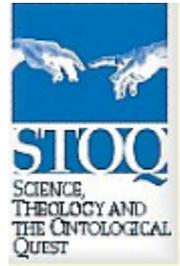




PONTIFICIA
UNIVERSITÀ
GREGORIANA

*Facoltà di Filosofia
Specializzazione
in Scienze e Filosofia*



Abstracts

Lectures to be given at the
III STOQ International Conference

***Biological Evolution
Facts and Theories
A Critical Appraisal 150 Years After
"The Origin of Species"***

Rome, March 3-7 2009

with the collaboration of
University of Notre Dame (Indiana)



Under the High Patronage of the
Pontifical Council for Culture

First Day of the Conference
Tuesday 3 March 2009

LECTURE SCHEDULE

First Session:

The Facts that We Know

09:00 Welcome from the Authorities

10:00 Simon CONWAY MORRIS: Why Evolution is
Predictable: Journeys of a Palaeontologist

10:45 Coffee Break

11:15 Werner ARBER: Bio-Molecular Evidence

11:55 Douglas J. FUTUYMA: Taxonomic Issues: Evidence from
Comparative Biology

12:45 Discussion

13:30 End of the Session and Lunch

Second Session:

Evolutionary Mechanisms I

15:30 Jean GAYON: History of Evolution Theories

16:15 Francisco J. AYALA: Darwin's Revolution

17:00 Coffee Break

17:30 Lynn MARGULIS: Symbiosis

18:15 Jeffrey L. FEDER: The Mystery of Speciation

19:00 Discussion

19:30 End of the Session and Dinner



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ABSTRACTS OF THE LECTURES

LECTURE I - Abstract

Why Evolution is Predictable: Journeys of a Palaeontologist

Simon Conway Morris

Darwin understood the central importance of the fossil record to his theory of evolution, and since then the many extraordinary finds have dramatically confirmed the genius of his insights. Nevertheless, whilst the reality of evolution is not in dispute problems remain. Darwin himself was very puzzled by the event now known as the Cambrian “explosion” and it is notable that in *The Origin* this is the one area where, in terms of explanation, he is almost entirely at sea. We know much more about the Cambrian “explosion”, but a general explanation is still needed. Perhaps we need to take a wider view as to how Earth-like planets may evolve in a biogeochemical context. But the Cambrian “explosion” is also of central importance because it marks the emergence of complex nervous and sensory systems, and ultimately brains and intelligence. It is received wisdom in nearly all neo-Darwinian circles that these, like any other evolutionary end-point, are effectively flukes, mere accidents of history. Such resonates, of course, with the emphasis on randomness, be it in terms of mutation or mass extinctions. Stephen Jay Gould observed, using the famous Burgess Shale as his exemplar, that were we to re-run the tape of life then the end-products would be completely different. No humans, for example. Drawing on evolutionary convergence I will argue for the complete opposite, and in doing so will suggest that evolution is like any other science, that is predictable.

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ABSTRACTS OF THE LECTURES

LECTURE II - Abstract

Bio-Molecular Evidences

Werner Arber

Shortly after the so-called “modern evolutionary synthesis” leading to Neo-Darwinism around 1940, microbial geneticists discovered that DNA molecules are the carriers of genetic information. Together with the thereafter discovered double-helical structure of DNA molecules, this led to molecular genetics and recently also to molecular evolution. Experimental investigations on spontaneous mutagenesis mainly with bacteria have revealed a number of different, specific molecular mechanisms that contribute to the generation of genetic variants, the drivers of biological evolution. These mechanisms can be classified into three natural strategies to generate genetic variants: (1) local changes in the sequence of nucleotides of DNA, (2) intra-genomic rearrangements of DNA segments, and (3) acquisition of a segment of foreign DNA. A few examples for these mechanisms and strategies will be discussed, as well as their qualitative differences with regard to their contributions to evolution. The general relevance of these insights into biological evolution for all living beings will be discussed. On the basis of present knowledge, specific “evolution gene” products are postulated to provide novel genetic variants in co-operation with several non-genetic elements such as structural flexibilities and chemical instabilities of biomolecules, the impact of chemical and physical mutagens, and random encounter. In conclusion: Natural reality actively takes care of biological evolution of populations of organisms and it keeps the rates of mutagenesis low, insuring a comfortable genetic stability to all organisms.

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ABSTRACTS OF THE LECTURES

LECTURE III - Abstract

Taxonomic Issues: Evidence from Comparative Biology

Douglas J. Futuyma

The similarities among species became explicable only when Darwin postulated that many of them were the consequence of inheritance, perhaps with modification, from the common ancestors of those species. Thus the hypothesis that all organisms are related, as portrayed in a phylogenetic tree, is both a central claim of evolutionary biology and a framework for tracing and understanding the history and modifications of organisms' characteristics. The common ancestry of diverse species is now considered a scientific fact, and methods for determining the relationships among species have become quite reliable. By comparing characteristics of species in this framework, a great deal has been learned about patterns and rates of evolution, including changes in anatomical form and function, evolved modifications of the embryological development of structures, changes in genes and proteins, the evolution of new genes and genetic functions, and the degeneration and loss of organs and genes that have lost their function. From the comparative anatomy and embryology of the nineteenth century to the sequencing of entire genomes in the twenty-first century, biological research has reaffirmed the principle of common descent and modification, and has provided ever deeper understanding of the pathways of evolutionary change.

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LECTURE IV - Abstract

History of Evolution Theories

Jean Gayon

Since 1859, evolutionary biologists have been haunted by the question of whether their conceptions are or are not 'Darwinian'. Although these terms are ambiguous, the repeated reference to Darwin has a theoretical signification. Darwin settled a conceptual framework that has canalized evolutionary research over one-and-a half centuries. The two major aspects of this framework (the hypotheses of descent with modification and natural selection) will be confronted with further evolutionary research, with special regard to the last 50 years. We propose a classification of the criticisms addressed to Darwin's two fundamental hypotheses.

In *The Origin of species*, the postulates underlying Darwin's hypothesis of "descent with modification" are expressed in a branching diagram, which has generated over time three major criticisms: rejection of gradual modification, rejection of a conception of change exclusively concentrated at the level of the species, and more radical objections regarding the very idea that genealogy can be represented through a unique "tree".

