

Animal, Vegetal, Mineral
Cave House Hotel, Yallingup, Western Australia
19–23 September 2016

Gerd Schroeder-Turk*

Event Details

The conference ‘Animal, Vegetal, Mineral’, selected by the Australian Academy of Sciences as the 2016 Boden Research Conference, was designed to encourage open and broad discussions between biologists, physicists, mathematicians, chemists and materials scientists. The idea was to explore the divide between the biological and the natural sciences, and draw out both the common features of living and dead systems and their essential differences.

The conference was jointly organised by Dr Gerd Schroeder-Turk (Murdoch University), Professor Stephen Hyde (ANU), Dr Bodo Wilts (Fribourg University Switzerland), Dr Myfanwy Evans (Technical University Berlin) and Dr Charlotte Conn (RMIT University).

A key focus was structure and pattern formation in biological and synthetic systems, on the nanoscale, and the role of structure and geometry for physical properties and evolutionary function. While such nanoscale geometries are found ubiquitously both in biological systems and synthetic self-assembly, it is becoming increasingly clear that fundamental differences in the formation mechanisms of the biotic and abiotic systems exist. Our understanding of these formation processes hinges on geometric concepts — from differential and hyperbolic geometry to computational and stochastic geometry, hence the importance of engaging the Australian Applied Maths community in this interdisciplinary event.

‘Animal, Vegetal, Mineral’ was a bold and successful attempt to encourage nearly 80 scientists from Australia, Europe, Asia and the Americas to think more fundamentally about their connections to the broader community of scientists, and look in detail ‘over the fence’ that usually divides life from natural scientists and mathematicians from lab- and field-based researchers. With 11 keynote lectures by some of the leading scientists of their fields, 10 invited talks, 27 contributed talks and 23 poster presentations, ‘Animal, Vegetal, Mineral’ was a major event within the Australian and West Australian science year 2016.

Report

The significance of the conference is well summarized by a quote by Professor Justin Marshall, ARC Laureate Fellow, University of Queensland:

... a superb and stimulating conference. The ‘cross-cultural’ aspect of getting biologists, physicists, mathematicians, chemists and engineers

*Email: G.Schroeder-Turk@murdoch.edu.au

together made it particularly powerful in finding ways forward. It showed the power of mixing it up—something we should do more.

This quote demonstrates that the conference achieved its stated goal to create a profound inter-disciplinary discussion forum, enabling genuine interaction between communities that are otherwise disjoint despite addressing related subject areas. The conference achieved this goal at a very high level, given the cross-section of participants:

- 76 participants
- 2 Fellows of the Royal Society
- 2 Fellows of the Australian Academy of Sciences
- 50 international participants (11 Americas, 11 UK, 3 Singapore, 3 Japan, 2 China, 1 Russia, 19 continental Europe)
- interdisciplinary audience (approximately 10% biochemistry, 12% biology, 12% chemistry, 10% materials science, 13% maths, 16% physics, 17% theoretical physics, and others)
- 26 professors

Immediate and tangible outcomes of the meeting:

- A forthcoming issue of the Royal Society Journal *Interface Focus* dedicated to the meeting, with approximately 12–17 research articles by conference attendees
- Several collaborations between conference participants
- Proposals and inspiration to hold follow-up meetings with similar scope and philosophy in the near future at the Kavli Institute at the University of Santa Barbara (Professor Mohan Srinivasarao), in continental Europe (Professor Angelina Angelova) or at the International Centre for Mathematical Sciences in the UK (Dr Adil Mughal)

Of equal importance is the contribution that this meeting has made to creating bridges between disjoint research communities, leading to synergies for future research directions. We feel that this meeting has achieved this goal, providing an important roundtable discussion forum for nanostructure formation in biology and chemistry and emphasizing the essential role that geometric mathematical approaches and modelling play in this field.

Topics covered

- Pattern and structure formation in biology and synthetic self-assembly
- Relationships between geometry and function/properties
- Geometric methods and concepts for applied and life sciences
- Nanostructures and biomimetic approaches
- Geometry, including hyperbolic, computational and stochastic geometry
- Protein and lipid assemblies in natural and synthetic membrane systems

Special presenters

- Professor Richard Prum, Yale University, USA: ‘Optical Evo-Devo: Self-Assembly and Evolution of Bio-Optical Nanostructures’

- Professor Poul Erik Jensen, University of Copenhagen, Denmark: ‘Plant chloroplasts development — cubic membrane structures and their components’
- Professor Konrad Polthier, Free University Berlin, Germany: ‘Covering and Uncovering Surfaces’
- Professor Neil Hunter FRS, University of Sheffield, UK: ‘Biogenesis, structure and function of photosynthetic membrane proteins’
- Professor John Seddon, Imperial College London, UK: ‘Bicontinuous and Discontinuous Lipid Cubic Phases’
- Professor Peter Vukusic, University of Exeter, UK: ‘New twists in circular polarisation reflection from scarab beetles’
- Professor Mohan Srinivasarao, Georgia Tech, Atlanta, USA: ‘Spontaneous emergence of Chirality and self-assembly’
- Professor George Attard, University of Southampton, UK: ‘When does the inanimate become animate? (and does it matter?)’
- Professor Justin Marshall, University of Queensland, Australia: ‘Stomatopod crustaceans: optical data storage, cancer detection and satellite design through nature’s nanostructures’
- Professor Leslie Dutton, University of Pennsylvania, USA: ‘Toward biogenesis of first-principle design and construction of light and redox proteins working in cells’
- Professor Yuru Deng, Changzhou University, China: ‘Living crystals: biological cubic membranes’

Program Outreach

The event was followed by a week-long research school conducted at Murdoch University, and attended by approximately 15 students and researchers. With a similar theme to the conference, yet more space and time for didactic presentation of the material, this school further contributed to spreading the important interdisciplinary concepts developed at the conference to a broader audience of younger students.