s to the early 410s (St. Augustine, 401–414/415 CE). In this work he assumed that when a view has been expressed about the Earth, size and distance of the stars, the nature of

animals derived from reason and experience, it is damaging to confront this view by purporting to speak in accordance to holy writings (O'Meara, 1984).

Modern science evolved a thousand years later as a separate aspect of our civilization, mainly due to emphasis on the experimental foundations of science. In a modern context the dialogue between science and faith has not disappeared. In fact, it became even more prominent. The root of agnosticism, a second aspect that affects the dialogue between faith and reason, reappeared in the meetings of The Metaphysical Society. This learned association of intellectuals was a monthly discussion group that met in London starting in 1869. The Society included clergymen, Positivists, Deists and Unitarians. Thomas Henry Huxley was a Victorian biologist and a keen supporter of Charles Darwin. He attended these meetings (Desmond and Moore, 1991). Rather than 'atheism' he preferred the term 'agnosticism'. In his view an agnostic avoided religious issues. He rather advocated a positivist position that is shared by contemporary science, in which biology and other sciences deal only with the knowable world.

At the beginning of the 21st century globalization has had the net effect of allowing ideas to disseminate more efficiently. A consequence has been the widespread discussion of questions such as the following*: To what extent is knowledge dependent on context?* These topics define the philosophical topic of relativism (O'Grady, 2002; Ambrosi, 2005). According to this doctrine we no longer have absolute values. It would even be argued that modern thinking should be adjusted to incorporate relativism. Inevitably a crisis of reason in confrontation with faith can be perceived in Western thought (Ratzinger, 2004).

In the context of these two aspects of postmodernism (agnosticism and relativism), we discuss the phenomenon of life, with natural selection as its mechanism of evolution. Our main objective is to discuss how agnosticism, relativism and natural selection affect our society. Science, through research in astrobiology, is close to answering basic questions on the nature of life in the universe (its origin and evolution). The new perspectives that astrobiology might make available would contribute to the dialogue between faith and reason. One of them is the possibility of identifying a 'second Genesis'. Up to the present we are only certain that life has originated on Earth, but space missions for the exploration of the Solar System are attempting to investigate whether elsewhere in the Solar System life may have originated a second time.

2. Has there been a Second Genesis in the Solar System?

The satellite Europa is a candidate for life in the Solar System. This follows from the indication that a large proportion of the spectroscopically detectable material on its surface is water (Soffen, 1976; Horneck, 1995). The Voyagers are two US spacecrafts that explored the outer Solar System during the period 1977-1989. They still continue their travel beyond the orbit of Pluto. The two Voyagers were launched the same year with different objectives. Voyager 2 completed a set of images of every planet in the Solar System.

According to the results obtained on the Jupiter system by the Voyager 2 mission, we know that there may exist an ocean of water under Europa's icy surface. The lure of this Jovian moon is due to the possibility of finding traces of life on that satellite. The Galileo Mission gathered much information during its activity (1995-2003). Galileo has changed the way we look at the Solar System and especially Europa. The Galileo spacecraft was the first to conduct long-term observations of the Jovian system from orbit. It found evidence of subsurface water not only on Europa, but also in Ganymede and Callisto. It also revealed the intensity of volcanic activity on Io.

Up to the present time we do not fully understand the divergence into the three 'domains' of life (previously called 'families') that arose from the evolution of the earliest ancestor of all life on Earth. Indeed, plate tectonics has obliterated fossils of early organisms from the crust of the Earth, which is the only record available to us on the evolution of early life. Europa is a candidate for the search of extra-terrestrial microbes either extant or extinct. There is at present a possibility for returning to Europa with LAPLACE (Blanc et al. 2008), a mission to Europa and the Jupiter System for the European Space Agency's Cosmic Vision Programme. The exploration of Europa raises significant questions: *Does it represent the "habitable zone" of the Jupiter system? Does Europa actually harbor life?* These questions on habitability can be answered in the future by the identification of reliable biosignatures, namely the identification of characteristic biochemical substances, or minerals that can be taken to be a reliable indicators of the biological origin of a given sample. This is a major priority in the current exploration of the Solar System. The options for selecting the right instrumentation for the purpose of searching for biosignatures have been discussed elsewhere (Chela-Flores and Kumar, 2008).