The natural selection hypothesis itself has been criticized at two levels: the level that Darwin called the "mere hypothesis", and that of a "principle" able to explain and unify the whole theory of the history of life. At the first level, three controversies have dominated since the 1960s: controversies over the neutral theory of molecular evolution, controversies over group selection, and controversies over the limits imposed by complexity and self-organization. At the second level (Darwin's "well-grounded theory"), contemporary evolutionary biologists have challenged Darwin's idea that natural selection does account for as many "independent classes of facts" as adaptation, extinction, divergence, geological distribution of fossils, geographical distribution of species, relations between embryology and evolution, and patterns of classification.



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Contemporary evolutionary biology admits that natural selection is the only acceptable explanation for adaptation, has raised serious doubts about the ability of natural selection to be an all-sufficient principle for the explanation of some or all the other classes of facts that Darwin explained through this principle.

In conclusion, we take S.J. Gould's successive and ambivalent attitudes regarding "Darwinism". In 1980, Gould claimed that Darwinism was "dead". In his *Structure of evolutionary theory* (2002), he had a more nuanced appreciation, where Darwinism had not been either "extended" or "replaced", but "expanded. In Gould's terms, "expansion" means a reformulation of the fundamental principles of Darwinism, through generalization of the main

Darwinian processes and addition of new principles. We conclude that the Darwinian framework has persisted, not under the form of the particular models of descent of modification and natural selection had in mind, but in the sense of high level heuristic postulates that have constrained and canalized the possible theoretical choices accessible to evolutionary biologists and paleontologists.

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ABSTRACTS OF THE LECTURES

LECTURE V - Abstract

Darwin's Revolution

Francisco J. Ayala

Darwin is deservedly given credit for the theory of evolution. He accumulated evidence demonstrating that organisms evolve over eons of time and diversify as they adapt to environments that are enormously diverse. Most important, however, is that he discovered natural selection, the process that accounts for the evolution of organisms and for their adaptive features; that is, their “design.” The design of organisms is not intelligent, as it would be expected from an engineer, but imperfect and worse: defects, dysfunctions, oddities, waste, and cruelty pervade the living world.

Darwin's theory of evolution accounts for the design and diversity of organisms as the result of the gradual accumulation of spontaneous mutations sorted out by natural selection. Mutation and selection have jointly driven the marvelous process that, starting from microscopic organisms, has yielded orchids, birds, and humans. The theory of evolution conveys chance and necessity, randomness and determinism, jointly enmeshed in the stuff of life. Darwin's fundamental discovery is that there is a natural process that is creative although not conscious.

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LECTURE VI - Abstract

Symbiosis

Lynn Margulis

Whereas speciation by accumulation of "random DNA mutations" has never been adequately documented a plethora of high-quality scientific studies has unequivocally shown symbiogenesis to be at the basis of the origin of species and more inclusive taxa. Members of at least two prokaryotic domains (a sulfidogenic archaeobacterium, a sulfide-oxidizing motile eubacterium) merged in the origin of the first nucleated organisms to form the earliest eukaryotic organism in the mid-Proterozoic Eon (c. 1200 million years ago.) Such a heterotrophic, phagocytotic motile protocist was ancestral to all subsequent eukaryotes (e.g., other protocists, animals, fungi and plants). The defining seme of eukaryosis, the membrane-bounded nucleus as a component of the karyomastigont, evolved as *Thermoplasma*-like archaeobacteria and *Perfilievia-Spirochaeta*-like eubacteria symbiogenetically formed the amitochondriate LECA (the last eukaryotic common ancestor). Their co-descendants (that still thrive in organic-rich anoxic habitats) are amenable to study so that videos of them can be shown here. There are no missing links in our scenario. Contemporary photosynthetic (green) animals (e.g., *Elysia viridis*, *Convoluta roscoffensis*), nitrogen-fixing fungi (*Geosiphon pyriforme*), cellulose digesting animals (cows, *Mastotermes darwiniensis* termites) and plants (*Gunnera manicata*) make us virtually certain that Boris Michailovich Kozopoliansky's (1890-1957) analysis (*Symbiogenesis: A New Principle of Evolution*, 1924) was and still is correct. Symbiogenesis accounts for the origin of hereditary variation that is maintained and perpetuated by Charles Darwin's natural selective limitations to reaching the omnipresent biotic potential characteristics of any species.

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ABSTRACTS OF THE LECTURES

LECTURE VII - Abstract

The Mystery of Speciation

Jeffrey L. Feder

Charles Darwin once described speciation as that “mystery of mysteries”. However, this is one mystery that is now arguably solved. In this talk, I will discuss advances in our understanding of how new species form since Darwin first posed the problem. I will outline current views regarding the geographic context and genetic bases for speciation. I will also examine how and why barriers to gene flow evolve - the crux of the speciation problem - highlighting a few case studies demonstrating incipient speciation in action. I will conclude by discussing current research directions in the field. Although we may understand the general mechanisms generating new species, much remains to be learned. In particular, we are entering an exciting new period of synthesis in which the ecological, physiological, developmental, and genetic bases for population divergence can now be fully integrated for model and non-model organisms alike. From this body of work, case studies are accumulating to soon allow broad patterns to be identified concerning the relative importance of different mechanisms for the genesis of biodiversity. Although the mystery surrounding speciation may be gone, the thrill is not. Speciation is as important and as fascinating a question now, as ever, for understanding life.

