Biographies of Participants and their Abstracts

John Hedley Brooke held the Andreas Idreos Professorship of Science & Religion at Oxford University (1999-2006), where he was also Director of the Ian Ramsey Centre and a Fellow of HarrisManchester College. In 2007 he was appointed Distinguished Fellow at the Institute of Advanced Studies at the University of Durham. He is also Honorary Professor of the History of Science at Lancaster University.He has been Director of the European Science Foundation´s network on science and human values, President of the British Society for the History of Science, President of the Historical Section of the British ScienceAssociation and of the UK Forum for Science & Religion. He is currently President of the International Society for Science & Religion. His main books include *Science and Religion: Some Historical Perspectives* and(with Geoffrey Cantor) *Reconstructing Nature: The Engagement of Science & Religion*.

"'God knows what the public will think': Darwin and the Religious Response to the *Origin of Species*""

Much has been written about the religious reactions to Darwinian evolution. It is well known that Darwin compounded problems faced by the Christian Churches by promulgating a view of human evolution that challenged a literal reading of Genesis, a sacrosanct view of human uniqueness, the affirmation of design in nature and the attribution of beneficence to the deity. These familiar problems when coupled with contemporary manifestations of an ongoing conflict between Darwin´s science and conservative religious positions can obscure the many attempts at mediation. In this lecture I shall examine some of the more interesting attempts to achieve rapprochement, drawing on such figures as Asa Gray, T.H. Huxley, William James and Theodosius Dobzhansky. Despite unprecedented polarisation, there are reasons why religious beliefs and practices are likely to survive in a Darwinian universe.

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Janet Browne is Aramont professor of the History of Science at Harvard University. In 2002 she completed a two-volume biography of Charles Darwin. She is currently working on a cultural history of the gorilla.

"Looking at Darwin: Making a Celebrity through Portraits and Images"

With increased attention on the visual in the history of science, there is renewed interest in the role of portraiture and other forms of personal imagery in constructing scientific reputation and the circulation of scientific ideas. This talk will discuss selected portraits of Charles Darwin paying particular attention to their circulation and highlighting shifts in usage with the rise of mechanically (and now electronically) reproduced media. Historicizing the variety of opportunities that people have had of “looking” at Darwin adds to our understanding of his scientific fame.

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Richard W. Burkhardt, Jr. is Professor of History Emeritus at the University of Illinois at Urbana-Champaign. His publications on the history of biology include *The Spirit of System: Lamarck and Evolutionary Biology* (Harvard University Press, 1977, 1995) and *Patterns of Behavior: Konrad Lorenz, Niko Tinbergen, and the Founding of Ethology* (University of Chicago Press, 2005) and numerous papers. He is presently writing a book on the founding and development of the first public zoo of the modern era, the menagerie of the Muséum d'Histoire Naturelle in Paris.

"Animal Behavior in Evolutionary Perspective: Two Centuries of Inquiry"

Making sense of animal behavior in an evolutionary context did not begin with Charles Darwin. 1809, the year of Darwin's birth, was also the date of publication of J.-B. Lamarck's *Philosophie Zoologique*, the most famous evolutionary treatise prior to Darwin's *Origin of Species*. There and elsewhere Lamarck represented behavior as both a product and an agent of evolutionary change. However, Lamarck was not a student of animal behavior himself, and uniting behavioral studies with evolutionary theory proved to be far from straightforward. Despite Darwin's own significant contributions to the area, questions of how to study the behavior of living animals and how to understand behavior in evolutionary terms remained in flux at the end of the nineteenth century. With special attention to the founders of evolutionary theory in the 19th century and the architects of ethology and their successors in the areas of sociobiology and behavioral ecology in the 20th century, this paper explores the interplay of theory and practice in evolutionary studies of animal behavior over a period of two centuries.

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Frederick M. Cohan studies the evolutionary genetics of speciation and adaptation. Under the mentorship of Richard Lewontin and Timothy Prout, he began his career by using *Drosophila* to study the forces of cohesion within animal species. As he grew weary of changing flies, he seized an opportunity to reinvent himself as an evolutionary bacteriologist, with the guidance of Conrad Istock, John Spizizen, and Richard Michod. While he first saw bacteria as a convenient system for studying very general questions about evolution that one might rather study in elephants (if one could), he has grown to see bacteria as very cool creatures in their own right. He is intrigued by what is the same and different about species and speciation across all walks of life, and has investigated how the unique combination of enormous population size and rare but promiscuous genetic exchange in bacteria affect bacterial speciation and diversity. He is a professor of biology at Wesleyan University.

