SOPHIA-IBERIA in Europe

Human Evolution:
in search of our anthropic roots

Universidad Pontificia Comillas
Madrid, September 5 - 8, 2007

HUMAN EVOLUTION:
IN SEARCH OF OUR ANTHROPIC ROOTS

SOPHIA-IBERIA IN EUROPE'S ACADEMIC CONFERENCE

Universidad Pontificia Comillas
Aula García Polavieja

Alberto Aguilera 23, Madrid

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PROJECT DESCRIPTION

The academic conference held in Madrid, in September 2007, forms part of the *Sophia Iberia in Europe* (SIE) project on Human Evolution. The general objective of the project and of this academic conference is to create an platform in which questions are raised and suggested that give rise to open and participatory reflection in the next few years.

The SIE project welcomes those who have registered for this academic conference and wishes to express the expectation that, through these meetings and their diffusion (web site, publications, etc), a process of reflection will be opened over the next few months in accordance with the project programme.

Some aspects of the SIE project, which can be consulted more fully at: www.upcomillas.es/sophiaiberia, will be overviewed below, providing a more precise explanation of the expectations of the organisers of the SIE as regards this conference.

1. Theme of the Project

The SIE project is oriented to themes which relate the results of science – in accordance with its methodology – with philosophy and theology. The project was created by a group of professors and researchers, aware that the meaning of life and the ultimate metaphysical truth of the universe always present great concern throughout the history of humanity.

Man seeks meaning and authenticity in his existence and must use reason in this search. The fact is that today the reason which seeks meaning cannot be exercised if it is not in accordance with the results of the most rigorous exercise of reason which we call science.

We find that the history of humanity provides us with a wealth of ideological, cultural and religious cosmo-visions. Christianity has reached us through a number of Churches which have different theologies within a basic Christian unity.

We also have access to the result of scientific research which today provides us with the most rigorous image of physical matter and the universe, life and its evolutionary development, the appearance of man and the emergence of reason.

The themes of the SIE project, which is also the theme of this academic conference, deals precisely with presenting the image of matter-universe, of life and man in his evolutionary unity from a strictly scientific image. This involves studying human evolution from its anthropic roots. The expression anthropic roots means that, if man has been evolutionarily possible, we must postulate, within a general evolutionary paradigm, that the ontology of primordial matter already had certain anthropic properties which made the organisation of an anthropic universe possible. The organisation of living matter which constitutes the immediate basis from where man would emerge and the appearance of the human mind as the final generator of possibilities for each man personally and for humanity as a whole follows.

The reflection on the anthropic properties which lead man from matter is essential in order to correctly understand human nature, including the nature and the functional use of reason. However, the organisers of the SIE project have considered that the grand metaphysical questions of humanity and the questions on the final meaning of life remain open, from the new scientific image of the world. Thus, the objectives of the SIE project go beyond the purely scientific in order to again address the ideological, philosophical and theological problems from the point of view of science.

Basically, the SIE project intends to create an area of critical and constructive reflection on the grand ideological, philosophical and theological traditions, from the perspective of the new image of the world provided by the sciences.

It should be pointed out that the SIE project also assumes the expectations of those who believe that, today, science offers a basis for the humanistic convergence of men and a basis for mutual recognition and convergence of the different cultural, religious and theological traditions, within the framework of a critical, non-dogmatic evaluation of the knowledge which leads to respect and tolerance as opposed to the diversity of interpretations of the world and the configuration of the meaning of life.

The organisers of the SIE project seek these objectives from a personal and institutional commitment with Christian and Catholic tradition. It is also clear that the organisers of the SIE project consider that its personal and institutional search is essentially united to the opening up of dialogue, to the participation of thought, and the evaluation and appreciation of the values 'of the other', within the framework of tolerance.

2. The first steps of the project

The SIE project began with two initial actions which constitute the 'first steps' or the appearance on stage of the framework which we wish to constitute in order to achieve our objectives:

a) The first step was the opening of the web site in June 2007. This web site will grow throughout the next few months and years and will be the reference point for our work.
b) The convening of the Academic Conference in Madrid, in September 2007 in order to have a first encounter which makes it possible 'to start out' so as to comply with the objectives set out.

3. The Madrid 2007 Academic Conference

This Conference has been organised at the beginning of the SIE project and must not be understood as a conference in the usual style (where the main point is the presentation of communications at separated, independent tables), but as the first meeting point in order to begin to think.

The expectation of the SIE organisers is that this conference might stimulate the organisers of the project, the speakers, the discussants, the participants, the audience and the participants which will access the documents of this conference

through our web site in order to draft precise, compromised papers which will give rise to an open enriching discussion. These participation papers, which we expect to be drafted within the next few weeks and months, will be immediately published on the web site and in the medium term, will be published on paper in the SIE project. Consequently the steps or stages in this conference, as understood by the organisers, are as follows:

a) The preparation of the basic documents for reflection. There are two. First, the framework documents, already posted on the web site and reproduced in this Conference Book. Second, the slides prepared in order to introduce each of the five sessions of this conference. The objective of these documents is not to close the discussion of the problems but to open, stimulate and provoke. These documents have been written in order to leave the problems open while showing the main scientific and philosophical positions. However, they have a certain inclination or bias: for example, they present a monist and emergentist position; they consider reductionism to be insufficient to justify anthropic evolution; they positively evaluate the new possibilities of quantum neurology and its connection with the physics of fields; they are inclined to weigh up the approach, while respecting atheism and agnosticism. In any case, the intention is not to close any possibility of thought, but to give rise to discussion, provoke the proposal of alternatives and personal contributions of all kinds which might enrich the analysis of the questions.

b) The contribution of the speakers and the presentations of the discussants. The speakers and discussants will provide the conference with a brief summary of their interventions which are published in the Conference Book, and will later appear on the web site. Their analysis and proposals also form part of the work material.

c) Contribution of the participants. The discussion of the problems by the participants and by the public will also contribute enriching points of view which will be added to the work material. Some participants have also contributed personal written papers to the Conference included in the Conference Book.

d) Presentation of final papers. After the Conference, the definitive papers may be presented enriched by the ideas arising during the Conference. The participants are requested to send in their papers within a period of time no greater than 6 months.

e) Publication on the web-site. The papers which are received will be published immediately on the web site after they have received the approval of the Publication Commission.

f) Publication on paper. All the material will also be published as a book. This will consist of all the introductory slides, the framework documents, the lectures given by the speakers, the papers presented by the discussants and the papers selected from the contributions of those participating and the general audience at the conference.

4. Other actions of the SIE project

As already stated, the main objective of the SIE project is to create an atmosphere of international reflection which makes it possible to order and analyse the proposals for thought in progress today in order to understand the anthropic

horizons which may open up for human evolution, described in an inter-disciplinary fashion through ideologies, philosophy and theology.

The SIE project will be developed over the next three years and will open up a process of participated reflection in order to make an in-depth analysis of several aspects of the themes of the project.

The most important undertaking will be the Web-Based Academic Seminars. An important group of professors will first debate relevant themes in a restricted manner. In the second stage, the topics for discussion will be opened up to the general public on the web site, to inform and open participation in the debate.

The planned academic seminars are the following:

a) *"Evolutionary genesis, ontology and functional nature of reason"*. The anthropological problem of the nature and emergence of human reason will be addressed. The scientific reasons for the emergence of reason and its functional nature are essential for understanding the products created by the human mind, including science, philosophy and theology.

b) "*Physical reality and psychic reality within a unitary universe*". The problem of the emergence of awareness-consciousness from the primordial physical world is addressed. The psychical world emerged in the living beings. However, the classical problem of sensitivity-consciousness continues to be obscure and must be illuminated from philosophical reflections and speculations, founded on scientific-phenomenological evidence.

c) "*Philosophy and Theology from the scientific image of human evolution*". The weighing up of the scientific image of the world and its projection on the problems proposed in philosophy and theology will be addressed. The various philosophical and theological models will be proposed and evaluated in order to define the arguable hypotheses on the anthropic future of humanity, as can be illuminated by reason.

The SIE project expects that those attending or interested in the Madrid 2007 Academic Conference will also be interested in the academic seminars which will be duly published on our web site.

5. Call for participation

The organisers of the SIE project wish to make a call for participants and those interested in this academic conference in Madrid 2007 to commit themselves to a growing commitment to reflection on the themes of the project which involve essential aspects for our scientific knowledge of the world and for the rational hypotheses which we can make as regards the anthropic future for man as a person and for humanity.

The success of the SIE project within the next few years will depend on the degree of participation and the quality of the scientific-philosophical proposals made.

The organisers of the SIE project will make sure that the papers which reach us do not arrive in vain. That is to say, they will be duly published and will also receive a response, an echo, within the framework of our project.

We wish to thank all the participants in the Madrid 2007 Conference for their contribution and for further input to the SIE project.

PROJECT TEAM

The project team of the Sophia-Iberia in Europe Project is formed by:

Christine Heller del Riego (Project Director)

Professor of the Department of Electrical and Systems Engineering
Escuela Técnica Superior de Ingeniería (ICAI)
Universidad Pontificia Comillas de Madrid

Javier Leach Albert

Full Professor, School of Computing. Universidad Complutense of Madrid, Spain
Director of the Chair of Science, Technology and Religion, Universidad Pontificia Comillas de Madrid

Javier Monserrat Puchades

Full Professor, School of Psychology, Universidad Autónoma
Ecclesiastical Schools, Universidad Pontificia Comillas.
Advisor to the Chair of Science, Technology and Religion.

Jens Degett

Executive Director of EAGLES - European Action on Global Life Sciences
Communications Advisor of the Chair of Science, Technology and Religion, Universidad Pontificia Comillas.

Amparo García-Plaza

PhD. Student, Theology Faculty, Universidad Pontificia Comillas
Sophia-Iberia Project Secretary

CONFERENCE PROGRAMME

Wednesday, 5 September 2007

16:30 Registration Opens
18:00 Welcome Cocktail

Thursday, 6 September 2007

9:00 - 9:30 **Welcome to Comillas University**
José Ramón Busto Saiz
Rector of Comillas University of Madrid

Presentation of Sophia-Iberia in Europe
Javier Leach Albert
Director Chair of Science, Technology and Religion

Session I: Matter and Universe
Chair: Agustín Udias
Complutense University of Madrid, Spain

9:30 - 10:00 Presentation of evolutionary moments
10:00 - 11:00 **William Stoeger**
Vatican Observatory and University of Arizona, USA
11:00 - 11:30 **Paul Gabor**
Vatican Observatory

11:30 - 12:00 Break
12:00 - 13:30 Debate and conclusions

13:30 - 15:30 Lunch

Session II: Life
Chair: Kuruvilla Pandikattu
University JDV, Pune, India

15:30 - 16:00 Presentation of evolutionary moment
16:00 - 17:00 **Niels Henrik Gregersen**
University of Copenhagen, Denmark
17:00 - 17:30 **Carlos Alonso Bedate**
Consejo Superior de Investigaciones Científicas, Madrid, Spain

17:30 - 18:00 Break
18:00 - 19:30 Debate and conclusions

Friday, 7 September 2007

Session III: Man and Neurology
Chair: Jens Degett
EAGLES Project, Spain

9:30 - 10:00 Presentation of evolutionary moment
10:00 - 11:00 **Francisco Mora**
Complutense University of Madrid, Spain
11:00 - 11:30 **Javier Monserrat**
Comillas University of Madrid, Spain

11:30 - 12:00 Break
12:00 - 13:30 Debate and conclusions

13:30 - 15:30 Lunch

Session IV: Formal Sciences
Chair: Christine Heller del Riego
Comillas University, Spain

15:30 - 16:00 Presentation of evolutionary moment
16:00 - 17:00 **Piergiorgio Odifreddi**
University of Turin, Italy
17:00 - 17:30 **Piotr Janik**
University School Ignatianum, Cracow, Poland

17:30 - 18:00 Break
18:00 - 19:30 Debate and conclusions

20:30 Conference dinner

Saturday, 8 September 2007

Session V: Theological Reflection
Chair: William Stoeger
Vatican Observatory and University of Arizona, USA

9:30 - 10:00 Presentation of evolutionary moment
10:00 - 11:00 **Fraser Watts**
University of Cambridge, UK
11:00 – 11:30 **Job Kozhamthadam**
University JDV, Pune, India

11:30 - 12:00 Break
12:00 - 13:30 Debate and conclusions

13:30 - 14:00 **Conference closure**

SESSION I: MATTER AND UNIVERSE

SPEAKER: **WILLIAM R. STOEGER**
VATICAN OBSERVATORY AND UNIVERSITY OF ARIZONA, USA

Stoeger is a staff scientist for Vatican Observatory Research Group and the University of Arizona specializing in theoretical cosmology, high-energy astrophysics, and interdisciplinary studies relating to science, philosophy and theology.

Stoeger's research has dealt with various problems connected with the physics of accretion onto black holes, and mathematical and physical issues connected with torsion and bi-metric theories of gravity, as well as the harmonic map structures contained in gravitational theories, including general relativity. More recently, with collaborators from South Africa, England, and the United States, he has been concentrating on observationally oriented projects in theoretical cosmology, attempting to build more adequate bridges between theory and cosmologically relevant astronomical observations and observations of the microwave background radiation. He also continues to pursue some research on the physics of the central engine in active galactic nuclei and quasars.

ABSTRACT: LIFE WITHIN A COSMIC CONTEXT

We can fully understand the origins of life and consciousness scientifically only by first understanding the cosmos within which they have emerged. That means not only knowing more about the universe the way it is now, but also – and more importantly – coming to know about the history of the universe from the Big Bang, or even ``before" that, until the emergence of life on our planet. For the innumerable necessary conditions for life, including particularly the evolving complexity on macroscopic and microscopic scales, were only gradually fulfilled during the first few billion years of its 13.7 billion year history. But at the same time, some of the most essential and pervasive cosmic requirements for complexity and life were determined during the first second after its emergence from the Planck era.

Thus cosmic evolution sets the stage for, and generates both the building blocks and the local environments within which complexity – and eventually life – can develop and thrive. It is best sketched by saying that the history of the universe from the Planck era (the period right after the Big Bang, when it was dominated by quantum fields, and space-time as we know them did not yet exist) is simply that of an expanding sphere of smoothly distributed gas, cooling and becoming ever more lumpy and complex as it cools. That is, as the universe expands and cools, new things and conditions become possible and emerges. Astronomy and physics become more complicated, chemistry emerges, and eventually from

chemistry life. For instance, there was a time – during at least the first several million years after the Big Bang – when the only chemical elements were hydrogen, helium and a little bit of lithium. Only after the birth of stars were all the heavier elements formed. Stars are the factories within which all those heavier 89 natural elements are produced. Obviously, then, stars are essential for the emergence of life. It is sobering to realize that there are many ways in which the universe could have failed to produce stars – leading to a completely sterile and boring cosmic environment, without chemistry and without life or consciousness.

This is an instance of the apparent fine-tuned character of the universe. If any one of the parameters which describe its properties – e. g., its very early, ``initial" rate of expansion, the amount of mass-energy it contains, the strength of gravity, electromagnetism, or the nuclear forces were just slightly lower or higher by a percent or two, the universe would be lifeless. This fine-tuning is often referred to as ``the anthropic principle" – though it is really neither ``anthropic" nor a ``principle". This strongly indicates that our universe – and any universe in which complexity and life thrive – is very special and unusual among the class of all possible universes. What accounts for such fine-tuning? From one point of view, the very fact we are here examining that question means that our universe has to be that way – for us and our necessary support systems to exist. There would be no observers in a lifeless universe. But, from an a priori perspective such fine-tuning demands an deeper explanation: How did it happen that the universe is of the special character that enables complexity, life and consciousness to emerge within it?

There are two possible answers to that question. The first is that the Creator – or the equivalent established the universe from the beginning with the initial conditions appropriate for eventual complexification and generation of life. But this solution, though possible, takes us outside the natural sciences, for it appeals to an intentional super-agent which cannot be either confirmed or falsified by scientific methods. Such considerations are proper to the realms of philosophy and theology. Thus, a second – though certainly not an ultimate answer has become standard among cosmologists: Our universe is but one of a very large number of existing universes, which represent a wide range of possible physical and cosmological parameters. There are many of them which are sterile, but a certain limited number of them which have all the values of their key parameters in the biofriendly range. Ours is obviously one of those. The real existence of a multiverse, though not in any way yet demonstrable, receives strong theoretical support in quantum cosmology for other reasons – mainly because it is very difficult to generate our own universe without also generating many others. However, this multiverse scenario does not provide an ultimate answer to our question. Though physics can potentially describe and model such a multiverse containing at least a few biofriendly universes, one can always ask the deeper question: what is the origin of the wave-function or the potential, and its physics, which spawned that type of multiverse?

If we focus just on our universe, what are the key stages in its evolution? First is the transition from the Planck era which established space-time as a continuum and gravity as a separate interaction. Within much less than a trillionth of second after that, there was probably a period of inflation – a period of very rapid

expansion and cooling – during which the universe expanded in size by at least 30 orders of magnitude. Then there was the crucial exit from inflation and the reheating of the universe – after which the universe continued to expand and cool much more slowly for the next 13.7 billion years – until now. These inflationary events have not been fully confirmed in any sense, but all the observational data is consistent with their occurrence. Two of the primary reasons why such extreme processes are invoked is that inflation seems to be the only adequate way so far suggested for generating the type of cosmic density fluctuations needed for seeding the cosmic structure we see all around us, and also the only way we know of to smooth the universe on large, super-horizon scales, consistent with the smoothness of the cosmic microwave background radiation, which was discovered in 1965. If it turns out that inflation, and a re-heating inflationary exit, are eventually disproved, there would have to be other processes which would adequately fulfil these two essential requirements.

Following the exit from inflation there followed a long period of gentle expansion and cooling. As that cooling took place, a number of important things happened. Very early – still less than one second after the Big Bang – both the strong nuclear force, and then the weak nuclear and electromagnetic interactions, split off from the grand unified force, and from one another. A little later the baryon asymmetry was established, and still later the first protons and neutrons condensed out of the quark-gluon plasma. One to three minutes after the Big Bang, when the temperature of the universe had fallen to about a billion degrees Kelvin, the conditions were just right for a lot of helium, and a little bit or deuterium and lithium to form. However, clearly everything was still completely ionized, and opaque to radiation – because of the strong scattering of photons and free electrons. Thus matter and radiation were strongly coupled, and it was impossible for the matter to clump in any way (because of radiation pressure). However, the density fluctuations generated by inflation – very weak but very significant – were preserved frozen into the cosmic plasma, awaiting their chance to grow.

That chance came about 300,000 years after the Big Bang, when finally the universe had cooled enough so that the matter in the universe could become neutral, and therefore transparent to radiation. With electron scattering no longer dominant, the matter was finally free to begin clumping, and small galaxies eventually began to form, and within the galaxies stars. As I have indicated earlier, this was a crucial step in the evolution of the universe. For it is in stars that all the elements beyond lithium form – carbon, oxygen, sodium, chlorine, silicon, iron, uranium. It is from these, much later, that rocky planets, comets and asteroids eventually formed around later generations of stars. Just as importantly, it is from these 92 chemical elements that a vast array of simple and complex molecules were gradually synthesized include those essential for the emergence to living organisms.

Significant for that eventual amazing transition, after the initial production of the heavier elements, there followed a long period of *non-instructed* chemical evolution which is still going on – the formation of molecules of all sorts in cool interstellar clouds and on planets and comets just according to local, generic chemical and thermodynamic conditions in those environments. At some point, under very particular and serendipitous conditions in a few places – at least on

Earth – *instructed* chemical evolution was initiated the preferential synthesis of certain chemical species, particularly sequences of RNA, DNA and amino acids (proteins) guided by specific semantic information from earlier generations of similar or compatible molecules through reproduction and/or metabolism under selection pressure. Eventually these complex interlinked chemical systems made the transition to life through encapsulation, differentiation, and mutual interaction. Biological evolution had begun, with all that followed prokaryotes, eucaryotes, multi-cellular organisms, those with advanced brains, and with varying degrees of self-consciousness and language. But none of this would have been possible without the billions of years of cosmic evolution in an expanding, cooling universe which preceded these transitions.

It's striking, however, to notice that, though we have reliable information that the physics and chemistry we know here on Earth is in force throughout the rest of the observable universe, we really don't know about biology or psychology – except what we surmise from what physics, chemistry and astronomy dictate. We don't really know if life exists elsewhere in the universe, though we are beginning to guess that it probably does, or how different it is from life here. And if it does, we don't know how prevalent it is or what variations it manifests. Much less do we know – really – about the existence and prevalence of self-conscious, intelligent life – or its capabilities and societies. This means that we really don't know anything very much about the biological universe.

From physics and chemistry, and from the biology on Earth, we can venture some generalizations about life and its necessary properties. First, it always involves complex systems and the selection, preservation, transfer and use of information. Complex systems are those which feature modular dynamic hierarchical structuring of components, the operation of feedback control loops, and the ability to adapt and evolve (see G. F. R. Ellis). A living system, furthermore, exhibits individuation and metabolic encapsulation – from its environment, and from other organisms – along with dynamic interaction with its environment, deriving energy and resources from it, contributing to and adjusting to it. These capabilities rely on the extensive information its ancestors have accumulated (in DNA) for its development, proper functioning and interaction with its surroundings. These characteristics imply that life will always be flexible but fragile – and individual organisms transient, but evolving into new, more environmentally suitable forms. This also implies that it possesses a certain directionality.

Returning to the larger, cosmic context, we begin to see that in a definite sense, these very general features distinguish nature and the universe as a whole – dynamic hierarchical structuring, on both macroscopic and microscopic scales, ongoing evolution, directionality (from any state at a given time, only a certain range of developments is possible), and its flexibility, fragility and transience. Not even stars last forever. Among the other obvious characteristics connected with these is the dominant importance of relationality – at every level of complexity new things with completely different properties and capabilities have emerged due to the constitutive relationships among their components – physical interactions and chemical bonding, for instance – and with their environment and their historical antecedents. Along with this, of course, is the highly differentiated interconnectedness of nature – which respects locality and individual integrity, but

at the same time unities all things through a common physical, chemical and biological basis and an overall system of overlapping contexts within one universe.

These perspectives pose a number of further fascinating scientific questions. But they also raise questions for understanding which take us beyond the competency of the natural sciences – what provides the foundation or basis of the marvellous order we see unfolding within us and around us, and of the existence which supports it?

DISCUSSANT: PAUL GABOR, S.J.
INSTITUT D'ASTROPHYSIQUE SPATIALE, ORSAY, FRANCE

Paul Gabor is in training to join the staff at the Vatican Observatory. He has a background in particle physics (Prague, Geneva, Grenoble), philosophy (Cracow), and theology (Paris). His current project, conducted at the *Institut d'Astrophysique Spatiale* near Paris, is preparatory work for the Darwin/TPF-I space mission, developing interferometric techniques for spectral analyses of atmospheres of Earth-like planets orbiting other stars than the Sun, in order to find evidence of life.

ABSTRACT: MATTER AND UNIVERSE

The talk will aim to stimulate the following discussion rather than to present a coherent picture of any particular topic. There will be two main focuses as well as a certain number of briefly evoked questions.

1. **Extrasolar planets.** The new and a rapidly progressing research into planets orbiting other stars than our Sun (extrasolar planets) can be regarded as a scientific quest for answers to certain traditional philosophical questions with enormous theological implications. The talk will contain a brief overview of the field, and especially of one of the projects in preparation, Darwin/TPF, the primary aim of which is to obtain the first quantitative estimate of how many of all the nearby Earth-like extrasolar planets show evidence that the chemical composition of their atmospheres is influenced by biological activity.

2. **Science, especially physics, as a spiritual quest.** Human efforts may primarily involve the body (physical work, sport), the mind (intellectual work, decision making, study) or the spirit (quest for one's place in life, meditation, contemplation, love of wisdom). These spheres are often closely interlinked. Climbing Mt Everest may be primarily a physical effort but its intensity challenges the very foundations of one's Self, and thus becomes a spiritual exercise. The pursuit of science in general, and of physics in particular, can likewise be regarded as a spiritual exercise. In fact, it represents a considerable sapiential potential, leading to a specific form of spirituality.

3. Other outstanding issues.

- Traditional cultures (e.g. African tribes) used to have cosmologies and cosmogonies that served as a vector of social and ethical orientation, sense, values, ideals, etc. Is it time to create, this time on scientific grounds, such a "functional cosmology"[1] that would give rise to a new and creative cultural epoch?

- Many reflections on the fine tuning of our Universe's laws use various forms of multiple universes. A reflection on these reflections re-opens the question of what is a sufficient explanation.[2]

- The leading theories in fundamental physics agree with experimental results to astonishing 15 decimal places. There is a doubt, however, whether this success is not merely a result of the way these theories are constructed (perturbation calculus). Do they provide a real grasp of the causes of observed phenomena? An analogy is often made with Ptolemaic astronomy which was better at predicting planetary positions than Copernicus' system[3]. Are such theories running the risk of being as fundamentally wrong as Ptolemy's astronomy?

- The causal structure of the Universe implied by the finite maximum speed of interactions in nature[4] poses a challenge to the theological description of the importance of the historical events around Jesus of Nazareth. Whereas a Cosmic Christ (St. Paul, Origen, Teilhard) can be easily envisaged within the framework of contemporary cosmology, what is an adequate way of talking about the historical Jesus and his importance on a cosmic scale?

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[1] N. E. Abrams and J. R. Primack, Science 293 (2001), 1769-1770.

[2] "What makes a situation 'natural'? […] We have an intuitive notion that certain possibilities are more robust than others. When we come across a situation that seems unnatural or finely tuned, physicists seize upon it as a clue pointing towards some underlying mechanism that made it that way. Such clues can occasionally be misleading, but they often serve to guide our thinking about how we can extend our understanding into unknown domains." (Sean M. Carroll, Nature, 440 (27 April 2006), 1132-1136.)

[3] Copernicus rejected the use of excentres. This meant that his heliocentric system with perfectly circular orbits was less accurate than geocentrism equipped with the full range of geometrical constructs (excentres, equants, epicycles, deferents…) until Kepler's introduction of elliptical orbits.

[4] Effect follows after its cause. How fast? Is it instantaneous (infinitely fast) or not (in which case there would have to be a maximum speed of interactions in nature)? Einstein's special theory of relativity shows that the answer is "no" and that the maximum speed is the speed of light in vacuum. This is not a limitation for everyday activities but if very large distances are involved, the existence of a maximum speed implies that there are some regions of our own Universe that will never be influenced by anything that has ever happened or will ever happen on Earth.

FRAMEWORK DOCUMENT I

MATTER: "THE ONTOLOGICAL PRINCIPLE OF HUMAN EVOLUTION"

In principle, the image of science starts from a monist principle and from an emergentist principle. That is to say, all that has been produced within the universe through its evolution in time is derived from the nature of matter and its ontological possibilities. The reference to matter as the primordial cause confers on science its explanatory unity.

This explanation will be constructed, taking the following into account:

a) the experience of everything which has been produced factually by evolution (including human phenomenology);
b) the models of matter proposed (in other words, the knowledge of matter proposed by science).

The problem of the explanatory breadth of the idea of matter proposed consists of the fact that not every idea of mater makes it possible to congruently explain what constitutes our experience of the evolutionary result, for example, the explanatory problems concerning reductionism.

The themes proposed for reflection in this session of the workshop are organised in three periods:

1) the problem of the explanatory breadth of the idea of matter;
2) the presentation and discussion of the different models of matter in science and
3) the selection of the anthropic profiles or properties present in the idea of matter in modern science.

Three types of anthropic properties ontologically anticipate the human world: the tendency towards the organisation of a stable, determined space-time world of differences; the tendency to maintain and constitute the unitary physical environments or holistic states; the tendency to organise a world which produces environments of indeterminacy in quantum physics and in the classical micro-physics, within the basic stability.

With regard to the ontology of matter, therefore, we find ourselves in the first state in which the nature and sense of the emergence and development of human evolution is anthropically anticipated. Matter, its models and the scope of its anthropic properties are the first theme for reflection in order to access knowledge of human evolution.

Objectives, criteria and methods

1. Matter and universe evolutionally move together: the universe is born as an evolutionary organisation of matter which responds to the real ontology of this matter. The knowledge of matter and the universe is almost inseparable. In the workshop, it was decided to first reflect on the universe, but in the conviction that these are themes which are inseparable in many senses.

2. We ask what the image of matter in present day science is. We refer to the first *evolutionary state* selected (see: D-I) in order to understand the scientific image of human evolution. Our intention is also that this image takes us forward to responding to the final question on the theology which this scientific image of human evolution leads to, if it leads to a theology at all.

3. The first response to the question on matter is the usual work hypothesis which seems to constitute a generalised expectation of science: matter is the ontological principle which produces the universe (and all its content, including life and man). Ontological means that the reality and being of matter, with its variety of properties, is the potential principle of evolution of the universe, life and man. Due to this expectation, we say that science in principle moves in a supposed, hypothetical *monist principle*.

4. The scientific image of matter in the monist principle must also be complemented with another principle: matter is the principle of emergence of a substantial variety of forms of reality and of their evolutionary production in the universe, in life and in man. Therefore, the *emergentist principle* is formulated in the hypothetical case of its harmony with the monist principle.

5. The emergentist principle makes it possible to understand obvious scientific reasoning. a) What are verified ontologically are the facts which arise in the universe and their factuality cannot be placed in doubt. b) Therefore, in accordance with the suppositions of the monist principle and of the emergentist principle, matter must be the potential principle of what is produced in the universe. c) If our image of matter does not make it possible to understand it as a potential principle of these facts, then only one of these two alternatives can be accepted: our image of matter is incorrect, or we must negate the monist principle (in other words, besides matter, there must be other ontological principles which contribute to explaining the nature of certain facts occurring in the universe, such as life or man, which are not explicable by the monist approach).

6. The supposition that matter must have the properties required to make man possible is expressed in the form of a new *anthropic principle*. This principle formulates the evidence that man is a fact produced from matter and, therefore, matter must be attributed to the properties required and sufficient for this. This is a "weak" formulation of an *anthropic principle* which does not suppose a philosophical thesis on a probable or not probable *intelligent design*.

The idea of matter
and the problem of its explanatory breadth

7. We have said that science moves within the hypothesis that the universe is explained from a primordial sub-stratum from which everything is produced. This sub-stratum is given the name "matter". However, this supposition does not include a precise idea or knowledge of this sub-stratum or, in other words, of what matter in itself is. In fact, the ideas on matter have varied throughout history, but especially in the evolution of physics in the last 150 years.

8. Consequently, the explanatory capacity of matter (to explain all the factual phenomena of the universe which, supposedly, should have been produced from matter) obviously depends on the idea of matter which is proposed. The scientific explanation is that the explanatory capacity is total (no phenomena produced in the universe can be excluded). If this were only partial, the reasoning explained in point 4 would be applied, or the supposed idea of matter should be rejected, or the monist and emergentist principles would be rejected.

9. From a historical perspective, we see that science has not always had (and does not have at the present time) this pretension to offer a total explanation. The classical mechanics of Newton, for example, intended to show an idea of matter which might explain "the physical world of immediate phenomenal experience". This continues to be the approach of quite a number of present day systems of physics.

10. On occasions, an idea of matter is constructed based on the pure, external, physical world, but, it also attempts to have a total explanatory capacity (the physical world, but also life and man in his psychic, phenomenological aspects). In order to have a total explanation, the idea of matter as a supposition to explain the totality of phenomena is forced and overvalued. This "explanatory violence" is known in the history of the philosophy of science as *reductionism*.

11. Occasionally scientists and philosophers have renounced a total explanation in accordance with monist and emergentist principles. In this case, they have postulated the existence of two explanatory causal principles (co-principles), which are ontologically different insofar as they cannot be equated (one could not have generated the other through evolution). History shows the two types of *dualism* which most influenced western thought: first the Platonic-Aristotelian-Scholastic dualism (except for nuances) and the Cartesian dualism. Dualism breaks the explanatory unity of the universe.