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Wednesday 4 March 2009

LECTURE SCHEDULE

Third Session:

Evolutionary Mechanisms II

09:00 Scott GILBERT: Evolutionary Developmental Biology:

Evolution by Epigenesis

09:45 Stuart KAUFFMAN: Evolution and Complexity

10:30 Coffee Break

11:00 Robert E. ULANOWICZ: Process and Ontological

Priorities in Evolution

11:45 Stuart A. NEWMAN: A “Pattern Language” for Evolution
and Development of Animal Form

12:30 Discussion

13:00 End of the Session

Fourth Session:

The Origin of Man

15:00 Giorgio MANZI: History of the Research

15:45 Olga RICKARDS - Gianfranco BIONDI: The Origin of
Man: Molecular Approach

16:30 Coffee Break

17:00 Yves COPPENS: The (H)Omo Event

17:45 Fiorenzo FACCHINI: Paleocultural Approach in
Hominization and Possible Philosophical Implications

18:30 Robin DUNBAR: The Evolution of Primate Sociality:
Brains, Cognition and Behaviour

19:15 Discussion

19:30 End of the Session

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ABSTRACTS OF THE LECTURES

LECTURE VIII - Abstract

Evolutionary Developmental Biology: Evolution by Epigenesis

Scott Gilbert

In 1893, Thomas Huxley, wrote, "Evolution is not a speculation but a fact; and it takes place by epigenesis." Note that evolution's chief defender did not complete his sentence with the phrase "natural selection," for Huxley was interested in the generation of the diversity needed for natural selection. That phase of evolution was regulated by development. Recent work has established five main mechanisms for the generation of anatomical diversity through changes in development, and this talk will review them and provide examples from the recent literature. These mechanisms are:

- (1) Heterochrony (changing the time or duration of developmental phenomena or gene expression)
- (2) Heterotopy (changing the placement of developmental phenomena or the cell types in which a gene is expressed)
- (3) Heterometry (changing the amount of gene expression in a manner sufficient to alter the phenotype)
- (4) Heterotypy (changing the sequence of the gene being expressed during development)
- (5) Heterocyberny (change in the "governance" of a trait from being environmentally induced to being genetically fixed)

These mechanisms have profound significance for how new traits can be generated, how they become integrated into developing organisms, and how they can become propagated through a population. It is argued that adding these developmental data and contexts provides a new and more complete theory of evolution.



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LECTURE IX - Abstract

Evolution and Complexity

Stuart Kauffman

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LECTURE X - Abstract

Process and Ontological Priorities in Evolution

Robert E. Ulanowicz

Although he was a fervid admirer of Isaac Newton, Charles Darwin nonetheless described evolution as a *process*, rather than as the action of laws upon objects. Later, the “Grand Synthesis” of Fisher and Wright and the ensuing discoveries in molecular biology diluted Darwin’s bold move by directing emphasis in evolution back towards material objects and mechanisms. Other life sciences, however, continue to lend themselves more naturally to description in terms of processes. It can be argued, for example, that the dynamics of ecosystems rest upon a set of fundamental postulates, each of which mirrors a particular aspect of process. Mutuality constitutes the ontological core of this metaphysic, known as “process ecology”. By way of contrast, competition is regarded as accidental and derivative. Selection in process ecology can act internal to the system, rather than exclusively via the exogenous agency of “natural selection”. Furthermore, the monist dictum, “survival of the fittest”, relates to only one element of a broader Heraclitean/Hegelian agonism that produces life. Such discrepancies with orthodox evolutionary theory suggest a far richer picture of evolution (and the ethos which it informs) than is available through the contemporary Neo-Darwinian narrative – one that follows Darwin’s original instinct to describe living nature as process.

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LECTURE XI - Abstract

A “Pattern Language” for Evolution and Development of Animal Form

Stuart A. Newman

Ancient animals arose from unicellular organisms that had billions of years of genetic evolution behind them. In this talk I will consider the role played by a core set of “dynamical patterning modules” (DPMs) in the origination, development and evolution of multicellular animals, the Metazoa. These functional modules consist of the products of certain genes of the “developmental-genetic toolkit,” in association with physical processes and effects characteristic of chemically and mechanically excitable systems of the “mesoscale” (i.e., linear dimension ~0.1-10 mm). Once cellular life achieved this spatial scale by the most basic DPM, cell-cell adhesion, a variety of physical forces and effects came into play, including cohesion, viscoelasticity, diffusion, spatiotemporal heterogeneity based on lateral inhibition, and global synchronization of oscillatory dynamics. I will show how toolkit gene products and pathways that pre-existed the Metazoa acquired novel morphogenetic functions simply by virtue of the change in scale and context inherent to multicellularity. I will show that DPMs, acting singly and in combination with each other, constitute a “pattern language” capable of generating all metazoan body plans and organ forms. Another implication is that the multicellular organisms of the late Precambrian-early Cambrian were phenotypically highly plastic, capable of fluently exploring morphospace in a fashion relatively decoupled from both function-based selection and genotypic change. The stable developmental trajectories (“developmental programs”) and morphological phenotypes of modern organisms would then have arisen by stabilizing selection that routinized the generation of morphological motifs that were originally manifestations of the physical properties of multicellular aggregates.





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This perspective provides a resolution of the apparent “molecular homology-analogy paradox,” whereby widely divergent modern animal types utilize the same molecular toolkit during development. It does so however, by inverting the neo-Darwinian tenet that phenotypic disparity was generated over long periods of time in concert with, and in proportion to, genotypic change.

ABSTRACTS OF THE LECTURES

LECTURE XII - Abstract

History of the Research

Giorgio Manzi

“Light will be thrown on the origin of man and his history”: this was the well known line that Charles Darwin devoted to human evolution at page 488 of the “*Origin*”, 150 years ago. Although this was only a short sentence, apparently incidental and innocuous, it actually represented a risky prediction. In other words, Darwin’s claim was: whether natural selection is the basic mechanism of the origin of species, there is no reason to exclude our own species from analogous circumstances. As a matter of fact, when the 1250 copies of the “*Origin*” went out of print in one day, an intense debate started immediately not about chaffinches or turtles, but focused on the argument, crucial in fact, included in that controversial single line of page 488 – i.e., the phylogenetic relationship of *Homo sapiens* with monkeys and apes. Other predictions about human evolution were put forward by Darwin elsewhere, as for instance in his 1871 book, where he decided to directly face the most challenging “mystery of mysteries” (as he had written in 1859). It was risky, for instance, to state that Africa was our more probable homeland, in a period when the only discoveries of fossil humans were from Europe – well before the discovery of *Australopithecus africanus* in 1924, *Homo habilis* in 1964 or the earliest representatives of *Homo sapiens* in the last decades – or when other scientists were suggesting to look toward the easternmost Asian regions, where effectively Eugène Dubois found his *Pithecanthropus erectus* in 1891. It was also risky to state that the fossil record and the science of paleontology as a whole couldn’t shed light on the process of evolution, in general, and on our origins, in particular.