"The Origin of Bacterial Species"

Darwin's *Origin of Species* has been criticized by Mayr and other neodarwinians for failing to solve the problem of its title. Indeed, Darwin did not appreciate the cohesive forces that bind populations within a species, and that the challenge of speciation is breaking the cohesive binding between populations. In the neodarwinian model of speciation, the irreversible splitting of lineages into species (cladogenesis) requires unusual circumstances and occurs far less

frequently than adaptive changes within a species lineage (anagenesis). Recently, the speciation-is-easy hypothesis of Mallet has challenged this neodarwinian view, suggesting that ordinary, neighboring populations within ordinary species are poised to begin speciation.

While the speciation-is-easy hypothesis is contentious for animal and plant speciation, it appears less controversial for the case of bacteria. Whole-genome sequencing allows us to test whether a single species identified by multilocus analysis actually contains multiple, newly-divergent species. Most importantly, a phylogenetic analysis of whole genomes allows a test of whether speciation and extinction proceed too quickly for species to be subjected to cohesive forces. Recent whole-genome data support a model of rapid formation of species that are subject to only very limited cohesion. This raises the possibility that there are two kinds of bacteria—those in longstanding, neo-Mayrian species that have been subjected to multiple events of cohesion, and those that are not members of any cohesive species.

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Pietro Corsi is Professor of the History of Science at the University of Oxford. He has published on the history of the life and the earth sciences during the nineteenth century, with particular reference to the history of evolutionary ideas and their relationship with contemporary political, philosophical and theological debates. He is the author of the website http://www.lamarck.cnrs.fr making available the complete theoretical works, manuscripts and the herbarium of Jean-Baptiste Lamarck.

"Darwin's Place in History"

The scholarship published over the last thirty years has completely changed our views of the personal and intellectual trajectory of Charles Darwin. Yet, the (perhaps inevitable) concentration on Darwin and the United Kingdom has often favoured anachronistic and parochial readings of the state of affairs in the life sciences of the nineteenth century at Continental level. A growing number of exceptions, dealing with Germany and selected features of the pre-Darwinian debate on species in England, have done little to convince commentators more active than usual in this centenary year that much work needs still to be done in order to appreciate the scientific and social context for the proliferation of evolutionary models throughout the nineteenth century and Darwin's place in history.

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Jerry Coyne is a professor in the Department of Ecology and Evolution at The University of Chicago, where he works on evolutionary genetics and the origin of species, using fruit flies as a model. He is the co-author (along with H. Allen Orr) of one book (*Speciation*) intended for evolutionary biologists, and another (*Why Evolution is True*) aimed at the general public.

"Speciation: Problems and Prospects"

In 2004, Allen Orr and I summarized the history of work on speciation and what it told us about nature. The ensuing five years has seen a flurry of work on the topic, encompassing molecular biology, natural history, genetic analysis, and even philosophy. This talk updates what I see as the important -- and tractable -- questions about speciation.

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Daniel C. Dennett is University Professor and Austin B. Fletcher Professor of Philosophy, and Co-Director of the Center for Cognitive Studies at Tufts University. His first book, *Content and Consciousness*, appeared in 1969, followed by *Brainstorms* (1978), *Elbow Room* (1984), *The Intentional Stance* (1987), *Consciousness Explained* (1991), *Darwin's Dangerous Idea* (1995), *Kinds of Minds* (1996), *Brainchildren* (1998). *Freedom Evolves* (2003), *Sweet Dreams: Philosophical Obstacles to a Science of Consciousness* (2005) and*Breaking the Spell* (2006). He co-edited *The Mind's I* with Douglas Hofstadter in 1981. He is the author of over three hundred scholarly articles on various aspects on the mind, published in journals ranging from *Artificial Intelligence* and *Behavioral and Brain Sciences* to *Poetics Today* and the *Journal of Aesthetics and Art Criticism*.

"Darwin's 'Strange Inversion of Reasoning': Confronting the Counterintuitive"

Darwin's theory of evolution by natural selection unifies the world of physics with the world of meaning and purpose by proposing a deeply counterintuitive ''inversion of reasoning'' (according to a 19th century critic): ''to make a perfect and beautiful machine, it is not requisite to know how to make it'' [MacKenzie RB (1868) (Nisbet & Co., London)]. Turing proposed a similar inversion: to be a perfect and beautiful computing machine, it is not requisite to know what arithmetic is. Together, these ideas help to explain how we human intelligences came to be able to discern the reasons for all of the adaptations of life, including our own. But the idea of competence without comprehension, which is at the heart of both Darwin's and Turing's insights, remains a troubling, even offensive, idea to many people.

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Douglas J. Futuyma (Ph. D. University of Michigan, 1969) is a Distinguished Professor of Ecology and Evolution at Stony Brook University. His research concerns speciation and the evolution of interactions between species. He is the author of the textbooks *Evolutionary Biology* and *Evolution* and of *Science on Trial: The Case for Evolution.* He is the editor of *Annual Review of Ecology, Evolution and Systematics*, and has been the editor of *Evolution*. He has been a Guggenheim fellow and a Fulbright senior scholar, and president of the Society for the Study of Evolution, the American Society of Naturalists, and the American Institute of Biological Sciences. He was elected to the American Academy of Arts and Sciences in 1996 and the U. S. National Academy of Sciences in 2006. He is an avid naturalist.