Previous work has suggested that there are at least two sources of heating of Europa independent of the Sun. They are tidal and radiogenic heating (Reynolds et al. 1987). Of these two forms of heating, on Earth we are familiar with radiogenic heating, which is a consequence of the heat produced by the accumulation within the Earth crust of radioactive compounds. The new factor in the Jupiter system is that unlike the Earth, Europa is influenced by its two neighboring satellites: the very volcanic satellite Io, which is closer to Jupiter, and the giant satellite Ganymede, which is even larger than planet Mercury. The dynamics of this three-body system keeps the satellites from perfect circular orbits. The consequence is that the eccentricity of the Europan orbit varies significantly in the points of closest and farthest approach to the giant planet, thereby creating thermal gradients that we have called earlier 'tidal heating'.

Fortunately, we have some clear observational evidence of this form of heating, since Io, its nearest Moon-sized neighbor, is not covered with ice like Europa itself, neither does it have a thick atmosphere such as that of Titan, the satellite of Saturn. It is possible then that the Europan internal ocean has consequently been formed (underneath a relatively thin ice cover) through dehydration of silicates, the heating source being due to tidal heating with an addition due to radiogenic heating. From the similarity of the processes that gave rise to the solid bodies of the Solar System, we may expect that hot springs may lie at the bottom of the Europan ocean. On Earth there is an analogous environment in Antarctica: Lake Vostok lies underneath the Vostok station of the Russian base. It appears to be harboring hydrothermal vents beneath the water surface. This is suggestive of what may be occurring on Europa. This lake is about 1,000 km from the South Pole and beneath 4 km of ice. In the southern region of Antarctica many bacterial species have been found in zones of accreted ice, about 120 m above the water-ice surface (cf. Dudeja et al. 2008 for references). The main thesis of the proponents of the existence of an Europan biota is that, as Jupiter's primordial nebula must have contained many organic compounds, then possibly, organisms similar to heat-loving microbes can evolve at the bottom of Europa's ocean (Oro et al. 1992).

3. On the Implications of Darwinism

The search for life on Europa represents one of the major efforts that will have to be faced in the foreseeable future to give us insights into life's origin that

would go beyond what we have been able to learn from research in organic chemistry. The general outline of life's emergence on Earth is nevertheless understood, and its implications for the humanities have been discussed elsewhere (Chela-Flores, 2005). For example, life is known to have emerged early in the history of the Earth, some 3.5 billion years before the present. The evidence comes form micropaleontology (Schopf, 1993). The microorganisms involved are fossils of stromatolites. These are geological features consisting of a stratified rock formation, which are essentially the fossil remains of bacterial mats. The bacteria that gave rise to these formations were mainly cyanobacteria. Similar mat-building communities can develop analogous structures of various shapes and sizes in the world today.

Besides, it is safe to assume that over three billion years ago there was a flora of cyanobacteria, although the exact date for the earliest ancestor is a hotly debated issue (Brasier et al. 2002). The early forms of life are also known to have been a major factor in the evolution of the hydrosphere and the atmosphere. The time sequence of these events has been inferred following standard procedures and hypothesis. Like other branches of science, these dates are subject to improvements by new experimental techniques and observation procedures. This state of affairs is in sharp contrast with the questions of faith that are based on tradition and revelation. The statements of science are closer to philosophy in the sense that both systems attempt to make their statements on a rational basis. Charles Darwin, the English naturalist, was the author of the theory of evolution through the mechanism of natural selection (Darwinism). His theory was published in 1859 in his book "*The Origin of Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life*". This work led to the definitive theory of evolution that had been anticipated in earlier incomplete forms by Charles' grandfather Erasmus Darwin and independently by Jean-Baptiste Lamarck.

The case of Lamark is especially relevant in the present context. He published in 1778 a book on French plants, *Flore Française*. At the beginning of the 19th century Lamarck in his late fifties began the revolutionary steps that led him to develop an evolutionary theory, rather than accepting that the living world was fixed and harmoniously organized. Lamarck believed that a change in the environment causes changes in the needs of organisms living in that environment, which in turn causes changes in their behavior, and once again in turn this leads to differential use of internal organs. (Eventually organs either continuously improve or gradually disappear.) Such a mechanism for evolution

of life on Earth — called Lamarckism — was different from Darwin's (particularly since Lamarck stated that these changes in the organisms would be inheritable). But, in the end, Lamarckism leads to adaptive change in lineages driven by environmental change, over geologic time. In spite of its limitations, the originality of evolution of life on Earth being driven by the environmental changes disrupted a view of life that persevered in the life sciences since the time of Aristotle. According to Lamarck, therefore, living species are interrelated through reproduction, slowly evolving through the course of generations.