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The circa twenty species of extinct hominids that we know at present – although some of them appear, and effectively are, controversial – clearly demonstrates that he was (fortunately) wrong in assuming such a pessimistic perspective about the fossil record. To tell the truth, the science of human origin, or paleoanthropology, seems now able to shed light not only on our evolution, but on the mechanisms underlining the evolutionary theory as a whole. Hence, Darwin's predictions like these may be discussed in the light of our present knowledge on the evolution of ourselves, with the provocative intention to evaluate where he was or wasn't wrong.

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ABSTRACTS OF THE LECTURES

LECTURE XIII - Abstract

The Origin of Man: Molecular Approach

Olga Rickards – Gianfranco Biondi

The shift from a metaphysical to a scientific way of knowing our history began roughly around the middle of the 18th century when Carl Linneus classified the human species in the order Primates, assigning it a place of rank in the natural world. About a century later, in a bold move to relocate man's history outside the realm of metaphysics, Charles Darwin set human evolution on a new time scale of the history of life, opening the perspective of thinking about humans as just one of many other animal species. This signalled the end to a creationist concept of the world, leaving the creation story a mere psychological support that sustains many in their metaphysical need of hope but as an explanation of life's origins is irrelevant for science. In the late decades of the 20th century, researchers began investigating the origin and variability within the human species with the aid of molecular studies, specifically, genome analysis. Current theory has it that the origin of *Homo sapiens* dates back 200,000 years ago to an evolutionary event that occurred in *Homo ergaster* inhabiting Africa, whence the new species spread to the rest of the world. Adaptation to different habitats led to the morphological and genetic variability that characterizes diverse populations. But such populations did not become different races because of the young age of the species and because of the admixture processes that took place among them over the course of time. Hence, the taxonomic category of "race" is as inappropriate as it is incorrect when applied to humans. More recently, evidence from studies on DNA recovered from ancient remains has demonstrated that the Neanderthals are not our direct ancestors. Contrary to long-cherished beliefs, and despite resemblance in essential features, *Homo sapiens* is a species apart from and unrelated to the Neanderthals.



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By molecular analysis it has been established that man's evolutionary line separated from that of chimpanzees about 6 million years ago. And it is estimated that the degree of genetic similarity the human species shares with African man-like apes is relatively high: 98.5% with chimpanzees and 97.5% with gorillas. This affinity between us and our African relatives suggested classifying them within our taxonomic family: the Hominids. In turn, our evolutionary line was reduced a notch to that of the subfamily of the Hominins. In this connection, ethology, the area of biological science that studies animal behaviour, has gained fascinating insights into our altruistic behaviour. Initial results indicate that it may be purely evolutionary in origin.

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LECTURE XIV - Abstract

The (H)Omo Event

Yves Coppens

Three million years ago (or a little less), a climatic change happened in the whole world ; it was a drought in tropical areas, a cooling everywhere else.

In tropical Africa, as elsewhere, the fauna had to react to try adaptations to the new environment to survive. Some animals became extinct ; some left the country, some arrived and some – most of them actually – « found » successful answers to the situation : transformation of diet and teeth (Elephants, Suids, Equids, Hominids), transformation of locomotion (Equids, Hominids), transformation of the brain (Hominids).

It was the time and the reason for the transformation of Prehumans into Humans, the reason of the emergence of the genus *Homo*.

As the very close link between the evolution of the environment and Hominid evolution has been demonstrated, for the first time, in the seventies, thanks to the fossil of the sediments of the Lower Omo Valley in southern Ethiopia, I proposed this bad pun *(H)Omo event* to call the climate crisis at the origin of Man's birth and the pioneer role of the Omo area in this so important discovery.

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LECTURE XV - Abstract

Paleocultural Approach in Hominization and Possible Philosophical Implications

Fiorenzo Facchini

The man behaviour is characterized by culture. Many Authors associate the concept of culture with the artistic and spiritual manifestations and with the language which are recognized in Homo sapiens of the last 100.000 years. This way of thinking reflects a narrow concept of culture. In fact also the products of technology, when they show a planning character and denote a symbolic capacity, reveal abstractive mind and therefore a reflected thinking capacity which certainly indicates that the human threshold has been reached.

The application of the concept of culture can meet problems in identifying man at his origins. Current taxonomy refers many species to genus Homo, but it can not be adopted as a criterion to recognize man.

A skeletal remain attributed to the genus Homo out of its anatomic features, does not necessarily imply that it represents man in a phylosophical sense, that is to say a thinking man. But when we happen to meet skeletal remains, which are connected with products showing systematic and innovative works, man presence can be suggested, whatever morphological and evolutive level the remain is to be referred to.

What distinguishes human technology from non-human one (as it occurs with Apes and Australopithecus) is the complexity of the actions by which the instrument was performed and even more the capacity to improve and innovate the technique (Bergson) and the significance assumed by products in the life context (Ries, Deacon).

Instrumental culture reveals a symbolism which we suggested to call functional, distinguishing it from the symbolism expressed in language (social symbolism) and from the spiritual symbolism represented by artistic and religious expressions, not connected with subsistence strategies.



ABSTRACTS OF THE LECTURES



On the phenomenological level culture reveals discontinuity compared with non-human Hominids, whatever the reason and kind of this discontinuity may be. Dobzhansky suggests an evolutive transcendence with the appearance of man. On recognizing such discontinuity, even in the most simple technology, it becomes difficult to identify the first human forms in the real sense of the world.

Time after time cultural manifestations become more meaningful and therefore human attribution turns easier. But attitude towards culture can be recognized even out of its simplest expressions, starting from pebble culture.

Identifying the evolutive level in which to put the human threshold in the process of hominization interests palaeanthropology more than philosophical and theological investigation, which affirm a qualitative difference, that is the spiritual dimension, between non human and humans. The same must be said about possible biological and social implications of the contemporary presence of human and non human hominids referred to Homo genus.