"Evolutionary Constraint and Ecological Consequences"

One of the most important shifts in evolutionary biology in the last 50 years is an increased recognition of sluggish evolution and failures to adapt, which seem paradoxical in view of abundant genetic variation and many instances of rapid local adaptation. I review hypotheses of evolutionary constraint (or restraint), and suggest that while constraints on individual characters or character complexes may often reside in the structure or paucity of genetic variation, organism-wide stasis, as described by paleontologists, might better be explained by a hypothesis of Ephemeral Divergence, according to which the spatial or temporal divergence of populations is often short-lived because of interbreeding with nondivergent populations. Among the many consequences of acknowledging evolutionary constraints, community ecology is being transformed as it takes into account phylogenetic niche conservatism and the strong imprint of deep history.

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Peter and Rosemary Grant have been studying Darwin's finches on the Galápagos islands since 1973. Their fieldwork is designed to understand the causes of an adaptive radiation. It combines analyses of archipelago-wide patterns of evolution with detailed investigations of population level processes on two islands, Genovesa and Daphne. Their work is a blend of ecology, behavior and genetics. They have collaborated with investigators to estimate phylogenetic relations among the species of finches and their relatives on the continent and in the Caribbean, and to identify the molecular mechanisms involved in the development of beaks that vary so conspicuously among the species. Their earlier work has been published in two books. A third book, entitled *How and Why Species Multiply*, was published by Princeton University Press in 2008. Rosemary was initially trained at the University of Edinburgh, received a PhD degree from Uppsala University, and was a Research scholar and lecturer with the rank of Professor in the Department of Ecology and Evolutionary Biology at Princeton University until she retired from teaching in 2008. Peter is the Class of 1877 Professor Emeritus in the same Department, having trained at Cambridge University and the University of British Columbia. Before joining Princeton in 1986 he taught at McGill University and the University of Michigan.

"Evolution of Darwin's Finches"

This year is the 150th anniversary of the *Origin of Species* in which Darwin established the scientific basis for understanding how evolution occurs by natural selection. Darwin was less clear about the actual process of species formation. Nevertheless he envisioned a three-step process: colonization, involving the expansion of a population into a new environment; divergence, when populations become adapted to novel environmental conditions through natural selection; and finally, the formation of a barrier to interbreeding between divergent lineages. He showed characteristic insight by suggesting that investigations of what we now call, "very young adaptive radiations" might provide windows through which we can view the processes involved. Since Darwin's time insights from the fields of genetics, behavior and ecology have continued to illuminate how and why species evolve. In this talk we will discuss

the progress that has been made in our understanding of speciation with special reference to the young radiation of Darwin's Finches.

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Marc Hauser obtained his BS from Bucknell University and his Ph.D. from UCLA. The author of six single- and multi-authored books and over 200 articles, he is a Harvard College Professor in the Departments of Psychology, Human Evolutionary Biology, and Organismic & Evolutionary Biology, Director of the Mind, Brain & Behavior Program and the Cognitive Evolution Lab. He was the recipient of an NSF Young Investigator Award, a Guggenheim Fellowship, and a Science Medal from the College de France, and was voted one of Harvard's most popular professors by the seniors of several graduating classes. In addition to his academic work, he frequently writes for the public, and appears on public radio and television stations.

"Where do Morals Come From? NOT Religion!"

A long standing tradition views religion as the source of our moral understanding. In the absence of religious guidance, so the story goes, we lack a moral rudder. And without a moral rudder, well, just about anything goes, and thus, so goes society. This view faces obvious conceptual problems, starting from all the immoral behavior carried out in the name of religion, to truly virtuous behavior carried out by atheists. I leave this debate to philosophy, and turn here to the tradition that starts with Darwin, and looks to our biology for an account of our moral intuitions, including why they evolved and the neurobiological mechanisms that both create and constrain our moral psychology. I present the results of cross-cultural data showing that independently of religious background, education, or sex, individuals deliver moral judgments based on a core set of principles, what I refer to as a universal moral grammar. I then show how discoveries in the neuroscience, including studies of clinical populations (e.g., psychopaths) and normal subjects with brain areas deactivated (e.g., transcranial magnetic stimulation), reveal key design features of our moral faculty, a system that evolved to balance fitness-relevant outcomes with details of an agent's intentions and beliefs.

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Hopi Hoekstra is the John L. Loeb Associate Professor in the Department of Organismic and Evolutionary Biology and the Curator of Mammals in the Museum of Comparative Zoology at Harvard University. She has received numerous honors including the Ernst Mayr Award, the American Society of Naturalists Young Investigator Prize and a Beckman Young Investigator Award. Her research has primarily focused on deer mice as a model to understand the molecular and genetic basis of adaptation. To this end, she employs a variety of approaches -- from ecological experiments in the field to molecular and developmental genetics in the laboratory -- to unravel the evolution of diversity.