12. Consequently, the study of the primordial *evolutionary state*, matter from the focus of human evolution (the proposed focus of the workshop) supposes that attention is given to two complementary themes. *First*, the different ontological models of matter since each present different explanatory capacities. *Second*, the *relevant evolutionary profiles* which must be valued in the models of matter in order to understand in which sense the evolutionary state of matter has an anthropic design, a nature which makes it explicable *a radice* why and how the subsequent evolution of matter could make man possible.

    Not any idea of matter would have been anthropic (for example, it is doubtful whether the "reductionist image" is). However, the fact that man (and previous life) exist obliges us to have an anthropic idea, if we wish to maintain the unitary monist congruence as regards the explanation of the world. The criteria for selecting one or other evolutionary profiles in matter in order to pre-judge its anthropic potentiality, has already been explained in D-I (see: *Human evolution as a phenomenological explicandum*, D-I, No. 6-8).

Knowing the properties of human evolution at the present time through phenomenology, in fact, provides us with a heuristic criterion in order to select features of the anthropic ontology of matter.

13. Below we refer to these two themes: first, the models of matter; second, the relevant evolutionary profiles in the ontology of matter as regards human evolution.

Ontological models of matter

14. Throughout history, the ontological idea of matter has responded to differentiated models which lead to several consequent analyses of the evolutionary profiles which link with human evolution.

    a. *Matter in classical mechanics: the corpuscular model*. Classical mechanics predicts the physical evolution of a system from determinist laws when certain initial conditions are supposed. Are physical laws determinists in themselves? Is it necessary to know all the initial conditions to predict its evolution? How can the precision of its predictions be explained? How would determinism be seen from the quantum idea of fermionic matter? What role does determinism play in creating a stable, differentiated world, apt for life (differentiation and inheritance)? Mathematical discontinuity and classical mechanics.

    b. *Radiation in classical mechanics: field models*. The field effects of matter provoked a re-definition of classical physics in terms of classical electro-dynamic and gravitational fields. Is classical determinism compatible with classical determinism with the number of degrees of freedom of the continuous fields? Is determinism compatible with relativity?

    c. *Quantum model: unity-duality corpuscle-wave.* The Newtonian thesis of corpuscles and the wave antithesis of Huygens were synthesised with the quantum principle of wave-corpuscle. Is this a dualist principle? On the contrary, is there a monist synthesis of different emergent properties of matter? What does this say about the continuity of matter?

    d. *Mechanical-quantum matter: ontological models*. The physics of elementary particles has scrutinised matter as far as sub-nuclear atomic levels dominated by quantum fields. What is understood by fundamental particle? Is there an ultimate material sub-stratum? Is it possible to conceive matter without interaction? What is the final ontology of space-time? Is it ether, the energy field, the quantum vacuum …? What is the ontology of "indeterminism" in quantum physics? Can quantum states produce indeterminate events?

    e. *Mechanical-quantum matter: the Copenhagen model*. Niels Bohr created an epistemology of quantum theory with no possibility of interpreting physics beyond the experimental result at a given time. Is an epiphenomenon everything which is not measured? Should research be

carried out in accordance with the advice to shut up and calculate? Is the quantum physics of Copenhagen complete?

f. *Holistic matter in classical and quantum models*. The gedankenexperiment of Einstein versus the Copenhagen model opened up new theoretical research into a non-local physical reality, which is the basis of the current teleportation technology. How is this non-local physical nature explained as fields? How can this contribute to understanding quantum coherence between quantum fields at a distance?

g. *Matter in the scale of Planck.* At energy 10^{25} eV, matter loses all its definition in favour of a dynamic energy field. Space – time itself becomes indefinite. There are only quantum fluctuations of energy. Is it possible to maintain determinism at this level? How does corpuscular matter emerge? What produces the stability of matter?

h. *Speculation on matter*: the Higgs, super-strings and multiple dimensions. Beyond the efficient but incomplete Standard Model, the theoreticians of particles search for a new model of matter. Is the field of Higgs the fundamental physical component? Is our material universe a three-dimensional bubble in a multi-dimensional space? Will the Large *Hadron Collider* detect a super-string?

15. Not all these models have the same support in empirical evidence. In a way, they are complementary as regards empirical aspects of reality. The fact that these models can be construed by the human mind (even when there is still a lack of empirical evidence, as occurs with string theory) shows the open and critical, hypothetical, not closed and absolute character of the idea of matter in scientific knowledge.

Evolutionary profiles of matter as anthropic principles

16. The criterion for giving prevalence to one or other of the profiles of matter depends on the previous phenomenological establishment of *human evolution as the scientific explicandum* (D-I, No. 6-8). As we said, this *explicandum* makes it possible for us to detect the profiles of matter which are relevant (significant) as regards human evolution. However, on studying the evolutionary state of matter at the present time, we can only select and describe those profiles which, in principle, might have anthropic value, as the germinal ontological principle of human evolution. Furthermore, the form in which they contribute to producing man must be analysed in other evolutionary periods (universe, life, man). It will be then that the potentiality of development is verified, or, "what the ontology of matter can give".

17. The main *anthropic profiles* are the following:

a. *Holism*. The holistic phenomena of matter are verified from the birth of matter in the big bang until its current re-production in the appropriate physical conditions. Material holism tends to be placed in connection with the holism of psychic experience. Expressed negatively: an ontology of

matter which is only discontinuous would render the psychic phenomena of “experiential continuity” strange.

b. *Difference-space*. Even when matter is holistic under precise conditions, it has an ontology which makes it derive towards the material apparition of differentiated organisations (particles, atoms, molecules, objects …). These entities have a “place” (an *ubi*) and constitute distances between each other which permit a metric space. These properties are at the base of objectuality and difference, spatiality, which will enable the scenario of life and of man.

c. *Classical macroscopic structural organisation*. The germinal ontology of matter, consequently, enables the structural organisation of a world which we call classical-macroscopic. Permanent structures create the order which will be perceived and adapted to by the living senses.

d. *Energy*. Matter is born as the energy of the big bang and its organisational ontology permits the constant production of energy (e.g. in the sun). Material energy will make work, action and the adaptive movement of living beings and man possible.

e. *Determinacy*. Matter is organised by responding to its ontological properties through precise and determined energetic interactions. Determinacy is the principle of order and security which makes life possible.

f. *Stability-legality*. Matter creates a stable system determined by laws as a consequence of the determinist properties of material ontology. The determinist laws create the stability to support the form of the universe and the stability of biological inheritance.

g. *Change-time*. In a balanced fashion, the ontology of matter creates an energetic system of changes and the transformation its states which create a time system (evolutionary) which makes space a space-time. This seems to connect with the temporal history of human life as an ontological material base.

h. *Indeterminacy*. Determinist ontology of matter permits environments of indeterminacy in a balanced fashion where future states which evolve in energetic change and which can occur or not occur. These “ontological loops of indeterminacy” would offer the ontological possibility for spontaneous self-determination of life, and man in order to choose their “own evolution routes”.

i. *Chaotic interaction*. The chaotic interaction of matter opens up a new perspective in order to insist on an indeterminist model of matter which offers the image of ontology for “living indeterminacy”.

j. *Probability*. The evolutionary states generated from material interactions open up a probabilistic future which is configured within a framework of

determinacy. Material systems tending towards probabilities or "propensities" are more congruent with the subsequent evolution of life.

k. *Creativity*. According to this, the theory of matter shows us its energetic change of state in time as a creative process (in the sense of the configuration of possibilities which are not necessary in time). Living beings could have appropriated this creative ontology of matter.

18. As a whole, the models of matter in science (see above: No. 13) present these profiles, but not necessarily, nor in the same form, in all of these. Therefore, the study of matter from an anthropic perspective must involve an in depth contribution and valuation of the models.

Discussion

Reductionist models

Do the reductionist models make sense? Do they have epistemological justification as regards the construction of an image of matter? Does this necessary inter-disciplinary factor of science make it necessary to construct models of matter valued from a global phenomenology of the universe and its variety of content? – History and analysis of reductionist science and its current presence and epistemological valuation or criteria.

Anthropic models

Is it epistemologically justified to demand that science construct explanations which are "anthropically" congruent in its different stages? What role has the anthropic played in the history of the physics of matter? Which authors have contributed to an "anthropic science" (Bergson, Whitehead, Teilhard, etc.)? Which hypotheses have they proposed? Is our proposal of anthropic profiles in the physics of matter correct? Must it be added to? Does it have alternatives?

Corpuscularity

Corpuscularity and reductionism. To what point is corpuscularity admissible in physics? Corpuscularity and discontinuity. Is corpuscularity-discontinuity "anthropic"? Its role in the evolutionary formation of the classical macroscopic world of differences. A physics balanced between corpuscularity-discontinuity and the field-waveness-continuity.

Holism

The history of holistic ideas in the physics of matter. Holism in classical mechanics. Material matter in the idea of radiation in the XIX century. Holistic phenomena in quantum mechanics. Holistic phenomena in current physics. The anthropic character of holistic phenomena.

Determinacy-indeterminacy

The ontological properties of matter lead to a balance between determinacy and indeterminacy. Why is the ontology of matter determinist? Why does a determinist system produce environments of indeterminacy? Can determinacy and indeterminacy be harmonised? Which type of ontology, epistemological or ontological? The balance between determinacy –indeterminacy as an anthropic property of matter. Is determinacy reductionist?

Continuity-discontinuity

There are models of matter which lead to discontinuity; others support continuity. Conceptual problems (mathematical, scientific, philosophical) concerning continuity-discontinuity. Their relationship with holism of matter and the theory of fields.

Stability-change -energy

Matter produces stable beings from resources of energy united to matter from the big bang, which are subjected to change. These material principles seem to play a very important role in the organised form of then universe and in the conditions which make life possible. In what sense does this matter prefigure an anthropic universe?

Difference-objectivity-subjectivity

In some way, matter has produced a world of differences and this is the basis for beings becoming subjects and objects for each other. How and why did matter create a world of difference which prefigures the world of subjects and objects which will make life possible? Could the world have been different? Could a material world be possible with no outlines, like undifferentiated plasma?

FRAMEWORK DOCUMENT II

THE UNIVERSE: "THE EVOLUTIONARY ORGANISATION OF AN ANTHROPIC WORLD"

There seems to be no doubt that the matter we know (the matter which in fact produced our universe) is anthropic matter which has made the existence of man possible. If this matter is a special derivation of a more primordial matter which could also have derived towards other forms of more primordial matter which could also have derived towards other forms of matter which were not anthropic, we do not know this; although we can speculate on this in string theory. In any case, science describes how matter has produced our universe as it organises itself in accordance with its ontological properties.

The universe is an evolutionary product of the organisation of matter. How has this evolution been produced? What is the origin of matter? What states have constituted its organisation? What are the structural properties of the universe as the resulting system? What future evolution can be foreseen? These questions, and other more precise questions, have been answered by the so called "universe models", or cosmological theories. All of these endeavours to respond to the empirical evidence which can be registered today, but which always entail more ambitious theoretical speculation. In some models the evidence is even minimum and speculation predominates. However, the universe, considered as a whole, has in fact some anthropic properties deriving from the ontological properties of the matter which produced this. Nevertheless, it is in the factual universe where science verifies how the pieces of the building (matter) have been organised in the form of a surprising scenario for human life.

Not all material organisation in our universe is anthropic (e.g. the surface of Mercury or of Jupiter), but the Earth is. A solid, stable world where man can live his life; an open world where man can choose options; a world of holistic fields where man can feel his life as he integrates into the totality of the universe. In the universe we find the second state in which the emergence of the nature and the sense of human evolution are anthropically anticipated.

Objectives, criteria and methods

1. The universe is the result of the evolutionary organisation of matter from primordial energy. It responds to the nature and the laws of matter which are manifest precisely in the form which the universe acquires. In the same way, if matter is the supposed origin of all that appears in the universe, this must have anthropic properties (which make man possible). In addition, the universe must reflect these anthropic properties of matter and constitute new cosmic properties in it and these are also of an anthropic nature.

2. If man is to be possible in evolution, the universe must be constituted as a human environment: as a place which receives the possible natural emergence and human action in order to make history. The universe must be a "habitat", first for life and then for man. Thus, it is possible to make a

study of the universe (and of matter) apart from human reality. This study leaves aside the knowledge of the structural properties of the universe which "makes it human", habitable by man, the appropriate scenario to construct human history. However, it is also possible to study the universe from an "anthropic" perspective. It is from this perspective that the workshop studies the universe.

3. To say that the universe is "anthropic" is a response to the use of this term in the sense explained above: if the universe produces man in fact, this is because it has the properties which make this possible. This "weak" anthropic principle does not involve any thesis on its causes; or as regards the so called *intelligent design*.

4. Consequently, the "anthropical" study of the universe entails two stages. First, verify the image of the universe in science. Second, analyse the anthropic properties manifested by this image. The first step involves the study of the *models of universe* which have been proposed until now. This reveals that, although the facts and the empirical evidence are unquestionable and are accepted by all, however, their interpretation in a cosmological theory may vary. The facts are unarguable, but their integration in a global theory can be argued. The second step involves the study of the *anthropic properties of the universe*.

There are two related perspectives: one is phenomenological and the other is speculative. Phenomenology makes it possible for us to objectively describe (by the phenomenological method) the properties which, in fact, organised matter has evolutionarily derived in the form of universe. Speculation allows us to study how these phenomenological properties are explained within the theoretical models of the universe. It would be possible that several speculative models might explain this. However, a model which cannot do so would be difficult to admit. It is not a question of admitting that the conceived universe should of necessity produce anthropic properties; in fact, our universe has not produced these in many areas (e.g. on the planet Jupiter or on stars). The question simply concerns the ontological possibility of producing these.

Models of the universe

5. The speculative theories on the universe are, of necessity, joined to the theories on matter. At the same time, these depend on experimental, observational and empirical evidence, registered up to now by scientific investigation. These are numerous and are recorded in the treatise of cosmology and astrophysics, which we refer to.

   However, these are also theoretical "speculation". This is constructed in such a way that it is congruent with the known evidence; it is obvious that if this were not so, it would not be admissible. However, what is established by these speculative theories are referred to times and states of the universe which are beyond the current possibilities of observation. The evidence could involve congruence (*ad hoc* hypotheses) with many speculative theories which cannot be harmonised. Thus, if a speculative

theory is to be considered acceptable, it must always have direct empirical evidence that its affirmations are being carried out in reality.

6. Bearing in mind that, on occasions, the following are exclusive, but on other occasions may be harmonised, we mention the following *models of universe*:

   a. The big bang model: this entails that the universe originated some 15,000 million years ago with a great explosion and has been expanding since that time. Its uncertain future evolution involves a triple scenario: limited expansion (closed universe), unlimited (open universe) and the intermediate case between both (flat universe). As regards the past, this includes the question on the state of things previous to the big bang.

   b. The model of stationary state: this is based on the hypothesis (Perfect Cosmological Principle) that the universe does not only present the same aspect from any point of observation (Cosmological Principle), but also at any point in time. This supposes that the reduction of the density of mass provoked by its expansion is compensated by a minimum rate of continual creation of matter.

   c. Oscillating model: this states that the evolution of the universe corresponds to an infinite series of oscillations between expansive states (big bang) and contractive states (big crunch): expansion followed by contraction, followed, again, by expansion, etc.

   d. Multiversal model: this maintains that, within the universe, there have been innumerable "sub-universes" which have been born from great explosions (big bangs). These are universes with full entity, in which the laws of physics might be very different from those we know.

   e. The energetic and dynamic model. In any case, any of the models of the universe entail a justification of the energy which permits its expansion, transformation. The dynamic conceptions of the universe must justify the source of energy which explains the "dynamics" of the "physis".

   f. The negentropic model. The universe continually produces an increase of entropy or internal disorder. But it also produces an appearance of order: from matter germinating the organised universe to the creation of order (an atom is ordered matter). This negentropy (the creation of order) must be integrated into the models of the universe constructed by science, as is executed.

   g. The mechanical–determinist model (clockwork): this is based on the metaphor of the universe as a clock or clockwork mechanism functioning with laws which are perfectly determinist. This refers to the question whether this "clock" necessarily entails a "watchmaker" who starts it up and maintains it.

h. The computational model: the universe is conceived as a storeroom and processor of information. The universe would be a quantum computer continually calculating its own dynamic evolution as reality develops.

i. The chaotic model: this admits the evolution of the universe and the physical phenomena in accordance with laws which are perfectly determinist and which, nevertheless, give rise to chaotic conduct, which is impossible to predict due to a lack of inherent precision as regards the initial conditions. The problem arises regarding whether chaotic evolution includes real, ontological indeterminacy, or is only a sample of lack of knowledge of the initial conditions (epistemological indeterminacy).

j. The probalistic-statistical model. Is it possible to offer the scientific view of the universe towards the future with determinist security? Do chaos and quantum mechanics compel us towards probabilistic and statistical future previsions? Should the models of universe take up a position with regard to these questions?

k. The open, flexible, indeterminate or determinate model. In accordance with the above, the models of universe take up positions as regards an open or closed idea of the future which is related with the basic problems as determination and indeterminacy of the future.

l. The standard cosmological model: the most elaborated model of the big bang. This includes the study of the synthesis of chemical particles and components from an initial soup of quarks, leptons and radiation, as well as the development of the grand structures of the universe (galaxies, cumuli, etc.) as a consequence of the lack of standardisation at the basis of the radiation of microwaves.

m. The inflationary model: this is a refining of the model of the big bang which includes a mechanism of exponential growth (inflation) of the radius of the universe in a standard model.

Evolutionary profiles of the universe as anthropic properties

7. These are properties of phenomenological experience which relate to the models of universe offered by science. Occasionally, these are congruent with all or with some of these. On occasions these may also be incongruent. In any case, it is essential that the universe which makes man possible has anthropic properties, insofar as these are those which will permit the origin of life and man in the future. Perhaps other property systems will also permit man, but our system has a certain “anthropic” form which should be described.

8. The following anthropic properties are selected:

   a. *Material diversification*. The universe is the result of the ontological properties of matter which enable the appearance of differences in the

course of time due to their energetic interaction: the appearance of difference in the manifestation of states of matter, from the corpuscular to the holistic, passing through solid, gaseous, liquid, plasma states, which are connected in the field unity of the universe. This balanced diversity of states of matter will lie at the ontological base which will make it possible to achieve the balanced composition of life.

b. *Physical entities, objects, bodies*. The universe is thus presented as the result of an infinite order of celestial bodies: stars, galaxies, planets, earth, objects and terrestrial material, etc. Among these bodies and the physical conditions which establish these, appear the living bodies and the human body.

c. *Measurable spatiality: ubiquitisness*. The form acquired by the universe as an organisational state of the evolution of matter leads to the formation of bodies in a special environment which permits measurable distances, the differentiation of place and of the entity of physical bodies.

d. *Energy, dynamism, change*. The universe is a process of change in the states of matter which is produced by the by the energetic ontology of this as described in the physical theory on the four natural forces (gravitational, electromagnetic, weak and strong nuclear). Living beings participate in this cosmic dynamism in order to adapt to the medium and to survive.

e. *Temporality*. The energetic interactions which produce the change in the states of matter manifest in the universe are the foundation of the succession of states and temporality. A static "petrified" world would not be an anthropic world.

f. *Cause-effect interaction*. The interaction of matter on matter, or bodies on bodies, within the space-time framework constructed in the universe is also the ontological possibility of a scenario which makes it possible for life and to interact with the medium in order to select the possibilities of its future.

g. *Determinacy, stability*. The ontology of matter shows a universe, as a result of its organisation, a stable physical order in which objects are maintained, last in the same conditions and able to address the construction of a history from identity.

h. *Indeterminacy, probability*. Determination has not prevented the ontological properties of the material interactions producing a non-closed universe, but one which is open in its real evolution, which opens possibilities which may comply or may not comply, but do permit the opening of "real indeterminacy loops" with the possibilities of events which will no necessarily occur, but which could occur.

i. *Variability, oscillating conditions, randomness*. Cosmic evolution has occurred variably, in such a way that, in different places, it has constituted oscillating conditions (none is identical to others), in which randomness

has played an important role. One of these products was the Earth: with selective physical conditions of a high quality as regards its anthropic potentiality.

j. *Systemic, holism interconnection*. Although it is differentiated, the universe is also a whole, a unitary system in complete interdependence. Nothing escapes this cosmic causal interaction. This is an interaction which is explained partly by the principles of classical mechanics and affects the classical macroscopic world, and is fused in the holistic phenomena deriving from quantum mechanics. This universe with physical, field phenomena of a holistic nature offers the ontological possibility to living beings to adapt to the environment with the support of the holistic nature of the universe.

9. Consequently, matter evolved until it produces the universe that has been organised as celestial bodies which contain bodies in different space-time locations. At the same time as bodies appear, matter fills the universe in other holistic states diffused in space such as light or other environmental niches. The energetic processes explode everywhere, maintaining the initial energy which gave rise to the evolution of matter in the big bang. However, mater has been organised in accordance with its own ontology and a stable and permanent framework has appeared, which gives rise to the different celestial bodies with an enormous variability of environmental conditions. Thus, a space-time framework has been produced which is continual and discontinual. Determinist stability and interaction between matter is not absolute as environments in which the material states have appeared are indeterminate and probabilistic, open to events which could occur or not, depending on unforeseeable factors, which are sometimes chaotic, and arise within the universe itself.

Discussion

Matter and universe

Matter and universe are ontologically related. Matter seems to be more primordial (anterior to the universe and its origin).However, science also tells us that matter is produced at the same time as it is expanded and the universe expands. How are the properties of matter related to those of the universe? How does the physics of matter shed light on cosmology and how does cosmology shed light on the idea of matter? Are the physics of matter and cosmology an indissoluble unity? How is this considered from string and super string theory? What ideas have the great authors (Einstein, Hoyle, Guth, Penrose …) contributed, and evaluate and show their contributions?

Empirical evidence

Theoretical speculation is necessary in Science that always has the control of empirical evidence. What is the current role in physics of matter and cosmology of the theoretical speculation and empirical evidence? What would the image of matter-universe be in accordance with pure empirical evidence? What role do mathematical formalisations play in order to construct the scientific image of matter-universe? Does the mathematical formalisation alter and falsify the empirical model of the physical world?

Models of the universe

Modern science has produced a large number of models of the universe which must be presented, valuated and interpreted from the idea of an anthropic universe. This discussion on models must make it possible to value the most probable and to consider their anthropic interpretation. In the models proposed and discussed where is the speculative and where is the empirical? Do the mathematical formalisations offer images of matter-universe which are useful and functional? Does their reality ontological reality communicate their reality? Does this falsify our knowledge of the world?

Anthropic properties

Is our universe anthropic? Are the models of universe discussed by science anthropic, and to what extent? What are the most relevant anthropic properties of matter-universe? Could the universe have been different? What forms of universe would make an anthropic universe impossible?

SESSION II: LIFE

SPEAKER: **NIELS HENRIK GREGERSEN**
UNIVERSITY OF COPENHAGEN, DENMARK

Niels Henrik Gregersen is full Professor in contemporary theology at the University of Copenhagen. Internationally known for his work on the relation between religion and natural science, he was formerly research professor in theology and natural science at the University of Aarhus. He has studied the connection between natural science and life philosophy in many ways, for example in the books: "Chaos and Causality. Chaos theory and its meaning for philosophy and theology" and "Rethinking Theology and Science. Six Models for the Current Dialogue". In his Danish language works he has in particular published articles on modern theology in the 20th Century and in the present one. He is the Danish National Church Representative in the Lutheran World Federation and Chair of the Board of the Institute for Oecumenic Studies in Strasbourg.

ABSTRACT: THE MANY FACES OF DARWINISM: THE EVOLUTION OF DARWINIAN THEORY FROM A THEOLOGICAL PERSPECTIVE

Darwin's revolutionary theory of evolution in the *Origin of Species* (1859) was about biological evolution, without claiming to explain the emergence of life, or the specific development of the human cultures. Nonetheless Darwin's theory was from the outset interpreted within more comprehensive world views ranging from classic-style materialism to social progressivism, and from religious to anti-religious views of reality.

Also in the current discussion, Darwinism has many faces. Some argue that natural selection can explain all evolutionary developments; others claim that biological evolution is both facilitated and constrained by universal physical laws and processes such as thermodynamics and self-organization; still others hold the view that evolution is characterized by a radical historicity that defies both law-like and selectionist explanations.

In *Part One* a general picture of the current developments within Darwinian theory is presented with a special attention to the allegedly religious or anti-religious implications of what it means to hold a Darwinian view of evolution today. In *Part Two* these questions will be pursued in the form of a set of theological *Gedankenexperimente*. What *if* selectionism were a self-sufficient biological theory? What *if* chance and circumstance rules the history and fate of the biological universe, beyond the grasp of physical laws and the principle of selection? And what *if* evolution is convergent upon specific higher-order adaptations, and the course of evolution is channelled through a very small window of that which is chemically possible? What *would* all this mean for religious self-reflection?

Finally, *Part Three* discusses the question to what extent evolutionary theory may cast new light on religion and religiosity as a human and yet as a natural phenomenon. Evolutionary psychology is a relatively new discipline that undertakes to discover and understand the structure and function of the human mind as a product of evolution. More specifically, the approach of evolutionary psychology presupposes (1) that the human mind is a functionally specialized system that works on the basis of physiologically specialized brain modules, and (2) that all faculties of the human mind have developed as a result of natural selection for specific adaptive purposes. Since the human species lived in gather-hunterer societies for more than 99% of its existence, evolutionary psychologists furthermore assume (3) that also modern human beings live and breathe in the mental schemata developed in hunter-gatherer societies. These mental schemata are taken to influence not only everyday life mentalities but also concepts of rationality and religion far beneath the threshold of our consciousness. While some theoretical biologist, such as David Sloan Wilson, argue that religions have an adaptive value for selection processes at group level in animal and human cultures, non-adaptive theories of religion are represented by the evolutionary psychologists Pascal Boyer and Scott Atran. These recent debates raise two sets of questions: (1) To what extent is the evolutionary role of religion related to group-building, and to what extent do religions deal with the cognitive challenges of the environment? And (2) to what extent is it an argument, *pro* or *con*, for the ontological commitments of religion, if religious thought scheme – such as God as a personal agent – can be seen to emerge from general cognitive capacities of our evolutionary past.

DISCUSSANT: CARLOS ALONSO BEDATE
CONSEJO SUPERIOR DE INVESTIGACIONESCIENTÍFICAS, MADRID, SPAIN

Carlos Alonso Bedate, born in 1935**,** graduated in Biology (University of Granada) and holds a Master in Genetics (University of California, Davis, USA) and a PhD in Science by the Universities of Nijmegen (The Netherlands) and Granada (Spain). Research Professor *ad honorem* of the *Centro de Biología Molecular*, *Consejo Superior de Investigaciones Científicas* (CSIC – Spain's National Scientific Research Institution), he is actively involved in several Bioethical Committees at regional, national and continental levels. His most important research activities have been focused on: Vaccine development against leishmaniosis, DNA vaccines, Adjuvant development, Regulation of the immune response and Regulation of gene expression.

ABSTRACT: EVOLUTION: SCIENCE AND RELIGION

The term evolution has been generally applied to biological evolution but recently it has been widened to cover evolutionary nuclear physics, chemistry, biochemistry, thermodynamics, geology palaeontology, biology and cosmology. Already as early as 1864 Herbert Spencer pointed out that the theory of evolution deals with the universe as a whole. Although he was more a Lamarckian than a Darwinian he developed an all-embracing conception of evolution as the

progressive development of the physical world, biological organisms, the human mind, and human culture and societies. According to this hypothesis all human beings evolved, body and mind, from earlier ancestors: the primates. Recently, evolution has been extended to understand the emergence of the traditionally called spiritual life or conscience.

A question we have to answer before we address the issues of human evolution is if the term evolution relates to the primordial entity, whatever it is, and if it is included in the evolutionary period. If the primordial entity is a product of evolution we must say that it came from something else, prior to it in time. In this context this primordial element would already be complex and it would have to have come from something else. If it does not come from something else it is necessary to understand that this primordial entity is the origin of all the existing things. Is that primordial entity being created or it is just there? Is it there a starting point in the process? Is it the primordial element simple or complex? Does a primordial element really exist?

In my view, I think that within the scientific community and academia the level of support of the evolutionary process to explain the origin of the complex and by which all aspects of the universe can be explained is overwhelming, while support for specific creation of complex organisms, in line with a literal translation of the bible, is very small among scientists. In contrast, I think that the level of support for the need of an evolutionary process to explain the origin of the primordial element that gave rise to the universe we see is not so wide because the scientific facts to sustain that claim are weak or at least no so strong a the facts that sustain inorganic and biological evolution.

Some people believe that since the creationist movement cannot be maintained in the traditional way it has to be substituted by another concept that takes the form of an Intelligent Design: The claim that certain features of the universe and of living things are best explained by an intelligent cause and not by a process such as natural selection and adaptation or fitness. The intelligent design supporters postulate that since there is continuous progress in complexity in the universe, even though restricted to particular domains, the complexity program has to have been conceived by “someone”. Intelligent design's advocates claim it is a scientific theory since it is derived from scientific facts. Intelligent design proponents also raise occasional arguments outside the physical world most notably an argument based on the concept of the fine-tuning of universal constants that make matter and life possible and which are argued not to be solely attributable to chance.

Evolutionism believes in a continuous increase in complexity, because the theory states that natural selection and mutation drives the emergence of elements with the potential of interaction and self-organization. The more complex the interaction is, the more complex is the resulting element. Science affirms that there is an increase in complexity in certain points. Thus, we have to admit that there is a net decrease in entropy is those locations and an increase in entropy in the surroundings. This means that the pluralities of all the chemical reactions that originate complex organisms are not spontaneous since spontaneous changes in isolated systems occur with an increase in entropy.

It is fairly easy to accept the truth of evolution when it applies to the external world. It is much harder to accept that our feelings, intuitions, the ways in which we love and loathe, are the product of experience, evolution and culture. Don't be mistaken: Such acceptance has challenges for the non believer, too. Scientific theories of human nature and behaviour may be disturbing and dissatisfying but as long as they remain within the filed of their methodology they are not illegitimate and should be considered.

Historically, science has had a complex relationship with religion since religious doctrines and motivations have sometimes influenced scientific development, while scientific knowledge has had effects on religious beliefs. Te conflict thesis stating that any interaction between religion and science would lead to open hostility with religion usually taking the part of the aggressor against new scientific ideas has been superseded by historical research.

I personally have no problems with accepting evolution and even behavioural human evolution but, however, from a religious point of view I have difficulties with the integration of "physical evil" in a process in which God is present and acting. I find even more difficult to reconcile the presence, in a God dependent world, of "love evil". Thus, the main question is not whether there is conflict between science and religion but if there is irreconcilable epistemological and anthropological conflict between the interpretation of scientific facts and theology, as the timely interpretation of religious beliefs.

FRAMEWORK DOCUMENT III

LIFE: "AS THE PROXIMATE ANTHROPIC PRINCIPLE"

In its evolution, matter organised as universe has produced "materials" which do not have the property of "life". Everything seems to indicate that not all the forms of organisation of the matter in our universe have become real. However, it is a fact that life, although not necessarily so, has been produced and responds to the anthropic properties of matter-universe.

Life is an "appropriation" of the possibilities given previously in the ontology of matter-universe. Once life appears, this becomes the real environment where the subsequent emergence of human evolution is produced. Thus, life is the real, biological, physical environment which produces the new anthropic properties which will soon make man possible. Life is the bridge between matter-universe and human evolution. In order to select, understand and value the anthropic properties of life, we must scientifically know what life is. And this knowledge depends on the models of matter and the models of the universe, which are discussed and depend on previous epistemological discussions.