On the philosophical field the gradualness of cultural manifestations bears the problem of the “ontological leap” due to man appearance, as John Paul II observed. If on the phenomenological field the discontinuity requires a long time to be observed, on the philosophical level the discontinuity must be radical, whatever its cultural expressions are, because the spiritual soul can not come out of living matter. There can not be any forms of intermediate psychism that are only partially human, as Maritain remarked.

Another implication regards the achievement of human level, which can have interested a population and since then all their descendents up the present humanity. After having reached the human threshold in the hominization process, man presence continues further in time with the generation of every human being who represents an ontological discontinuity with respect to animals.

The obscurity in representing the appearance of the spiritual dimension is similar to what happen in the ontogenesis of every man.



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The beginning of human form happened inside time, but the project of God is outside the time. We can assume that the project of God Creator includes at a certain moment of the evolutive process a corporeity enriched by the spirit, not in the sense of an entity which is added to another one, almost placed on or beside it, but which exists inside the other one, as and when wanted by God, in the similar way that happen in the human ontogenesis.

The creation of the spirit is outside the empirical evidences and can be reached on the philosophical level whether for the human phylogensis or the ontogenesis.

The exact moment when the hominid becomes aware of itself can not be represented by methods of science or by our imagination. Cultural manifestations can not demonstrate the moment of the achievement of the human threshold, but only if the threshold can be considered reached.

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LECTURE XVI - Abstract

The Evolution of Primate Sociality: Brains, Cognition and Behaviour

Robin Dunbar

Primates have unusually large brains for body size. The general explanation (the social brain hypothesis) argues that this is because primates live in unusually complex societies, and therefore require more computational power to handle this complexity. I will review the evidence for the social brain hypothesis. I will then use these findings to explore the evolution of sociality in humans, and show how humans fit perfectly within the primate relationship between social group size and brain size. I will consider the cognitive demands that underpin these relationships (conventionally referred to as social cognition), and report recent neuroimaging experiments that explain why this kind of social cognition that underpins primate sociality is so neurologically demanding.

Third Day of the Conference
Thursday 5 March 2009

LECTURES SCHEDULE

Fifth Session:

Some Anthropological Questions about Evolution

09:00 Anne DAMBRICOURT-MALASSÉ: The Human Lineage:
a Macro-Evolutionary Process Acting During Embryogeny
with Emergent Macro-Evolutionary Implications

09:45 Colin RENFREW: The Concept of Evolution as Applied to
the Development of Human Cultures

10:30 Coffee Break

11:00 Ludovico GALLEN: Moving Towards Humankind?

11:45 David S. WILSON: Some Philosophical Considerations on
Human Emergence and En-Culturation

12:30 Discussion

13:30 End of the Session

Sixth Session:

Philosophical Aspects of Evolution I

15:00 Jürgen MITTELSTRASS: Evolution and the Conditio
Humana: A Philosophical Introduction

15:45 Dominique LAMBERT: Between Analogy and Prediction.
Some Epistemological Questions Concerning the Use of
Mathematics in Evolution Theory

16:30 Coffee Break

17:00 Elliott SOBER: Evolution and Naturalism

17:45 Vittorio HÖSLE: Why Teleological Principles are
Inevitable for Reason

18:30 Discussion 19:00 End of the Session

ABSTRACTS OF THE LECTURES

LECTURE XVII - Abstract

The Human Lineage: A Macro-Evolutionary Process Acting During Embryogeny with Emergent Macro-Evolutionary Implications

Anne Dambricourt-Malassé

The morphological transformations that mark the major stages of the human phylogeny among the primates, may be seen as successions of embryonic patterns, structurally stable during long geological periods, the transition being that of discrete changes, i.e. punctuated equilibria. Not only macro-evolutionary processes underlay human origins, but also, the iteration of morphogenetic changes such as the sphenoidal rotation at the cephalic pole of the embryonic axis, reminding the irreversible and deterministic chaotic processes (non-linear dynamics, selforganized criticality, strange attractors). This replicable evolutionary trajectories of embryonic morphogenesis (neural tube rolling up generating the sphenoidal flexion, homeotic genes acting along the cerebro-spinal axis), supposes the existence of conservative regulatory mechanisms when the system was traversed by a flow of stochastic or dissipative genetic informations (source of numerous spontaneous abortions, fetal teratology and post-natal abnormalities). The emergence of hominids (i.e. permanent bipedalism) c.a. 5 millions years, depends on favourable environmental factors (water at least for long pregnancy, feeding), but the natural mechanism is that of discrete and neguentropic macro-evolutionary process, characterized by epigenetic effects of increasing complexity, canalized on the psychomotor control of postural balance. This neural and vascular growing complexity has allowed the development of different reflexive consciousnesses emerging in neo-cortical territories (different hominids species). At present time, in their cells, human beings are a stage of an irreversible macro-evolutionary process.



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This was the case for any species of great apes between 18 millions and 5 millions years ago, but devoided of a singularity which now characterizes *Homo sapiens* in front of the fragility of any form of life, the sense of freedom and responsibility. In the era of Quantum Mechanics which underlies any macroscopic dynamic process, itself printed by the first instant of the proto-universe, it does not seem any more possible to support a nihilistic assertion of the origins without taking into account its major implications. Either the sense of the values is a pure utopia, and the notion of crime against humanity is a total illusion, either the illusion concerns certain scales of time and space of the evolution devoid of sense.

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ABSTRACTS OF THE LECTURES

LECTURE XVIII - Abstract

The Concept of Evolution as Applied to the Development of Human Cultures

Colin Renfrew

The emergence and development of our species, *Homo sapiens*, can certainly be encompassed within the framework of Darwinian evolution. Nor is it argued that there is anything in the development of human cultures and societies which runs counter to Darwinian principles. But the ‘human revolution’, commonly taken to refer to that emergence, took place some 200,000 years ago in Africa. The ‘sedentary revolution’, accompanied by the development of agriculture which followed some 10,000 years ago, and then the rise of urban communities which succeeded it in some regions, do not seem much clarified by the application of such principles. Attempts to propose ‘evolutionary’ mechanisms for human culture change, comparable perhaps to the genes which underlie explanations of biological development (such as ‘memes’ or ‘cultural viruses’) have not been successful. It has sometimes been proposed that the diversity of human cultures which developed could be compared with the geographical distribution of sub-species within a biological species, but the parallels are difficult to sustain.