Throughout his life Darwin avoided the problem of the origin of life, except from making a few speculative remarks about the possible environments where life could have originated, the so-often-quoted 'warm little pond'. This was a very reasonable attitude for the late 19th century, before experimental science began to address the question of the origin of life with Fox, Haldane, Oparin, Miller, Oro, Ponnamperuma and others.

4. Darwinism, Philosophy and Theology

Darwin, wisely for his time, avoided the question of the origin of life. He rather focused on the origin of the species by introducing the term 'natural selection' for reproductive success, allowing adaptation to changing environmental conditions. In other words, natural selection is the non-random element in evolution that gives evolution its direction. The magnitude of this revolutionary contribution to science is evidenced by the perennial difficulty to insert this fundamental aspect of science into the mainstream of cultural knowledge. This may be illustrated with the dialogue between his Eminence Cardinal Christoph Schönborn and George Coyne SJ. The main point made by Schönborn is that evolution in the sense of common ancestry might be true, but evolution in the neo-Darwinian sense — an unguided, unplanned process of random variation and natural selection — is not (Schönborn, 2005). Any system of thought that denies or seeks to explain away the overwhelming evidence for design in biology is ideology, not science.

However, the point made by Coyne, and shared by most scientists, is that science is completely neutral with respect to philosophical or theological implications that may be drawn from its conclusions. Those conclusions are always subject to improvement. As we have emphasized above this is the nature

of science. But to deny today's science on religious grounds is to go beyond the natural boundaries of theological thoughts, which are interpreted by Coyne in very clear terms as (Coyne, 2005):

> "Theologians already possess the concept of God's continuous creation with which to explore the implications of modern science for religious belief."

Likewise, to attempt to make changes in theological thought on the strength of science is to go beyond the natural boundaries of science. Western civilization has faced this dichotomy before during the Enlightenment. This was an intellectual movement of the 17th and 18th centuries in which ideas concerning God, reason, nature, and man went into a synthesis that had many supporters. Amongst the most distinguished thinkers of this period we have: Descartes, Diderot, Montesquieu, Pascal, Rousseau and Voltaire. This movement was influential in the development of art, philosophy, and politics. Reason was the main theme underlying most innovations of this period. The thinkers behind this movement searched for a deeper understanding of the cosmos. Rationalists strived towards more freedom, knowledge and happiness. Under the influence of the Enlightenment the French philosopher Auguste Comte (1798-1857) founded a movement advocating that intellectual activities should be confined to observable facts.

The reason why this movement was called "positivism" is that Comte called observable facts 'positive'. Indeed, positivism can be considered as a philosophical system of thought maintaining that the goal of knowledge is simply to describe the phenomena experienced, not to question whether it exists or not. This point of view was developed much later by a group of philosophers working in Vienna in the 1920s and 1930s. They were known as the "Vienna Circle".

The nucleation of the group began with Moritz Schlick, when he settled in Vienna in 1922 (Feigel, 1963). Some of the Vienna Circle's members were Rudolf Carnap, Hans Reichenbach, founder of the Berlin Circle, Herbert Feigl, Philipp Frank, Kurt Grelling, Hans Hahn, Carl Gustav Hempel, Victor Kraft, Otto Neurath, Friedrich Waismann. Also K. R. Popper and H. Kelsen were related to the Vienna Circle, although they did not strictly belong to it.

This group of philosophers maintained that scientific knowledge is the only kind of factual knowledge. The distinctive aspect of this version of extreme positivism was an attempt, referred to as 'logical positivism', to develop knowledge based on experience (empiricism), with the help of mathematics and logic. They insisted on the soundness of logical analysis of scientific knowledge. Indeed, logical positivists appealed to the earlier contributions of Russell and Wittgenstein. The Vienna Circle maintained that all traditional doctrines are to be rejected as meaningless. They were generally hostile to metaphysics and theology. The Vienna Circle went beyond positivism in maintaining that the ultimate basis of all knowledge rests on experiment. Although some scientists have adopted this philosophy, either consciously or unconsciously, the fact remains that modern science begins with Galileo, who initiated the tradition of formulating theories based on observation and experiments. No underlying philosophy was adopted then beyond the dialogue between theory and experiment. On the other hand, there are a large number of issues that science cannot handle, or even formulate. In his *History of Western Philosophy* Bertrand Russell makes this point (Russell, 1991)**:** "Almost all the questions of most interest to speculative minds are such as science cannot answer".