What is "life" for science? Depending on previous epistemological options, a variety of models of life appears in biological science. In the same way as science on matter-universe has derived from more reductionist-discontinuous conceptions to other more modern ones where stress is laid on holism-continuity, the classical reductionist-discontinuous biology (today computational) seems to derive towards a more holistic-quantum biology in modern times. Classical macroscopic

neurology seems to derive towards a new type of quantum neurology. This gives rise to the big questions to be discussed within the area of philosophy of biology.

A powerful, manifest trend appears in the new biological holism-quantum; however, this new trend is strongly combated by the remaining reductionism, or "politically correct" paradigm in certain sectors of current biology. Undoubtedly the new biology gives rise to an image of life where its anthropic properties are more manifest and congruent with the phenomenological evidence.

Objectives, criteria and methods

7. The expectation of science is that matter already contains the anthropic principles which permit, cause and condition human nature. Along the same lines, the universe will develop the anthropic properties of matter and will constitute a grand anthropic scenario in itself as the environment which makes history possible. However, within the energy and cosmic dynamism of change and transformation, at a moment in time, a new type of physical entity emerges: life. Life is the first step towards the appropriation of the anthropic properties already present in the previous physical universe. When life was formed by transformation and continuity with the preceding universe, and "emergence" occurs. What is understood by "emergence"?

8. The emergentist principle, understood from the fact of the emergence of life, means that:

    a. a reality other than matter does not emerge (the monist principle is maintained: see D-1, No. 2-3);
    b. what "emerges" is a new form of systemic or structural organisation of matter;
    c. this new material organisation produces the "emergence" of a new form of real being, known as life and qualitatively irreducible to the previous materials;
    d. the emergent qualities do not surpass the ontology of matter, but are fused in a specific (optimum) use of these materials.

9. Life as an anthropic principle means that it is the ontological origin of man. Life in itself constitutes new emergent entities evolutionarily and these will be the ontological principle (what establishes or causes the real production of subsequent effect) of the evolutionary generation of the human species. Thus, life contains emergent anthropic principles (in keeping with the monist principle). These act as gradual evolutionary bridges which go between the physical world and the human world, at the same time as they also gradually anticipate the psychic properties which will appear finally and fully in the human. Thus, life, while still not "human", contains "anthropic principles" insofar as these make man evolutionarily possible. In this type of universe, if there had been no life, man would not have been possible. However, not any type of life, life without anthropic properties, would have made man impossible.

10. The knowledge of human evolution involves knowing life as an *evolutionary state* which determines the subsequent process towards man. The anthropic principles of matter, the universe and life, together in systemic interaction, will determine the possibility and the real emergence of the human species. Therefore, the study of life from the viewpoint of its anthropic properties must be constructed from the image of life in science (in scientific biology). This entails three components which are related:

    a. The phenomenology of life as a scientific *explicandum*. Science is always explanation (*explicans*) of phenomena (*explicandum*). In biology the *explicandum* is the phenomena of life. However, the form to present this as a phenomenon which "must be explained by science" depends on certain scientific epistemologies. At the present time, we move in the most recent supposition which has already surpassed "objectivism positivist-behaviourism". However, in fact, this has not yet been surpassed completely in all the biological theories which are still in force in certain areas. The current, more modern epistemological position considers that the human phenomenological experience (agreed to by inter-subjective dialogue) is a describable empirical fact which must be explained by science. From this perspective, and by extension, some phenomenological properties only noticed by man in himself (for example, sensitivity) can be attributed to life, at least to higher forms of life analogically.

    b. The "models of life" in biological science. It is evident that biology has proposed different "models of life" in recent centuries, that is to say, different explanations of its causal principles, of its ontology and of its nature, as well as of its functional organisation. Therefore, when we speak of "life" this is not always understood from the perspective of biological science. As we know, scientific theories are not absolute theories, but proposals of interpretive systems, often in dispute with each other. These interpretations are seen in the epistemological theory of current biology.

    c. The anthropic properties of life. It is evident that its knowledge and analysis depend both on the initial, biological *explicandum* (the phenomenon of life which we must explain) and on the "models of life" proposed by biology to explain it. The scientific models of "life" will make this possible or not, and will modulate the form for selecting and valuing the anthropic principles of life.

Models of life in biology

5. Therefore, according to what has been said, these models always entail an epistemology (or epistemological theory of biological science) which gives sense to its scientific positions. On changing the epistemological presuppositions, some of these models lose their logical, argumentative basis.

    a. *The mechanicist-reductionist model*. Life arises in complex, physical systems which are explained by the same mechanicist-determinist theories of matter-universe. These are dynamic systems held in balance by complex cause-effect interactions as regards the internal and external

environment. Thus, life is explicitly "reduced" to the real, existing mode of being of the physical world: the same real quality, but with a greater degree of complexity. This model always involves isolated, differentiated, fermionic matter: each entity (particle, atom, molecule, matter, object …) remains as an isolated entity, although involved in chains of cause and effect with the other entities of the cosmos.

b. *The teleonomic model*. Life is a form of organisation of the physical world which responds to the same, basic, physical-chemical laws. However, in life a superior level of organisation was produced evolutionarily and this permitted the emergence of a form of real, existing being with a "quality" distinct from the physical world. Life is a mechanical-determinist system with *telos*: the finality of optimum self-maintenance in the environment. The scientific explanations of biology are in part reductionist and in part new as these are "teleonomic" (the logic of natural, dynamic self-organisation and its balance in the environment).

c. *The ethological-behavioural model*. The "finality" (telos) which life is oriented towards is understood here as objective behaviour: this is the teleonomic principle. However, its explanatory context is finally teleonomic reductionism. From its physical-chemical-teleonomic causes, the explanation of objective behaviour (objectivism-behaviourism) is constructed.

d. *The ethological-phenomenological model*. This model admits the basic supposition that behaviour is caused by internal, psychic processes which are interpreted by analogy with the phenomenological experience of human psychism. Thus, in life, an "experiential interiority" was produced (we should remember the pan-psychism of Whitehead) which in the higher animals produces sensations, perceptions, consciousness, memory, emotions, etc. These psychic processes have a causal influence on the production of behaviour and the mechanicist-determinist evolution of life is oriented to these. Therefore, in this model, it is not denied that the explanation of life is given largely through reductionist and teleonomic reasons; but there is something more, conscious psychism, which has a "descendent causality" which interferes and controls the physical-chemical processes.

e. *The Darwinist model*. The formation of life (responding to any of the above models) arose evolutionarily in conformity with the processes of adaptation to the environment, selection and mutation, within the grand mass of events, considered in the perspective of the Darwinist theory. The neural Darwinism of Edelman would be applicable not only to man, but to the general origin of the living beings which selectively generate their nervous systems.

f. *The quantum-holistic model*. This model links with the above models, especially with the ethological-phenomenological model. It would admit the reductionist, teleonomic and ethological models in a balanced way, but would add an essential contribution: the explanatory connection of

experiential holism and living indeterminism with its possible physical support in the quantum-holistic phenomena of the matter/universe. In the biological systems of differentiated, macroscopic-classical (fermionic), niches of bosonic matter had been "lodged" and this would produce phenomena of corporal, quantum coherence and in connection with external environments of the physical world (e.g.. light). The ideas of Fröhlich, Hameroff, Penrose, Popp and others are along these lines.

g. *The vitalist model*. As regards the above models, vitalism proposed that life is explained by a vital "principle" or "élan" which is not reducible to the physical world. The concept of these living "hypothetical speculations" would link up with certain dualist philosophies, with certain nuances, but today it has few followers. The dualist approaches still have followers in philosophical-theological environments of the Christian, Platonic-Aristotelian traditions.

Evolutionary profiles of life as anthropic properties

6. In life, certain emergent innovations are produced which constitute a first step which indicates human emergence. The selection of these steps and their description depend on the models of life which are considered to be correct and are applied in scientific biology. A) It is a fact that these emergent states were produced: they are not speculation, but unquestionable, empirical facts. B) Their anthropic character is not speculation, but a simple connection between their nature described by science and the subsequent nature of the human fact which will emerge evolutionarily.

   Let us look at an example. It is a fact known by science that in the living animal world the first sensitive systems were formed. It is a fact that the human species presents specific sensitive systems. It is a fact established by science that the human species has been formed evolutionarily from the preceding living species. Therefore, "animal sensitivity" is an anthropic principle which announces the emergence of "human sensitivity". Thus, we could argue about other properties of life as anthropic principles of the human species: the human body in all its morphological and physiological aspects, the human psychic system, human knowledge, etc. Thus, life is a first step in the gradual process which leads to man from the anthropic properties of matter -universe.

7. The evolutionary moment of life contains a set of properties which act as a bridge between matter-universe and the emergence of man. These are anthropic properties insofar as they make man possible. The living beings are physical "objects" which have evolved by optimising properties of matter-universe until "living objects" were produced with emergent properties. We make a selection of these fundamental anthropic properties: not all of these are found in all the living beings, but they are found in all of life, including the non-human higher living beings.

   a. *Stable objects with adaptation to the changing environment*. The living is constructed as a physical world and receives the physical, mechanical-

determinist stability, however, it adds an important specification: life is born as a dynamic and changing exchange with the environment. The stability of the physical world is relatively more static. The living is achieved by more dynamic physical-biological systems. The changing dynamism which will lead to man emerges in this property of life.

b. *Energetic objects in growth, development and death*. The energy of the universe arises in the big bang. The living fuses in energy which leads to birth, growth-development and death (when the stable dynamic balance achieved during the living time is broken). Life achieves changing dynamism, but it does not manage to stabilise this, not even to the extent of the greater part of the physical states of differentiated matter. Man is pre-figured in the temporary, changing, dynamic balance of life.

c. *Objects with dynamic self-organisation*. Life was possible because matter/universe enabled this through its ontology, it produced an evolution towards the birth of dynamic systems with self- organisation. Life is the evolutionary discovery of the laws of this dynamic self-organisation from birth (embryogenesis) until the dynamic changing adaptation as regards the environment. Man will be a qualified product of this dynamic self-organisation in balance.

d. *Objects with detection of information*. A system which contains an enormous amount of information on matter and the universe, as environments to which life must adapt (selective Darwinism). The rules of self-organisation suppose "information" on the environment and, finally on the existing reality. It is information which makes the self-organisational design of life efficient and this is achieved from the more primitive processes where everything functions in accordance with mechanical-determinist reductionism. This effective information accumulated throughout life is an anthropic sign which announces that man will finally be possible.

e. *Objects with sensitivity-consciousness*. Sensitivity-consciousness, which already emerges in the living world, has efficient causality in the adaptation to the environment and is thus understood in the models of life in force today. It is the living capacity to feel that points anthropically towards man. This seems to indicate that life must have arisen as pure mechanical-determinist systems of organisation (physical-chemical reductionism). However, at a certain time in evolution, "sensitivity" must have appeared and this faculty is extraordinarily effective as regards the adaptive survival in the environment. What was the "physical support" of this new emergence of "sensitivity"? The complex human "sensitivity-consciousness" will be the essential component of subsequent human psychism.

f. *Objects with knowledge and psychism*. The same must be said of animal knowledge and the architectonic structure of their psychic systems. These are a development of sensitivity-consciousness and are also a premonitory sign which points anthropically to the proximate emergence of the human

species. Man appears evolutionarily from the systems of knowledge and psychism already constructed in the preceding species of hominids.

g. *Objects with psychic subjectuality*. Evolution not only caused systems of information (and afterwards "sensitivity"). Information and sensation are integrated with response automatisms (for example: the sensation of light which makes it possible to modulate movement). The perfection of unitary sensation of the body itself and the integration of the sensitive systems (consciousness) made the "passive subject" emerge little by little. The "subject" coordinates the information and generates adaptive responses of the animal as an "all". The "animal subject" is thus an immediate precedent of the "human psychic subject".

h. *Objects opened with holistic integration*. The objective circumstances (biological-neurological structures and the objective behaviour in the environment) are sufficient indication in order to infer that "life" produced "holistic environment" of sensitivity in animals. We must infer that the animal "feels" its body as a unitary totality; the higher animal has visual images which install it in a field of external light which is felt "holistically". Holism which is present in the phenomenological experience of subsequent human psychism must have begun to be produced in the preceding organisation of "life".

Discussion

Reductionism

The reductionist models today still have a wide influence on biology and neurology. What is the epistemology of reductionism? What image of "life" is offered by reductionism? What arguments continue to justify reductionism today? Can reductionism justify the phenomenology of human psychism? How can the argumentation of the great authors and researchers who have defended and continue to defend reductionism be valued?

Automatisms

Life began through mechanical-determinist organisation. Complex automatisms were fused and functioned apart from sensitivity-consciousness. However, animal behaviour seems to present oscillation, flexibility, certain indeterminacy. How are determinism (automatism, routines) and spontaneous self-determination related in "life"? Are the components to define the determinism-liberty problem which will arise as regards the human species already present in life?

Information

Living beings were formed as systems whose organisation supposes the accumulation of an enormous amount of information on the environment of the matter-universe to which they must adapt. How is this presence of information in living beings to be understood? Are computational models valid? How would this be understood from the neurological perspective? Is the animal distinguished from man in the differences in their information systems?

Subjectuality

The subject is an essential factor in the emergence of life. The higher animals have constituted a "psychic subject". What factors explain the emergence and nature of the psychic subject? What is its role in behaviour? How is the "psychic subject" understood in the different "models of life"? Would there be sensitivity-consciousness and psychic experience of holistic environments (propioception and vision) if there was no subject capable of registering the "sensation"?

Knowledge

Knowledge appears in the animal world and is a prefiguring of human knowledge. What is animal knowledge? How does it depend on the more basic psychic processes? How did it arise evolutionarily? What role does memory play in the genesis of animal knowledge (Edelman)? How does animal knowledge function? What role does it have in behaviour? How are knowledge and instinct related? Is knowledge "proto-human" behaviour (Lorenz)?

Holism

Is holism present in the psychic self-experience of the animal? What empirical and theoretical evidence can be adduced? What physical structures of matter-universe and of the neurological structures of the animal would be the "physical-biological-neurological support" of the animal holistic experience? What significance does holism have for the traditional, reductionist model? Do the new holistic perspectives oblige us to rethink biology? How are holism and mechanicism-determinism coordinated?

SESSION III: MAN AND NEUROLOGY

SPEAKER: **FRANCISCO MORA**
COMPLUTENSE UNIVERSITY OF MADRID, SPAIN

Francisco Mora is doctor of Medicine from the University of Granada and doctor of Neuroscience from the University of Oxford (England). He is likewise Professor of Human Physiology in the Faculty of Medicine of the Complutense University of Madrid, and Adjunct Professor in the Department of Physiology and Biophysics of the Faculty of Medicine of the University of Iowa in the United States, where he has been honoured with the Helen C. Levitt Professorship Award.

ABSTRACT

My objective is to give a perspective of man from what we know about the brain and how the brain works. In fact I think this New Century will be the beginning of a new era in Science. Eric Kandel (Nobel Laureate 2000) said "The scientific community today agrees in that the XXI century will be the century of the Biology of Mind like the XX century was for the Biology of Gene". Neuroscience is in a progressive expansion providing knowledge about the brain through the application of the Scientific Method, the only method able to approximate objective knowledge.

2

The area of influence of Neuroscience has expanded as far as to reach the classical disciplines (humanities), and establish a dialogue with them. Those include Philosophy, Ethics, Sociology, Economy, Art and also Religion. All that has increased the interest of people in the brain, not only of specialists in both sides of knowledge (Science and Humanities) but also lay people. Everyone is very much interested on how the brain produces thought and knowledge, emotions and feelings, and the mental processes. Today it has been reached a point in which, as stated by a recent Editorial from Science Magazine, Descartes has died. It is clearly accepted these days that mind is not something different and separated from the brain but the workings of the brain itself. Man is just a single entity not divided in a dualism of any sort and a product of evolution.Very few things can be understood in biology, included man, unless they are analyzed under the light and perspective of evolution. Only under that perspective can we hope to reach some understanding of our own Nature.

3

From Australopitecins to the genus homo and in only 3-4 million years, the brain has increased in size and weight by more than 1 kilogram. During that time many different changes of reduction, increases and reorganization of specific areas occurred in the brain. In very general terms these are the following.

1. A reduction of area 17 (primary visual cortex) and expansion of areas 18 and 19 (Association visual cortex)

2. Expansion of posterior parietal cortex (area 7)
3. Expansion of inferior parietal cortex (angular gyrus (area 39) supramarginal gyrus (area 40)
4. A gradual and global increase of brain weight
5. Reorganization of frontal lobes and increase in cerebral asymmetries (area 44)
6. Gradual increase of association areas (prefrontal cortex and parieto-temporal cortex) with increases in the number of interneurons.

4

In mammals and in general, the biggest the brain weight (relative to body weight) acquired during evolution, the larger the proportion of that brain weight growing after birth. A good example is that of the chimpanzee and humans. Because of the anatomical constrains posed by the female pelvis both species are born with approximately the same brain weight, that of around 300 grams (250 gr. for the chimpanzee and 350 gr. for humans). However, from the moment of birth on, the human brain grows up to a final weight of 1.450 grams while the chimpanzee only reaches 400-450 grams. This indicates that the chimpanzee, at birth, already has 60-65% of its final brain weight and the human only 20-25%. That is, the human brain develops almost 75% of its final brain weight outside the womb in direct interaction with the surrounding environment. This, apparently small biological and anatomical phenomena, has one of the most spectacular consequences in evolution. Man, in contrast with the rest of the animals, constructs its brain according to the sensory information it receives and transforming it into anatomy and physiology of the brain. Precisely, this is what really sharps, creates and modulates the individuality of each human brain during development.

5

Nobody would doubt, at the current stage of scientific knowledge, that the human being, each human being, in health or diseases, is the product of an interaction between his genes and the environment. James Watson who published in Nature in 1953, together with Francis Crick, a model of the structure of the DNA, wrote in 1989 “We used to think our fate was in our stars. Now we know, in large measure, our fate is in our genes”. Watson probably would have changed this sentence today. Today we know that our destiny is not written anywhere. Humans have an open fate which is constructed day after day, minute after minute, in a dynamic interplay between our genes and the environment. The life and trajectory of a human being is absolutely unique through a constant process of change through time and space.

6

Today we know that the formation and development of the brain, not just in humans but in every living being with a brain, particularly mammals, is not a monolithic process following a fixed set of genetic instructions. The codes in our genes are more a “project” that could be developed through alternative ways depending on the “environment” in which that project is developed. Today is clear that there exists a continuous interplay between genes and environment. That interplay is not just taking place during development but during the entire period of life of the individual. As a consequence also the barriers between biochemistry, morphology, physiology and behaviour have been broken. Constant changes in

the activity of our genes as a result of our interactions with the environment give rise to the synthesis of new proteins and this in turn give rise to changes in the morphology or anatomy of our dendrites and synapses having as a last consequence changes in the function of specific neuronal circuits and behaviour. The brain is a plastic organ. We humans are the product of dialectic interplay between our genes and our emotional and social environment. We are a process of change rather than a permanent body or essence. In fact human beings are biological individuals that keep memory of themselves but that they are always different.

7

The human brain contains more than 1 billion neurons. Also the brain contains some other type of neural cells (glial cells) in the amount of a trillion. However, the intimate organization, the detail in which those cells are interconnected, giving rise to specific circuits codifying for specific brain functions is not known. We certainly have thousands of working hypothesis. Also we do know very much about the hierarchy or levels, that bottom up (following the Human Brain Project created in 1980) flows from molecules-synapses-.neurons-maps-CNS. However, we do still not understand the jump between levels, since understanding the molecular-synaptic-cellular level is necessary but not enough to understand the level of networks or circuits. Research becomes very much complicated when we try to reduce mind and behavior to systems, neural pathways, central and local circuits, synapses, membranes and molecules and ions. To complicate matters we know today that astrocytes, together with neurons, also play a role in neural transmission. The end result is that we do not know the underpinnings of the function of the brain and how that constant interaction between genes and environment is integrated in a dynamic, plastic ever changing living brain.

8

As a general idea, the brain works as follows. The sensory receptors translate the different kind of energies surrounding us into the language the brain understands. Electromagnetic waves (vision), pressure waves (sound) mechanical deformation of the skin (touch, vibration and pressure) and different kinds of molecules (olfaction and taste) are translated into electrical events (local potentials and action potentials) and chemical events (release of neurotransmitters). The sensory receptors give rise, in the corresponding areas of the brain, to sensation and perception. Taken vision as an example we could say that information from the retina and thalamus reaches the primary visual cortex and from there information is distributed in both parallel and serial pathways to reach other visual areas in the posterior and anterior inferior temporal cortex which contains neurons and circuits that seem to construct all the sensory characteristic of an object. The inferior temporal cortex projects to a variety of areas, including the prefrontal cortex which contains the visually responsive neurons that categorize objects. Also, and importantly, that information reaches the limbic system or emotional brain, where the information is impregnated with emotional meaning, that is, good or bad, reward or pain. From there the information is distributed to other association areas of the cerebral cortex.

9

Among the higher functions of the brain perception, feelings, learning and memory, language, creativity, consciousness I will comment on creativity (Process that requires all these previous ingredients of perception, learning, memory and language). Particularly I would like to concentrate on that creative process of the brain we call abstraction. By abstraction I mean that capacity of the brain not to represent the particulars as they are but to create an idea inferred from many particulars, so that it can be applicable to many particulars. The brain works with abstractions, with ideas. This capacity of the brain together with categorization is the one leading to knowledge. Always between perception and cognition exists (in the brain) the process of categorization (perceptual categorization is the cognitive operation in which the brain (mammalian brain) groups together objects that share common properties, regardless of their physical differences).We know today some of the neuronal basis of that process in the brain. It is in fact a central topic in Cognitive Neuroscience.

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Art has to do with abstractions and feelings. Art starts with sensation and conscious perception and then abstraction and then emotion. But the brain of an artist goes beyond those initial steps of abstraction and emotion since the artist is constantly changing those processes in its brain. Even at the very end of those changes in the artist's brain, the final idea is always unsatisfactory leading to a deep dissatisfaction and frustration. Precisely a real artist is someone able to put in paint or words those unsatisfied abstractions and emotions in a way able to create beauty which in essence means to frame and impregnate abstractions with very deep and unique emotions and feelings. A genial artist as for instance Michelangelo goes even far beyond that description. The genius is a complex mixture of talent (execution) and inspiration (abstraction plus emotion) able to generate in the viewer a sensation of unfinished beauty thus allowing the spectator to finish the artistic work in his own brain and with it, perhaps, to satisfy its own sensation of frustration with reality. In this way art could even be interpreted as a psychological therapeutic tool for many people.

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Art is a process that hastens our cultural evolution. In fact we are now, these days, assisting to the birth of a revaluation of humanities through a process we have been calling NEUROCULTURE, a new cultural perspective based on the codes and functioning of the brain being unrevealed by neuroscience.

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God is a product of the workings of the brain. God is an abstraction although with special characteristics. Abstractions have their original roots and critical substrate in sensory images. That is not the case for God. The abstraction I call God has many and different ingredients. Probably God has been constructed in the brain like a work of art does, being the result of a deep frustration or deep dissatisfaction created when contrasting the ideal with the particulars of the world. God will be then a universal and beautiful abstraction. Emotions and feelings, at the highest level, would provide beauty to that abstraction. The difference of the idea of God and the idea of a real universal work of art, plenty of beauty and admiration and admired by everyone is that the work of art always can be

contrasted with the reality (even in abstract work). That is not the case for God. Discussion of these ideas will end my presentation.

DISCUSSANT: JAVIER MONSERRAT
UNIVERSIDAD AUTÓNOMA DE MADRID, SPAIN

Javier Monserrat is a professor of Universidad Autónoma de Madrid, and is a member of the Department of Basic Psychology of the Faculty of Psychology. He also teaches in the ecclesiastical faculties of Universidad Comillas, and forms part of the Advisory Council of the University's Cátedra CTR. For three years, he studied theology in Germany (Frankfurt). His professorial and investigation activities are focused on perception, more specifically, on visual perception and theory of mind, for which he spent one year in the Institute of Cognitive Studies of the University of California in Berkeley. His academic interests include epistemology, theory of science, fundamental theology, and the relationship between science and theology.

FORMALIZATION AND QUANTUM NEUROLOGY

I propose the following reflections based on my professional and personal interests in epistemology, cognitive psychology and vision science. I also hope that my modest contribution to this Work-Conference will open a window to interdisciplinarity, to the psycho-bio-physical unity of knowledge, and to its foundation on the radical ontological unity of the universe.

I think that something as essential to us like our own human, personal, and social life, as described by phenomenological disciplines, has probably been falsified by a "reductionist," mechanistic, and deterministic image, by an essentially "robotic" image of the universe, life, and psychism. We feel it is important and enriching to be open to an emerging alternative image of a holistic universe, which seems to allow a more integrated and unitary knowledge that is more congruent with our own phenomenological experience. This holistic universe explains the nature of natural systems, and especially, of living systems or entities within those natural systems.

The machines constructed at the service of human life depend on the ontology of the world. Computational machines also depend on the world's ontology. Granting that the new holistic ontology is correct (I am posing a hypothesis, and not an already established knowledge), we should evaluate on the basis of this holistic ontology the type of "machinism" constructed up to the present, and the formalizations permitting it. We also have to evaluate the ontological possibilities for a new "machinism" (probably closer to a "living machinism") and the formalizations it makes possible.

This presentation is about this new machinism and its possible formalizations. I will talk about a new holistic ontology connected to quantum neurology, and its possible formalizations. I do not think we presently can classify them beyond heuristic speculations. But let us not ignore them. To advance in our knowledge of

the natural world's ontology and the technologies it allows, we should make an effort to imagine what this holistic world would be.

I will comment first on the concept of formalization. Then, I will refer to quantum neurology as a discipline enabling us to contemplate the dimensions of this new hypothetical knowledge concerning the universe's ontology. Finally, I will draw the consequences of this new holistic ontology, speculating on certain aspects of this new ontology's possible formalizations. What I will say involves a great dose of imagination, from which every science is born. We now begin with the concept of formalization.

Formalization is a product of the human mind. It has an abstract dimension because the mind can conceive and imagine abstract "forms" either inspired by the world or purely imaginary, but never claiming to be an immediate representation of reality. Mathematics, logic, the formal systems theory, the design of structures in general, can produce abstract forms serving as natural models and as pure abstract imaginations. But formalization also has a real dimension: To formalize is to give form to reality by configuring the natural world (understanding and manipulating natural forms, as science normally does), and by configuring artificial forms (conceiving and constructing artificial forms, which are proper to technology).

Natural and artificial configurations are founded on an abstract dimension that offers a repertory of forms. Artificial configuration presupposes the creation of real forms (a computer) capable of producing (or processing) natural processes (expert systems, simulations) and the creation of abstract systems (Fourier's theorem). But not every artificial configuration is computational. Current technology has constructed mechanical, electronic, cybernetic, bionic, etc., configurations that do not exactly respond to the concept of computation. Turing's machine is an example of an abstract configuration. Von Neuman's computer is an example of an artificial configuration of real forms; more precisely, it is a real physical system of computation.

What role does formalization have in the computational sciences? Computation is inspired by physical nature's psycho-bio-physical dimensions, and in general, by its real structures. But for computation to be possible, it is necessary to create first abstract computation designs, or abstract computational forms like Turing's universal machine. It is also possible to conceive of other computation designs, like the PDP connectionist design. Our heuristic position is that the new holistic ontology would lead to new designs still to be conceived abstractly and implemented physically. Some designs could go beyond the computational.

Regarding the abstract form of computation represented by Turing's machine, we see that, on one hand, its real physical implementation has changed from von Neuman's computer to the current heuristic attempts at quantum computation. But on the other hand, with the availability of a real computation machine created by computational engineering (hardware), we see the creation of algorithmic or logical processing designs (software) allowing the computational processing of real or abstract systems. These computationally-processed systems (within a

specific machine) can be natural (as in artificial intelligence and simulations) or abstract (like the processing of abstract systems like mathematics).

An extremely important epistemological question (proper also to cognitive psychology) is why the human mind is capable of formalization. This decisive question introduces us to a scientific theory explaining what the mind is, and why it functions as it does (like formalizing, among other things). Instead of delving into this problem, we would like to offer a brief outline of the response within the framework of an evolutive epistemology.

The real world is constructed as a "structure", or as a totality of internally connected elements, operators, and projectors resulting in a functional unity. "Sensing" this world of structures has enabled living organisms to adapt behaviorally, becoming efficient to survive optimally. The senses, then, are systems that produce sensible formalization, or the sensation of structural forms, as happens in vision. But reason, in evolutive continuity with sensation-perception, is the process of mentally re-presenting the real as structure. To represent the world and its profound structures, reason imagines abstract forms (formal sciences) serving as models to understand real structures, and applies the forms to understand the world intensively (real sciences). Formalization thus depends on the natural ontology of forms. Formalization is inspired by natural physico-bio-psychic structures. But what is this physico-bio-psychic ontology?

The classical response, based on classical physics' image of a discrete, differentiated and mechanical world, leads to classical neurology. But a new heuristic response, constructed from an image of a world composed of holistic fields, leads to quantum neurology. Classical neurology uses formalizations inspired by a discrete and differentiated world. The new quantum neurology should be inspired by still to be conceived and implemented new formalizations based on a new holistic ontology. Science does not expect quantum and classical ontologies to be mutually exclusive. On the contrary, it hopes that the two ontologies are mutually enriching, and can be coordinated and integrated within a single harmonious system.

We now move to quantum neurology, the second part of our presentation. Its importance and strength depend on its capacity to explain (or to understand the causes of) our phenomenological experience, described by disciplines dealing with phenomenology. Instead of explaining this experience, we would just emphasize its three essential traits: unity of consciousness, holism, and indetermination. Our own personal and social experience is the *explicandum* (or what needs to be explained based on its causes) of the human sciences. And the *explicans* (or the explanatory causes or real structures) are the psycho-bio-physical causes, which, in turn, direct us to the radical physical support that evolutively produced life, and later, sensation-perception, integrated consciousness, and the cognitive-emotional unity of human life.

The important question of the bio-human sciences is: What is the physical support that makes intelligible the psycho-bio-physical ontology of our phenomenological experience? The answer obviously depends on the physical sciences' image of the world. Nineteenth-century's classical matter-radiation dualism was resolved by

quantum mechanics' corpuscle-wave duality principle. The classical explanation of psycho-bio-physical ontology was grounded on the idea of corpuscle, giving rise to an understanding of the world as composed of differentiated, discrete, and discontinuous entities, but resulting in reductionism. In contrast, the new quantum explanation is strengthened by the field properties of matter, opening new perspectives explaining the enigmatic world of physico-bio-psychic experiences. As said earlier, science ultimately expects a unitary classical-quantum explanation.

FRAMEWORK DOCUMENT IV

MAN/NEUROLOGY: "THE MIND AS AN ANTHROPIC FACTOR SEEN FROM THE HUMAN SCIENCES"

Man appears as a living physical reality in the evolution of the universe. Thus his scientific explanation depends on the physics of matter, cosmology and biology. However, something new appears in man and this produces all human specificity, whose causes must also be explained by science. This explanation would be the most specific and proper to the human sciences as human physics and biology are explained within the framework of physics and biology (including the psychic, holistic aspects shared with the living world).

We refer to the emergence of the "specific" psychic activity of man, specifically with regard to his "rationality". That is to say, the decisive anthropic property emerged in evolution and will make man definitively possible. Reason is the grand anthropic event of the evolution of matter-universe-life which transforms this into "human evolution". What is reason? What are its causes, as these can be known by science? The "models of man" in the human sciences depend on the "models of matter-universe" and on the "models of life" in the physical and biological sciences. The "explanatory models of the emergence and nature of reason" depend on these. They are models which cannot be constructed without the interdisciplinary confluence of several sciences.