"What Darwin Did and Didn't Know: the Ultimate and Proximate Causes of Evolutionary Change"

Darwin's theory of evolution by natural selection was especially remarkable because he was, at the time, without any knowledge of genetics. Since Darwin, the discovery of chromosomes and later DNA has provided that missing mechanism of inheritance. More recently, we have been able to take advantage of molecular genetic, and now genomic, tools to provide yet another layer of evidence to instantiate Darwin's theory. That is, we can identify the precise DNA base-pair changes, which are the targets of natural selection that give rise to the great diversity we observe on earth. In this context, I will present some of the latest results -- from both the laboratory and the field -- on the ultimate (time, strength and agents of selection) and proximate (molecular, genetic and developmental mechanisms) causes of evolutionary change and summarize what Darwin did and didn't know about adaptation.

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David Jablonski received his B.A. from Columbia University and his PhD from Yale. He has published 140 papers and book chapters on macroevolution and evolutionary paleobiology, and co-edited three books. He has been a John Simon Guggenheim Memorial Fellow, and is a Fellow of the American Academy of Arts and Sciences. He is a member of the Senior Advisory Board of the National Evolutionary Synthesis Center and for six years was Chair of the University of Chicago's Committee on Evolutionary Biology.

"Paleontology and evolutionary biology: the revitalized partnership"

Darwin's gradualism required that the fossil record's imperfections be emphasized in the *Origin*, but paleontological data are robust for many questions, and can provide crucial insights into many large-scale evolutionary questions. Enlarged temporal and spatial scales reveal evolutionary patterns and processes that are virtually inaccessible to, and unpredictable from, short-term, localized observations. These larger-scale phenomena range from evolutionary stasis at the species level and the mosaic assembly of complex morphologies in ancestral forms to the non-random temporal and spatial distribution of the origin of major evolutionary novelties and clades. Extinction, particularly clade-specific extinction, is the Achilles' heel of many neontological approaches to reconstructing evolutionary processes, from diversity-dependence of evolutionary dynamics to the assembly and consequences of key innovations. Paleontological data both fill these gaps and drive novel research programs on evolutionary processes across scales and hierarchical levels, and the increasing interchange between paleontology and evolutionary biology promises to illuminate many issues neither field could address adequately on its own.

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David Kingsley studied somatic cell genetics with Monty Krieger at M.I.T (Ph.D. 1986), and classical mouse genetics as a postdoc with Drs. Neal Copeland and Nancy Jenkins at NCI-Frederick. He moved to Stanford in 1991, where he is now Professor of Developmental Biology and an Investigator of the Howard Hughes Medical Institute. Dr. Kingsley's laboratory has

pioneered the development of molecular tools for threespine stickleback fish, making it possible to identify the molecular basis of evolutionary change in recently evolved vertebrate species.

"Fishing for the Secrets of Vertebrate Evolution"

When Darwin wrote *The Origin of Species* in 1859, the principles of heredity were not understood, and the actual origin of interesting variants remained a mystery. Genetic and genomic studies are now making it possible to identify the detailed molecular basis of major morphological differences between naturally occurring species. We have been using crosses between marine and freshwater sticklebacks to map the number and location of chromosome regions controlling dramatic morphological and physiological changes that have evolved in many different postglacial lakes and rivers throughout the northern hemisphere. Detailed positional cloning and transgenic studies show that several major skeletal and pigmentation differences have arisen through regulatory changes in genes encoding key developmental signaling molecules and transcription factors. Interestingly, the same genes tend to be used repeatedly when similar traits have evolved in many different populations. The lessons learned from initial studies of a few traits have identified molecular signatures that can now be used to identify many other genomic regions that also contribute to evolutionary change. Further study of recently evolved populations may help elucidate general rules about the genetic basis of new traits in nature, with wide implications for understanding of many different species, including humans.

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Joel Kingsolver is William Rand Kenan, Jr. Professor in the Department of Biology at the University of North Carolina, Chapel Hill. His research combines physiology, ecology and evolution to understand mechanisms and patterns of natural selection and microevolution, in both experimental and natural populations.

"Strength and Mode of Selection in Natural Populations"

A wealth of field studies during the past several decades have documented directional selection and microevolution of quantitative traits in nature. But evidence for stabilizing selection on such traits is largely lacking, and current estimates suggest that disruptive selection may be as common as optimizing selection. Theoretical models and field estimates of selection give conflicting views about how close most natural populations are to local adaptive optima. I will discuss potential methodological and biological reasons underlying this apparent paradox. Two main challenges currently limit our progress in resolving this paradox: estimates of selection and fitness surfaces based on integrated measures of fitness; and the temporal and spatial dynamics of selection. A predictive understanding of selection and microevolution of quantitative traits in nature will require a theoretical framework for quantifying environment and environmental variation that is grounded in functional biology and ecology.