The paper seeks to analyse further some of the difficulties arising when an attempt is made to employ Darwinian principles in the explanation of culture change. A similar set of problems arises when the focus is upon languages and the explanation of linguistic diversity.

ABSTRACTS OF THE LECTURES

LECTURE XIX - Abstract

Moving Towards Humankind?

Ludovico Galleni

In April 1955 Pierre Teilhard de Chardin died. He is very well known for his synthesis in Science and Faith and for the theological and philosophical consequences of his papers.

He was a scientist, one of the most outstanding paleontologists of the XX century, one of forerunner of many contemporary topics in evolutionary biology. He considered biology as the science of the complexity of living and the Biosphere as the complex object to be studied in order to fully understand the mechanisms of evolution.

These new perspectives in evolutionary biology started from a philosophical necessity: that of finding a peculiar place of humankind in nature.

Was the thinking creature the casual result of stochastic mechanisms or the final result of describable natural laws? These laws gave as a result the *moving towards* complexity and consciousness.

In a book published in 1871, "*The genesis of species*" the English zoologist St. George Jackson Mivart proposed mechanisms of evolution based on deterministic laws similar to those of chemistry. This was a clear alternative to the mechanisms proposed by Darwin and related to the casual encounter between the origin of the variability and the diffusion of variants thanks to natural selection.

Among the proofs described by Mivart there are those related to parallelisms in evolution.

The search for parallelisms was also one of the main scientific topics developed by Teilhard de Chardin and by the Russian genetist Vavilov.



ABSTRACTS OF THE LECTURES



Parallelisms were the experimental proof of evolution as a *moving towards* and in Teilhard de Chardin also of the complexity and consciousness law.

Teilhard de Chardin and biological complexity: changing the scale of investigation also the mechanisms must change : what is good for a local population is not valid for larger space and times: continental evolution is a topic to be investigated side by side with the population level. The present day discussion about evolution of Mammals at the continental level is a good example of the validity of Teilhard proposal. His last issue is the science of the Biosphere investigated by a new science: Geobiology. The laws of Biosphere are the very motors of evolutions when Biosphere is considered a complex system evolving.

Here are coming out all the potentiality of Teilhard work: the Biosphere as a complex system. This proposal recovers the system theory in biology in parallel with Waddington.

The development of this proposal is given by the mechanisms described by Lovelock and related to the maintenance of stability. These mechanisms could generate a top down causation conditioning evolution of livings and giving reason of the *moving toward* complexity.

Other aspects of complexity such as threshold effects and the presence of the so called deterministic chaos could be related to the *moving towards*.

These groups of perspectives are a good way to find a solution between deterministic and stochastic models, and a good tool to show that there is *moving towards* in spite of non strictly determinist mechanisms.

The final discussion is about the philosophical implications of this model. The evolution of the universe and life are not based on strictly deterministic laws not leaving any room for the free action of the thinking creature. Neither they are based only on stochastic mechanisms. *The moving towards* is based on mechanisms of complexity where the thinking creature will find the best conditions for his/her free acting.

Third Day of the Conference
Thursday 5 March 2009

ABSTRACTS OF THE LECTURES

LECTURE XX - Abstract

Some Philosophical Considerations on Human Emergence and En-Culturation

David S. Wilson

The concept of a group as like an organism has a long history in philosophical, theological, intellectual and scientific thought. It was largely rejected during the second half of the 20th century by various forms of individualism, but it is now strongly supported by evolutionary theory. The organisms of today are literally the social groups of past ages. Social insect colonies qualify as superorganisms, complete with a group mind. I will review how the superorganism concept is justified by modern evolutionary theory and how human groups qualify as superorganisms, at least when appropriate conditions are met.

Third Day of the Conference
Thursday 5 March 2009

ABSTRACTS OF THE LECTURES

LECTURE XXI - Abstract

Evolution and the Conditio Humana: A Philosophical Introduction

Jürgen Mittelstrass

Today developments in biological and medical knowledge place Man in the unique position of being able to change not only nature in a general sense, but also his own nature, namely to intervene ever more powerfully not only in evolution in general but even in his own. And he is on the brink of changing the measures with which he previously described and regulated his situation, that is to say, the human condition. In fact, the *conditio humana* is changing: in the sense that now even Man's biological foundations are at his disposal. This creates a completely new and momentous situation in the domain of anthropology as well as in the domain of ethics.

While we must accustom ourselves to the fact that this disposal of Man over himself will increase, driven as it is by scientific and technical development, we must at the same time preserve, in opposition to this development, those indispensable things which are experienced in love and in happiness, in sickness and in death, and in which, despite the threat of the triumph of *homo faber* over *homo sapiens*, an essential part of our humanity is contained. This will be explained in some detail, using the distinction between natural artificiality and artificial naturalness in describing Man's nature or essence.

Third Day of the Conference
Thursday 5 March 2009

ABSTRACTS OF THE LECTURES

LECTURE XXII - Abstract

Between Analogy and Prediction. Some Epistemological Questions Concerning the Use of Mathematics in Evolution Theory

Dominique Lambert

Mathematics happens to be very useful now in many areas of biology and in particular in Evolution Theory. But this fact leads immediately to the following questions. Could mathematical theories provide us a real and deep explanation of biological phenomena and in particular of major evolution thresholds? With respect to the prediction ability does mathematics play the same role in Biology and in Physics? With these questions we are facing some important epistemological problems. Starting with a study of the notion of explanation in Biology and focusing on some particular example, such as the description of plasticity, we will show that mathematics can be “unreasonably effective” in Evolution Theory. Nevertheless we will also explain that mathematical models can trap the thought in some formal analogies and generalizations and this can lead us to inaccurate interpretations of biological phenomena and evolution in the framework of a Philosophy of Nature.