Human paleoanthropology knows how the species *homo* arose from the hominids and now constructs hypotheses on the causes which could produce the hominization of knowledge and behaviour. However, its proposals must be valued from the in depth contribution of disciplines such as neurology, cognitive psychology, epistemology and philosophy (including physics and biology). This is the field of the current grand discussion on the "theory of mind".

Our proposal for discussion in this work document is to explain man with a holistic-quantum biology approach, which goes beyond the reductionism-computational approach. In addition, it would be possible to make conjectures that the evolution of the nervous system towards neurological "hyperformalisation" would have situated the human species in the appropriate psychic conditions "to feel" the reality of a new form and "to represent" real things as "structures". The process of analysis and synthesis of the human mind oriented towards representing an objective world of "structures" in order to survive in it would then have produced the emergence of reason and science.

Objectives, criteria and methods

1. The study of human evolution is focused on its essential objective that explain the appearance of man as a "natural object" in the universe, the evolutionary constitution of his specific, psychic system, his "mind", and the production of history. Man is explained as an evolutionary product of matter, of the universe and of life, but this supposes the appearance of a new level of emergence of ontological possibilities. With man, in fact appears a new mode of real being, irreducible to the others which had already arisen in evolution, but also situated in continuity with these. Therefore, when science explains man, it maintains the continuity of the evolutionary process and the emergence of new qualities, attributed to an effect caused by a new form of systemic structuring of the preceding biological organisms. These are the questions which the human sciences as a whole attempt to respond to in interdisciplinary collaboration and with physics, cosmology and biology.

2. As in all sciences, the starting point of human sciences is the description of its *explicandum*. This is the current experience of the human reality, already constituted in history. We know by personal and social (intersubjective) experience what man is as a real fact constituted in history, or what, in fact, the terminal product of human evolution is. We have made a phenomenological approach to "human evolution as phenomenological *explicandum*" as an initial basis for all the sessions (see D-I, No. 6-8). In this there appeared *common phenomenological features*, shared with the physical world of matter, with the universe and with life. However, *specific risks were* verified to be singular to the human being. Thus, the human sciences explain man in connection with the physics, cosmology and biology (common features); they also explain the specifically human by themselves, as is seen in the personal, inter-subjective, social and historical phenomenological experience (specific features).

3. *Common features*. Man as a natural entity is an evolutionary consequence of preceding anthropic properties which are explained in accordance with the physical sciences (matter), cosmological (universe) and biological (life). Thus, the physics of matter and the conformation in the universe of our "terrestrial niche" explain the human reality insofar as it is a physical object among others. However, the basic, specific living properties of our biological body is explained by matter, the universe and life. All the anthropic properties stated previously in sessions 1 (matter), 2 (universe) and 3 (life), represent several aspects of the human explained by physics, cosmology and biology. For example, the "holistic" experience of the senses has already been presented and explained (if this is the case) in the life sciences. The explanation of human, experiential holism would be a prolongation of the same explanation of living holism.

4. *Specific features*. Specific features also appear in man and their explanation is the task of the human sciences. These explanations of the specifically human constitute the novelty and peculiarity of the human sciences in their relation with the interdisciplinary framework of science. More specifically: if "rationality" is the essential phenomenological feature of man, as regards

preceding life, the explanation of rationality is an essential is an essential task of the human sciences. A scientific explanation, however, always involves knowing the causes (the causal system, cause system) which have produced the emergence of a real phenomenon: thus, here we endeavour to know the emergence of human reality from its causes. How and why the world of life ended up producing the world of human reason. Likewise, the human sciences should also address the explanation of all the other features of the specifically human way to be real: sensitivity, emotion, language, work, the history in its variety of content, etc.

5. *The human faculties: the production of history*. Consequently, the basic human sciences explain the causes which have produced the evolutionary emergence of the specific human faculties (e.g. reason). In this session, we refer above all to the basic explanations. However, the human sciences also explain human history in all its facets. They explain society (sociology), work (economics), politics (political science), knowledge (culture, philosophy, science, technology), religions (theology), etc. In the fifth session, we refer to one of the most surprising products of the human faculties: the production of the formal sciences. In the sixth session we refer to the production of theology as the fundamental theme to which our study of human evolution refers.

8. *Models in human sciences*. Man must be explained in the human sciences. However, the explanation is not always constructed in the same way. There is a diversity of explanatory models in human sciences which dispute the suitability of their approaches. The offer of alternative options should not surprise us as this responds to the nature of science: one thing is the facts (whose essential aspects are not discussed), however, their interpretation is another matter.

   Thus, the study of human evolution cannot be carried out without knowing the variety of "models of man" in human sciences as the reference framework. Only with these is it possible to precisely specify the essential question of the human sciences: the explanation of the causal system which produced the emergence and the nature of human rationality. We refer to these two themes below.

Human evolution
From the "models of man" in human sciences

9. It is evident that "models of man" is understood here as only a general approach to address the knowledge and explanation of the man in an evolutionary framework. In fact we are speaking of "models of mind", mainly with regard to the neurological problem. These "approaches" can be complementary and, therefore, not exclusive. Their explanatory scope, however, does not always cover the same extension: some explanations may be deeper than others: that is to say, they go more to the explanatory root, permitting better constructed theories (although this all depends on the subjective, scientific appraisal which may tend towards one or other explanation). Therefore, here we propose the following selection of "explanatory models".

a) *Philosophical models*. In connection with philosophy we must verify some models which continue to have restricted areas of validity, although they attempt to concur with modern scientific evidence. These are, above all, the Platonic-Aristotelian–Scholastic models, with an inevitable dualist orientation (and those who defend this attempt to soften it as much as possible today). There are also the Kantian and Neo-Kantian models (which are explained from classical rationalism) in which reason is understood as a transcendental a priori nature (not arising from biological evolution) which explained the universality and functional necessity of the human mind.

b) *Emergentist models*. The generalization of the evolutionary principles from the XIX century led to conceiving man (and his mind) as an evolutionary result. In order to maintain the ontological unity of evolution, simultaneously with the specific novelty of evolutionary products, the appearance of life and man should be seen as an "emergence" process (a real novelty within an ontological-evolutionary continuity). At the present time, most of the theories of man are within a specific type of "emergentist" framework.

c) *Darwinist models*. Darwinism not only introduced evolutionism in the XIX century, but also contributed an explanatory proposal of the form in which "emergence" of vital and new behavioural forms had been caused: the mechanisms of natural selection and adaptation completed later with the biochemical contributions to Neo-Darwinism. Along the same lines, there is the outstanding interpretation of Darwinism made by Gerald Edelman – the so called neural Darwinism – which explains how the nervous system is the result of massive processes and adaptive functional selection.

d) *Models of neural networks*. Classical neurology explained the animal and human minds – and, therefore, human nature – through neuronal theory and the systems or networks of neural interaction. The stimulus or information connects with neural networks (engrams, canons, structures, patterns…) which, on being activated, produce psychic life as correlated (sensations or *qualia*). The psychic subject is born evolutionarily from the stimulus-response connection. Thus, the brain is organised in specialisation with a precise localisation, but integrated into an interactive architecture which permits holistic life coordinated with the living organisms as a totality directed unity.

e) *Ethological-palaeontological models*. Within the framework of palaeontology, the palaeoanthropology has studied how the human species appears from the preceding evolution of the hominids (from the *Australopithecus* to *Homo Ergaster* or *Erectus*, *Homo Heidelbergensis*, *Neanderthal* or *homo sapiens*). A model of man appears conceived from the evolution of the species, in which there are certain outstanding causes which contributed to the emergent process which produces genus man: the lack of biological specialisation (Gehlen), work from the erect position,

socialisation-language, the evolution of behaviour by adaptation (Riedl, Lorenz) from proto-human behaviour. These models are preferably historical and can be harmonised with the other models which offer more ontological and radical explanations of human nature.

f) *Mechanicist-computational or reductionist models*. These models are the modern version of the classical mechanicist and determinist, reductionist explanations in the XIX century and part of the XX century. The model of the machine has been substituted by the model of the computer, which is much more complex and efficient. What evolution has produced are biological systems of computation which are more and more complex and perfect. The nervous system is a computation system, for some it is a "serial" and for others "connectionist" PDP, *parallel distributed processing*). Behaviour (human responses and activities in general, from perception to thought) is explained as the effect of underlying mechanical-computational processes. "Sensations" (and the conscious psychic life in general) are a marginal evolutionary effect (epiphenomenon) which human behaviour is not the cause of (logical-computational physicalism, identism, epiphenomenalism, computational functionalism).

g) *Quantum-holistic models*. These consider that the previous models do not explain an essential aspect of the phenomenological, psychic experience of consciousness: the holistic sensation of propioception of one's own body and the vision of the external field of reality. To achieve this, the classical neurology of neural networks is developed through quantum neurology which, from holistic, physical ontology, would explain how living beings and man have constructed their world of sensations by appropriating the holistic properties of matter universe. We refer to the contributions of Bohm, Hameroff, Penrose and Popp, among others.

The explanation of rationality

10. The proposals to explain human rationality are constructed from the "models of man" already selected. These offer us an explanation of the causes which, given the previous set of anthropic properties, constituted from matter, the universe and life, have produced the emergence of reason as a new specific feature which makes it possible to understand the root of human innovation. We have made the following selection of explanatory approaches to reason.

    a) *Philosophical explanations*. Obviously the philosophical positions always imply an explanation of reason. This occurs in the Platonic-Aristotelian-Scholastic dualisms or in the rationalist and Kantian anthropologies. The problem of these models is their reconciliation with science, which is more monist and evolutionary (not a priori-transcendental).

    b) *Evolutionary explanation … by non-specialisation*. Within the emergentist model, the classical theory of biological non-specialisation (Gehlen) tells us that reason was a forced adaptive resource in the human species due to the biological error of the loss of biological specialisation. However, what

neurological or ontological transformation in the human species made the emergence of reason possible?

c) … *from evolutionary palaeontology: work, socialisation, language*. This explanation contributes three factors which probably contribute to the hominisation and emergence of reason. However, neither do these seem to be valid as a radical, "in depth" explanation of human reason. Work, socialisation, language seem to suppose that they are products made possible by reason, already constituted in human psychism.

d) … *from evolutionary ethology (Lorenz, Riedl)*. Physical evolution and the adaptive apparition of life is a morpho-ratio process of the accumulation of information on matter-universe. This process continues in animal behaviour up to proto-human behaviour: reason is thus the congruence of animal-human behaviour adapted congruent with the objective demands of matter-universe. Reason is a behaviour adapted with greater complexity which responds to the mechanisms arising in the functions of animal psychism.

e) … *from the representation-memory mechanisms (Edelman)*. The theory of Edelman on the origin of the psychic processes from memory (*the remembered present*) completes the ethological-evolutionary explanation with a theory on the origin of representation as "memory packs" in the animal mind which are related with each other and little by little produce the emergence of the logical functions.

f) … *from neural Darwinism (Edelman)*. Edelman formulated his theory of neural Darwinism from two aspects: the massive proliferation of neural tissue and the selection of adaptively effective "mapping". This theory made it possible to explain the two most important components of phenomenological experience of consciousness: its unity (integration of the conscious ego) and its variability (the selection of adaptive options from among a massive offer of neural possibilities). Edelman thinks that this explanation is sufficient to explain unity (holism) and selection (indeterminacy, liberty), while quantum holism is unnecessary. For Edelman man is not a computer but selective dynamics can be simulated by appropriate computer designs.

g) … *from the theory of neural networks*. Classical neurology of neural networks would explain how the sensitive registers in its own modules would commence to be "read", through the expansion of the association brain. The front lobules began to construct representative packets for the memory (Edelman). This process of connection and analysis continued with the development of the front and pre-front areas where new tissues of neurons permitted the nascent complexity of the mind. Reason was a result of neuronal complexity for the inter-connection and analysis of all the modular registers and networks of the old and the modern brain. Man was not a computer, but functioned through psychic activity which emerged from the neural networks, supported by highly complex unconscious

structures; however, this activity could be partially simulated in accordance with a "weak metaphor" of computation.

h) … *from the theory of biological hyper-formalisation (Zubiri)*. The theory of Zubiri is a hypothetical case which interprets what would have produced the growing complexity of the nervous system. The animal perceives forms (objects), but "it feels" them as stimuli and reacts through instinctive automatisms (signitive). The human animal would have evolved towards a nervous system which would enable feeling-perceiving through "hyper-formalisation". This "hyper-formalised feeling" makes the human contemplate the stimuli as "reality" (as something which is observed in itself). This contemplation of "reality" leads to the representation that reality is real as "structure" (as a unitary system of components). The psychic activity for reality as a structure would be the genesis of reason. Science would be the most rigorous form to analyse the real world and for it to be represented as "structure".

i) … *from the genetic-evolutionary theory (Piaget)*. In the genetic psychology of Piaget we find a proposal similar to that of Zubiri: through movement and sensations, the child constructs his sensations and representation of a structural idea of his body and the objects which constitute the genesis of adult reason. He constructs a structural representation of reality.

j) … *from computational theory*. The computational model also requires proposing an explanation of the evolutionary genesis of reason. This is only the selection of responses to the information of the medium through complex processing programs constructed in human neural evolution. The psychological reason (experimented as action directed and caused by the conscious ego would only be a marginal psychic epiphenomenon).

k) … *from neural determinism*. Modern neurological investigation (from Libet) has verified evidence that the mind functions through neural determinism which would make liberty only an illusory phenomenon (epiphenomenal). This type of neurology would serve as support for the computational theorists of reason. It is clear that, if man were a robot and liberty an illusion, the idea of a society constructed on the evidence of moral responsibility.

l) … *from functionalism*. This would consider that it is not possible to explain the causes of the human mind, given the current limitation of scientific knowledge. However, it would be possible to offer a functional theory of the mind (a description of its functioning). From this point of view, functionalism involves a number of options, including computational functionalism.

m) … *from the quantum-holistic neurology*. This would be in congruence with many of the previous explanations of reason. However, it would add that the holistic-indeterminist properties of matter-universe must be applied to the explanation of the holístic-indeterminist explanation of the psychic

experience. The rational activity would be the exercise of the psychic activity founded on the holistic-indeterminist experience constructed evolutionarily in life and terminally in the human consciousness. The psychic spontaneity of the mind and reason would have their origins in the indeterminacy of the quantum states (quantum superimposition).

11. *The mind as an anthropic principle*. The evolutionary appearance of the rational human mind is the most important anthropic factor. This reason, together with the other human faculties has produced history. The possession of a "rational mind" explains why the human phenomenological experience is evolutionary. However, what is the mind? What is its origin? The answers to these questions (the models of man and the explanations of reason which must be discussed) influence the way to understand the anthropic consequences of the mind and its projection on the human future.

Discussion

The epistemology of the human sciences

The human sciences, especially psychology, anthropology, philosophy and neurology, must be constructed in accordance with a certain epistemology which has been discussed in recent years. Where do "behaviourism" and "methodological objectivism" stand in the human sciences today? How are the phenomenological facts considered in the epistemology of the human sciences? Which epistemological presuppositions are established in the cognitive sciences and in neurology? What epistemology is founded by the computational paradigm and by the emergentist paradigm in human sciences? What consequences do these epistemological approaches have on the way to understand the anthropic properties which are manifested in anthropology and neurology?

The phenomenological explicandum

What must anthropology and neurology explain? What are the phenomenological features which science must explain? Is the phenomenology proposed as a point of reference in these working drafts, correct?
Are there alternatives? How would phenomenology be made with a computational approach? And with a dualist approach? How does phenomenology influence the valuation of the results of the human sciences?

The models of man

In current human sciences, there are several paradigms which disputed the correct scientific interpretation of man. How can we present and judge the content of these paradigms or "models of man"? What consequences do these have on the way to understand the anthropic principles which have made man possible? As regards the "models of man", what are the empirical evidence and the facts and where do the discussible interpretations begin?

The explanation of reason

The explanation of the most essential distinctive feature of the human condition, reason, must be made from within the logic of "models of man" constructed by science. How are the proposals to explain the evolutionary origin of reason? How is this done within the "models of man"? What anthropic consequences does the explanation of reason have?

Is the "explanation" of man science or philosophy?

The explanation of man frequently mixes science and philosophy. What point does the purely scientific image of man reach? What does science contribute as unquestionable knowledge and what gaps does it leave open? What does philosophy contribute? How do science and philosophy complement each other in order to understand human evolution? In what sense does our scientific and philosophical explanation of man (especially the explanation of reason) have consequences as regards our form of understanding and valuing human discourse on God, la religion and theology?

SESSION IV: FORMAL SCIENCES

SPEAKER: **PIERGIORGIO ODIFREDDI**
DEPARTMENT OF MATHEMATICS, UNIVERSITY OF TURIN, ITALY

Piergiorgio Odifreddi has taught in both Italy (Turin, Alessandria, Siena, Milan) and in the United States (Cornell University). Since 2001, he has been a Professor of mathematical logic in the Department of Mathematics at the University of Turin.

He has written editorials and books reviews for La rivista dei libri (the Italian edition of the New York Review of Books), is a regular contributor to Le Scienze (the Italian edition of Scientific American), and has also written for several newspapers such as La Repubblica, La Stampa and the weekly L'Espresso. The television stations Radio Tre, RAI Due and RAI Tre have hosted many of his discussions on various scientific topics.

ON THE PITHECANTHROPIC PRINCIPLE

The anthropic principle, so much (and too much) talked about, is based upon the trivial observation that the initial conditions of the universe determine the final conditions of mankind: if the world had been different, so would have been we, but the world is as it is, and so are we. But, as Hume had observed long ago, man has a natural tendency to misunderstand reason's arrow, by readily interpreting its effects as ends: in the specific case, by proudly deluding himself that the world is as it is *so that* we can be as we are, instead of humbly noticing that we are as we are, *because* the world is as it is.

These two little words, «so that» and «because», set apart causality from teleology, and determine the paradigms of our vision of the world and of man: scientific in one case, and religious in the other. But it is difficult to distinguish these little words and set them apart, unless one reaches a logical maturity which, far from being innate, is instead historically acquired, in a process whose reconstruction constitutes an important chapter of human history: of how, that is, man has gone from being a pure and simple «animal», to an impure and complicated «rational animal», according to the definition given by the stoic Chrysippus in the third century before our era.

More precisely, a «logical living being», if we literally translate the original expression *zoon logikon*, which underscores that logic is indeed what sets man apart from the animals, marking the true evolutionary discontinuity of life, and hence how the history of logic is what constitutes our true *Genesis*. But, if things are really so, then man has become himself only recently: more precisely, only in the two millennia before our era, when he has painfully unravelled the logical concepts from the mythological and literary bundle of primordial language and thought.

The first historical testimony of an explicit logical notion goes back to the eighteenth century before our era, and it is found in the juridical sentences of the Hammurabi Code, which all follow the same pattern of the *lex talionis*: «if a man has put out the eye of another man, his eye shall be put out». The laws of the Pact of Alliance, which Moses dictated to the Jews in the *Exodus*, follow the same schema: including the *lex talionis*, in the contracted form «an eye for an eye».

The notion in question is *implication*, that forms the basis of any hypothetical reasoning: without it, one could not perform deductions, nor give proofs, and language could exist only in a primordial declarative form, consisting of isolated statements all mutually unrelated. With time, naturally, implication became of common use: if we are to believe Callimachus, the Alexandrine librarian who lived in the second century before our era, in his days «even the crows on the roofs cawed about the nature of implications».

The reason for this cawing lies in the fact that the notion is complex, and about it only one thing is clear: that if one starts from a true hypothesis, and reaches a false conclusion, then something has gone wrong in the reasoning, which must hence be false. The problem is to know what happens in the remaining cases, that is when the hypothesis is false or the conclusion is true. The Megarian philosopher Philo proposed a radical, and therefore simplistic, solution: to consider the implication as true in all these cases.

The proposal has been, and continues to be, well accepted because of its practical usefulness, despite some paradoxical consequences: for example, it is true that «if $2 + 2 =5$ then I am the Pope», simply because the hypothesis is false. When a friend asked Bertrand Russell to prove such an implication, the philosopher answered that if $2+2=5$ then, by subtracting 3, also $1=2$, and since the friend and the Pope were two, they were also one. Jokes apart, a good deal of the development of propositional logic has been devoted to finding more natural and commonsensical definitions of implication, through logics of various kinds (constructive, minimal, relevant, and so on).

Less problematic than implication is *conjunction*, about which it is not surprising to come to know that it is true only if both conjuncts are true, and it is false if at least one of them is false. The same happens in marriage and divorce: it takes two to get married, but only one to get divorced, as the ancient logicians already knew, but the modern theologians still haven't learned.

The same thing happens with *disjunction*, who in its common logical meaning is false when both disjuncts are false, and true if at least one of them is true. Some of its properties are subtle, such as those who regulate its relationship with conjunction, but others have always been known, even to ancient dogs. Chrysippus, for example, once saw one running after a prey, and noticed that when the dog came to a triple intersection, first it smelled the first two roads, and then, not having smelled the prey on either, ran on the third road without smelling again. According to Chrysippus, the dog had made the following reasoning: «The prey went through the first, the second or the third road. But not through the first, nor the second. Hence, through the third».

Not always dogs reason as mature people, though. In *The Descent of Man*, for example, Darwin tells that once, on a hot and still day, his dog was lying on the lawn, and at a little distance a slight breeze occasionally moved an open parasol, to which the dog growled fiercely and barked, every time the parasol slightly moved, on the false assumption of the presence of some strange living agent. Darwin relates this automatic and inconscious behaviour of the animal to the tendency in savages to imagine that natural objects and agencies are animated by spiritual or living essences, in a sort of «dog theology» of which we can see some remnants in the name of the Holy *Ghost*.

The stoic analyses of the connectives (implication, conjunction, disjunction) are contemporary to the peripatetic ones of the quantifiers (all, some, none), culminated in Aristotle's *Organon*. The older Platonic dialogues, instead, witness the confusion that still housed, on these and other topics, in the heads of the animals that were then and there acquiring their rationality. In the *Euthydemus*, for example, Plato argues, apparently in a serious fashion, that if one knows something, then one knows everything, and that either one knows everything, or one does not know anything. In the *Gorgias*, that if the temperate soul is good, then the intemperate soul is bad. In the *Cratylus*, that since declarative statements are true or false, then so must be the names occurring into them. And so on, with a plethora of beginner's mistakes.

Plato and his contemporaries were indeed true beginners in many things, in the literal sense that logical awareness was getting born right then and there. But they were not beginners in everything, since for example in the *Republic* one already finds the first reference to the *principle of non contradiction*, which was instead perceived as shocking, more or less at the same time, by the taoist Chuang Tzu, who wrote: «How could the Tao have become so obscure, that there is now a distinction between true and false? How could words have become so obscure, that there is now a distinction between affirmations and negations?»

Similarly, after the garbled logical mess of the *Parmenides*, a dialogue that even today many naive philosophers still continue to consider a highlight of thought, in the *Sophist* one finally reaches the «parricide» of the Eleatic thought, and the comprehension of the fact that, if one wants to make sense, then one can talk of «being or not being something», in the sense of satisfying or not a specific predicate, but not of «being or not being absolutely».

And, again, in the same *Cratylus* already quoted for its naiveté about names, one nevertheless finds the not-at-all-naive *truth criterion* that Aristotle condensed in the motto «it is true to say of that which is that it is, and false to say of that which is that it is not», and the scholastics on their turn in the motto *adequatio rei et intellectus*, «correspondence between things and thought». Both mottos, together with the rest of logic, have become the pillars of scientific thought, but continue to be battled against by the socalled humanistic thought, whose armies of mythologists, theologians, literates and philosophers still fight in the jungle, using as weapons their freewheeling words, a war against the rationality that constitutes our only true distinction from the animals.

DISCUSSANT: PIOTR JANIK
THE UNIVERSITY SCHOOL OF PHILOSOPHY AND EDUCATION IGNATIANUM, KRAKÓW (POLAND)

Piotr Janik was born in 1967. He obtained an MA in Cybernetics (1992) at the Faculty of Electronics, Wroclaw University of Technology (Poland) and entered the Jesuit Order in 1994. He studied then Philosophy (B.A. in 1998, at *The University School of Philosophy and Education IGNATIANUM* in Cracow - Poland) and Theology (B.A. in 2002 at *Pontificia Facoltà Teologica dell'Italia Meridionale*, PFTIM, in Neaples – Italy and M.A. in 2003, at the *Pontifical Academy of Theology* in Cracow - Poland). Since 2003, he has been working on Ph.D. in Philosophy, about: *C.S. Peirce's Pragmatic Conception of Belief Revised*.

FORMAL SCIENCES AIDED MIND
FORMAL SCIENCES - AS THE ANTHROPIC PRODUCT OF HUMAN REASON

Introduction

There is an inevitable dilemma in our lived reality. We may predict the course of certain events, discover how things are, know the reasons for their existence. It is not true, that we do not achieve very true knowledge and share it or make it public. At the same time, we see that an understanding is not given once and for all. If once we had captured the meaning of something, recognize fiction and reality, we would expect to repeat this, to know the conditions of such discoveries, to offer proofs for being certain of the objectivity of the knowledge we possess/acquire or to be simply convinced. It causes us to reflect not only on the subject of our knowledge, but also upon ways of proceeding, and perhaps to be more attentive to the ways of our own thinking, and to formalise them.

My reflection as the contribution for discussion about the formal sciences is divided into three points: (i) ideas concerning growth of complexity of formalisations, (ii) questions related to aims: what are formalisations for?, and (iii) some issues regarding "structure". At the end, I offer some postulates about the future of formalisations. The title I proposed, "Formal Sciences Aided Mind", is a stylization of popular CAD (Computer Aided Design) software for engineers.

The step-by-step growth of the complexity of formalisation

> Every work of science great enough to be well remembered for a few generations affords some exemplification of the defective state of the art of reasoning of the time when it was written; and each chief step in science has been a lesson in logic. (C. S. Peirce)

What may one learn from the history of science?

In the history of science it is possible to distinguish some milestones as an exemplification of good reasoning in the time, in which they were performed. It is the fact that some predictions have changed common beliefs permanently. For instance, there is the insight that between Magic and Mystification remains an attitude offering a third way toward solid facts, e.g. J. Kepler's discovery of the

orbit of Mars; some remains as an alternative way of thinking such as "the transcendental method" of I. Kant; other predictions substituted by more sophisticated ones' as in the case of I. Newton's theory.

It seems to be impossible to understand such steps apart from the time, in which they occurred and it is simply mistaken to analyse them as contemporary events. Some of them remain incomprehensible even for different educated minds, i.e. as a trivial product of mind (see: Mill's statements about Kepler's discovery – J. S. Mill, *System of Logic*, III, 2, § 3.).

Science moves towards solid facts; on the other hand, it may not bring one nearer to the solution one is looking for. Error has a significant part in human thought. Verification and/or falsification tests in science may be seen as a proof that gives certainty to assumed propositions. In any case, the proof is not "neutral" to environment.

The difficulties mentioned above are not difficulties at all, if one knows that the human being has progressed due to self-correction; and self-correction has given on more in depth complexity of knowing, which may be badly organized and managed, and therefore confused.

Aristotelian, traditional and contemporary logic syllogism

Let's have a look at the syllogism to note changes through the ages. J. Łukasiewicz in his book *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic* (1957) points out that a difference between Aristotelian and traditional sylogism is fundamental, but often not recognized. The Aristotelian syllogism (BARBARA) has a form as follows:

> If A is predicated of all B, and B of all C, A must be predicated of all C. (*Prior Analytics*, I.4.26a)

for "A is predicated of all B" as α, "B is predicated of all C" as β, and "A is predicated of all C" as γ, we receive:

> if α, β then γ.

In the Aristotelian syllogism an "ergo", i.e. "therefore", is not necessary. The syllogism is a proposition. As a proposition is *true* or *false*. Let's compare with the traditional syllogism:

> Every B is A
> Every C is B
> *ergo* Every C is A

The traditional syllogism is a schema, and therefore is valid or not valid. It is not an implication as in case of Aristotle's syllogism, but an inference. Aristotle writes:

> A syllogism is discourse in which, certain things being stated, something

> other than what is stated follows of necessity from their being so. (*Prior Analytics* I.2, 24b)

In the perfect syllogism, he adds, between premiss and consequence the tie is obvious. In other words, the perfect syllogism does not require proof, and is not demonstrable; thus, it is an axiom (Łukasiewicz). In the case of the traditional syllogism we do not have a proposition, but a schema.

In the third type of syllogism (Peirce), named here the *contemporary logic syllogism* (PJ), the schema is similar to the traditional one. Three dots in the last row stand for the "ergo" (therefore).

> Rule: All European swans are white.
> Case: These swans are from Europe.
> ∴ Result: These swans are white.

In the contemporary logic syllogism there are at least two nuanses, both absent from the past usage of such forms. Firstly, the case (e.g. "These swans are from Europe") is given by the representative sample data and generalized to other members. Secondly, in the rule is involved a theory (sometimes only a "professional intuition"). In addition, it may be observed that a corollary is the case of a theorematic inference, i.e. the rule is assumed to be inviolable, and not just locally operated; in other words it is covered by some theorema. One day, due to a counterexample, the theory that "all swans are white" may no longer obtain....

He makes no errors who does not state anything.

Levels of proposition and discurse.Interpretation

On the ground of the 19th century approach to logic due to G. Boole, on the path prepared by G. W. Leibniz in the 17th/18th century, it was possible to give some solution to Greek Paradoxes, e.g. "Achilles and Tortoise", "Lair Paradox" (Peirce, Russell, Tarski). But, with the use of language arise new paradoxes, e.g. "in regard to this matter it doesn't matter", "Make sense in that sense", "it's true that it's not true".
So, it is necessary to "manage components" of proposition or discurse, in regard to the very meaning. The reference to a proposition or a discurse, i.e. the statement of its truth or falsity, is not on the level of the proposition (or the discurse), but it is made from a meta-level. But, the meta-level may be unreachable in some cases, so what then?

To "make sense" means "to interpret". The interpretation requires the "*intelligible*" data and this is not possible without some kind of interaction. There are three categories applicable to the unique "form-alisation": possible, actual and general (PJ, cf. Peirce). The possible one is the formalisation "as is" (some interpretation); the actual one is the formalisation "as evidence" (structure; the interpretation); the general one is the formalisation "as the meaning/signification" (the "*intelligible*" interpretation). The interpretation is being made within some universe (or theorem).

Aims of formalisation

> Kepler's greatest service to science was in impressing on men's minds that this was the thing to be done if they wished to improve astronomy; that they were not to content themselves with inquiring whether one system of epicycles was better than another but that they were to sit down to the figures and find out what the curve, in truth, was. (C. S. Peirce)

Help in knowing the real

I propose to divide the history of thought on the basis of an attitude towards seeking the real, into three periods: (i) the ancients (Plato, Aristotle, others), (ii) the scholastics, (iii) after the $15^{th}/17^{th}$ century, in Europe. In the first period different approaches strive to, characterize the real more or less exactly, i.e. independent of temporality and human influences. There appear a variety of proposals which focus on a specific fragment or aspect of the real; some of them are more elaborated, e.g. Socrates (ethics), Plato (ethics, politics), Aristotle (philosophy of nature). Interests sometimes are common, but theses are often incompatible (e.g. the "idea" for Plato and Aristotle).

In the second period, there arises the problem of knowing the individual as the real, and the universal as the real, too. For ancients knowing had general nature, therefore the knowing of the individual was impossible and unimportant. Two main schools of scholastics which gave a new foundation to thought was: thomism and scotism. School of the jesuits of the 16^{th} century, i.e. F. Suares, was a reconciliation of the two.