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Philip Kitcher obtained his B.A. from Christ's College Cambridge and his Ph.D. from Princeton. The author of ten books and over 120 articles, he has been a President of the American Philosophical Association (Pacific Division) and Editor-in-Chief of Philosophy of Science. He is a Fellow of the American Academy of Arts and Sciences, and was the first recipient of the Prometheus Prize, offered by the American Philosophical Association for lifetime achievement in expanding the frontiers of science and philosophy.

"The Importance of Darwin for Philosophy"

In the century and a half since the publication of Darwin's *Origin*, many people have attempted to draw from it conclusions about human nature and human social life. Some of these ventures are over-ambitious, offering provocative claims based on speculations about our evolutionary past. I suggest that we do better to emulate Darwin's own method, and to try to understand our social practices and institutions in terms of their historical development. I develop this perspective with respect to ethics, conceived as a thoroughly human project that has occupied us for tens of thousands of years. I also use the same approach to develop an analysis of religious practices.

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Eric Lander is President and Director of the Broad Institute of Harvard and MIT, and a professor at both universities. A mathematician, geneticist and molecular biologist, he obtained his A.B. at Princeton University and his D. Phil at Oxford University. He was one of the principal leaders of the Human Genome Project, and currently works on the application of the human genome to medicine. He also serves as co-chair of President Obama's Council of Advisors on Science and Technology.

"Genomics and Darwin in the 21st Century."

The availability of the genome sequence of the human and many related species has made it possible to explore a wide range of questions about evolution, including aspects of mutation, negative selection, positive selection, speciation and so on.

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Richard Lewontin is Alexander Agassiz Research Professor in the Museum of Comparative Zoology at Harvard University. His work has centered on characterizing, at the protein and nucleotide level, the genetic variation that exists in natural populations. His theoretical work has been comncerned with the dynamics of the selection process.

"Mapping the Process of Selection: The Units of Selection Problem"

Attempts to assign natural selection as a cause of genetic change and standing genetic variation have varied greatly in the quality of the evidence for the presence and causes of fitness differences among individuals of different phenotypes. The most compelling explanations have involved the measurement in nature of contributions to overall fitness of all the components of the life cycle including fertility and survival of definite genotypes. Less convincing are (1) estimates of only one component of fitness in nature, or estimates of fitness in laboratory conditions, (2) inferences of some component of fitness from effects on physiology and development, (3) Reasonable invented stories about how certain phenotypes might have been selected, without any direct measurements of actual reproductive fitness. Unfortunately the frequency of explanatory schemes as been in inverse proportion to the degree to which there is direct fitness measurment of known genotypes in nature.

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Jane Maienschein is Regents' Professor, President's Professor, and Parents Association Professor at Arizona State University, where she directs the Center for Biology and Society. She also directs the Embryo Project (http://embryo.asu.edu) She specializes in the history and philosophy of developmental biology and the way that biology, bioethics, and biopolicy play out in society. Maienschein has won the History of Science Society's Joseph Hazen Education Award and all of Arizona State University's major teaching and other distinguished faculty awards, served as co-editor of the Journal of the History of Biology, and is currently president of the History of Science Society. Her 3 books and 12 (co) edited books include the well-received *Whose View of Life? Embryos, Cloning, and Stem Cells* (Harvard University Press).

"Embryos and Evolution: A History of Courting and Separation"

I will sketch an overview of major points in history where embryos and evolution have come together. In each case, after some excitement, they then largely ignored each other. Examples include von Baer, Darwin, and Haeckel as background. Then experimental embryology, deBeer/Garstang, and the Modern Synthesis provide twentieth century examples, where the reasons for embryologists to ignore evolution are also worth noting. Finally, we have a call now for "evo-devo," and I will look at the various versions that fall under this name. The examples will lead us to ask about the significance of the ways in which the two fields have come together and informed each other or have productively ignored each other in different times and contexts.

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Ronald L. Numbers is the Hilldale Professor of the History of Science and Medicine at the University of Wisconsin-Madison, where he has taught for thirty-five years. He has written or edited some thirty books, including *Science and Christianity in Pulpit and Pew* (Oxford University Press, 2007), *The Creationists* (Alfred A. Knopf, 1992, republished by Harvard University Press in 2006), *Darwinism Comes to America* (Harvard University Press, 1998), and Disseminating Darwinism: The Role of Place, Race, Religion, and Gender (Cambridge

University Press, 1999), coedited with John Stenhouse. Most recently, he edited the book Galileo *Goes to Jail, and Other Myths about Science and Religion* (Harvard University Press, 2009).