Positivism avoided all considerations of ultimate issues, including those of metaphysics and religion. However, as anticipated by Russell, the reduction of all knowledge to science is a matter that debate has not yet settled. Natural selection was expanded by the gradual growth of the science of genetics, especially molecular genetics. The origin of life on Earth is on similar grounds; the phenomenon is understood in its broad outline. The details of the specific organic pathway from biochemistry to a microorganism are still being sought. But our theories imply that once the biomolecules of life were self-assembled into a functional living cell, natural selection led to evolutionary pathways that left clear records in the fossils.

5. Discussion

So far the above discussion of the emergence of life on Earth is subject to experimental refutation. The example mentioned earlier in relation to dating of the oldest microfossil of 3.5 billion years before the present is a clear example of the way science progresses. Refutation of arguments previously assumed to be on secure basis constitutes a normal procedure in science. The philosophical discourse, on the other hand, is in a 'no-man's land' between faith and reason.

One clear illustration is provided by the question of relativism. One universal truth in a theological sense is the omnipresence of divine action, which is an act of faith that requires no scientific support, neither is it subject to the relativist constraints. As a question in the philosophy of religion, relativism may be marginally more interesting. But relativism is irrelevant to faith that is based on tradition and revelation. These premises of faith are common to the whole Abrahamic tradition that is professed by Jews, Christians and Muslims alike.

With Augustine we believe that it is erroneous to attempt to confront the scientific implications of natural selection with religious statements from the Holy Books. This would take us beyond the natural frontiers of science. It would be equally erroneous to confront the theological statements related to divine action with scientific concepts: theological thinking should only concern revealed truth and related rational thinking. No controversy should arise in relation to teaching science and religion. If natural selection were eventually faced with scientific facts and observations that suggest it not to be the best hypothesis for the evolution of life on Earth, then a better mechanism would be suggested, due to newer facts that would not allow a traditional Darwinian interpretation. Likewise if new prophecies were to be lead to new revealed truth in the realm of theological thought, then this would lead to a new theologies, not to new scientific approaches. This has occurred repeatedly in Western civilization when, for instance, the revealed truth of Judaism was supplemented with the revealed truth of Christianity, and later by that of Islam. Nevertheless, these parallel avenues of thought often address the same questions, such as what is the relation between humans and the universe.

Darwinism and theological thought have been shown to be compatible within the framework of kenotic process theology. Indeed, kenosis as a concept 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 the generosity and respect that flow from it (Ellis, 1998). God is the sole ground for the world's being (Haught, 1998, 2005). This approach to natural theology leads us to explain the world in terms of evolution, as understood within the Darwinian tradition (Russell et al. 1996). Haught focuses on process thought. 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.

Our main conclusion on the question of faith and reason is that space exploration, especially the exploration of Europa, can encourage a constructive dialogue between faith and reason for the benefit of culture in general.

6. Glossary

Agnosticism is the doctrine that humans cannot know of the existence of anything beyond the phenomena of their experience. The term is sometimes used loosely implying skepticism about religious matters especially rejecting traditional Christian beliefs. The growth of science is assumed to have influenced this doctrine.

Astrobiology is the research into the origin, evolution, distribution and destiny of life, not only in the Solar System, but also in the whole 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.

Divine action The Mosaic traditions (Judaism, Christianity and Islam) assume a process of deliberate self-revelation of God to humanity. Accompanying such forms of piety is the attribution to God of both intentions and the capacity for action as a means of expressing those intentions. Making sense of the concept of divine action is a current challenge to both philosophy and theology.

Darwinism A theory of the mechanism of evolution due to Darwin. It is assumed to explain organic change. It is brought about by three principles: (1) variation, (2) heredity and (3) the struggle for existence.

Faith is a subjective response to divine truth as well as a supernatural act of the will.

Natural selection is a term suggested by Darwin for the struggle for existence, differences in survival, in fertility, in rate of development, in reproductive success. It is a process resulting in the adaptation of an organism to its environment by means of selectively reproducing changes in its genetic constitution. The magnitude of this revolutionary contribution to science is evidenced by the perennial difficulty to insert this fundamental aspect of science into the mainstream of cultural knowledge.

Natural theology is the body of knowledge about religion that can be obtained by human reason alone, without appealing to revelation.