In the third period, with the boom of the specification of areas of interest within science, there came into being a variety of new sciences; it is possible to distinguish them on the basis of their attitude towards the individual or the universal (with the terms "individual" and "universal" understood as in the prior period). There appears in a new form a question: "what is the real?", but in a different formulation: "what is normative?", i.e. as in the first period, "independent of temporality and human infuences". In the 19^{th} century G. Boole provides *An Investigation into The Laws of Thought on Which Are Founded The Mathematical Theories of Logic and Probabilities* (1854). The works of Boole are indispensable for contemporary logic, which from the rule of the "Organon" (Aristotle) becomes the normative science; its function remains to guarantee, with certainty, the passage from what we just know and assume/assert (premisses), on account of the rules (the principles) to true conclusions (cf. inference).

Looking for certainty and/or demonstrability

According to Descartes certainty of mathematical operation is obtained "from being stated as", regardless of the real existence. Descartes writes: "for whether I am awake or dreaming, it remains true that two and three make five, and that a square has but four sides" (R. Descartes, *Meditations on First Philosophy*). For Aristotle, as we just have said, the perfect syllogism was an axiom, to which the "causes" did not apply. Thus, in such cases, certainty and/or demonstrability did not concern the "first principles" but rather more complex theses as derived

theses, which are therefore understandable. The truth was guaranteed within the theory or on the basis of the belief of human being. But the theory may be surpassed and human being may err.

The "first principles" until the 19th century were unquestioned. Then, the ideal of a solid metaphysics "more geometrico" disappears. There arises an idea of evolution and of process with new vigor (Lamarck, Darwin; Peirce, Whitehead, Kuhn). In this new approach, certainty and/or demonstrability would apply to a new, not yet existent world. Hence, how can we know it will be our world?

Making predictions

If Kant is right the problem of synthetic judgments a priori, i.e. mere sense-experience, on the one side and necessary connections or true universality, on the other, is not trivial at all. As in the 12th-14th centuries the metaphysical debate concerning universals showed a variety of positions in respect to the real. Two of them had particular impact on successive thinkers, i.e. that of Thomas Aquinas and on the contraries, that of Duns Scotus. Thanks to the second one the real and the formal in mind met themselves. ("Scotus added a great deal to the language of logic. Of his invention is the word reality" – Peirce).

In what metaphysical point are we today? How can we pose rightly questions in the process approach? Some attempts were made, e.g. Heidegger, Whitehead, de Chardin, Lonergan.

If prediction and the following act are made in the strictly formal way (e.g. under an algorithm or a piece of software) it does not generate "new", in the sense of "new world", but "new", in the sense of explication of assumed/asserted axioms. The question of "new" in the former sense requires surpassing the formal and makes it relative, a particular case of a more complex view. Thus, the "new" is not given once and for all (cf. The History of Formal Logic).

Border case

An observation: A. Einstein modified his theory of relativity to adequate it to a stationary concept of universe, by adding the cosmological constant (1916). Einstein was forced to abbandon such constant after the discovery of Hubble (1929). The stationary universe was an unforgotten fault. But in the 1990s, the discovery of cosmic acceleration has changed situation in favor to the cosmological constant, once again (Cf. J. D. Barrow, *Theories of Everything. The Quest for Ultimate Explanation*).

The above is rather complicated border case, any way – every border case generates difficulty, because it is impossible to state if it is true or false, etc.

Some issues concerning formalism, i.e. "structure"

> Ordinary men live so completely within the house of the Stagyrite that whatever they see out of the windows appears to them incomprehensible and metaphysical. [...] Long it has been only too manifest that, fondly habituated though we be to it, the old structure will not do for modern needs. (C. S. Peirce)

Categories of being

Category:	Firstness	Secondness	Thirdness
***characteristic*:**	pure qualities or possibilities	relations or reactions replica of (pure qualities or possibilities)	representations or mediations replica of (relations or reactions) replica of (pure qualities or possibilities)
"as is":	forms	structures, raw facts	configurations, ideas, norms, values, symbols, arguments, etc.
***concept*:**	universal	actual	general

(Peirce, cf. Wittgenstein)

Assertion of "structure"

The Modus Ponendo Ponens also known as the Law of Detachment is the classical way of making positive predictions. It is simple enough to serve as an illustration of an assertion.

> if p then q, and p,
> (*ergo*) therefore q.

There are two things to be asserted here: a law – „if p then q" and the state of things, a premiss – "p". Note, both of them are not of the same type. Given the rule (if p then q) and the premiss (p), the consequence (q) follows. No assertion of a premiss (p) results in repeating the rule; therefore, an assertion of q does not take place., i.e.:

> if p then q, and [if] p,
> (*ergo*) therefore [if p then] q.

The sense of this operation, recalled recently (Peirce, Frege), is to establish a tie between conceptions (or notions) and what is given in perception (or stated). In other words, before an assertion being made a structure is "blind": the assumed/asserted one becomes the medium of contact. In the past, the term

"structure" carried the static meaning, but why not to see it as dynamic? In any case, a "dynamic structure", from time to time named "animated" (especially within the software), is not a living being at all.

Meaning of "structure"

The term "structure" may be understood widely as an imitation of the being taken into account. Thus, structure is directed to its own precise meaning, dependent on an applied approach, and the term may signify *intelligibility*. Thus understood, structure remains the subject of some special science.

Analyses and formalisations of dynamic structures from the outside or from the inside (e.g. introspection) have to determine limits beyond which something real does not meet the normative (the real), and something real results in some form of "disease". More over, dynamic structure is the subject not only of study, but often of manipulation and interferences. Thus, the meaning of structure equals some signification, especially from the point of view of study of the case; but this is not the proper meaning.

The proper meaning of dynamic structure may be virtually reached due to corrections and approximations, i.e. "re-con-struct[ure]-ed".

A prognostic end of the postmodern "de-con-struct[ure]-ion"

Beyond outrages, the postmodern "deconstruction", i.e. taking apart the structure, may be seen as an action of general refoundation, i.e. going backward to free itself from error (meaning the old structure) and then, in a new environment, explicating the "new vision".

But a different attempt is possible, too. It may result in virtual reconstruction, i.e. determining pieces of shapes of structure thanks to different sciences, including the formal sciences. In many cases it will be necessary to reformulate the particular science itself.

One thing is certain in both ways of proceeding, i.e. that of necessary support from formalisation as an explication of intelligibility. So, maybe there is not a time for just Computer Aided Thinking, but the Formal Sciences Aided Mind.

Some predictions and/or questions about the future of the formalisation

From uniformity to multiformity

The medieval debate about universals may be seen as a reconciliation of the Aristotelian- Platonic concept of the real, i.e. the being of universal/general nature, with the search for the common nature, the forms of the beings. In other words, bringing together what is universal/general (subject of science) with what is individual (existent, known in a different sense). The modern interest for what is individual is in tension with the aims of sciences, i.e. paying attention to the universal/general or the repeatable. To know the individual means to formalise; on the other hand, this is exactly opposed to knowing the individual. What the concept of the individual should we have then? The problem seems to be

resolvable under an assumption of multiformity, i.e. a proper form for every individual.

Strict tie between the real and the formal

Beyond formalism sense-experience is blind. But the formalisation of some kind is the negation of another one. To state something means to omit something else.

The real is not understandable without the formal; on the other hand, may be recognized as the real. The recognizing and the understanding taking together guarantee a strict tie between the real and the formal.

From static structure to dynamic one

The human body may be seen as dynamic structure because of: (i) its development, (ii) its memory of interactions, (iii) its adaptability, etc.

There are kinds of software with a built-in mechanism of learning (e.g. chess software); it will be interesting to see the dynamic version of the formal sciences.

The formal sciences aided mind

The Mind is looking for support in the formal sciences, made by pencils and computers. Until now the role that the formal sciences have played is auxiliary to the control of the mind in the best cases. The control of the mind is through beliefs and the habitus. Scientific minds are trained minds. Is it possible that the formal sciences will be better advisers than minds themselves?

FRAMEWORK DOCUMENT V

FORMAL SCIENCES: "AS AN ANTHROPIC PRODUCT OF HUMAN REASON"

The emergence and stability of the rational mind in the human species produced history. Looking towards the future of human evolution, its possibilities must be foreseen through a prognosis founded on forecasts of the future of reason. In the past, an eminent product of reason was the creation of the so-called formal sciences. These were and will continue to be an instrument created by the mind in order to ponder on what the future might be. The formal sciences are the most effective "extension of the mind" in order to assess what the future of the human species might bring.

The "expansion of the mind in formalisation" means that we must address exciting themes for discussion such as the re-ontologisation and re-functionalisation of the mind. What are the formal sciences? What are the causes which have produced formalisation and what does this consist of as a natural product of the mind? These questions must be answered scientifically within the framework of the current discussion on the nature of the natural mind (see: session four, D-4): the formal sciences are a product of the natural mind. The proposal in this framework document, which must be assessed and discussed, is that the formal sciences are "structural representations" constructed by the mind.

They are products derived from the "structural" representative functioning of the natural mind in order to survive by adaptation to an objective world constructed as a "structure"; the world, in fact, is accessible to the senses and perception as "structure". According to this, the formal sciences would have commenced by abstracting and imagining "structures" applicable to the cognitive organisation of a world of "structures". Does the real world which is maintained as "structure" present absolute consistency and self-sufficiency in itself? Are the structures "imagined" by the human mind in the formal sciences absolutely consistent and self-sufficient in themselves?

When the real structures of the world are known supported by the formal structures, can the human mind construct formalisations which are so consistent (or self-sufficient) that they make it possible to know, predict and control reality absolutely and self-sufficiently (that is to say, matter-universe-life-man)? These are the questions which human evolution presents and which involve us in what can be called the metaphysics of formal sciences, already noted in the theorem of Gödel.

Objectives, criteria and methods

1. The formal sciences are a product of the natural human mind: more specifically of its evolutionary classification as rational. The "rational mind", therefore, has produced the formal sciences and this shows one of its most surprising emergent manifestations (the human mind as a new psychic product which did not exist in preceding life and is qualitatively irreducible to this).

   By "formal sciences" we understand the fact that the rational mind "has imagined abstract forms". a) *Imagined*: the formal sciences are constructs "created" by the human faculty to "imagine"; or, although they are viewable (for example with a paper and pencil, as has always been done in mathematics), this viewing responds to an internal imaginative and creative representation of the mind. b) *Forms*: what is imagined are "forms", or "structures" or "systems": that is to say, sets of "imagined objects" and the dynamic relationships between these in accordance with certain regulations. c) *Abstracts*: there are "imagined forms" searched for and conceived in themselves, "abstracting" (separating) from the real world.

2. To say that the formal sciences are "abstract" does not signify that this has not been produced with applied objectives: that is to say, oriented to using these abstract, imagined forms for the knowledge of the real world. In fact, the formal sciences were born as a mathematics of immediate application in order to count and measure time and space (arithmetic and geometry). The idea of abstract formalisation arose little by little and is a modern contribution. This justifies considering them as "sciences" (even though they do not directly intend to obtain "knowledge", but only "help to know"). In fact, science has always been "knowledge" of the real world; if the "formalisations" are at the service of "science", they should also be considered to be "formal sciences", as they conceive "forms" at the service of knowledge. They have been considered in this way and used in the history of science.

3. The construction of a variety of "forms" has given rise to classes of formal sciences. These have multiplied in recent years. There has been a mathematical, arithmetical or geometric formalisation; a logical formalisation; a systemic formalisation; a linguistic formalisation; a computational formalisation, among others. The knowledge, control, and even construction, of real systems which are more and more complex mean that today new hyper-complex, formal systems are also necessary to give rise to new classes of formal sciences (the formalisations applicable to computation sciences, for example, were unknown a few years ago).

4. Just as life, matter and the universe contain properties which we have classified as "anthropic" because they make possible and anticipate human emergence, as well as the current "human mind" presents properties which we can also consider to be "anthropic" insofar as they make possible and anticipate the man of the future. The mind of today, and especially its surprising formalising activity, enables us to gain an intuition and value human evolution beyond the present time.

5. The formal sciences are a fact. They have a history which leads to our days and can be reconstructed with precision. At the present time the formal sciences have an unquestionable, objective presence, and even their possible future evolution can be studied. Thus, they constitute more empirical evidence in the phenomenological *explicandum* of human evolution. They are facts which have been produced by the human mind and, therefore, they are a evolutionary product of the natural human faculties which "must be explained". The question is why the human mind has been able to "imagine" the formal sciences?

6. The formal sciences pose the problem of their origin: they point to the knowledge of how and why they have been created by the human mind. That is to say, what the causes which produced them were. It is evident that explanatory theorisation on this depends on the idea of the human mind which has been established as a presupposition, as, in the end, the formal sciences are a product of the faculties of the natural human mind (this is the theme of the fourth session of the workshop on man-neurology).

   Consequently, the formal sciences as a real produced fact denote where human evolution has reached. These are, in fact, *explicandum* which must be known scientifically as a product of the human mind. However, they are also a product of the mind which, as we said, has an extraordinary anthropic value, which enables us to have an intuition of the future evolution of the human mind. In any case, both knowledge and the anthropic valuation of the human sciences depend on the theory which is previously established in order to explain the natural human mind; or, the theory of the causes which produce it, its nature and its natural functioning.

   We refer to this below: firstly to the models of the causal origin of the formal sciences in the human mind, secondly to their anthropic valuation.

7. The models respond to the inevitable supposition that formal science is a product of the natural human mind. Their differences arise from the way to understand how the human mind produces formal sciences. And this depends on the ontology of the presupposed mind (the idea of its causal origin, of its nature and of its functions: see the fourth session, D-4). According to this, we select the following models in order to explain the natural origin of the formal sciences.

    a. *A priori, logicist, rationalist models*. Formalisation would arise from the capacities contained in the human mind a priori. The mind would be "constructed factually" (separate from evolution) in such a way that it would impose the laws of logic, mathematics, language, etc. This is how the Scholastics, Kantians, Logicisms (perhaps that of Russell), rationalisms (perhaps that of Chomsky), etc. seem to think.

    b. *Functionalist model*. Functionalism does not propose theories related to the origin of the formal sciences, but describes the laws of the functioning of the mind which made it possible to create these and their results (or, the formalisations which the human mind has, in fact, constructed in history). The study of both factors can make it possible to propose functional theories (basically "descriptive") on what the formal sciences are.

    c. *Platonic-intuitive model*. In accordance with the classical platonic essentialism, the formal forms or essences (e.g. mathematics) would be the fruit of the creating imagination carried out by the same mind through a "direct intuition". Authors such as Whitehead or Penrose seem to have insisted on this form of understanding the origin of the formal sciences.

    d. *Evolutionary models*. As regards the three previous models, the evolutionary models consider that the mind is formed evolutionarily and, therefore, the formal sciences must also be a product which is in consonance with evolution. They do not have a "construct" state which is proper to an atemporary mind, but are a product of evolution in time within the biological framework through adaptive and *a priori* mechanisms. Perhaps the most probable is that the "rationalism" of Chomsky must be understood as evolutionary.

    e. *Representative-neuronal models*. As they have arisen from evolution, the formal sciences respond to the natural activity of the mind and, therefore, are the result of the functioning of the nervous system. Specifically, they are the result of the representative, cognitive, imaginative activity possible through the ordinary mechanisms of the neuronal networks. This means that, in the final analysis, the formal activity of the mind would be founded on an imagination connected to the sensitive systems. Even the formal-abstractive activity would be produced from sensitivity.

    f. *Constructivist models*. These would be the fruit of a free construction from the imagination which would not respond to conditioning separated from the creative process. Some conceptions of the origin of mathematics such as the constructivism of Brouwer would seem to respond to this case.

g. *Adaptive-a posteriori models*. This would be a constructivism in which force is placed on an imaginative construction which depends on the *a posteriori* experience of an objective world to which the mind must adapt. The world is presented as "structure" (matter and universe are a construction which organises the differences in unitary systems). Thus, the human mind generalises the concept of structure from its experience of the structure of the world: conceiving the structures which make it possible to understand the real objective world and, at the same time, conceive other possible worlds imaginatively.

h. *The Piaget model (Piaget).* This is a way to explain the origin of the formal sciences in accordance with the adaptive –a posteriori model. It has had considerable influence.

i. *The Zubirian modelo (Zubiri).* This is also a version of the same adaptive-a priori model. The mind feels the "reality" which is presented to it a posteriori and notices that this is real as a "structure". Thus, their capacity to imagine structures whether these respond or not to the real objective world.

j. *Epiphenomenalist computational models*. As regards computationalism, the nervous system is a computer constructed biologically by evolution in order to process optimum adaptive responses. This natural, dynamic process understood as computational biological self-programming or connectionist networks (PDP) would produce an overabundance of formalisation (that is to say, more formalisations than those which, in fact, are being applied in order to react as regards the medium). Consciousness would be a marginal phenomenon (epiphenomenon) which would not intervene in causing the behaviour (as this would be an automatic result of the computation of the information or of the connectionist networks). According to this, on constructing the formal sciences, the epiphenomenal consciousness would verify the presence of the overabundant formal systems constructed in the mind by natural evolution.

8. These models represent explanatory options of the natural mind which are sometimes exclusive and sometimes not. To be inclined towards one model or another supposes being situated in a direction which will value the anthropic power of the formalising capacity of the human mind. This will also influence the way to understand philosophical, metaphysical and religious-theological discourse.

Anthropic valuation of the formal sciences

9. The functional faculties of the human mind indicate future evolution tendencies. The formalising faculty of the mind and its products are perhaps where these evolutionary tendencies point with more impact. It is a question of "anthropic" tendencies because, from the current reality of the mind, these will make the "man of the future" possible as this will be a product of the possibilities of the mind itself. These are tendencies which are discussed insofar as the proposal and the valuation can be made in different ways. Today

this discussion forms a substantial part of the philosophy of science and the philosophy of formal sciences. As a suggestion, we point out the following anthropic tendencies of the formal sciences.

a. *Imaginary list of possible forms*. Through the formal sciences, the mind is open to an almost infinite "imaginary list" of possible forms and structures, which is both static and dynamic. Dynamic because it can imagine structures which change its form depending on the changing internal and external information or depending on the self-generation of change designed in the same form. They can be freely imagined or inspired in a real aspect (space, time, thought, language …). The generating dynamics of the forms and of the formal change can be produced by several designs; it can even be generated by machines. One of these designs is computational: when change is generated in series or in parallel, by computing operations which respond to the imagined dynamic design. The future of human evolution will depend on the capacity to design and develop these forms, as well as the nature of this "growing imaginary list of forms" which will be placed at the service of human life.

b. *The design, register and synthesis of knowledge*. Through dynamically acting forms and machines, complex human knowledge can be registered, recovered, manipulated and related. For example, through the existing calculation designs which we know as expert systems or "artificial intelligence" in general

c. *The design of formalising technologies*. Technology consists of systems of cause-effect interactions between material states, either in series, or in parallel, until they produce certain useful results. These specific technologies always respond to formal dynamic designs which serve to operate already created formal systems, e.g. la mathematics (in series or in PDP parallel). Interactions can even be designed between technologies and independent formal designs (e.g. computational and connectionist). The new formalisations which are created can inspire and boost the imaginative list of new physical, biological and neurological technologies required to "operate these".

d. *The heuristic design of knowledge*. The formalisations can automatically and creatively generate new knowledge. Thus, they will be heuristic systems: dynamic systems to seek and conceive new knowledge. There are formalisations which only organise and relate existing knowledge (before, points b and c: e.g. expert systems in medicine). But there are other really heuristic formalisations which open up, suggest and conceive new knowledge. Thus, the formalisations which conceive and suggest material states beyond the observable and predictable: the formalisations applied in string theory, or the simulations of atmospheric weather, the origin-evolution of our universe, and other possible formalisations.

e. *The heuristic design of technology*. In addition, in the same way as there are heuristic formalisations in order to produce knowledge, it would also be possible to design formalisations oriented to heuristically producing

new technological possibilities. New and unforeseen technological systems could be generated by dynamic heuristic formalisations designed to invent them.

f. *Extension of the mind*. According to this, the formalisations are the grand means or instrument created by the mind for its own expansion. They have an extraordinary anthropic force in order to modulate the possibilities of the man of the future. Formalisation has enabled science to expand knowledge quantitatively and in an organised way, as well as increasing the rapidity and extension of the register, recuperation, technological handling, relation and production of knowledge. It has also permitted the extension of creativity by automating heuristics in knowledge and technology.

g. *Simulation of the mind*. The "extension of the mind" in formalisation does not entail ontological mind-formalisation-machine (computer) identity, nor functional identity. The formalisations and the computing machines in which they are dynamically implemented are not "ontologically" equal to a living being with sensitivity and consciousness. Neither are they equal in their way of functioning in order to achieve results, nor are the formalisations of calculators functionally equal to a living being and its mental functions. However, it would be possible to use formal systems in order to "simulate" functions of the natural mind and implement these in a calculator (we refer only to the functional, not to ontology). Although it is an issue under discussion (remember the opinions of Penrose), everything seems to indicate that the mind will be increasingly more possible to simulate functionally (not ontologically), both as regards production and the heuristics of knowledge.

h. *Re-ontologisation of the mind*. Therefore, the formalisations involve something like a re-ontologisation of the mind; or, in other words, the production of a new artificial mind, with a different ontology from the natural mind, although it will be designed and controlled by the natural mind. Nevertheless, where the re-ontologisation of the mind will reach is still a subject of discussion. Until now, it is a re-ontologisation which is different from the natural mind, although it can be coordinated with this (different as regards its *hardware* and as regards its *software*). If current *hardware* (calculators) is replaced by biological systems which implement formal dynamic systems, it would be a question of a re–ontologisation which is more similar to the human one. If possible, an ontological connection beyond the merely instrumental remains open. Moreover, matter-universe possesses holistic properties (which the physical-ontological support for sensation perhaps depends) and these could be technologically manipulated in order to construct "sensitive" *hardware*. These are speculative possibilities. This would pose questions on the possibility of connecting these new biological technologies to the sensitive biological *hardware* of living species.

i. *Re-funcionalisation of the mind*. The formalisations also involve a re-funcionalisation of the mind. The logic or software of the dynamic

formalisations in themselves and the machines designed to generate their operative capacity (including their possible biological capacity), in fact, entail the appearance of new functional faculties, which are not in the natural mind, but are instrumental in boosting the objectives of the mind, and even perhaps, as stated before, ontologically and functionally connectable with the mind itself. With what has been sated up to now, we see how the functions of the natural mind used to operate mathematics have been o re-functionalised by computers (Turing's machine) in order to operate mathematical more complex problems more rapidly.

j. *Absolutisation of the mind*. The increasing growth of formalisation will augment the possibilities of domination and control of matter-universe-life-man to the same extent through the "extension of the mind". Where will this domination reach? Will an absolutisation of the mind take place? If this is to take place, two conditions must be fulfilled: a) the availability of formal systems which are absolutely consistent in themselves, perfectly constructed, self-sufficient, consistent and closed; b) the knowledge of natural events (matter, universe, life, man) in order to make these correspond with these formal systems. To what extent is it speculative if nature could correspond with these absolute formal systems, the human mind would possess an absolute domination and control over reality? In any case, the theorem of Gödel, and other speculations on the metaphysics of the formal sciences pose questions on the possibility that the mind might create absolute formal systems, with a closed self-sufficient consistency.

Discussion

Epistemology of the formal sciences

The way to understand the formal sciences and their anthropic, orientating role in the future of human evolution depends on the epistemology of the formal sciences which is presupposed. What are the formal sciences? What role do they play in science? Are the epistemological principles presented correct? Do they connect with the scientific-neurological image of the natural mind? Can alternatives be proposed?

Classification and interdisciplinary nature of the formal sciences

Today there is a growing variety of formal sciences and their numerous technical applications. What are these? How can their specific epistemologies be presented? What anthropic possibilities do they indicate for the future of the human species?

Formal sciences and sciences of reality

The formal sciences are not a purely "imaginary" world, they are something created by the mind "from" and "for" reality. How do the formal sciences arise from the natural mind? Are there alternatives to the proposals made in the work document? How do these connect and open up possibilities for the real sciences? What conditions does the form of the "structure of the matter-universe-life" establish so that the formal sciences may be "instrumental" or "useful" for the real sciences?

Models of the natural origin of the formal functions of the mind

A number of explanatory models have arisen in the work document. How are these to be valued? What arguments back these up and what criticisms are they subject too? Are there alternative models?

Anthropic properties of the formal sciences

The fact that the mind has created the formal sciences points toward important anthropic properties, insofar as they indicate where the human species might evolve towards. In the work document, we have listed some of these. How are these to be valued? What anthropic lines of evolution do they indicate? Are there alternatives?

Natural ontology and artificial ontology of the mind

The anthropic line of the re-ontologisation and re-funcionalisation of the mind gives rise to important speculative discussions. What new "instrumental" possibilities will appear for the "extension of the mind"? Will an "ontological-functional extension of the mind" be possible? Will a biological extension of the natural mind which makes a new ontology and a new functional software emerge be possible? How much of this is legitimate scientific speculation and how much is science-fiction?

Metaphysics of the formal systems

The ontological-functional growth and limits of formal sciences and their implementation technologies in machines or biological systems give a probable measure of the anthropic future of the human species. As well as a measure of the metaphysics or final knowledge-domination of the reality of matter-universe-life. What direction does the "metaphysics of the formal sciences" indicate? Do these "metaphysics" really exist? What do the speculation and interpretation of the theorem of Gödel contribute to this issue?

SESSION V: THEOLOGICAL REFLECTION

SPEAKER: **FRASER WATTS**
QUEENS´COLLEGE, UNIVERSITY OF CAMBRIDGE, UK

Reader in Theology and Science, and Fellow and Director of Studies, Queens' College, University of Cambridge Fraser's research covers two broad fields -- that of the interface between psychology and theology, and that of the psychology of religion.Work carried out in the first of these fields is summarised and integrated in the forthcoming book Theology and Psychology, due to be published in January 2002 by Ashgate. The next major project will be on theological and psychological perspectives on the human emotions. Collaborative work is in progress on the theology and psychology of forgiveness. The recently published Psychology for Christian Ministry (Routledge, 2001), presents an approach to the psychology of religion applied to a broad range of the work of the Church.

ABSTRACT: **THEOLOGICAL REFLECTION**

At first blush, Darwin's theory of evolution by natural selection seemed to be an enemy of Christianity. However, following in the footsteps of Aubrey Moore, I want to argue that, though evolutionary theory appeared in the guise of an enemy, it has actually prove to be a good friend of Christianity. Christian doctrine has been rethought in the light of Darwin and, I believe, at every point it has been rethought for the better. I want to argue this in relation to our views on

- God's creation and provenance,
- evil,
- human nature,
- Jesus Christ.

First, Darwin has helped us to recover the sense that God's creative work is continuous. In Darwin's time there were many 'deists' who took the heretical view that, though God had created things once for all at the beginning, he was no longer actively involved in creation. Darwin helped people to understand that creation is an ongoing project for God. That is actually the point that Aubrey Moore had in mind when he first said that Darwin appeared in the guise of an enemy, but proved to be a friend of Christianity. Creation is not something God did once for all, but has been God's on-going way of creating species. Evolution is a remarkable way for God to have brought species into being. As Charles Kingsley said, it is a 'loftier' thought that God should create primal forms capable of development than that he should create every species fixed at the beginning, incapable of any further development.

Second, Darwin has drawn attention to the struggle for survival in nature. Tennyson spoke of nature 'red in tooth and claw'. Before Darwin, many people had clung to a romantic view of nature in which they had averted their eyes from the struggle for survival, and the evil and suffering that goes with that (though

there were exceptions such as Malthus who had influenced Darwin). Darwin made people aware of how much struggle takes place in the natural world. At first blush, that seemed to be a threat to Christianity. However it was only a threat to the ill-considered Christianity that wanted to pretend that everything in nature was good. Exactly how evil has entered into creation is one of the great mysteries. However, it is an evident fact that good and evil are intertwined in creation.

Third, Darwin was a threat to an exalted view of a human nature. Human beings sometimes like to pretend that they are the pinnacle of creation. The Victorian world had an exalted and unbalanced view of human dignity, which was threatened by Darwinism. People thought that if humans were descended from monkeys, Darwin was saying that humans were just animals, and they found that very offensive. However, Ecclesiastes 3 also says flatly that humans have no advantage over animals and all suffer the same fate. People imagine that an exalted view of human dignity is as central tenet of Christianity, but it really isn't. Darwin has helped us to recover a more balanced view of how good and evil are intertwined in human beings. We humans have evolved to the point where we have a unique capacity to do things deliberately. The struggle between good and evil has been brought to a new height in human beings, because we are more knowing than any other species. Darwin has helped to wean us off an exulted, and almost idolatrous view of human beings, and we can now take a much more balanced view of human nature than was possible 150 years ago.

Finally, Darwin seemed to have set out a view of the world in which there was no place for Christ and, in that sense, Darwinism seemed to be a threat to Christianity. However, we have now come to understand the place of Christ in evolution, and that has really enriched our understanding of his significance. You can see evolution as a long march preparing the ground for the point where the incarnation of God in Christ was possible. For God to reveal himself to his creation there needed to be a species capable of understanding God's revelation of himself. It is admittedly more difficult to suggest how Christ has had an impact on the course of evolution. However, with human beings, evolution has taken a new turn, and now seems to be more about the evolution of culture and consciousness than about basic biological forms. The incarnation can be seen as crucial to those further stages of evolution. One idea, advanced by Gerd Theissen, is that Christ is a kind of spiritual mutation; another is to suggest that Christ marks a turning point in the evolution of consciousness.

All such theological interpretations of evolution depend on the idea that there has been some kind of evolutionary progress. That is a notoriously controversial idea. Can it be defended? At very least, following Ayala, I suggest that that clearly has been directional change in evolution, whether that is seen as a movement towards greater complexity, or (better) towards greater capacity for processing of information. The directional change of evolution is one that serves what Christians assume to be God's purposes. That should not be confused with the idea that the evolution has, in every way made things better. As I have already indicated, human beings have a greater capacity for both good and evil than other species, and evolutionary developments usually seem to be morally ambiguous. I suggest that it is sufficient for the theological interpretation of evolution to

maintain that has been directional change consistent with God's purposes; it is not necessary to claim that evolution has in every way made things better.

There has recently been a good deal of interest in the evolution of religion. There is no serious dispute about the fact that religion has evolved. However, that is neutral as far as the validity of religious beliefs is concerned, despite the fact that many people working on the evolution of religion take it for granted that religion is false. Evolutionary atheism is as speculative as a natural theology based on an ubiquitous religious instinct.

It is frequently assumed that religious thinking represents a violation of intuitive principles, and a cross-over to the inanimate domain of ways of thinking that belong to animate things. That, in turn, rests on the assumption that, before religious thinking, emerging humanity kept domains more strictly separate than when animism began. However, as far as I am aware, there is little evidence about what came before animism. The assumption that domain-specificity preceded animism is parallel to the assumption that literal thinking preceded metaphorical thinking, an assumption that sits uneasily with etymological evidence that indicate that language becomes increasingly metaphorical as far back as you can trace it. The assumption that there was a shift from domain specific to cross-domain thinking seems parallel to the religious myth of a Fall, but one that is consistent with materialist, atheist assumptions.

