

Symposium on Evolutionary Biology (October 2009)

Marking the 200th anniversary of the birth of Charles Darwin, the 150th anniversary of the publication of Darwin's *On the Origin of Species*, and the 200th anniversary of the publication of Jean-Baptiste Lamarck's *Philosophie Zoologique*, The Royal Society of Western Australia held a Symposium on Saturday 17th October on Evolutionary Biology at the Webb Lecture Theatre, UWA. Some 120 members, guests and other registrants attended the Symposium which covered wide ranging subjects from palaeontology to modern concepts in evolution, including evolutionary microbiology, neo-Lamarckism, transposable elements as facilitators of evolution, to exploration of the predecessors and contemporaries of Darwin. After a welcome by the RSWA President Lynne Milne, The University of Western Australia's Senior Deputy Vice Chancellor Winthrop Professor Bill Loudon welcomed the RSWA to the University campus. Bill Loudon discussed the significance of the year 2009 to Evolutionary Biology and the role of The Society in promoting Science through such events.

Professor Ken McNamara from Cambridge University gave the Keynote Address "Shapes of Time: Fossils, Development and Evolution". Darwin was concerned that the imperfect fossil record made the palaeontology less than supportive of the theory of the origin of species by natural selection. But the fossil record does illuminate the patterns of evolution, and by looking at developmental changes the processes of evolution can be unraveled.



Ken McNamara

Ken showed how heterochrony is a major factor in evolution by its influence in the evolutionary trends in Early Cambrian trilobites, and its impact on trilobite lineages before and after the late Devonian mass extinction. Of interest is the changing frequency of paedomorphosis and peramorphosis through the Palaeozoic, and before and after the mass extinction event.

Dr Ted Steele discussed "Lamarck and Immunity: somatic and germline evolution of antibody genes", describing how antibody variable (V) genes are used to examine reverse transcriptase-coupled soma-to-germline feedback, which violates the Weismann's Barrier and thus supporting some type of Lamarckian gene feedback during evolution of the vertebrate immune system.

Dr Stefan Revets made two presentations firstly, "No man is an island: Evolution before Darwin" showing that Darwin and Wallace did not publish their Theory of Evolution in an

intellectual or conceptual vacuum and that the confrontation between a static and dynamic view of the world goes back to the beginning of speculative thought. The nature of the organic world played a role in these early debates and would become a focal point of attention. Stefan sketched the thoughts and ideas on organismic change from the earliest Greek "Phusikoi" through the ages up to Darwin and Wallace's time. Charting the evolution of Evolution as a concept should help and illuminate the climate and context in which Darwin and Wallace proposed their important theory.

In his second presentation, the final presentation of the Symposium, Stefan, described Alfred Russel Wallace as co-author of the Darwin-Wallace Theory of Evolution. The intellectual effort, insight and courage to formulate a theory of evolution driven by natural selection was as great for Wallace as it was for Darwin. However, Wallace has been neglected. To attempt to redress this, a sympathetic sketch of Wallace is called for. Through his publications, correspondence and life history, we regain a picture of Wallace which should encourage us to extend the credit which he is due.



Stefan Revets

Dr Alan Tapper in "Philosophical Perspectives on Evolutionary Theory" suggested that discussion of Darwinism by philosophers seems to have gone through a number of phases, from indifference (in the first 100 years), to criticism (in the 1960s and 1970s), to enthusiasm (since about 1980), and speculated about what underlies them. He noted on the present state of the debate, where rapid and important changes within evolutionary theory may be passing by unnoticed by philosophers.

Dr Kevin Thiele in "The Tree of Life as biology's most important organising metaphor- Theophrastus, Darwin, Haeckel, Hennig, and challenges from modern genetics" defended the concept of the Tree of life in the light of recent challenges from modern genetics and presented a historical perspective that The Tree of Life, represented the inter-connectedness of all living things, that it has an old history and has been a powerful organising concept in mythology, religion, philosophy and science.

Keith Oliver in his talk on "Transposable elements: powerful facilitators of evolution" outlined the hypothesis he developed together with Wayne Greene that Transposable Elements (TEs) are of two types. Type I, retro-TEs, transpose via an RNA intermediate using a "copy and paste" mechanism. Type II, DNA-TEs, transpose using a "cut and paste" mechanism. New infiltrations of genomes by TEs occur in two ways: 1. DNA-TEs horizontally transfer between genomes; 2.

some retro-TEs, e.g. SINEs, are synthesised de novo within a genome. Only ~100 SINE families are known, but they powerfully facilitate evolution. SINEs, like most retro-TEs, cannot transfer horizontally, but some DNA-TEs can: the hAT super family transferred between widely different taxa (rodent, frog, bat, lizard) ~15 to 46 Mya, spawning large bursts of TE activity, powerfully facilitating evolution. There is selection for those lineages that have active TEs, or abundant homogeneous inactive TEs.