"Antievolution in America: From Creation Science to Intelligent Design"

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.

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Lynn K. Nyhart is professor of the history of science at the University of Wisconsin–Madison. She is the author of *Modern Nature: The Rise of the Biological Perspective in Germany* (University of Chicago Press, 2009), which analyzes the pre-history of German ecology in popular and museum science of the late nineteenth and early twentieth centuries; and of *Biology Takes Form: Animal Morphology and the German Universities, 1800-1900* (University of Chicago Press, 1996). She is currently working on projects on the history of the aquarium and on the history of ideas about biological parts and wholes.

"Geographic Isolation from Wagner to Mayr"

In 1959, Ernst Mayr sought to delineate the progress made on understanding the role of geographic isolation in evolution in the century since publication of the *Origin*. Mayr's strongly self-interested views have deeply shaped the subsequent historiography of this problem, especially in focusing attention closely on the logic of speciation theory and the status of evidence for different ideas about speciation. The present talk reviews isolation's place in evolutionary theory from a broader perspective, focusing on developments in German and American biogeography and museum-based research, as these fields interacted with new developments not only in genetics, but also in ecology and paleontology. In particular, the significance of isolation changed as the other elements in these intellectual systems, such as migration, ecological barriers, and assumptions about the relevant temporal scale of change, went in and out of play. This paper thus contextualizes Mayr's views–and his history–as part of broader trends in a complex and evolving cultural system of evolution-oriented biology that was not identical with the "Modern Evolutionary Synthesis."

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Robert J. Richards is the Morris Fishbein Professor of the History of Science and Medicine at the University of Chicago. He is a Professor in the Departments of History, Philosophy, and Psychology. He directs the Fishbein Center for the History of Science and is recipient of a John Simon Guggenheim Memorial Fellowship. He has authored several books dealing with evolutionary theory: *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (Univ. of Chicago Press, 1987); *The Meaning of Evolution* (U. of C. Press, 1992); *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (U. of C. Press, 2002); and *The Tragic Sense of Life: Ernst Haeckel and the Struggle over Evolutionary Theory* (U. of C. Press, 2008). He has edited several books on evolutionary theory and is currently at work on a Historical and Philosophical Commentary on Darwin's *Origin of Species*.

"Darwin's Moral Reconstruction of Nature"

The iconic Darwin to whom most contemporary biologists look, including several of my colleagues at this conference, is not identical to the historical Darwin, the author of the Origin of Species. The iconic Darwin produced a theory that is non-progressivist and abandons all teleological assumptions about biological development. For this symbolic Darwin, natural selection operates mechanically to effect only opportunistic alterations, and so the evolutionary process lacks any directional force. Unlike the nature of old, guided by Divine intent, neo-Darwinian nature has no purpose. I believe the historical Darwin to be quite other than his neo-Darwinian Doppelganger. The historical Darwin constructed nature as displaying intelligent forethought; and he conceived natural selection to operate with purpose, ultimately to produce moral individuals, namely us. He thus construed evolution to be progressive, attaining ever higher levels of perfection, culminating in advanced civilization. Why have we thought otherwise? Because of a certain view about the nature of theories and because of neo-Darwinian predilections. The creative and ahistorical misreading of Darwin has, as a result, been quite advantageous to the development of modern science.

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Michael Ruse is the Lucyle T. Werkmeister Professor of Philosophy and Director of the Program in History and Philosophy of Science at Florida State University. He is the author or editor of several books on Darwin and his revolution, including *The Cambridge Companion to the "Origin of Species"* co-edited with Robert J. Richards. He has long been interested in the relationship between science and religion and this is the topic of his next book, *Science and Spirituality: Making Room for Faith in the Age of Science.*

"Has Darwinism Passed Its "Sell By" Date?"

My aim is simply to compare the theory of evolution that Charles Darwin gives in his *Origin of Species* with the theory of evolution that is endorsed and worked upon and within by professional evolutionary biologists today. Do we have essentially the same theory or have things moved on (evolved) so far that truly we no longer have a Darwinian theory at all? My reply is "yes" and "no." Both Parmenides and Heraclitus were right: nothing changes; you cannot step into the same river twice. The analogy I draw is with the Volkswagen Beetle. Not

one part of the original “people’s car” of late 1930s Germany is to be found in the Bug of today, and yet so obviously they are the same car. The interesting question is whether we will have the same car – and theory – in 2109.

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Douglas Schemske received his PhD from the University of Illinois, was a postdoctoral fellow at the Smithsonian Tropical Research Institute, and has held academic positions at Amherst College, The University of Chicago, and the University of Washington. He is now Hannah Professor of Biology at Michigan State University, where he holds appointments at Kellogg Biological Station and in the Department of Plant Biology. His research investigates the ecological and genetic mechanisms of adaptation and speciation in plants from temperate and tropical environments.