DISCUSSANT: JOB KOZHAMTHADAM, SJ
PONTIFICAL INSTITUTE OF PHILOSOPHY AND RELIGION, INDIA

Job Kozhamthadam, SJ, born in Kerala (India, 1945), holds a Master of Science in Physics (Patna University, India, 1972) and a Master of Arts and a PhD in History and Philosophy of Science (Notre Dame University, USA, 1980 and University of Maryland, USA, 1986). He is Professor of Philosophy of Science, Cosmology and Science & Religion in Jnana-Deepa Vidyapeeth (Pontifical Institute of Philosophy and Religion), Pune, India, and has been Visiting Professor of Philosophy of Science in Loyola University (Chicago, USA). He is Founder-President of IISR (Indian Institute of Science and Religion) since 2001. Having published 6 books and more than 60 professional papers in international and national journals, his book *The Discovery of Kepler's Laws: The Interaction of Science, Philosophy and Religion* was chosen by *Choice Magazine* as one of the *Outstanding Academic Books of the Year 1994***.**

RESPONSE TO DR. WATTS

Given the fact that both science and religion have always remained powerful forces influencing the lives and minds of people, some serious confrontation between the two was almost inevitable. However, it was often thought that religion was the loser in the bargain since new scientific developments were expected to undermine the legitimacy and credibility of religious claims and beliefs. Fraser Watts takes a path counter to this traditional one, and argues that in the case of the Darwinian Theory of Evolution, in the long run, the encounter benefited the Christian religion. I am in general agreement with Watts, although I

will make a few comments on some of the different conclusions he draws, and then go further to show some deeper impact of Evolution on the Christian religion, particularly on its worldview. For instance, I point out that the new perspective on scriptural interpretation originated already in the end of the 16th century, thanks to the contributions of Johanes Kepler, Galileo Galilei, etc.

Coming to the more profound impact of Evolution on Christianity, I point out that this theory calls for a change in the traditional Christian static worldview in favour of a dynamic one. The static worldview, initiated by Parmenides in the 5th century B.C., legitimized by Aristotle and fostered by Christianity, has been and still is basically the official worldview of Christianity. The Theory of Evolution calls for a dynamic, Heraclidean worldview. This shift from the static to the dynamic worldview will have serious and far-reaching consequences, calling for radical changes in the value system and religious beliefs. For instance, the static worldview basically assumes that God created a perfect world in the beginning, but in course of time it got vitiated because of the intervention of fallible and sinful humans. It subscribes to a backward-looking process in which progress is achieved by going back to the pristine original stage. On the other hand, the dynamic worldview presents a forward-looking process since here progress is something to be achieved in the future, and the whole creation is moving towards the Pleroma or the Omega Point, as Teilhard de Chardin has envisaged.

This study also brings out a more general implication. The encounter between a really good scientific theory and a good religion can and often does have salutary effects on religion as well as on science. Scientific developments, far from being a threat to good religion, may be looked upon as an opportunity for further clarification and consequent deepening of religious claims and beliefs.

FRAMEWORK DOCUMENT VI

PHILOSOPHY AND THEOLOGY: "WHAT ANTHROPIC HORIZONS DO PHILOSOPHY AND THEOLOGY OPEN UP FOR HUMAN EVOLUTION?"

Science does not put any limits to its wish to know reality. However, the scientific method has limits which pose ultimate questions which cannot be answered by science alone. At this point, science naturally leads to scientific-philosophical reflection. However, not all the results of science have the same value as regards suggesting scientific-philosophical reflections.

a. In the first place, we must make a list of scientific results which are projected towards metaphysics and theology; these are the results which can shed light on the ultimate metaphysical questions due to their nature. Science is based on the ascertainment of a real universe constructed as a system or structure. The expectation of science is that this system contains the self-sufficiency required to be real.

b. From the results of science, scientific-philosophical reflection constructs three positions as regards metaphysics, which are, in fact, three positions concerning the problem of self-sufficiency of the universe, agnosticism, atheism and theism.

c. Finally, science and philosophy are projected towards the theologies which the historical religions have constructed in order to give meaning to their beliefs.

The theologies are dependent on systems of thought from the past and on the influence of other cultural periods. Is the current image of human evolution in science congruent with these theologies? What new approach or adaptation should this mean for the traditional theologies? Is it possible to continue to talk of God, religion, theology in the "era of science"? In what way? Can the "theology of science", promoted by the religions and theologies, make a new dialogue and inter-religious and inter-theological ecumenical approximation possible?

Objectives, criteria and methods

1. Science seeks to know reality and does not place limits on this objective. However, the method of science imposes certain limits; this occurs when the scientific method cannot state anything when faced with certain questions or in certain areas of reality which are open o reason. For example, the question, "What was there before the *big bang*?", cannot be answered with a scientific hypothesis. The environment of "the ultimate", the "absolute basis of existing reality" is not possible to know as the result of the normal application of the scientific method, at the present time. However, questions on and environments of reality beyond the reach of the scientific method can also be addressed legitimately by human reason in philosophy and, in relation to this, in theology.

   It is legitimate for the rational human species to ask how and why there is "system of reality" which we verify phenomenologically by our senses. These questions are not unfamiliar to science, although on many occasions they cannot be answered by its method (science is not only open to the "how" of things, but also to the "why"). This is the question on the absolute or ultimate (metaphysical) basis of reality: it is the grand question which philosophy has attempted to answer, as well as, at their own levels, the religions and their theologies (and also, at its level, science). In fact dependent on these questions are important vital questions and the sense of life, which are legitimately asked by man. History and culture prove this. Theism, atheism, agnosticism, religions are different forms of taking up a philosophical or metaphysical position faced with the ultimate, the absolute.

   Today, when our enlightened, scientific culture continues to ask these philosophical questions on the ultimate, the metaphysical, the answers which are constructed cannot ignore the results of science. Thus, it is possible to speak of a type of scientific-philosophical reflection (philosophy of the results of science) and its consequences as regards theology. Of course, philosophy is not reduced to science: it must also be founded on reflection on other facets of existence (art, history, ethics, emotions, human feelings, etc.). However, the image of the universe in science is an important, necessary reference – although not exclusive or unique– for current philosophical reflection.

2. Scientific study on human evolution from its anthropic roots also leads reason to ask what philosophy leads to? How does the ultimate, absolute, metaphysical dimension of reality appear? What type of theology is possible from this scientific from this scientific image of human evolution? Moreover and as regards the special objectives of this workshop. What forecasts on human evolution do philosophy and theology lead to? Can our present in human history, explained by science, be a possible anthropic sign of a future religious "salvation" and survival "beyond death"?

   These questions are not strange or unnecessary for the scientific study of human evolution from its anthropic roots. Science seeks knowledge with no limits and, when it does not achieve this by its method alone, it appeals to philosophy in order to continue asking inevitable questions. Human evolution is produced from the anthropic properties of matter-universe-life, but human reason, assisted by its powerful capacity for formalisation, produces thought (hypotheses and conjectures) on its future. This complex, scientific, philosophical and theological thought makes it possible to glimpse signals from a possible future. Thus, philosophy and theology (starting from science) are, in fact, obscure anthropic signs (they do not have the security of science) because they reveal current forms of thought which might foreshadow a "new future of possibilities for humanity". This was so in the past and the question is whether science today permits this to continue in the future.

   However, we do not mean that metaphysical, scientific-philosophical reflection "necessarily" leads to describing these "future" horizons for humanity only in the religious sense. The result of scientific-philosophical reason applied to the metaphysical may be agnosticism or atheism. In any case, the argumentation and the taking up of a personal position as regards theism, atheism, agnosticism or religion (and their theologies) must be constructed within the framework of reflection on human evolution. That is to say, asking from the present time, given human evolution and the nature of reason, which hypotheses and conjectures can be constructed in relation to the future of the human species. This is where the capacity for free, personal evaluation must provide the arguments in favour of theism, atheism, agnosticism and religions. Several "anthropic" hypotheses will appear: hypotheses on how, from the present, reason makes it possible to understand the future of man. This is precisely what this sixth session of the workshop deals with.

3. Below we present a framework of ideas and suggestions which make it possible to think, deepen, evaluate, discuss and present alternatives, in relation to three main topics:

   a. *Relevant scientific results*. These are the most important results of the scientific image of human evolution which can be considered to be "relevant features or content" in relation to a possible philosophical reflection and its connections with theology. That is to say, the results produced by science do not have the same meaning or capacity of suggestion for philosophy and theology: here we make a proposal of a list

of the more outstanding results which seem "to suggest" inevitable lines of philosophical reflection.

b. *Relevant philosophical consequences*. Which philosophical inferences permit the results of the scientific image of human evolution? We refer to the ultimate, the absolute, and the metaphysical. In short, it would be "to suggest" the response routes of philosophy to the question which science seems to impose on man.

c. *Relevant theological consequences*. Along the same lines, the results of science and its consequences for philosophy must also lead to certain consequences for theological reflection from current culture: that is to say, the image of God in theology and whether this must be congruent with science and philosophy.

Scientific results: profiles which point to philosophy

4. Below we make a list of scientific results and the "profile" these present as regards the philosophical. The results are purely scientific; on reasoning that these results have a "profile" which is projected on philosophy is, evidently an interpretation. We note that, on occasions, we do not refer to results which are more or less "definitive" (although there is nothing "definitive" in science), but to trends in current science. The list is selective and interpretative. It is possible to value, perfect, enlarge, reduce, criticise and is susceptible to alternative proposals. However, it is a starting point for suggesting scientific-philosophical reflection.

5. We establish the following results, trends, profiles:

   a. *Scientific epistemology*. All that we say about science belongs to an "epistemological" discourse. It is not possible to speak about science and evaluate its results, without an "epistemology of science". Several epistemologies will lead to several ways of seeing science. This need for a fundamental epistemology within the framework of popperianism and post-popperianism.

   b. *Causal systems and method*. Science always attempts to know the causal systems of phenomena. Describing the phenomena (*explicandum*) and finding the causes which have really produced these (*explicans*). The *explicandum* is obtained by phenomenology. However, science aims at the knowledge of causes "without limits" (the "how" and the "why"). On occasions, its method does not permit it to construct precise "scientific" arguments regarding the ultimate questions. Thus, its connection with philosophy and theology. Science must not be confused with philosophy; but "philosophy from science" is possible. Today this connection seems to be acknowledged by all (theists, atheists, agnostics and religious), independently of the personal positions.

   c. *Self-sufficient systems*. Science attempts to causally know self-sufficient systems. Science seeks self-sufficient "causal systems", causes which

"explain" the phenomena with no need to appeal to other causes. It seeks "self-sufficient explanations (causal systems)". This is the same as saying "absolutes": causes sufficient to explain the real phenomena. Science seeks "structures" (systems of interdependent causes) which are self-sufficient. When the method of science does not permit hypotheses on these "self-sufficient causes" is when science connects with philosophy and, possibly (depending on opinions), with theology. All recognise this search for explanatory self-sufficiency; agnosticism considers that it is not possible ton achieve this (at the present time or under any circumstances), but it does not deny that human reason seeks this self-sufficiency.

d. *The monist principle*. Science works in accordance with the monist principle. This is a logical tendency for human reason: the universe with all its content (phenomena) is ascertained and, in principle, its causes are sought within the same universe. Therefore, matter or the first causal substratum of the universe must be the causal principle of all that we observe. The supposition is that the evolutionary process has a "monist unity". This supposition gives sense to this workshop as it seeks to find the anthropic roots in matter (D-1), in the universe (D-2), in life (D-3) and in the neurological configuration of the mind (D-4 y D-5). However, when science searches for self-sufficiency within the monist framework, problems may arise which connect with philosophy.

e. *The reductionism-dualism problem*. The results of science have posed a traditional problem (today in the process of being overcome, but still present in many fields and authors): On the one hand, the "explanatory reduction" of all reality, including life, psyche and man, to a certain physical-chemical paradigm of science; on the other hand, the reaction as regards "reductionism" postulating a "dualist" explanation of reality (counter to the monist expectation). This problem is being overcome as science evolves towards a new "non reductionist" paradigm. The "psych-physical" problem has existed and continues to exist today in certain approaches of science. This result cannot be ignored. However, it is a fact that modern science is attempting to "holistically" integrate or complement non exclusive explanatory principles which have the advantage of important phenomenological evidence.

f. *The complementary nature of monism-emergentism*. Science has an "emergentist" tendency, complementary to "monism". The monist principle is maintained, but it is also admitted that a continual evolution of the monist substratum of the universe produces the emergence of entities which permit a "new form of real being", which represents a "leap in the quality of existence". Leaving apart emergences of a minor nature, today science ascertains three grand emergences: The emergence of the universe ordered from unformed matter, the emergence of life from matter-universe, the emergence of man from life. Each level of emergence has its own forms of causality which are "not reducible" to each other. Science today involves emergentism which does not deny, but assumes theism.

g. *Complementariness of differentiation-holism*. Science today tends towards an idea of matter (of the universe, of life and of man) in which the differentiation is joined as a "complement" with "holism". In evolution the properties of matter have made it possible to produce "differentiated entities" (planets, bodies, organisms, men …) and "holistic states" in which matter loses its differentiation and forms unitary, physical, field states. Quantum mechanics today explains how the differentiation which makes it possible to construct bodies is produced and how the constitution of holistic states of matter which still persist within the universe (and probably within living beings is produced.

h. *Complementariness of determinism-indeterminism*. The tendency of science today is to complement "determination" with "indeterminacy". The causal interaction between "physical entities (or biological) differentiated" tends to be "determinist" (the preceding states or concurrent causes necessarily and inevitably produce certain effects, which some authors of the past explained through the model of "mechanicism"). This is the normal causality in the description of the world in classical mechanics. However, matter still not trapped in rigid, stable, differentiated structures (or, in more primitive states with more inclination to holism) presents an evolution to a great extent, but not totally, undetermined. The states of quantum superposition can, in fact, derive towards specific collapses. A particle has an unpredictable evolution within an oscillating range of probabilities or "propensities" (Popper), as explained in quantum mechanics. However, classical mechanics (statistical mechanics, chaos, complex systems …) today poses the problem of how to understand the "mechanical-classical" indeterminist evolution of the systems. Science today describes the world in a balanced fashion as a balance between determination and indeterminacy.

i. *The monist explanation of complexity*. The enormous complexity of reality is a fact: physical complexity (matter-universe), biological complexity (life) and human complexity (neurology). How does science explain this? As seems to be logical, it attempts to do so by formulating certain hypotheses which conserve the "self-sufficiency" of the universe. The first explanation is the nature of matter itself: the complexity would be an ulterior consequence its ontological properties (today theoretically string and superstring theory point to this). The properties of self-organisation of matter (Stuart Kauffman) explain the microscopic order of matter and the macroscopic order of the universe. Moreover, the biological and neurological complexity are explained by Darwinism (from simplicity to complexity in short adaptive leaps in accumulated chains); but not only this, as we must also add the intrinsic properties of the self-organisation of matter (which are ascertained in biology in an extraordinary way). Science is at present moving towards an explanation of the causes which have produced the emergence of the complexity within the evolution of the universe.

j. *The monist explanation of life and psychism*. Science shows a tendency towards the emergentist explanation of the "physical support" of

psychism. The explanation is founded on the monist-emergentism, determinism-indeterminacy complementariness and on the explanatory theories of complexity. Life would be a balanced equilibrium between determined, stable organisms which occupy a defined place in space-time and the undetermined holistic fields which are the foundation of the universe of sensations, of consciousness and freedom.

k. *Problems concerning the "self-sufficient" image of science*. Science, in fact, seeks, in principle, to construct knowledge of the universe, and all its content, in the form of a self-sufficient structural system. This is the initial expectation. This natural objective of human reason in science, however, is checked by certain problems which have been, and continue to be, the subject of discussion.

   i. *The problem of the stable consistency of the universe*. Science reaches its limits of knowledge as regards the problem of the consistency, stability and sufficiency of the universe. The expectation would be that reason would make it possible to know a consistent universe which is stable in time; that is to say, self-sufficient in itself (absolute) as regards its own reality. However, the results of science do not make understanding this self-sufficiency easy to understand. The problem was already raised in the "standard cosmological model" (the idea of the universe, in principle, non-speculative, based on empirical evidence). However, everything becomes complicated in the speculative discussion of the *big bang*, the stationary universe, the universe of plasma, the multiverse universes, the oscillating universe, the universe of Smolin, or the speculative universe arising from string theory. The consistent, self-sufficient stability of the universe is very far from being definitively solved.

   ii. *The problem of the physical and biological orders*. Science reaches its limits of knowledge concerning the problem of the causes which produce the physical and biological order. We have seen how science constructs theories to explain the evolutionary emergence of the physical and biological order: the natural properties of the ontology of matter towards self-organisation and the Darwinian key to the accumulative adaptive leaps. However, other ways to analyse and solve the problems have again raised the classical hypothesis of *intelligent design*. Without going into more detail, it is sufficient to ascertain the level of the current discussions to see that this problem is still very far from being solved.

   iii. *The problem of the psycho-bio-physical ontology of matter*. Science reaches its limits when faced with the problem of the real "ontology" of matter which permits a final, convincing psycho-bio-physical explanation. It is a fact that sensitivity-consciousness, psychism and human reason have been produced in the monist evolution of matter-universe. Differentiation and holism must originate in the ontology of matter. However, today when science seeks the ultimate ontological origins of matter (we are thinking of string theory, even though it is

speculative), this refers to an ultimate foundation which is still strange and unexplained, and may be called "quantum vacuum", "energy reserve", "implicit order", "geometry of space" …, from which a universe capable of constructing differences (bodies) and of opening up environments of holistic interaction would arise. The knowledge of the final ontology of the universe has not yet been solved definitively.

Philosophical Consequences

6. The results of science which we have just synthesised present problems which cannot be solved by the rigorous application of the scientific method. It is at this point that science is open to its connection with the type of reflection of philosophy; or rather, of the philosophy of science or scientific-philosophical reflection. As this is more imprecise and dependent on the evaluating freedom of each individual, the philosophy of science produces several opinions which are finally three: agnosticism, atheism and theism.

   It is true that these three positions are not assumed by individuals as a result of a pure scientific-philosophical analysis. Other factors influence this global taking up of a position: historical, cultural, existential, social, psychological, etc. However, the scientific-philosophical argumentation is important: it is decisive for certain intellectual minorities and influences society due to its presence in popular culture. Given the orientation of this workshop, we will not enter into a general discussion of agnosticism, atheism and theism. Broader studies are possible (including more factors), but we focus only on the discussion of the scientific-philosophical argumentations. We begin with agnosticism.

   a. *Agnosticism*. This is the most immediate scientific-philosophical position which arises almost from the same data of the problem. Faced with the de facto impossibility that science might solve certain, ultimate, metaphysical questions, by its own methods and faced with the enormous complexity of the problems which scientific-philosophical reflection must answer, agnosticism declares its option not to answer or not to commit itself philosophically. Agnosticism does not know what to say regarding the ultimate form in which the universe is self-sufficient.

   b. *Arguments in favour of agnosticism*. A) This is a coherent position as regards a metaphysical problem which is difficult to solve. B) It is a way to keep within the strict limits of science, without risking the commitments of a philosophical nature. C) It respects both atheism and theism as it gives them a margin of probability (if it did not give this to both, it would no longer be agnosticism), therefore it is socially more comfortable. D) It maintains personal honesty because the sincere valuation of the difficulty of the problem morally justifies that the agnostic position be freely assumed as a result of an intellectual evaluating honesty.

   c. *The atheist hypothesis*. Atheism is an immediate position which responds to the general expectation of science: our consciousness testifies that we are in a universe which, in principle, can be attributed self-sufficiency.

Atheism proposes arguments to understand this. These arguments must explain why the universe is self-sufficient as regards producing all that it contains.

d. *Arguments of atheist likelihood*.

   i. *A consistent, stable, self-sufficient universe*. The universe must be founded on an environment which has always existed as, if at any time, it had not existed, it would be very difficult to understand how it came into existence. Moreover, its nature must be able to explain the physical properties which are ascertained bys science. The difficulties which the "standard cosmological model" poses for the self-sufficiency of the universe are overcome by atheism by alternative theories and by speculation: it criticises the big bang, the model of a stationary state, the universe of plasma, mutiverse universes in their different variants, the oscillating universe, string theory and multiverse universes, etc.

   ii. *A universe which produces the physical, biological and human neurological order*. The "anthropic" properties and the properties of order of the universe are explained in a self-sufficient manner: a) by chance within the immense masses of events (multi-verse); b) by the ontological properties of matter which lead to self-organisation; c) by the Darwinian logic of accumulative adaptation from the simple and its biochemical registration in the DNA (the classic "chance and necessity" of Jacques Monod).

   iii. *Other arguments*. Atheism is also founded on other reasons of a historical, existential, social order etc.. The so called "theories of alienation" attempt to explain why men – with no serious rational arguments to do so – have produced the belief in God and in religion.

e. *The theist hypothesis*. This is the strangest position because, in principle, there is only immediate experience of the universe and not of God. However, socially it is the most obvious as humanity has always been almost totally theist. Theism intends not to remain apart from scientific reason and seeks reasons to consider that the universe does not show its self-sufficiency. Therefore, it constructs arguments in order to justify that self-sufficiency must be funded on a divine being.

f. *Arguments of theist likelihood*. Throughout history, theism has constructed many arguments. In modern times it has also attempted to construct these from the image of matter-universe-life and from human evolution, as offered to us by science.

   i. *The universe must be founded on the Divinity*. The image of modern cosmology, especially the standard cosmological model, offers a vision of the universe in which its self-sufficiency seems difficult to understand. For theism the hypothesis of a creator Divinity is the most

likely explanation on which to base the consistency, stability and sufficiency of the universe.

ii. *The physical and biological orders are produced from the creator design of God*. At the present time, the theist authors continue to consider that the universe as a whole makes it possible to glimpse, that is to say, make "likely" or probable (but not "demonstrate") that the universe, as a congruent scenario which leads to human freedom, might respond to a rational design of the Divinity.

iii. *The ontology of the universe makes divine ontology congruent*. The new ontology of matter-universe-life which combines the differentiation with holism (together with the other complementary factors mentioned above.) permits the reductionism of mechanistic nature to be surpassed progressively in order to present an image of the ontology of God as the holistic foundation of the universe and from whom everything is born and produced, which is becoming more and more likely. Within this new holistic ontology, it would be necessary to include the surpassing of the dualisms and the logic of emergentisms, including the emergence of human psychism, reason and its special opening up to the Divinity. This new anthropology, which is congruent with religious tradition, with the ontology of the universe and with divine ontology, would contribute to making the hypothesis of the Divinity more likely.

iv. *Other arguments*. Theism also presents other hi arguments of a historical, experiential, social type, etc., which we do not address in this workshop, which is focused on the scientific-philosophical argumentation. Outstanding among these are the "religious experience" which becomes more likely when it becomes congruent with the scientific-philosophical "likelihood" of the existence of the Divinity.

g. *Reality, being, events, sufficiency, self- sufficiency, absoluteness*. What scientific-philosophical logic leads to the agnostic, atheist and theist hypotheses? This can only be the logic of natural reason (see: D-4). Human reason ascertains a *reality* which *exists* in space-time (which includes man) as *facts* (empirical evidence). The basic inference of reason (which provides knowledge and science with meaning) is that if something is existing reality it is because "it can exist" (interpreting the classical proposition, we can say, *ex facto ad posse valet illatio*). Therefore, in a way (and an attempt must be made to know this) the existing reality is installed in an environment of sufficiency or absoluteness (absoluteness = sufficiency in order to be real). Given that the universe is what is immediately ascertained, the starting hypothesis for reason is that the universe must be self-sufficient.

h. *An enigmatic universe*. One conclusion which we consider to be inevitable for current scientific-philosophical reflection is that we are in an extremely enigmatic universe. We postulated its self-sufficiency, but once we try to

understand it in accordance with the facts and scientific theories, submitted to philosophical reflection, its self-sufficiency is difficult to understand. This is when agnosticism, atheism and theism appear as positions regarding the problem of self-sufficiency. This diversity of interpretations (since, in fact, they exist) shows the enigma of the universe. Modern epistemology leads us to understand this opening up to a diversity of ultimate hypotheses.

i. *Necessity*. The theist philosophy poses the problem of necessity. However, scientific-philosophical reflection first seeks self-sufficiency. To do so, it can construct two obscure hypotheses: a pure world with no God (atheism) and a transcendent God (theism). One or the other must be true, but both are very obscure (theism probably more so). To either of these, if true, necessity must be attributed by "postulation" (if God or the universe ceased to exist in the past, present or future, their existence would have no explanation). However, some questions such as the following are questions with no scientific-philosophical response. Why does anything exist? Why does the universe exist or not exist? Why does God exist or not exist? The scientific-philosophical reason can only start from the facts, search for self-sufficiency and postulate the necessity of the universe or of God.

j. *Epistemology and limits of knowledge*. The plurality of hypotheses must be understood in the light of the principles of modern epistemology: that is to say, positivism has been surmounted, in the light of popperianism and postpopperianism. This epistemology leads us: a) not to confuse the revisable, critical hypothesis with absolute, dogmatic truths, and b) to respect the feasibility of the alternative hypotheses and the free honesty of the interlocutor to follow them. Atheism and theism are defended by persons, who are, undoubtedly, highly prepared. The atheist is inclined towards atheism because he honestly and freely considers that this hypothesis is the most probable (its arguments convince him more). The theist considers that theism is more probable (he values its reasons more). However, it is useless for an atheist or a theist to go to a kind of objective, universal court which declares them to right from a position of absolute neutrality. This court does not exist. The only reality are the persons who are honestly inclined to one or other option precisely because they subjectively judge that this is the most probable for them.

k. *The silence of the possible Divinity*. Scientific-philosophical reflection must admit that there are two possible hypotheses to understand the final sufficiency of the universe: a pure universe with no God and a creating Divinity. The religious hypothesis is arguable, but is not imposed with necessity as the alternative hypothesis with no God is possible. The social evidence shows this. There are atheists and theists. Thus, if there is a creator God, this God created an enigmatic world where reason is not imposed necessarily. Therefore, it can be said that the possible Divinity is in "silence" before the universe.

l. *An autonomous, self-creating universe.* Scientific-philosophical reflection must take note that current theism admits that the universe is an autonomous, "self-creating" process without reverberations. It is admitted that the ontology of matter, its physical and biological laws of self-organisation, the Darwinian principles, etc. are "sufficient" to explain all the states of the evolutionary process (the eyes, the immune system, the nervous system…). Today the arguments in favour of theism are not moving in search of a "God to fill the gaps" (as authors such as Behe and Demski and recent theory of *intelligent design* seem to do), but move in the search of God, the foundation for the sufficiency of the universe as a whole and for the perfect *global design* of an autonomous universe which is oriented towards making human freedom possible.

m. *Neutrality of the holistic ontology of the universe.* Scientific-philosophical reflection must also take into account that the new holistic image of science is also compatible with the atheistic hypothesis. However, it is also certain that the holistic image does not only appear to explain animal and human psychism better, but it offers a reductionist image which makes the theist hypothesis more likely. Holism does not explain why matter has "consciousness" or, rather, does not have it. It is a fact that it must be admitted that matter is susceptible to producing consciousness and holism explains which field structures and which physical properties have enabled living beings to make consciousness useful. Holism seems to be compatible with atheism and theism.

Theology of Science

7. The religions formed in cultures have a long history, and, in this history, the theologies have been constructed. The theology of each religion has its own history where we discover a true evolution. It is logical that theologies with so many years of history and arising from dialogue with philosophical ideas and cultures from the past today ask about the form of understanding their religions – and, therefore, their theologies – from the point of view of science and modern culture. They would then become oriented towards the construction of a "theology of science": an explanatory theology of religiosity from the current image of reality in science. This objective is the final aim of the Sophia-Iberia project in Europe: the metaphysical and theological reflection to which the image of human evolution seems to lead in science.

8. This "rethinking" of theology from the image of science affects the different religions, including Christianity. Within Christianity, it also affects the Christian Churches and theological traditions. In each of these, similar questions and problems must be proposed. A) What results does scientific knowledge seem to impose at the present time (see D-6, paragraphs 4-5). B) What metaphysical inferences seem to be drawn from a scientific-philosophical reflection on these (see D-6, paragraph 6). C) In the light of these analyses (A y B), how must theology or theological tradition be examined critically? D) How must this theology or theological tradition be reformulated or readapted in order to enrich these from the current image of science?

9. We now make a selection of several positions concerning the questions which occupy us. Is the scientific image of human evolution compatible with metaphysics and theology? What type of theology does it permit? How must the theologies and theological traditions be thought from the point of view of the challenge of science? Does the "theology of science" offer a "convergence zone" for dialogue and consensus between the theologies and theological traditions?

    a. *Agnosticism, atheism, a-theologies*. As we have stated, it is possible, and some of society has done so, to consider that science does not permit the construction of metaphysics, and even theology. Reason does not permit probability to be attributed to the existence of God. In relation to this position, a field of analysis of authors, scientific arguments, philosophical and humanistic approaches, etc. is opened up.

    b. *Classical Catholic theology*. This is formed as from Scholasticism, inspired in Greek philosophy, and still defended today in sectors of Catholic theology. How must this be considered from the image of present day science? Is it possible to maintain Greek ontology today? How is "dualism" to be considered? How must the classical proofs of the existence of God be reformulated? How is "Theo-centrism to be considered" (or the rational-existential evidence of God)? Is a non-religious hypothesis of the universe and man possible?

    c. *Transcendental Catholic theology*. This is the reinterpretation of Thomism from the transcendental philosophy of Kant. Is modern science understandable with Thomist ontology? Is it possible to defend the Kant type transcendental apriorism faced with the aposteriori-evolutionary paradigm of current science? Does apriorism not produce an excessively "religious centred" vision where secularism and atheism have difficulties fitting in?

    d. *Teilhardian and neo teilhardian theology*. Teilhard made the first proposal of a theology of science in the Catholic world. He assumed and presented a monist and holistic image of the universe in the Divinity. However, does his proposal not seem excessively "religious centred"? How do secularism and the a-religious interpretation of man fit into this? Is it possible to rethink Teilhard from neoteilhardian perspectives?

    e. *Classical Reformation theology*. This is the theology of the Christian Churches which arose from the Protestant Reformation: the Anglican Church, the Evangelical Church, Presbyterian, Baptist, etc. Its initial focus attempted to present pure faith from criticism of the Scholastic natural reason (Barth, Ebeling …). How can these theologies be revised and rethought from science and modern cultures? Authors such as Pannenberg, Moltmann and Hans Küng have contributed to presenting and discussing this question.

    f. *The theology of process*. This philosophy-theology arose from reflection on the philosophy of Whitehead and intends to be a "theology of science": a revision of Christianity in the light of science and the modern world. Has it achieved this? Is the idea of a Platonic God, a non-creating Demiurge, which sustains and gives impulse to the universe coherent with science?

Are its ideas on divine omnipotence and omniscience compatible with traditional Christian religiosity? Does the God of process have the properties required to be understood as the foundation of the sufficiency of the universe? Are there alternatives to its explanation of evil and suffering?

g. *Theology of Kenosis*. Science offers us the possibility to understand the world without God and this seems to lead to the idea that God has not imposed his presence in reality. This appears in modern culture and has produced the renaissance of the traditional "theology of Kenosis" in Christianity. Throughout the second half of the XX century, a number of authors proposed a new theology of Kenosis (among which is the theology of process). What are these proposals? How do they assume and reformulate the traditional theology of Christianity? Are they in consonance with the image of man in science?

h. *Authors and schools*. Authors such as Barbour, Peacocke, Polkinghorne, Ellis, Zubiri, among others, have proposed ideas for a theology of science which must be considered and discussed.

i. *Hindu theology*. How is science projected onto Hindu theology? Does it offer new possibilities for dialogue and convergence with the theologies of other religions?

j. *Buddhist theology*. How is science projected onto Buddhist theology? Does it offer new possibilities for dialogue and convergence with the theologies of other religions?

k. *Islamic theology*. What roles do reason and science play in Islamic theology? How can science boost the progress of Islam? Can science contribute to the encounter of Islam with other religions?

Discussion

Scientific Results

Is the list of scientific results which are projected onto scientific-philosophical reflection which leads to metaphysics and theology correct? Are there alternative proposals? Must the scientific results be interpreted differently?

Philosophical Consequences

Is the analysis proposed acceptable? What alternatives are there? Does science impose on us an enigmatic world which leaves several possibilities for scientific-philosophical possibilities open to the metaphysical?