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Thursday 5 March 2009

ABSTRACTS OF THE LECTURES

LECTURE XXIII - Abstract

Evolution and Naturalism

Elliott Sober

Discussions of the relationship of the theory of evolution to the question of whether God exists often distinguish metaphysical naturalism from methodological naturalism. The former holds that the only things that exist are things inside of nature; the latter holds that scientific theories should postulate only things that exist inside of nature. The idea that evolutionary theory is committed only to methodological naturalism means that evolutionary theory is silent on the question of whether supernatural entities exist. In my lecture, I will discuss both sorts of naturalism, focusing on (i) how evolutionists understand the idea that mutations are "unguided", and (ii) the use of mathematics in evolutionary theory.

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Thursday 5 March 2009

ABSTRACTS OF THE LECTURES

LECTURE XXIV - Abstract

Why Teleological Principles Are Inevitable For Reason

Vittorio Hösle

No reasonable person can deny that Darwin's and Wallace's discovery of the principle of natural selection is one of the most important events in the history of science and that it has further discredited the traditional form of the argument from design, which had already been criticized by Hume and Kant. However, from Kant's "Critique of Judgment" one can learn why it is not easy to get rid of teleological representations. I will discuss four forms of it: a.) the simplicity of natural laws and their intelligibility, b.) the teleonomy of organisms, c.) the peculiar position of humans as beings that have both cognitive and moral purposes, d.) the anthropic principle, i.e. the assumption that nature had to bring forth beings able to understand it.

Fourth Day of the Conference
Friday 6 March 2009

LECTURES SCHEDULE

Seventh Session:

Philosophical Aspects of Evolution II

09:00 Card. Georges COTTIER: Metaphysical Sense of Creation
and Evolution

09:45 David J. DEPEW: Accident, Adaptation, and Teleology in
Aristotle and Darwinism

10:30 Coffee Break

11:00 Massimo STANZIONE: The Recurrent Debate: Darwinism
and Philosophy

11:45 Ronald NUMBERS: Antievolution in America: From
Creation Science to Intelligent Design

12:30 Discussion

13:00 End of the Session

Eighth Session:

Theological Aspects of Evolution I

15:00 André WÉNIN: The Theme of Creation in the Old
Testament

15:45 Jean-Michel MALDAMÉ: Les Divers Sens du Mot
Evolution: Science, Philosophie et Théologie

16:30 Coffee Break

17:00 Jacques ARNAULD: Creationism, “Intelligent Design” and
Evolution

18:30 Discussion

19:00 End of the Session

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ABSTRACTS OF THE LECTURES

LECTURE XXV – Abstract

Metaphysical Sense of Creation and Evolution

Card. Georges Cottier

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ABSTRACTS OF THE LECTURES

LECTURE XXVI – Abstract

Accident, Adaptation, and Teleology in Aristotle and Darwinism

David J. Depew

It is sometimes said that Darwin reintroduced an Empedoclean account of organic origins into biology. It is true that Empedocles posited accidentally compounded and conjoined body parts that coalesce into organisms. Some of these conjunctions perpetuate themselves, he asserted, because they are stable in their environments. Those failing to meet this test, he continued, “perish and continue to perish” by a selection process. I argue, however, that the analogy between Darwinian natural selection and Empedocles’s appeal to “incidental (*kata symbebekos, per accidens*)” final causality, as his critic Aristotle calls it, is mistaken. My argument also shows that in spite of considerable differences on the issue of whether descent from a common ancestor is possible—for Aristotle it is not--there is a strong analogy between Aristotle, our first great biological theorist, and Darwin on the subject of adaptation. This affinity explains why Asa Gray, Darwin’s American correspondent and early interpreter, was right to say that Darwin was a teleologist and why Darwin was right to agree with him.

ABSTRACTS OF THE LECTURES

LECTURE XXVII – Abstract

The Recurrent Debate: Darwinism and Philosophy

Massimo Stanzione

“My theory would give zest to recent and fossil comparative anatomy; it would lead to the study of instinct, heredity, and mind-heredity, whole (of) metaphysics” (*Life and Letters of Charles Darwin*, vol. I, p. 8).

There are four main points in which Darwin’s investigations possess philosophical importance.

- 1) Darwin’s energetic renewal of the old idea of evolution had his chief importance in strengthening the conviction of this real continuity in the world, of continuity in the series of form and events. Together with the recently discovered law of the conservation of energy, it helped to produce the great realistic movement which characterizes the last third of the XIX Century.
- 2) Struggle for life and natural selection are principles which have been applied, more or less, in every department of thought. The philosophical importance of these ideas does not stand or fall with the answer to the question, whether natural selection is a sufficient explanation of the origin of species or not: it has an independent positive value.
- 3) Human thought itself is, then, a variation (or a mutation) which has been able to persist and to survive. Is not, then, the problem of knowledge solved by the evolution hypothesis? Many authors gave an affirmative answer to this question before and after the appearance of the *Origin of Species*.
- 4) To many people the Darwinian theory of natural selection seemed to change the whole conception of life, and particularly all the conditions on which the validity of ethical ideas depends. Darwinism, it was said, has proclaimed brutality. On the contrary, Darwin has, indeed, rendered a great service to ethics in making the difference between the life of nature and the ethical life appear in a strong light.



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These points were already clearly stated a century ago by Hoffding. Today they are to be reconsidered in the frame of the recurrent debate about the Darwinian foundations of the scientific naturalism.

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ABSTRACTS OF THE LECTURES

LECTURE XXVIII – Abstract

Antievolution in America: From Creation Science to Intelligent Design

Ronald Numbers

Despite Charles Darwin's announced effort to overthrow "the dogma of separate creations," organized opposition to his revolution did not appear until the early 1920s. Even then, the Christian fundamentalists associated with William Jennings Bryan's crusade to eradicate Darwinism from the schools and churches of America readily accepted the paleontological evidence for the antiquity of life on earth. It was not the coming of "scientific creationism" in the 1960s and 1970s that large numbers of antievolutionists began insisting on the recent appearance of life and assigning most of the geological column to the year of Noah's flood. During the past fifteen years or so a new, nonbiblical, form of opposition to evolution has arisen under the banner of "intelligent design," which seeks to "reclaim science in the name of God" and to change the very rules governing the practice of science.