Neo-Darwinism. The evolutionary synthesis of Charles Darwin's theory of the evolution of species by natural selection, Gregor Mendel's theory of genetics as the basis for biological inheritance, and the mathematical formulation of population genetics. This aspect of evolution has been due to the work of several scientists, including Theodosius Dobzhansky, Thomas H. Morgan, Ronald Fisher, J.B.S. Haldane, William D. Hamilton, Julian Huxley, Ernst Mayr, George Gaylord Simpson, G. Ledyard Stebbins. and several others. These evolutionary biologists introduced the connection between the units of evolution (genes) with the mechanism of evolution (selection). The term also applies to the unification of several branches of biology especially genetics, cytology, systematics, botany, and paleontology.

Positivism is a philosophical system of thought maintaining that the goal of knowledge is simply to describe the phenomena experienced, not to question whether it exists or not. In other words, in philosophy positivism is any system that restricts itself to the data of experience to the exclusion of arguments based on metaphysics.

Reason A faculty contrasted with experience, passion or faith.

Relativism (cultural) A given culture should be understood on its own merits. Morality for one culture could be considered immoral in a different culture.

Relativism (ethical) What is ethical for a person is not an absolute concept but depends on circumstances, or the given society to which the individual belongs.

Revelation A process by which communication of truth by God takes place. Christian philosophers have distinguished between 'truths of reason' and 'truths of revelation'. (cf., natural theology.) The monotheistic religions state that God has chosen to manifest himself through the prophets, but He can manifest Himself through his main creations: the universe and the life that has evolved in it. In the Judeo-Christian tradition the prophets are witnesses and interpreters of God's divine action, both in their transmission of God's messages, as well as in the way to interpret His divine action.

Theology (Kenotic Process Theology) An approach to natural theology emphasizing God as the sole ground for the world's being. It attempts to explain the world in terms of evolution as understood within the Darwinian tradition

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Dialogue

Tom Barbalet
From Section 1:
There are a number of points made as truisms I find concerning.

Cultural relativism is used haphazardly in contemporary discussions. No contemporary society allows isolated individuals to commit acts of murder or wantonly damage property. Whilst the state may be able to do these things in a variety of contemporary societies, no society allows the individual at an undetermined time to do these acts. From that grounding cultural relativism has limits and can not be used to justify all acts as relative across cultures. Somewhat non-trivially this also undermines the assertion of ethical relativism, although this is more controversial.

> "… it is erroneous to suppose that Holy Scriptures have any significance beyond the purely historical record."

It would appear to be erroneous to suppose that Holy Scriptures have any significance with regards to the historical record either.

> "Modern science evolved a thousand years later as a separate aspect of our civilization, mainly due to emphasis on experimental foundations of science."

Bar perhaps the sciences with a mathematical component that can be traced back to Classical mathematics, if not earlier. Not to forget sciences that require engineered/applied experimentation that also can be traced to ancient Egypt. In fact, to say modern science comes from the modern age is a temporal truism. To say modern science evolved from somewhere between 1000 and 1800 CE (depending on which prophet starts the thousand year counter) neglects the foundations of science that predate this time.

From Section 2:
There is a popular misuse with regards to astrobiology, similar to quantum mechanics in new age spirituality and genetics in memetics, that lays credit to a wide variety of farcical possibilities. The language used by scientists with regards to astrobiology needs to be metered with a substantial degree of caution otherwise it is likely to be used as evidence rather than possibility.

Even with primary contact to a crime scene, for example, the ability to find genetic evidence is still non-trivial. In terms of planetary exploration, in order for astrobiological evidence to be credible to the definitions of modern science alluded to in section 1, there will need to be substantial detailed exploration in the future. The contemporary remote and piecemeal sensing of planets and their satellites give a quality of information analogous to grainy photographic plates as an attempt to prove a person's identity.

From Section 4:

> "... science is completely neutral with respect to philosophical or theological implications that may be drawn from its conclusions. Those conclusions are always subject to improvement."

Early quantum mechanics and Kantian philosophy could be a counter-example to this hypothesis. Whilst the dialogue of the early practitioners of quantum mechanics seems to indicate that they where interested in basing their mechanics in Kantian perception, they metered their conclusions based on this philosophical view as well. This has been challenged thoroughly by practitioners following them, without question.

To a certain extent, I think biological phyla are a counter example to this as well. This is a structural methodology with philosophical and theological roots which predate contemporary Darwinian biology and continue to circumvent conclusions.

Perhaps I am predisposed to the idea that particular dominant philosophies perturb all aspects of the scientific process.

Julian Chela-Flores
I welcome these comments hoping that our readers will not only take both points of view into account, but that they will also participate in a constructive dialog.