Theology of Science

How can the forms of a-theology be valued and discussed? How can the How can traditional "theologies" be valued and discussed? What does the scientific image of man contribute to these? How must they be re-converted to a "theology of science" today? Can science help beliefs and non-beliefs to live together in an enlightened, tolerant and respectful fashion? Can science help ecumenical, inter-religious, inter-Christian and inter-theological dialogue? What congruent proposals does modern science does modern science lead us to in order to present the sense and meaning of theologies to society? What alternatives and proposals can be made in relation to these questions?

ABSTRACTS OF PARTICIPANTS

HUMAN EVOLUTION: A DIALOGUE BETWEEN SCIENCE, PHILOSOPHY AND THEOLOGY

Carlos Beorlegui

Breif description

The relation between science and faith has been experienced in many a conflictive way in many of the main issues that concern humankind. One of those conflict and dialogue scenarios is the evolution and the origin of human species. Next to extreme postures, which deny the possibility of an integrating dialogue between science and faith, there are other postures that defend the legitimacy and the contributions of such dialogue, understanding that science and faith are two different but convergent scopes to reality. Its contributions can be joined in a useful and convergent way.

Summary

In order to analyze the difficulties of a conciliation between the scientific and religious scope in issues as the origin of life, the evolution of species, the birth of humankind and consciousness, it is important to understand in a proper form the borderlines between science, philosophy and theology. This point is useful in the dialogue with the *intelligent design* theory. Its pretensions of being considered as a scientific paradigm are totally failed, given that its interpretation of some biological structures as specified or irreducible complexities due to an intelligent designer do not respect the epistemological parameters of scientific knowledge and suppose a conception of divine action supported by a wrong theology and an incorrect theodicy. Contrasting this way of understanding evolution and the convergence between the functioning of the world and God's founding intervention on it, we defend the need to separate in a correct way the scientific and philosophical-theological scopes, joining them in an integrating dialogue that help us to overcome old images of God and to propose new and more adequate models of the action of God in our world.

THE RELEVANCE OF QUANTUM MECHANICS IN NEUROBIOLOGICAL PROCESSES: IN SEARCH OF ANSWERS

Òscar Castro Garcia

I would like to deal with the following question: What are individual neurons doing? Are they simply acting as computational units? Neurons are cells, and cells are elaborate structures. In fact, they are so elaborate that even if we only had one cell, we would still be able to do very complex things. For instance, a paramecium (a unicellular being) can swim towards its food, flee from danger, avoid obstacles, and apparently, learn from experience. All these actions seem to suggest the

presence of a nervous system, but a paramecium does not possess a nervous system. There are no neurons in a paramecium; there is only a single cell. How, then, is it able to do all these things?

Guenter Albrecht-Buehler's works established that cells have a certain type of "vision" because of their centrioles, and that these centrioles have a data-integration system. Centrioles are made of microtubules. Albrecht-Buehler also said that microtubules act as if they were nerves [1]. These are not metaphorical analogies, but are biosemiotic performances that allow clarificatory comparison.

Take the example of cortical neurons. If they display this kind of activity performances, then, despite the lack of centrioles for cellular mitosis, they are still able to perform the microtubular activity of transporting neuropeptides and essential neurotransmitters that are indispensable for interactivity to take place.

I also would like to deal with how the mesh of tubulins in a microtubule permits the coherent pumping of long-range phonons. Fröhlich proposed a transition phase outside the heat balance, a state in many ways similar to or resembling that of a laser beam [2]. Each macro-molecule emits several rapidly vibrating charges. To begin with, these vibrations are incoherent and disordered both in phase and frequency. In Fröhlich's model, the vibration spectrum depends on the flow of energy supplied to the system (chemical GTP energy or electromagnetic radiation energy). Fröhlich showed that electronic vibrations reach the same frequency by being far from equilibrium (between 10^{11} and 10^{12} Hz) via a dielectric behaviour, which Stuart Hameroff and J.A. Tuszynsky discovered in the activities of microtubules[3]. This same frequency is therefore reached when the critical flow in the supply of energy is exceeded.

What, then, are the conditions that allow long-range quantum phenomena, initially in a state of mesoscopic biological components, to emerge or evolve towards the processes of a classical field?

Quantum decoherence plays a fundamental role in the transition from a quantum to a classical field. An observer's intervention is still crucial for the collapse of the wave function, since the intervention allows the concrete realization of any one of the multiple states of the wave-particle's moment and energy. This decoherence, nevertheless, would not take place had there been no quantum superposition proceeding from the coalescence of two or more eigenvectors presenting two or more eigenvalues.

Is this the case in cells? Those who have researched into the phenomenon of quantum coherence have located it in the α/β tubulin dimmers, the main components of microtubules. According to Jibu and Yasue[4], these microtubules, like some components of the cytoskeleton, act like non-linear coherent optical devices, whose optical and computable signals are free of noise and thermal loss. This, in turn, is linked to Albrecht-Buehler's research.

It is becoming increasingly clear that quantum coherence plays a fundamental role in maximizing energy transduction processes. As a matter of fact, it is considered as the main factor contributing to the exploitation of solar energy in

photosynthetic processes [5]. It may not be surprising if there soon will be empirical evidence that quantum coherence not only allows wave-function collapse in microtubules on an "inter-neuronal" level, but also contributes to sustaining local manifestations of large scale "intra-neural" activity. It is probable that quantum coherence is one of the causes that generate neuronal networks, and that a growing coherence permits a higher quality of synaptic function (on a chemical and electrical level) richer in terms of neurotransmitters and neuropeptides.

According to Zurek's line of argument [6], all this means that by maximizing the non-local performance of quantum mechanics in the brain, a benign randomness is generated in the midst of a photonic ocean. This randomness is able to select those superimposed states that allow greater efficiency in the transference of energy by minimizing its dissipation.

An interesting related concept is "Quantum Darwinism," according to which the self-selection of eigenvalues allows decoherence to take place, thereby indicating that quantum reality is under predictable classical states. Quantum reality is self-selective ("the environment as witness," in the words of Zurek). This means that a state can evolve extensively on a macroscopic level because quantum information is available to several viewers, thus making possible information consensus in the quantum state.

When the environment acts as witness, it modifies the quantum states towards a decoherent behaviour. This means that there is a certain macroscopic activity in molecules allowing a higher structural stability that, in turn, maximizes performance output. With the maximization of output, the constructive activity reaches its greatest efficiency. Jacques Monod calls this ordered, constructive, and maximized activity as "coherence" (for protein performance) [7]. If this is the case, we can understand that from the cilia of the paramecium, down to the microtubule of a neuron or a glial cell, these performances confer a certain state that Whitehead refers to as "proto-consciousness," which Stuart Hameroff considers as "funda-mental" in the study of the emergence of consciousness [8].

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CAUSALITY: COSMOLOGY & THEOLOGY

Khalil Chamcham

The twelfth century witnessed the most passionate debate on Rationality and Faith [i.e. Science, Philosophy & Religion] driven by the Andalusian philosopher Ibn Rushd [Averroes] - the most prominent Philosopher and Theologian in promoting and interpreting/discussing Aristotle - and culminating later on in the work of Thomas Aquinas. This debate spanned a wide range of topics such as creation of the universe, its eternity or finitude, the nature of time, the nature of matter and the soul, atomism vs. continuity and the nature of causality, just to name few. These issues are far from being resolved in the present day and the lesson any scholar can learn is in the pertinence of the ideas of that period and the depth with which these issues were discussed and analysed.

However one can sum up that most of the medieval debate revolved around the concept of causality as it is the key concept in defining the emergence of phenomena in the world and the nature of Divine action particularly at the birth of the universe. I consider that understanding causality and putting its analysis under detailed scrutiny is still a key issue in modern science [and theology] particularly at the quantum level and at the pre-Big Bang era, although the modern scientific culture does not give room to such a debate [i.e. it is taken for granted that when a model parameters fit a data set the phenomenon represented by these data is explained and there is no need in explicating the causal process behind it]. We can ignore this issue as long as we can but nature is catching up with us by putting into question what we try to avoid.

Deciphering a causal process is meant to be the strength of a physical theory and a way of improving the experimental issues related to this theory. This supposes asking the right questions and identifying the different agents in action and the different stages of evolution of the process[es] involving these agents. But in most cases this situation is avoided by identifying the coincidence cause-effect and the conditions of occurrence of this circumstance. However temporal coincidence or spatial conjunction is not a guarantee of the causal relation between phenomena nor it can offer an explanation of their occurrence/emergence.

The lesson retained from the medieval debate is for the scientists, philosophers and theologians to dig out these issues and to offer challenging explanations and interpretations: modern cosmology is badly in need of these challenges, particularly that the questions put forward by the medieval thinkers are still unanswered and they still impose their actuality.

Causality, as we understand it, is a relation order between sequences of events that sum up a given phenomenon: this involves temporality (i.e. time evolution of the events/processes involved), the notions of simultaneity and reversibility. In general this view is strongly supported by repeating the experiment describing the phenomenon [i.e. a situation that is not offered in the study of the universe]. However this exclusive/linear view can obscure the dynamics underlying the processes concerned and the fact that a cause can be transformed to an effect and vice versa [i.e. chaos, self regulated systems etc].

Is causality a relational order between sequences of events or is it determined by the intrinsic dynamics of the events/systems involved? Event 'A' causes event 'B' but event 'B' happens only because the system has the property to allow for it to manifest itself. So within the same causal process we are dealing with different levels of causality: external/internal, potential/actual cause-effect and their reversal, and reversibility or not of the process. Things get more complicated when we look at complexity and emergent properties [or systems].

The underlying assumption in the discussion above is that things are boxed in time: 'we know when they start and we know when they end' (i.e. this is not a Rumsfeldia). Can we define causality at the origin of the universe? How can temporality be engaged at this phase? Do we need to know all that it involves [i.e. original events, final events, intermediate sequences] to define the causal relations? Can we know all that is involved? [i.e. causality is a process not only a relation between two states of a system].

Similarly one may ask how causality can be interpreted within Mach Principle: matter generates space curvature, but can space curvature generate matter? This is relevant to understand mainly at the horizon and around singularities. Do we know the causal processes behind inflation and all along this particular phase of evolution of the universe? Can we still talk about causal relations when we describe phenomena in terms of processes?

When we state that God is the Creator of the universe does it mean that He is the cause of its emergence and that the universe is His effect? Is the creation of the universe an act or an intention? Is causality - at this level - a process that can be deciphered between intention and action? Is information on this process accessible at all? Can we speak at all of causality when we involve Divine action in the creation of the universe or does our notion of causality break down [in a way that it is only valid for systems confined in finite space and time duration].

We think of causal processes in term of 'inert' matter evolving under the influence of physical laws/processes [laws of nature in action], in this way we disengage our [responsibility from/involvement in] the world and therefore we have no ethical duties to ensure. However should we consider our intentionality and agency in the processes happening in the world our ethical attitude would be drastically changed by re-considering our responsibility particularly in the exploitation of the processes described for our different needs.

A medieval lesson that one can update in the current debate within cosmology is our reluctance in considering a Divine Principle of Creation and its replacement

with a lower level concept such as the Anthropic Principle. The AP assumes that all the causal evolution of the universe were directed towards Anthropos as a final product. Is this methodologically grounded and theologically consistent? But why is it that modern cosmology accepts easily a vague principle such as the AP but not a Divine Principle of Creation? Is this a cultural issue or an implicit demonstration that the God hypothesis is useless in providing any information on the nature of the universe and its structure?

HUMAN EVOLUTION: IN SEARCH OF OUR ANTHROPIC ROOTS

Cornelio González Valdenebro

Brief description

Cosmic TOTALITY and MAN are so UNITARILY bound, that in "the" REALITY they are one and the same thing. And for our good fortune, quantum-relativistic laws and procedures that govern and describe this UNITARY relation are, from the Eternity, written in the *Intrinsic Theory of Numbers of the System of Decimal Numeration.* The genius of Einstein predicted, almost two decades in advance, the so called *Compton effect*, caused when photons affected free electrons. This is a practical application of the development of the *black body* or black matter physical-mathematical pattern, fundamental for the theoretical improvement of quantum mechanics, and it also explains the literal "human physiology" of *black bodies* that it itself constitutes, to Cosmic Microwave Background Radiation of 3° Kelvin.

Summary

It is clear for Javier Monserrat, in his article published in www.tendencias21.net 01-12-06: *Is it the world in my head?*, appeared on the occasion of the first basic session of the General Seminary of CTR Lecture, on December 14, 2006, that the human vital-conscious experience must in last instance *be generated, to perceive itself directly* and without any excess of organic intermediaries, in a "field" governed by mechanic quantum norms, and I would also say, regulated by relativistic norms.

On this subject I think that not in vain the electrical currents that circulate around our nervous system, form a microwave electromagnetic field that ruled by UNITY laws TOTALIZE it in and by itself, allow us, in a strictly Gibsonia sense, *to perceive and* electromagnetically *directly to take part* in a Cosmos also TOTALIZED in its own UNIT: I am also making a reference to the electromagnetic "fielded" Cosmic Microwave Background Radiation of 3° Kelvin. And for our fortune, the "theory" of how and why this can happen can be found, literally and from Eternity, written in a crucial aspect of the *Intrinsic Theory of the Numbers of the System of Decimal Numeration*, aspect which seems to me, still has not been studied in depth. I allude to the self of decimal-fraction-

rational-cyclical UNITARIAN characteristics, originated in and by *1/x*, being *x a* prime number unlike from 2, 5, and different also from 0 and/or 1.

The laws of the Physics are fulfilled so much in the inanimate matter as in the organic matter, which is, lives. When MAN in his scientific task - in this case, Physics - tries to define the what and how of Life and Consciousness, begins to tread footpaths that habitually have been a patrimony of Philosophy. Luckily for us, the application of the *Intrinsic Theory of the Numbers of the Decimal Numeration System* to the physical-theoretical model denominated *black body*, is basic for the completion of the theoretical development of the so called *quantum mechanics*, (a ramification of Physics that deals with the laws that rule ultra-microscopic phenomenon), and that also spans a natural bridge between Newton's macro-cosmos and quantum-mechanics micro-cosmos. With this, it concurrently constructs a cosmogonist bridge between the physics of *Universal Black body* that in itself is the Cosmic Microwave Background Radiation of 3° Kelvin, and Biology, Psychology and Philosophy, binding thus, a very indissolubly and for Eternity, a unique quintet: Man-Physical of the Black Body-Biology-Psychology and Philosophy.

SOME CRITICAL NOTES ON THE ANTHROPIC COSMOLOGICAL PRINCIPLE

Miroslav Karaba

The so-called Anthropic Cosmological Principle is a statement of natural sciences, especially cosmology that has been animatedly discussed in recent decades. According to this principle, the structure and evolution of the universe essentially depend on certain coincidences of natural invariants and on accurate starting conditions, which enabled the existence and evolution of life in the universe, and even the intelligent one – i.e. the human existence.

In the present paper I will not deal with the various variations of the Anthropic Principle – neither with their formulation, fundaments, consequences, etc. This paper intends to point out some problematic aspects of the Anthropic Principle in philosophy and theology.

The Philosophical Critique of the Anthropic Principle

1. Epistemology

- Weak Anthropic Principle (WAP) is sound but irrelevant, and accordingly, it cannot be called a "principle" either. Such principle is not explicative, but only affirmative and thus with no meaning whatever. (W. B. Drees)
- WAP is a pure tautology, i.e. a logically necessary truth, but not a scientific explanation. (J. Leslie)
- Some authors admit at least a heuristic and methodological utility of WAP.

2. Metaphysics

- Strong Anthropic Principle (SAP) is only a hypothesis that can be neither verified nor falsified. It is rather a metaphysical or theological principle.
- SAP belongs among the departure points of epistemic idealism and is bonded with a teleological conception of universe, which has been overcome since Newton and Darwin (B. Kanitscheider).
- SAP is subjectivistic, anthropocentric or, at least, anthropomorphic. It does not explain the accurate values of physical and cosmological invariants – it is an *a posteriori* (*post factum*) explanation and not a predictive principle (J. P. Lonchamp, S. L. Jaki).
- SAP is a speculative explanation, which is risky and scientifically unacceptable.
- Many World Interpretation (MWI) is neither scientifically demonstrable nor economical; existence of many universes is only an assumption or postulation – a metaphysical interpretation.
- MWI is a too simple explanation in the sense that it is grounded on an arbitrary assumption, confounds possibility with reality and is only a kind of philosophical oddity.
- MWI is basically an anti-anthropic explanation, for the reason that it tends to explain all unusual phenomena in the observable universe as a natural necessity, which is a negation of the very principle (J. V. Balašov).

3. Philosophical Theology

- The anthropic coincidences, which seemingly confirm a plan, might be explained by scientific theories in the future (W. Norris).
- Even after applying the Ockham's razor MWI is a more economical principle than theistic conceptions, because this structure does not require the new entity – i.e. God (W. B. Drees).
- Our observation of anthropic coincidences is subjectivistic – we tend to see a plan where we should seek simply "comprehensibility" (E. McMullin).

The Theological Critique of the Anthropic Principle

1. Theology of Creation

- The discussion about the character of evolution, to what extend the evolutional processes are guided or accidental, is still continued.
- Unresolved remains the issue of existence of extraterrestrial civilizations – which cannot be positively excluded (R. de la Peña).
- Theologians do not accept the idea of cosmological anthropocentrism.
- The risk of concordism – God as a stopgap. (F. G. Brambilla).

2. Theological Anthropology

- The challenges of natural scientific achievements often appear to theological anthropology as subjective interpretations of scholars influenced by their philosophical or theological views or work models they use in their research.
- There is a contradiction between Final Anthropic Principle (FAP) and temporal limitation of biological life in the universe.

- Body-mind problem: There is still a fluctuation between an absolute reductionism (reduction of mental states to nerve impulses) and a hard dualism, which conceives the mind as an independent entity that uses the brain as its instrument.
- Question of controlled evolution.
- Attempt to create an artificial intelligence.

3. Dogmatic Theology

- Instead of anthropocentrism, the Christ centrism should be emphasized; whose consequence is, again, a certain form of anthropocentrism.
- FAP and Tipler's Omega Point Theory are not mutually consistent.
- Cosmic Christ in the strict sense does not exist, only Resurrected Christ exists.

This brief review of critical comments on the Anthropic Cosmological Principle from the philosophical and theological viewpoint is not complete. Its aim is just to point out a number of wrong interpretations employed, often *bona fide*, by some philosophers and theologians (but also natural scientists). The very discussion about the Anthropic Principle should be oriented to such an interpretation that would be acceptable for natural sciences as well as for philosophy and theology. Personally, I am convinced that a reasonable application of the Anthropic Principle in philosophical and theological context could open new horizons and, above all, it could make theological research more comprehensible for contemporary culture. This very inculturation is an indispensable condition for theology not to remain marginal in the cultural context of the world of today and tomorrow.

SAME GOAL, DIFFERENT PATHS?

María López Ferreiro

We are going to present some strange theories in this little paper. I know it will be judged as widely non-scientific, and I know too that philosophic, non-scientific and chimaera are supposed to mean (sadly too often) the same thing. As a research worker, my whole task all these years has been directed to try and prove that that's not necessarily the case, and that's what I'm intending to do here, at least partly. If Philosophy has to face a real problem nowadays, it's the (sometimes too right) accusation of lack of rigour and of inconsistency, and that must be philosopher's first and main concern. Nothing really valuable can be philosophically done without that previous purifying work. But if we have got something in our favour is our flexibility, the wide variety of interests that we can and want to touch, that protean capacity which allow us to relate to almost every field one way or another. That's the road we need to pursue to become really adapted to modern times.

This intention will be directed by another one, almost as important and dear to me, and far more connected with the plan of this event. If the purpose of the whole meeting is talking about our anthropic roots, let's take the Anthropic Principle and

see if Philosophy can have something to say about that. It is not an anachronic monster; it can help Science nowadays just because there's a close relationship between them (believe it or not). They both try to do the same things, to answer the same questions. They do use really different ways, but have the same goal, in fact. So, perhaps they could work together far better than alone. They can help each other to improve their methods, to go on. They did so in the past and can do it again. It's the only way Philosophy has to overcome the difficult situation she is in now. But Science can get some important benefits too.

We'll see that here by presenting just a little example. We'll see how much Science and Philosophy are related, and how the second could be useful and important to the first. First, we'll present (if really superficially) the basic formulation of the Anthropic Principle and its consequences. There are at least half a dozen formulations of the matter, but the main consequence we can infer of the whole thing is that some scientist nowadays thinks that the laws of the universe are such as to lead the entire cosmos to produce intelligent life. That is to say that every little thing in the universe is carefully disposed to prepare our coming. Universe needs observers and it will always work to produce them. That is a really polemic and difficult concept, thoroughly discussed for decades and it maybe a little weird in a scientific context, but it has a lot of interesting derivations.

Given that principle, we'll travel backwards through time and place, until we reach the Middle Ages last. There we will find some agreeable surprises. Authors as John Duns Scoto, Jean Buridan and Nicolas Oresme will show us the amazing and unsuspected opening of the modern science, an opening that walks under Philosophy's guidance and depends on the same questions that the Anthropic Principle: are there really a lot of possible universe or is this cosmos the only one possible? What's our place here? Are we here necessarily or just by chance? Could all be different from what it is or not?... and quite a lot of others. As we can see, same questions, but different ways.

If we go a little further travelling backwards, we can reach the origin of Science and Philosophy, and we will see the same problems, referred in almost the same language… but with some interesting differences. What I'm trying to prove here is the permanence of some constants during our long and winding intellectual evolution. That's one of the few things that allow us today to understand ourselves, one of the few supports we still have to identify what to be a human being is. We have changed a lot, but not so much as we seem to think. We still have an only a permanent essence, just the same, but enriched and improved by time and change.

Philosophy has been a witness of all those changes, it has made them possible, standing by Science hand by hand. If they have got that in the past… what couldn't they do now, working together? That's my proposal and my challenge too. Today, the intellectual path needs a complete change, a revolution, a total purification. Philosophy has to face the actual times and needs to be useful to them. But also Science needs a change, an improvement, which perhaps Philosophy could give it. I think it's worth trying. What about you?

AN ONTOLOGICAL MODEL OF MATTER AND OF SPACETIME

Miguel Lorente Páramo

Epistemological presuppositions: We can consider three levels of human knowledge in the comprehension of physical world. **Level 1:** Physical magnitudes, such as distance, time interval, mass, force and so on, that are given by our sensations and perceptions. **Level 2:** Theoretical models, which are the generalization of metrical properties given by measurements and numerical relations among them. **Level 3:** Fundamental concepts, representing the ontological properties of physical world given by our consciousness in an attempt to know the reality. There must be some connections between the three levels. In Quantum Mechanics the theoretical models of microphysics in level 2 are related to observable magnitudes in level 1 by correspondence laws. Besides that, the level 3 is the ontological background of the theoretical model of level 2. In a relational theory of the nature of spacetime, the concept of substance should be adscribed to the fundamental entities, the interaction of which gives rise to the set of relations responsible for the structure of spacetime. (1)

The ontological background: It is possible to make some Ansatz about the nature of these fundamental objects in level 3? If we take the extension as the first property of matter, as Descartes has claimed, space and time should be considered necessary at the beginning of a fundamental theory. We prefer the point of view that the most essential property of material objects is the capacity of producing effects in other objects, which was identified by Leibniz with the concept of force. There is a causal relation between the force and the effect. The set of all causal relations among the fundamental objects can be taken as the ontological background in level 3 for the relational theories of space time. If we want to implement the principle of causality with quantum effects, we have to introduce the probability laws in the production cause-effect, as required by the postulates of Quantum Mechanics. Coming back to the level 3, the ontology of material objects is characterized not only by the principle of causality but also by the laws of probability.

The one and the multiple. According to Teilhard de Chardin, the structure of cosmic beings is based in the duality "one-multiple", consisting of the self realization of one being of higher perfection in other beings of lower perfection. The causal relation between the beings of higher and lower level has an intrinsic character (formal and material causality). By the contrary, the causal relation among beings of the same level is of extrinsic character (efficient causality). In order to use modern terminology, every cosmic being, as constituted of the one and the multiple possesses a double principle: the principle of immanent actions (the principle of being-in-himself) and the principle of transient actions (the principle of being in others). The existence of each cosmic being is realized by the mutual communication of the one in the multiple through the immanent principle (in two directions: actively and passively). The interaction of one cosmic being with others of the same level is fulfilled through the transient principle (also in two directions: actively and passively) (2)

Pure multiplicity. The structure "one-multiple" can be found in all entities of the real world. One finds its highest level in the human being, and its lowest level in the simplest entities of the Universe. Logically these must exist, although they can never be detected. According to Teilhard they are called the pure multiplicity. The interaction among themselves is extrinsic through the efficient causality. These interactions give rise to a set of relations, which we consider the ontological background for the concept of spacetime. But they are open to belong to some being of higher level, through the intrinsic causality or immanent principle, forming a new structure in which this superior being is self-realized. These elementary beings can be considered the ontological background for the world of elementary particles, whatever they may be. We call the constituents of the pure multiplicity "hylions" from the Greek word for mater.

The interpretation of space. We start with entities we call "hylions". They are nowhere, timeless. Between these entities some actions take place which are of two kinds: one hylion can produce some effect in another hylion or can receive it from another one. Suppose there is a chain of hylions in such a way that one hylion can only act on two different ones (1 acts in 2, 3 acts in 2 and 4, 5 acts in 4 and 6, and so on): 1 - 2 - 3 - 4 - 5 - 6

We can think of one-dimensional line, in which the position is only a relational term. Then we can take a network of hylions, each acting with four different ones. We can think of a two-dimensional surface, in which it is possible to talk about straight lines, orthogonal and parallel directions, Cartesian coordinates an so on, using only relational terms. Of course, a different lattice structure could have been built up in two dimensions, with curvature different of zero, the calculation of which should be made with the combinatorial properties of the network of hylions. (3)

The interpretation of time. We take for the sake of simplicity two interacting hylions: the action of one hylion in a second one can be considered in such a way that it determines the second one to produce a new action in the first one. The succession: action- effect- determination - action - effect - and so on, is only a causal relation of logical structure and can be interpreted as an ontological model for the observational time. In the case of a cubic lattice, every hylion is interacting with six different ones, triggering these hylions to produce new actions in six neighbouring hylions. The coordination of causal order for all the hylions in the cosmic network can be considered as the ontological background of the universal time.

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CONSCIOUSNESS AS EMERGENT UNITY AND CONTRADICTION IN INFORMATION PROCESSING SYSTEMS OF LIVING BEINGS

Sara Lumbreras

Starting point

For every study of consciousness, the starting point should be personal experience of both consciousness and free-will. Even from a radical scepticism as assumed in Descartes [DESCARTES], we cannot doubt that we doubt, experiment qualias, and have the impression of taking free decisions (may this be true or not). In addition, the physical support for these is a body that we perceive to be classical, although it might well have characteristics that gave quantum mechanics an important role in some of its functions.

We look for a theory of consciousness that is consistent with these facts, and which can give us an explanation of what these are and how they relate to each other, to life and the reality around us.

Do we have an existing model coherent with these?

The answer is partially affirmative. Orchestrated Objective Reduction [HAMEROFF 82, 06] states that consciousness involves a specific form of quantum computation which underlies neuronal synaptic activities. These computations occur inside microtubules, the basic bricks of the neuronal cytoskeleton. Microtubules are conformed as self-assembling cylindrical polymers of the protein tubulin, which has two different conformational estates that, due to the influence that quantum physics has into them, appear to be superpositioned as quantum qbits. This qbits interact and compute by nonlocal quantum entanglement. Eventually, they are measured and therefore reduced to definite estates that represent the solutions of the prior calculations.

The decoherence, or objective reduction, would occur periodically according to this theory, which is consistent with the best electrophysiological correlate of consciousness found until the moment, the gamma EEG oscillations (which lie in the range from 30 to 90 Hz). The effects of some anaesthesias can be explained by assessing their impact on microtubules.

Involving quantum physics in the problem of consciousness has two major strengths:

- Quantum indetermination would include some non-computable factor in the calculations that would allow us to escape from determinism and keep free will.
- Quantum entanglement, as a phenomenon that is able to convert several individual entities in a single unity until decoherence, could explain the holicity of consciousness. Regardless of the number of computation units involved (neuron cells or tubulins), qualia are a single entity.

- Less importantly, Orch-OR allows rejecting the conclusions of Libet's research. Experiments conducted in the 1970s by Benjamin Libet [LIBET 04] suggested that the brain activity corresponding to a perception happens up to 500 ms after the perception was generated. By then, conscious responses have often been generated. Libet suggested that they were automatically generated but were "referred backwards" when they were registered in memory, so consciousness control is only an illusion. Orch-OR opens a possibility for information travelling backwards in time as quantum mechanics enables, allowing us to have a consciousness that is not merely epiphenomenological.

Nevertheless, there are some important questions that have not been addressed by Orch-OR satisfactorily:

- What are qualia? Why does Orch-OR produce subjective experiences (this is known as the *hard problem*)?
- What is consciousness? Adding a new layer of complexity to the neural engrame theory [EDELMAN 00] does not answer this question. Identifying consciousness with Orch-OR is equivalent to stating that it is identical to the firing of cortical neurons.
- Can there be consciousness outside a brain, or outside a living being? What is the relationship between consciousness and its physical support? And between consciousness and life?

There are two different levels of reality underlying these questions:

- What are the physical properties of matter that allow the appearance of consciousness? What is the **physical substrate** of consciousness? This is the question that Orch-OR is addressing. The reason why these properties produce subjective experiences and not a different thing is considered out of the scope of this work.
- What is consciousness? We would like to understand the **nature** of consciousness as an aggregate of processes. The answer to this would be the key to identify different occurrences of consciousness with maybe dissimilar physical structure. The study of dynamic systems, of complexity and emergent properties is part of the necessary framework to understand this question, which is not tackled by Orch-OR.

In my complete paper the sections *Determinism vs. Predictability*, *The third conception of reality*, *Consciousness and brain* and *Life and Consciousness* refer to the first "physical level" of the consciousness problem, meanwhile the final paragraphs *Theory of Systems* and *Consciousness as an emergent property of life* refer to the second "ontological" question.

CAN INTELLIGENCE BE CONSIDERED A NATURAL PRINCIPLE?

Fátima Masot

In this paper we wonder about the possibility that Intelligence be a natural principle. Since Intelligence is not a physical quantity that can be measured, in order to understand the intelligent pattern in Nature, we need to analyze the effects and evolution of Intelligence along the Natural History. We will see that this pattern affects all natural frames, from living to non living systems, explaining as well the origin of human intelligence as a natural consequence. We will also discuss the differences between this model and others like the Anthropic Principle, the Intelligent Design and the natural Darwinian Selection.

Summary

As long as science exists, the highest goal is to achieve the solution of all natural phenomena in one single principle, that allow explain observed behaviours, as well as predict the still non observed ones. The Principle of Least Action in Mechanics and the second law of Thermodynamics are examples of well known principles that express the tendency of a physical magnitude for a maximum or a minimum (extremal behaviour).

Despite Intelligence is not strictly speaking a physical magnitude since it is not quantifiable, still is an unquestionable natural reality that can be ranked by its effects and/or achievements. The height of these achievements is the human intellect, –at Earth level, at least-, as the first natural system aware of itself, that is able to transcend matter into abstract thought.

The astonishing evolution of the human intellect above its closest hominid relatives remains an enigma. Especially meaningful is the development of skills for music or maths, with no direct impact on surviving. Despite many hypotheses have been proposed, such as ecological variability, food processing, tool use, mutations, female selection favouring mental endowment or other combined models linked to social dynamics, none has achieved complete or general acceptance [1].

If we track the evolution of the human intelligence from the first man (Homo Habilis) to the recent individual (Homo Sapiens Sapiens), we see a stable rate of progression that not only affects the cranial capacity but also significant behavioural changes. This rate of progression shows an exponential trend with time, that has a strange continuity in the evolution of life from the first fossil microorganism up to the pre-human life. But still more surprising is the continuity of this trend into the pre-biological frame, (the biochemical evolution from an inert substrate to the DNA molecule), and also into the post-biological frame (the technological evolution developed by man based on silicon), not based at all in the same biological principles [2].