ABSTRACTS OF THE LECTURES

LECTURE XXXI – Abstract

Creationism, “Intelligent Design” and Evolution

Jacques Arnould

For Charles Darwin, the creationists were initially the partisans of the fixity of species. Is this idea of a theologically founded reason to refuse the idea of evolution? Dalmace Leroy thought said no. Nevertheless, from its philosophical origin, fixism has theological stakes which have all their actuality. Since Darwin, creationist movements have evolved; the current form of the intelligent design presents another type of interest in regard of theology ; ID invites theologians to re-examine the place granted to natural theology, and to analyze the temptations of the « God-of-the-gaps ». If the various forms of creationism invite today to a serious and critical theological reflection on creation, on the one hand, and on the relationship between science and faith, on the other hand, theology must take with serious the current data of science, in the spirit of the speech of the pope Jean-Paul II to the Pontifical Academy of Sciences, in October 1996.

Pour Charles Darwin, les créationnistes étaient d’abord les partisans de la fixité des espèces. Est-ce là un motif théologiquement fondé pour refuser l’idée d’évolution ? Dalmace Leroy pensait que non. Pour autant, d’origine philosophique, le fixisme n’est pas dénué d’enjeux théologiques qui ont toute leur actualité. Depuis Darwin, les mouvements créationnistes ont évolué ; la forme actuelle de l’intelligent design présente un autre type d’intérêt pour la théologie, en invitant à revoir la place accordée à la théologie naturelle ou encore à analyser les tentations d’un Dieu bouche-trous. Si les diverses formes de créationnisme invitent aujourd’hui à une réflexion théologique sérieuse et critique sur la création, d’une part, et sur le rapport entre science et foi, d’autre part, la théologie doit prendre au sérieux les données actuelles de la science, dans l’esprit du discours du pape Jean-Paul II devant l’Académie pontificale des sciences, en octobre 1996.

Fifth and Last Day of the Conference
Saturday 7 March 2009

LECTURE SCHEDULE

Ninth Session:

Theological Aspects of Evolution II

09:00 William R. STOEGER: Emergence, Directionality and
Finality in an Evolutionary Universe

09:45 Rafael MARTÍNEZ: The Reception of Evolutionary
Theories in the Church

10:30 Coffee Break

11:00 Robert J. RUSSELL: Assessing the Theological Debates
Around Evolution

11:45 End of the Conference

*Fifth and Last Day of the Conference
Saturday 7 March 2009*

ABSTRACTS OF THE LECTURES

LECTURE XXXIII – Abstract

Emergence, Directionality and Finality in an Evolutionary Universe

William R. Stoeger

Natural selection and symbiogenesis arose as essential processes only in the richly ordered, dynamic and complex environment which developed over 9 billion years since the Big Bang until the formation of the Earth, and at least 500 million years since the formation of the earth until the advent of life. During these epochs of cosmic and chemical evolution – and later with biological evolution – networks of systems and organisms emerged, possessing properties and capabilities far beyond those of their more primitive ancestors. Along with the emergence of such complexity was the emergence, too, of both broad and more focused directionalities and finalities in nature. Here we shall explore the origin and scope of these “teleological” tendencies, finding them to be essential features – “outcomes”- of the relationships that develop within and among emergent systems. They are essential aspects of the specific behaviors such systems exhibit. Finally, we shall consider the scientific evidence – or lack of scientific evidence – for an overarching cosmic teleology. From a strictly scientific perspective, that can neither be supported nor denied. From a philosophical point of view, it can be strongly, but not incontrovertibly, argued.

ABSTRACTS OF THE LECTURES

LECTURE XXXIV – Abstract

The Reception of Evolutionary Theories in the Church

Rafael Martínez

Interaction between scientific theories and the cultural or religious community is often presented according two radically different views: the *conflict* image, made popular in the late nineteenth century by W. Draper and A. D. White, and the *harmony* view, sometimes presented with apologetic intention. Both interpretations appear in some way reductionist, and requiring a further examination of the historical, epistemological and cultural context of the encounter between science and faith. The reception of a new scientific theory is always a complex phenomenon. Conflicts are usually caused by many different factors, and they could appear different when considering the attitudes of single scientists or thinkers, believers or not, or those of different groups and communities, such as academic scientific or theological communities, intellectual milieu, press, pastors, local or universal authorities.

The reception of evolutionary theories in the Catholic Church during the last decades of nineteenth century clearly shows that complexity. Recent declarations of the last Popes have asserted the full accordance of Catholic doctrine and evolutionary biology, although discordant opinions have been sometimes expressed within the Church. During twentieth century, Catholic theology has also gradually accepted that compatibility. However, during the last part of nineteenth century, the reaction of Catholic theologians, intellectuals and pastors to the Darwinian theory was generally negative. In some cases it declared opposition, and gave origin to some local conflicts.

The attitude that Vatican authorities keep regarding evolution in that period, has been generally poorly known. Although no explicit condemn of evolution was issued, theology handbooks spread the idea that the Holy See opposed itself to evolutionary theories. The actual circumstances were not clearly known.



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Only after the opening of the Archives of the Congregation for the Doctrine of the Faith, in 1998, it has been possible to reconstruct the actions of Vatican authorities against evolutionary authors, on the ground of the documents conserved on the Archives of the Index and the Holy Office, trying to better understand the interaction between the new scientific proposal of Darwinian theories, and the different philosophical, theological and ecclesiastical positions of that period.

Evolution could have become “another Galileo case.” Fortunately, the attempts made to condemn evolution, did not succeed, although the common attitude regarding those who propose a *Christian evolution* were sometimes harsh. Examining in detail the process would it be possible to gain a more precise insight on the meaning of Catholic attitude about evolution. It could also throw some light on religious-based objections that today are sometimes presented against evolution.

Fifth and Last Day of the Conference
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ABSTRACTS OF THE LECTURES

LECTURE XXXV – Abstract

Assessing the Theological Debates around Evolution

Robert J. Russell

In this lecture I will summarize and assess some of the recent theological debates around evolution. I will then offer a constructive theological interpretation of evolution that includes theologies of creation and redemption and draws on the writings of Karl Rahner, Celia Deane-Drummond, Denis Edwards, Jurgen Moltmann, Ted Peters and Martinez Hewlett, and Joseph Zycinski.