"Ecological Factors in the Origin of Species"

Darwin developed his theory of natural selection to explain how populations diverge morphologically and ecologically as they adapt to local environmental conditions. To Darwin, speciation was simply the endpoint of a chronological series of steps, beginning with variation among individuals within species to the production of adaptively differentiated varieties and eventually to new species, with extinctions occurring along the way. Critics have accused Darwin of failing to appreciate the importance of geographic isolation in speciation, and have thus dismissed his contributions as being more about the origin of adaptations than the origin of species. While it is true that Darwin did little to connect natural selection with reproductive isolation, he viewed ecological adaptation as key to understanding the origin of species, something that later authors have often neglected. In this talk, I will briefly review Darwin’s views on the origin of species, discuss the criticisms of these views, and present a synthetic approach that integrates the evolution of adaptation with the origin of species using examples from plant studies conducted in temperate and tropical environments. I conclude that ecological factors play the major role in speciation, consistent with Darwin’s proposal 150 years ago, and suggest that future studies consider that there is a continuum between adaptation and speciation—the line between them is often more imagined than real.

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Thomas W. Schoener is Distinguished Professor of Biology at the University of California, Davis. He received his undergraduate and graduate degrees from Harvard University. He went on to become a Junior Fellow, Assistant and Associate Professor before moving to the University of Washington, where he was Associate and Full Professor. He has spent the past 29 years at Davis, where he was the first chair of the Section of Evolution and Ecology. He is a member of the National Academy and the American Academy, and he has held a Guggenheim. He has done both theoretical and empirical work on feeding strategies, competition, predation, food webs, extinction, and natural selection. His present field research takes place mostly on Bahamian and

Great-Barrier-Reef islands, using them as experimental arenas to investigate basic questions in ecology and evolution.

"The Newest Synthesis: Evolution + Ecology = EvoEco"

The enormous influence of ecological factors on the direction and magnitude of evolution has been well established for over a century. But effects of evolutionary change on ecological processes have received almost no attention until very recently, indeed only during the last several years. We now know, especially in the context of human-caused environmental perturbations, that adaptive evolution can occur very rapidly. Hence, given that evolutionary and ecological time scales may be largely commensurate, the potential for evolution to influence ecology would seem quite high. I discuss this potential, and the degree to which it has been realized in experimentally perturbed ecological systems. I consider how adaptive change in a given species alters both its role in the food web as well as how other species affect the given species' ecological properties, such as its population size. Possible implications of such experiments for the unmanipulated natural world are suggested.

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Eugenie C. Scott is Executive Director of the National Center for Science Education, Inc., a not for profit membership organization of scientists, teachers, and others that works to improve the teaching of evolution, and of science as a way of knowing. It opposes the teaching of "scientific" creationism and other religiously-based views in science classes. A former college professor, Dr. Scott is an internationally-known expert on the creationism and evolution controversy, and is called upon by the press and other media to explain science and evolution to the general public. The author of *Evolution vs Creationism: An Introduction* and co-editor with Glenn Branch of *Not in Our Classrooms: Why Intelligent Design is Wrong for our Schools*, she is the recipient of numerous awards from scientists and educators, and has been awarded six honorary degrees.

"What Would Darwin Say to Today's Creationists?"

Many elements of the modern American creationist movement would be familiar to Darwin, especially the argument from design, which of course was very well known (and well-regarded) by educated people of his time. Young-Earth creationism, on the other hand, would be puzzling to him; Bishop Ussher's 4004 BC age of the Earth was not considered mainstream Christian theology in the late 19th century.

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Neil Shubin is Robert R. Bensley Distinguished Service Professor at The University of Chicago and on the staff of the Field Museum. His work focuses on evolutionary morphology where he utilizes techniques of expeditionary paleontology and molecular biology to address major

questions on the evolution of animal form. He is a Fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science.

"Using Fossils and Genes to Understand Anatomical Evolution"

The tree of life can be a tool of discovery. Armed with a knowledge of the relationships of different taxa and their distribution in the stratigraphic column, we can make predictions about the kinds of creatures yet to be discovered in the fossil record. Often these tools can be used to recover creatures with features that are intermediate between major taxa, such as between fish and limbed animals. Interestingly, a knowledge of the fossil record, when placed in a phylogenetic context, suggests experiments in molecular biology by enabling predictions of the kinds of genes and pattern-forming processes that exist in basal taxa. This ability to use different lines of data as tools to predict discovery in each field is a demonstration of the power of the information contained in the tree of life.

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Elliott Sober is Hans Reichenbach Professor of Philosophy and William F. Vilas Research Professor at University of Wisconsin-Madison. His research is in the philosophy of science, especially in the philosophy of evolutionary biology. Sober's books include *The Nature of Selection -- Evolutionary Theory in Philosophical Focus* (1984), *Reconstructing the Past -- Parsimony, Evolution, and Inference* (1988), *Philosophy of Biology* (1993), *Unto Others -- The Evolution and Psychology of Unselfish Behavior* (1998, coauthored with David Sloan Wilson), and *Evidence and Evolution – the Logic Behind the Science* (2008).