This regular progression in the intelligent achievements does not seem subjected to eventual environmental difficulties or advantages. On the contrary, seems stable throughout the epochs, overcoming punctual, local difficulties, and what is

most: producing just-in-time paradigm shifts, at the exact times when are needed in order to keep the pace. Examples of paradigm shifts are the steps from matter to life (the appearance of the NDA molecule), and from life to intelligence (the appearance of the awareness), still not explained by Darwinian natural selection, and to a less extent, the intellectual achievements of our modern society. This suggests an independent self capacity of Nature for problem-solving above punctual or local physical circumstances, a self capacity that shows up in the form of a tendency or discrimination towards the best possible solution in the long term.

But if this natural capacity actually exists, it would not only affect *the result* (intelligent life), and *the path* followed up to it (the evolution): it will also affect *the origin of why that intelligent life is able to exist.* Surprisingly, we find in the physical laws that govern the Universe, an extraordinary combination of physical constants that turns to be critical for hosting intelligent life [3].This set of constants are so extremely fine-tuned, -for instance, the electromagnetic force to the gravity ratio needs to be tuned with a precision of one part in 10 to the 40th power; similarly, the total number of electrons to the total number of protons could not vary by more than one in 10 to the 37th power -, that some have interpreted this, not as a coincidence, but as the designing action of a supra natural entity (Intelligent Design hypothesis). This interpretation differs from our Natural Intelligence hypothesis in that it requires the existence of an out-of-the-world d*esigner*. In our model, although we also appeal for an intelligent factor, for us it is an inherent potential of Nature, just like any other reality such as Space, Time, Energy, Matter or Life.

Others have seen in this "just-right" Universe a relation between origin and result, linking the purpose of the Universe to the human existence (Anthropic Principle). This relation is not surprising, since between man and Nature there is a deeper connection beyond the pure cause-effect link: Maths. The man's mind is able to understand Maths, which, at the same time, strangely seems to be the language for natural law [4]. In a way, Nature closes the circle, and finally comes to understand itself through the man's mind. We agree in the connection between origin and aim, (if Intelligence is a natural factor, it would affect all natural frames, from the start to the end), however we disagree in *what* is *the aim*. For the Anthropic Principle, the aim is the human intelligence: that is the final product that does the Universe to make sense. For us, instead, the aim would be much wider. All the different types and levels of intelligence that we observe in Nature, from viruses to man, would be, not dead ends, but expressions of that intelligence at some level, as well as a necessary substrate for further developments, since the biological diversity is more efficient than uniformity to allow more and more complex forms of life. Natural Intelligence would be a necessity of Nature that impels itself to higher and higher heights of self awareness. From that point of view, we could explain the human anxiety for knowledge, despite it is not strictly necessary for surviving. Unlike the Anthropic Principle, however, our model would not close the door to other forms of intelligent life in other parts of the Universe, and it would foresee new paradigm shifts, like the end of the human race in favour of new and more intelligent species.

But probably the most successful theory so far in explaining the evolution of species has been Natural Selection. Initially, the object of selection was the individual, and the reason of the selection was that that individual was fitter than the rest. If we take the natural selectivity as the natural capacity for problem solving (applied to surviving), both hypothesis, Natural Intelligence and Natural Selection, almost coincide. However, the individual surviving would not explain the supra-balanced equilibrium that complex ecosystems formed by a high number of species show, unless you extend the range of application of Natural Selection to groups and species. Either it would not explain the origin of life itself, unless you extend Natural Selection into the pre-biological frame (purely chemical), at gene level. Recently, this extension has been done [5], which, as we see it, represents a strong support for our hypothesis of a natural capacity affecting all frames, not only biological, but also chemical and physical, filling the gaps between them. The fact that species perfectly adapted to the environment, such as the marine species, are in danger of extinction by the direct or indirect action of man, and the evident over-dominance of humans over the rest of species, cannot be explained only by a simple innocent fight for surviving, or surviving of the fittest, unless you consider the intelligence as an essential factor of adaptation. Time have no sense without Change. If we accept the change as characteristic of Nature, it's reasonable as well to accept that Nature also has a natural metabolism to process that change, probably conditioned by the physical constants, that drives evolution in a determined direction. So far we have accepted that that direction was Life, (Nature selects the fittest, in order to preserve Life). However, Nature not only produces Life, but also Intelligence. It would be strange that Nature had capacity to preserve Life, without having capacity to preserve a most precious value.

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FROM INORGANIC TO LIVING - FROM INFORMATION TO SPIRIT

Iulian and Alice Rusu

The design of new materials with predefined properties is one of the main interests of our day's science. Taking into account that in many cases we don't know the laws that rule the correlation between the three main terms of the problem (i.e. synthesis, structure and properties) different methods based on quantum mechanics, statistics and other empirical approaches have been developed [1]. However, very interesting results were obtained based on the ***information theory*** and by the use of expert systems [2].

Most of the applications of information theory used for the study of chemical substances are referring to the so called `informational molecules' (DNA and RNA) from the living systems. The lack of interest regarding its applications in the inorganic field has the starting point in the false premise that the nonliving matter contains few information or even not at all [3]. Despite this belief, recent researches have proven that the appearance of any property into an inorganic compound is closely related to the increase of the informational content of the molecules, the inner information being reflected on the exertion of its properties. For example, if we are talking about superconductors, the higher the informational content the higher the critical temperature (T_c) [4, 5].

Another proof in this direction concerns the last decade researches on bioactive glasses. Scientific reports have shown that more than 60 genes are Si-sensitive and hydrated soluble silicon will enhance the proliferation of bone cells (osteoblasts) and active cellular production of transforming growth factors [6, 7]. Apart from the spectacular therapeutic applications, these discoveries have important theological/philosophical implications.

It is accepted that the disorder → order phase transformation, from nonliving to living, ***characteristic of life***, involves the equivalent of `heterogeneous' nucleation by DNA [8]. It is equally well accepted that all DNA is synthesized within a cell, directed by the DNA already present. No DNA is synthesized de novo outside a cell and transported into a cell to serve its replicative function. Even viruses, which can be considered as mostly `naked' segments of DNA, are replicated within a host cell using the biosynthesis pathways of the host.

However, starting from the above results, an elegant chemical mechanism was proposed for the synthesis of the first biopolymers and implicit the DNA on α-quartz crystals, the author concluding that their ***inorganic origin*** is irreversibly and immutably locked into the very beginning of the genetic code [7]. According to the mechanism, it seems that the α-quartz crystals contain the ***information*** requested for the synthesis of DNA.

If we are looking from the theological perspective, these conclusions are strongly supported by several quotes from the Holy Scripture: e.g. “All go unto one place; all are of the dust, and all turn to dust again.” (Ecclesiastes 3.20) However, the Bible suggests two distinct actions concerning the life creation on Earth. The first one regards the physico-chemical mechanism of creation and the second one, full

of mystery, the giving of life: “the LORD God formed the man from the dust of the ground and breathed into his nostrils the breath of life, and the man became a living being.” (Genesis 2.7) and “The Spirit of God has made me; the breath of the Almighty gives me life.” (Job 33.4) If the scientific researches tend now to prove the first statement, it seems very plausible that the second one is also true. In fact, recent studies on artificial cells, with porous membranes for ATP penetration, containing a mixture of DNA and all biomolecules needed for protein synthesis could produce protein for some days but lack the possibility of cell division [9].

Therefore, the answer to the fundamental question: is the intrinsic information enough in order to pass from nonliving to living seems to be no! Both inorganic matter and information are the necessary but not sufficient conditions to solve the problem of this qualitative jump. We may conclude that for the moment, both Science and Theology indicate that something superior is needed - ***the spirit*** - in order to bring the entire system to life. On the other hand, the presence of informational content needed in all new materials production, from inorganic ones to cells, strongly suggest the use of Intelligent Design approach for further analyses.

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CREATION-EVOLUTIONISTIC DISCUSSION IN RUSSIA: RELIGIOSITY LIMIT OR PRIVATE OPINION?

Ivan Vikulov

Brief description

The intension is to make survey about the topicality of the problem in Russia and the main trends of Russian orthodox thought on the issue of World’s creation and Origin of Man. The matter of interest for me is intra-confessional Russian orthodox dispute. And I dwell on the following issues: Is it a matter of principle for its participants? Can it become a stumbling block or will it remain in the realm of partial theological studies? What is the reaction of the Head of Russian Orthodox Church on the given polemics? How are the principal positions in the dispute to be stated and what definitions are they to be given?

Summary

The purpose of the given paper is not to consider the discussion of proponents of creation and evolution theories in Russian Orthodox Church (ROC) or analysis of arguments of both sides. The prestige and the competence of the participants of the dispute is high enough as that lack of special theological and scientific education, besides, doesn't allow me to perform a detailed analysis. My intension is to make survey about the topicality of the problem in question in Russia and the main trends of Russian orthodox thought on the issue of World's creation and Origin of Man.

First of all it should be noted that the given problem has arisen time and again in Russian society before (pre-revolutionary years, the subsequent anti-religious propaganda, Church restoration during perestroika) but it was half-formed, didn't excite great public interest or heated discussions in the Russian clerical environment or among representatives of scientific community and creationists. As for the present moment, mass media has been widely covering the story of a fifteen-year-old girl from St. Petersburg Maria Schreiber by name who refused to study biology at school, saying her world outlook is in contradiction to Darwin theory of evolution it is based on. On August 1, 2006 together with her father Cyrill Schreiber and their friend PR-manager Anton Vuima they brought in an action against Ministry of Education of Russian Federation with the demand to exclude from school textbooks this hypothesis which is not scientifically grounded. The suit has aroused wide response all over Russia. Solidarity with the Schreibers was expressed by the representatives of different confessions. This case also has had a wide response from Russian interconfessional and especially protestant Internet Portals. A whole number of scientific conferences has been involved in the discussion of the polemics between creation and evolution theories proponents in modern world. Well-known Russian scientists joined in as well. Pseudo-science and Scientific Research Struggle Committee at Russian Academy of Science began publishing its own bulletin. However the court case was lost on February 21, 2007, it was labeled "Russian monkey trial". The girl had to drop in from school and left overseas.

Among the many problems aggravating in the context with Maria Schreiber's case we were interested in intra-confessional Russian orthodox dispute on the subject of World's creation and Origin of Man. Is it a matter of principle for its participants? Can it become a stumbling block or will it remain in the realm of partial theological studies? What is the reaction of the Head of Russian Orthodox Church on the given polemics? How are the principal positions in the dispute to be stated and what definitions are they to be given?

No doubt, for any Russian orthodox Christian Nicene-Constantinople Creed is a dogma. Speaking about the limit of man's religiosity, it's one of them. According to the metropolitan Cyrill (Gundiaev), "If a person doesn't acknowledge the dogma that God is a Creator of Universe, he stops being a believer, he stops being religious". But, as is well-known, the difference is often laid in details and interpretations. The idea of creation itself directly touches deep strata of human existence: concept of man and his place in the world, outlook, meaning of history, correlation of science and theology, value of Holy Fathers heritage.

Evolution theory of the Origin of the World and Man has become a major test in the relations of religious outlook and modern science. The main confessions have already expressed their own attitude towards the problem. Orthodox Church as a largest Christian confession in Russia currently doesn't have an officially acknowledged opinion on the given issue. A the end of October 1999 the Department of Religious Education and Catechization of Moscow Patriarchate carried out a scientific educational conference on the subject of "Teaching the Course of Creation of the World, Life and Man in the Russian Orthodox Schools" where the discussion between the proponents of "scientific creationism" and "theistic evolutionism" took place. Both Archbishop Councils in 2000 and 2006 seemed to pass over in silence this matter, so the consensus of opinion wasn't formulated.

The position of "scientific creationism" in Russian Orthodoxy is maintained by traditionalists who may be also called fundamentalists in the better sense of this word. Literalism in treating a religious doctrine, restoration of traditional values of Orthodox Russia, rigorism in perception of Church rites on the whole that's what is common for them. Its adherents set up an Orthodox mission center "Shestodnev" (Creatio) in May 2000 blessed by His Holiness Patriarch of Moscow and Russia Aleksii II. The Center is conducts conferences, arranges disputes, publishes books, and is actively involved in Internet projects. It places itself as an orthodox society for the defense, study and revealing the essence of Holy Fathers doctrine about the Creation of the World. The leader of the project archpriest Constantine (Bufeev) who participated in Maria Schreiber's case as an expert openly proclaims Darwinism as satan's creation and defines orthodox evolutionism as heresy and paganism. Shestodnev Center is focused mainly on subtleties of theological interpretation of the problem and evaluation of evolutionism in socio-cultural and religious context.

The most zealous critic of evolution theory in Russian Orthodox Church is a celibate priest Seraphim (lay name Eugene Rose) who was brought up in a traditional protestant family in California. His publication "Orthodox view on evolution" is an epistle to the Greek supporter of evolutionism theologian Alexander Kalomiros. Although father Seraphim (Rose) admits that "evolutionism is strictly speaking, not a heresy", he treats this doctrine harshly. "Evolutionism, he says, is an ideology extremely alien to the orthodox Christian doctrine, it also draws into such multitude of false doctrines and views that it would be better if were a mere heresy".

Evolutionists in Russian Orthodox Church do admit the progressive development of the world and man considering it to be directed by God. Holy Scripture, in their view, doesn't contradict the scientific data, but describes the same process in different terms according to the level of mentality of the old days. Orthodox "scientific creationism" (or neocreationism, cause they seem it not original) is viewed by evolutionists among whom there are a good number of scientists, as a weak, ungrounded reaction on serious scientific theory. According to one of the champions of Pierre Teilhard De Chardin's ideas and evolution as a whole G.L. Muravnik, – creationism is "a bad allergy fit of a certain number of protestants in the west on Darwin model of evolution" which recruited adherents in ROC.

Orthodox evolutionism is presented by such figures of the past and present of ROC as bishop Vasily (Rodzianko), a theologian Alexey I. Osipov, archpriest Vasily (Zenkovsky), archpriest Alexander (Men'), deacon Andrey (Kouraev) and also some well-known scientists. The list of names can be continued but it should be noted at that, ideas expressed by these people are qualified in most cases as a personal opinion. And it's only in the book of the deacon Andrey (Kouraev), perhaps, do we find a thorough theological answer supported by Holy Fathers heritage on the criticism of Christian evolutionism by creationists. As for the majority of the representatives of the given trends, they prefer to correlate evolutionism in science with biblical description of creation. Many proponents of evolution theory in Russian Orthodoxy are at the same time accused of orthodox modernism, ecumenism and renovationism. Thus the stumbling block elucidates some of the old inner Russian Church conflicts.

The disputes around evolutionism in Russia are more often directed not to the criticism of scientific arguments and well-grounded polemics with scientists, but to the evaluation of different significance of the concept and to the possibility of it theological treatment. Let's enumerate the principal problems in the theological polemics between "literalists" and "evolutionists":

1. Duration of creation act in time.
2. Presence in nature a creative response to the call of the Creator.
3. Theological interpretation of man's and nature's state before the Fall.
4. The problem of death origin in nature.
5. Missionary and moral significance of "evolutionism" and "creationism".
6. Holy Fathers heritage in exegesis of the first chapters of the Genesis and its interpretation.

The question of the official acknowledgement of this or that conception remains open in spite of considering the problem in Synodal Theological Commission. According to Professor A. Osipov both conceptions are principally acceptable for orthodoxy. The possibility to constantly see the limits of scientific and theological competence allows to avoid conflicts and prevent mutual prejudices.

BIOGRAPHIES OF PARTICIPANTS

Carlos Beorlegui Rodríguez (1947), Doctor in Philosophy and Licentiate in Theology, Professor of Philosophy (Philosophical Anthropology, Deontology, Philosophy of Mind) in Deusto University (Bilbao, Spain), and invited Professor for PhD Studies in Ibero-American Philosophy in "José Simeón Cañas" Centro-American University, San Salvador (El Salvador, C. A.). Published books: *Lecturas de Antropología filosófica* (1988, 1995), *García Bacca. La audacia de un pensar* (1988), *Antropología filosófica. Nosotros: urdimbre solidaria y responsable* (1999, 2004), *El pensamiento filosófico de J. D. García Bacca, en el contexto del exilio republicano* (2003), *Historia del pensamiento filosófico latinoamericano* (2004, 2006).

Óscar Castro García, born in Barcelona (1967), graduated in Philosophy at *Universitat Autónoma de Barcelona*, studied Physics at *Universidad de Barcelona* and has completed post-graduate studies as specialist in Epistemology and Cognitive Sciences. He is currently working on his Ph-D thesis about biosemiotics and neuro-science. To his participation in numerous Conferences (in Jerusalem, Santiago de Chile, Donostia, Barcelona, Madrid and Lleida) and in several workshops in *Centro de Astrobiología de Madrid* (NASA, INTA) should be added his presentations of papers (in some cases as special invited speaker) at various Universities (*Universidad Pontificia de Comillas, U. A. Barcelona, Universidad del País Vasco, Arteleku, Universidad Complutense de Madrid, Instituto Químico de Sarriá* and *Universidad de Lleida*). He is author of several articles about biosemiotics, quantum neurology, mathematical thinking and scientific popularization. As a founding member of the *Asociación UNESCO de Lleida* (where areas of Inter-Religious and Inter-Cultural Dialogue, Artistic and Cultural Heritage and Education are developed), he acts as its Secretary.

Khalil Chamcham, Ph.D., D.Phil., holds a French doctorate in nuclear physics from the University Claude Bernard, Lyon, France, a D.Phil in astrophysics from Sussex University, UK and a MSt in Science and Religion from the University of Oxford, UK. He taught for many years in Morocco and worked at several international institutions. He is currently carrying out his research in astrophysics and theology at the University of Oxford. His main research interests are galaxy formation, the foundations of cosmology, Christology, scientific development in the Islamic world and the interfaith dialogue. He is a member of the International Astronomical Union, where he is involved with the Commission for Education and Astronomy Development. He served as an advisor to the John Templeton Foundation since 2003.

Cornelio González Valdenebro was born in 1939 in Manizales (Colombia). Professionally a civil aviator, he is now retired. A long autodidact search of 34 years supports his mathematical ideas and expositions, which recently have found a written expression in comments to articles appeared in www.tendencias21.net and also in his own writings being published in the web of the *Cátedra Ciencia, Tecnología y Religión* of the *Universidad Pontificia Comillas de Madrid*.

PhDr. Miroslav Karaba, Ph.D. (born in Piestany, Slovakia, 1976) is a lecturer on the University of Trnava. He received his PhDr. in natural theology from the University of Palacky, Olomouc (Czech Republic) with thesis concerning the Anthropic cosmological principle and his Ph.D. in philosophy with thesis *Philosophical Implications of Quantum Theory in the Philosophy of Nature*. From 2002 he is an active agent in interdisciplinary dialogue and has organized several interdisciplinary lectures, discussions and conferences in Slovakia. He is a member of European Society for the Study of Science and Theology and initial member of LSI group "Towards Reconciliation of Religion with Science".

María López Ferreiro achieved her Philosophy Graduate at the University of Santiago de Compostela (2003). She is now an investigator and scholar in the Philosophy Faculty of the University of Barcelona (Department of History of Philosophy, Aesthetics and Philosophy of Culture). Her PhD. thesis (in the making) concerns the Philosophy of the Renaissance (Giordano Bruno and the Pre-Socratics).

Miguel Lorente Páramo, SJ, graduated in Physics, Philosophy and Theology. Once obtained his Ph.D., he initiated his university teaching in the Faculty of Physics at *Universidad Complutense de Madrid* and has later been Professor of Physics in the *Universidad de Oviedo*. Recently retired as Professor Emeritus, he collaborates regularly in the *Cátedra Ciencia, Tecnología y Religión* of the *Universidad Pontificia Comillas de Madrid*.

Sara Lumbreras graduated as an Engineer and earned her PhD in the Escuela Técnica Superior de Ingeniería (ETSI ICAI) of Universidad Pontificia Comillas (Madrid). She currently works in JP Morgan, London. She received a research grant in the Cátedra Ciencia, Tecnología y Religión (ETSI, Universidad Comillas).

Fátima Masot graduated in Physics at the University of Seville (1988), (MSc 1991, PhD 1996). In 1991, she joined the Department of Applied Physics as Associate Prof. She has enjoyed brief research stays in the Oregon State University (USA, 1995) where she got an appointment of Assistant Prof. (*courtesy*), also in the University of Newcastle upon Tyne (summers 1997, 1998) and in the University of Leeds, UK, (Research Fellow, 1999), where she worked in the design of high frequency systems. In 2002 she became Profesor Titular of the Department of Applied Physics in Seville, where she works at the moment

Alice Antonela Rusu is a family doctor in the National Health Assurance House (Romania). She studied at the University of Medicine and Pharmacy of Iasi (Romania) and as of 2003 is a specialist doctor in Family Medicine. Member of ESSSAT she has attended 5 International Conferences (participating in the Organising Committee of ECST XI in Iasi-2006). She has authored 11 scientific papers, including: A. Rusu & I**.** Rusu, *Implications of a new theory regarding the appearance of life on inorganic substrates*, Ann. Univ. "Aurel Vlaicu" Arad, Theology, 1 (2000) 235-240. The following grants were awarded to her: the grant of the German Science Foundation to present doctoral research results at IRIS-IX (2000) and the grant of the European Community to present doctoral research results at ICBIC 10 (2001).

Iulian Rusu holds a PhD as Chemist Engineer (1998) and is lecturer in the Faculty of Chemical Engineering & Environmental Protection of the Technical University of Iasi (Romania). In 2004-2006 was Vice-president of ESSSAT (Organiser of ECST 2006 and SRARC 2006 in Iasi) and since 2005 acts as Editor-in-Chief of the European Journal of Science & Theology. He has participated in 22 international conferences (especially ECST VIII and XI) and has authored 79 scientific papers. His biography was published in *Who's Who in Science & Engineering*, 9th edn., 2006-2007. His papers on Science and Theology include: I. Rusu & G. Petraru, *Nobel prizes for chemistry. Values and ethical issues*, Ann. Univ. `Al. I. Cuza' Iasi, Theology, 8 (2003) 359-364 and I. Rusu & G. Petraru, *Influence of Church on Cultural Evolution*, Eur. J. Sci. Theol., 1(1) (2005) 3-9.

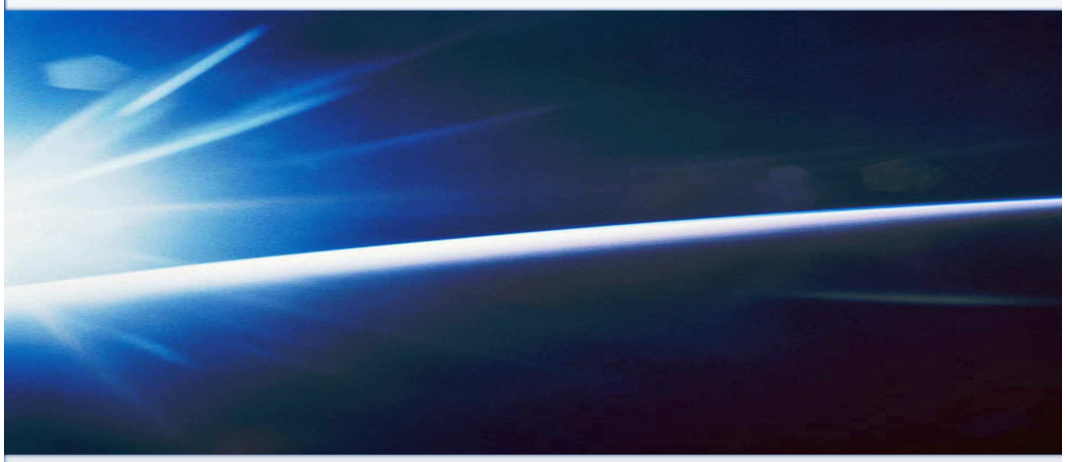
Ivan Vikulov, born in 1974 (Vladimir, Russia), graduated in Cultural Studies, obtaining in 2004 his Diploma of Higher Education in the Vladimir State University, and is now preparing his PhD thesis at the Department of Philosophy and Religious Studies, Faculty of Humanitarian and Social Sciences, Vladimir State University. The theme of his scientific investigation is *Religiosity Interpretation in Terms of Religious Pluralism: Russian Experience*. Since 2004 he has been a lecturer on Religious Studies and History of Religion affiliated with this same Department. Ivan Vikulov is the author of 9 publications, including: Vikulov I., *On the Problem of the Defining Notions "Religion" and "Religiosity"*, Proceedings of the International Conference “Religion and Personality: Past and Future” (Vladimir, November 15-17, 2003), Candle-2005, vol. 12, Vladimir University Publish House, Vladimir 2005, and Vikulov I. *The View of Intentionality and The Sensible Sight Eye: Phenomenological Parallels*, Proceedings of the XIII International Conference for Undergraduate and Graduate Students and Young Scientists "Lomonosov" (Moscow, April 12-15, 2006), Volume IV, Moscow University Press, Moscow, 2006.

LIST OF PARTICIPANTS*

	Name	Organization	City	Country
1	Alemany Briz, Álvaro	Centro Pignatelli	Zaragoza	Spain
2	Alonso Bedate, Carlos	Centro de Biología Molecular, CSIC	Madrid	Spain
3	Balsas, Álvaro	Faculdade de Filosofia	Braga	Portugal
4	Bardavío, Jorge	Seminario de Teología y Ciencia (STIC) Barcelona	Cardedeu	Spain
5	Béjar, Manuel	Cátedra Ciencia, Tecnología y Religión (CCTR), Universidad P. Comillas	Madrid	Spain
6	Beorlegui, Carlos	Universidad de Deusto	Bilbao	Spain
7	Bertrán Rusca, Juan	Universidad Autónoma de Barcelona / STIC	Barcelona	Spain
8	Bugajak, Grzegorz	Cardinal Stefan Wyszynski University, Institute of Philosophy	Warsaw	Poland
9	Casadesús, Ricard	STIC Barcelona	La Garriga (Barcelona)	Spain
10	Castro García, Óscar	Departmento de Filosofía, Universidad Autónoma de Barcelona	Lleida	Spain
11	Cazalis, Roland	EI Purpan, Laboratoire d'Agrophysiologie	Toulouse	France
12	Chamcham, Khalil	University of Oxford	Oxford	UK
13	De Vicente, José Miguel	Universidad Pontificia Comillas	Madrid	Spain
14	Degett, Jens	Cátedra CTR, Universidad P. Comillas	Madrid	Spain
15	Devos, Pierre	Facultés Universitaires Notre-Dame de la Paix (FUNDP)	Namur	Belgium
16	Dinis, Alfredo	Faculdade de Filosofia	Braga	Portugal
17	Escalona Santafé, Isabel	Centro Pignatelli	Zaragoza	Spain
18	Fitzmaurice, Arthur	California Institute of Technology / UCLA Med School	Los Angeles	USA
19	Gabor, Paul	Institut d'Astrophysique Spatiale	Paris	France
20	García Doncel, Manuel	STIC Barcelona	Sant Cugat (Barcelona)	Spain
21	García-Plaza, Amparo	Cátedra CTR, Universidad P. Comillas	Madrid	Spain
22	Gorini, Alessandra	Department of Psychiatry and Neuropsychology, University of Maastricht	Milan	Italy
23	Gregersen, Niels	University of Copenhagen	Copenhagen	Denmark
24	Heller, Christine	Cátedra CTR, Universidad P. Comillas	Madrid	Spain
25	Iaia, Gaetano	Studio Francescano, Pontificia Università Antonianum	Napoli	Italy
26	Janik, Piotr	Universitary School of Philosophy and Education IGNATIANUM	Cracow	Poland
27	Kalam, Kalmar	Kalmar Advising Center LLC	Tiskre, Harku vald	Estonia
28	Kapusta, Pawel	Pontificia Università Gregoriana	Roma	Poland
29	Karaba, Miroslav	Theological Faculty, Trnava University	Leopoldov	Slovakia
30	Koch, Giuseppe	Vatican Observatory	Castel Gandolfo	Italy
31	Koster, Edwin	Vrije Universiteit Amsterdam	Amsterdam	The Netherlands
32	Kozhamthadam, Job	Jnana-Deepa Vidyapeeth (Pontifical Institute of Philosophy and Religion)	Pune	India

* Only Conference participants registered as of 1st September 2007 are included in this list.

	Name	Organization	City	Country
33	Kummer, Christian	Hochschule für Philosophie	Munich	Germany
34	Leach, Javier	Cátedra CTR, Universidad P. Comillas / Universidad Complutense de Madrid	Madrid	Spain
35	Lewandowska, Bogusława	Institute of Fundamental Technological Research, Polish Academy of Sciences	Warsaw	Poland
36	López Aguilar, Fernando M.	Departamento de Física, Universidad Autónoma de Barcelona	Sant Cugat (Barcelona)	Spain
37	López Pérez, Manuel José	Centro Pignatelli / Departamento de Bioquimica, Biologia Molecular y Celular, Universidad de Zaragoza,	Zaragoza	Spain
38	Lorente Páramo, Miguel	Universidad de Oviedo / Cátedra CTR, Universidad P. Comillas	Madrid	Spain
39	Losantos, Xavier	STIC Barcelona	Sant Cugat (Barcelona)	Spain
40	Lozano, Manuel	STIC Barcelona	Barcelona	Spain
41	Lozano-Gotor, José Manuel		Albacete	Spain
42	Lumbreras, Sara	JP Morgan	London	UK
43	Masot, Fátima	Universidad de Sevilla	Sevilla	Spain
44	Monserrat, Javier	Universidad Autónoma de Madrid / Cátedra CTR, Universidad P. Comillas	Madrid	Spain
45	Montoto San Miguel, Joaquín		Boadilla (Madrid)	Spain
46	Mora, Francisco	Universidad Complutense de Madrid	Madrid	Spain
47	Odifreddi, Piergiorgio	Dipartimento di Matematica, Università di Torino	Turin	Italy
48	Pandikattu, Kuruvilla	Jnana-Deepa Vidyapeeth (Pontifical Institute of Philosophy and Religion)	Pune	India
49	Rojo Martínez, José Antonio	Centro Pignatelli / Centro Politécnico Superior, Universidad de Zaragoza	Zaragoza	Spain
50	Romero Baró, José María	Universidad de Barcelona / STIC	Barcelona	Spain
51	Romero Moñivas, Jesús	Centro Universitario Villanueva, Universidad Complutense de Madrid	Madrid	Spain
52	Rusu, Alice	National Health Assurance House	Iasi	Romania
53	Rusu, Iulian	Faculty of Chemical Engineering, Technical University of Iasi	Iasi	Romania
54	San Miguel de Pablos, J. Luis	Cátedra CTR, Universidad P. Comillas	Madrid	Spain
55	Seidel, Johannes	Hochschule für Philosophie	Munich	Germany
56	Sequeiros, Leandro	Facultad de Teología de Granada	Granada	Spain
57	Stoeger, William R.	Vatican Observatory, University of Arizona	Tucson	USA
58	Tomczyk, Jacek	Institute of Ecology and Bioethic, Department of Anthropology, Cardinal Stefan Wyszynski University	Warsaw	Poland
59	Udías, Agustín	Cátedra CTR / Facultad de Físicas, Universidad Complutense de Madrid	Madrid	Spain
60	Viia, Mariina	Tartu Ülikool (Tartu University)	Tartu	Estonia
61	Vikulov, Ivan	Philosophy and Religious Studies, Vladimir State University	Vladimir	Russia
62	Watts, Fraser	Queen's College, University of Cambridge	Cambridge	UK
63	Wiltsher, Christopher	ESSSAT (European Society for the Study of Science and Theology)	Durham	UK
64	Wittouck, Pierre			Belgium



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