Kevin Thiele

Dr Kemanthi Nandasena, in “New understandings in microbial evolution”, addressed the impact of modern genomic data and the convergence of fresh ideas on evolution on pre-genetic concepts on microbial (prokaryotic) evolution. Do Lamarckism and Darwinism still stand true in the face of modern molecular biology? The origin of life involved development of transcription and translation apparatus, the central machinery of all life, requiring a great degree of optimization of the genetic code. It is feasible that evolution during the beginning of life was Lamarckian, with vertical descent marginalized by premature forms of lateral gene transfer.

Evolutionary processes that currently create new prokaryotic entities from the pre-existing ones follow a different trend. The origin of new microbes can still pursue a Darwinian type evolution with natural selection playing a central role. Research on microbial genome sequences shows a high degree of plasticity and their ability to reconstruct when confronted with environmental stresses. Evident also is that microbial genomes host a variety of viruses or other alien DNA that play a significant role in the reconstruction of bacterial genomes. Given this, how valid is the very concept of an organism in isolation? The budding image of prokaryotes as gene-swapping entities stipulates a revision of such concepts as organism, species and evolution itself. Kemanthi proposed a prokaryote is a ‘composite entity’ with a multiple decent of origin. The central housekeeping machinery of cells could be traced vertically to the time of their origin. By contrast, niche specific functions, such as nitrogen fixation, metabolism of carbon sources, antibiotic resistance, can have separate evolutionary decent and have accumulated in the genome at different times via lateral transfer of genes.



Kemanthi Nandasena

Dr Kate Trinajstić presented a talk on “Polymorphism, variation and evolutionary change in early vertebrates from the Gogo Formation, Western Australia”. Kate noted that the imperfection of the fossil record was used by Charles Darwin to explain the lack of evidence for ‘organs of extreme perfection and complication’, which under his theory of natural selection must have evolved through a series of gradual transitions. A major premise in the theory of natural selection is that variation between organisms is required for selection of particular traits to occur. Kate illustrated her talk with fossils of exceptional preservation including the Gogo Formation of Western Australia, a Late Devonian reef fauna, with exceptional three-dimensional preservation of macrofossils combined with unprecedented soft-tissue preservation has preserved examples of the transitional forms and morphological variation Darwin predicted.

The most significant discoveries have contributed: insights into reproductive biology (including the oldest known vertebrate embryos and evidence of sexual dimorphism with internal fertilization), the anatomy and variation present in the earliest gnathostomes, the placoderms, and provides evidence of directional selection leading to different feeding niches. Some of the earliest morphological changes required in the transition from an aquatic to land environment are seen in the primitive tetrapodomorph, *Gogonasus*. The Gogo Formation offers a unique window into a time of extreme evolutionary changes and the exceptional preservation has enabled the study into the mechanism of this evolutionary change.



Kate Trinajstić

Dr Kate Bryant discussed “Evolution for undergraduates: fostering critical thinkers”. She recognised that the process of evolution underpins all in biology and that Evolutionary Biology is a broad field of study that draws on many disciplines (from molecular biology to ecology to palaeontology) and has applications in numerous areas such as medicine, conservation, and

agriculture. She discussed how one might teach evolution to university undergraduates meaningfully, and what is required of students to learn. Teaching evolution offers opportunities to convey more than just content: it immerses students in the process of science and should encourage them to think critically and carefully analyse concepts, problems and evidence. For students nearing graduation, it offers them the opportunity to draw together their learning across different areas in biology, asking them to synthesize their thinking and appreciate how problems in evolution can be analysed with multidisciplinary tools.

Professor Ken McNamara provided a summation of the talks of the Symposium, emphasizing the multidisciplinary nature of the study of Evolution that had been borne out by the diversity of presentations at this Symposium. Dr Vic Semeniuk also provided a summation of the Symposium from a phenomenological perspective – that is, that “Darwinism” had a major impact on Society, Science and Church, that continues to this day, and foreshadowed the formation of a multidisciplinary Specialist Group within RSWA for the Study of Evolution. Dr Lynne Milne thanked all concerned in organising the Symposium (Dr Vic Semeniuk and Keith Oliver), and the Council members involved in administration, logistics and catering (Margaret Brocx, Penelope Clifford, Phil O’Brien and Jane Rosser), and formally ended the Symposium.



The speakers at the Symposium, from left to right: Keith Oliver, Alan Tapper, Stefan Revets, Kevin Theile, Ken McNamara, Ted Steele, Vic Semeniuk, Kate Trinajstic, Kate Bryant, and Kemanthi Nandasena