"Did Darwin write the *Origin* Backwards?"

After clarifying how Darwin understood natural selection and common ancestry, I consider how the two concepts are related in his theory. I argue that common ancestry has evidential priority. Arguments about natural selection often make use of the assumption of common ancestry, whereas arguments for common ancestry do not require the assumption that natural selection has been at work. In fact, Darwin held that the key evidence for common ancestry comes from characters whose evolution is *not* caused by natural selection. This raises the question of why Darwin puts natural selection first and foremost in the *Origin*.

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Kim Sterelny is an Australasian philosopher whose whole career has been spent on the boundaries between philosophy and the natural sciences; especially the life sciences. In recent years, he has published extensively on human cognitive and behavioural evolution, developing a positive alternative to nativist versions of evolutionary psychology. The best known of these works is his Thought in a Hostile World. He is currently based mainly at the Australian National University, but retains a foothold at the Victoria University of Wellington.

"The Fate of the Third Chimpanzee"

Jared Diamond once pointed out that a visiting zoologist surveying the fauna of Earth three millions years ago would hardly have been impressed by our ancestors — raggedy-arsed apes scratching a living amongst an impressive and formidable African fauna. In the last three million years, our lineage has expanded demographically, ecologically, geographically and technologically. Our behaviour, our lifeways and our minds have been transformed. Like others, I think the evolution of human co-operation is the key factor in these changes, but in this talk I will develop a different take on the origins, basis and consequences of our co-operative ways

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Philip Ward is a professor of entomology at the University of California (Davis), interested in insect evolution. His research focuses on the taxonomy, phylogeny and biogeography of ants. Current endeavors include the Ant AToL (Assembling the Tree of Life) project that seeks to understand relationships among the major lineages of ants and the key features of their evolution; biogeographic and systematic studies on the ant fauna of Madagascar; and a global taxonomic revision of the ant subfamily Pseudomyrmecinae.

"What does phylogeny tells us about evolution?"

The study of phylogeny informs us about evolution in multiple ways. At the most basic level, the repeatable recovery of well supported phylogenetic trees validates the idea that macroevolution is an irreversible branching process: beyond a certain point lineages do not fuse with one another. Phylogenetic analysis can also help to refine our understanding of exceptions to this pattern, due to lateral gene transfer or introgression. Phylogenies allow us to estimate rates of diversification and character change. When used in this way, they often reveal marked variation among clades in the tempo of molecular and morphological evolution, and in net rates of species production. In conjunction with fossil data, molecular phylogenies permit inferences to be made about the ages of taxa, the timing of radiations, and past movements of organisms in relation to paleogeographic events. Phylogenies can be used to reconstruct the histories of character state change, often implying a greater frequency of convergent evolution (at the phenotypic level) than was previously suspected. In analyses of correlated character change the use of phylogenetic information permits the researcher to tease out the effects of shared history. Phylogenetically-based comparative methods have become widely adopted in interspecific studies of ecology, behavior and physiology. The new field of community phylogenetics attempts to understand variation in the phylogenetic relatedness of assemblages of organisms as a function of different histories and selective forces. Finally, phylogenies force us to reexamine our concepts of higher (more inclusive) taxa, revealing novel perspectives to question such as “what are dinosaurs?” and “why did they go extinct?” (it turns out that they didn’t).

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William C. Wimsatt is Peter B. Ritzma Professor of Philosophy at the University of Chicago. He teaches teaches Philosophy, History of Science, Evolutionary Biology, and directs the Big Problems program at Chicago. After Engineering Physics at Cornell and Philosophy at Pitt he post-doc-ed with Lewontin and Levins. He works on complex organization (function, kluges in design, units of selection, aggregativity, modularity, emergence, reduction, evolvability, generative entrenchment) in biology, technology, and cognition, and relevant methodologies (modeling strategies and biases, robustness, satisficing, heuristics). *Re-Engineering Philosophy for Limited Beings* (Harvard, 2007) integrates many of these themes.

"The Central Role of Development in a Theory of Cultural Evolution"

Evolutionary developmental biology now permits a richer synthesis. But no similar synthesis has occured for cultural evolution, where institutional, technological, and individual development are crucial. Earlier acquired forms tune receptivity, transform-ation, and transmission of later ideas and practices for individuals, deeply confounding heredity, development, and selection. But processes of generative entrenchment can yield an alternative "endogenetics" (endomemetics?), while culturally induced population structure molds development as multiple sequentially acquired skills generate a coordinate "exomemetics". Overlapping breeding populations in a "socio-ecological" network promise a richer evolutionary dynamics of cultural change than "memetics".