

**Nov. 422; workshop at the University of Alberta  
“Integrating different biological approaches”**

**Program**

**Friday, Nov. 13**

- 5:30 pm – **Public keynote lecture by Brian Hall**  
7:00 pm “Charles Darwin and the Integration of Embryology and Evolution: 1859–2009”  
Location: Earth Sciences 327
- 8:00 pm Dinner at Origin India (all workshop participants)

All Saturday and Sunday sessions take place in  
Assiniboia Hall 2-02 (Department of Philosophy)

**Saturday, Nov. 14**

8:30 am – 9:00 am	Continental breakfast
	<b>Session 1: Determination of non-homology</b>
9:00 am – 10:00 am	Ingo Brigandt (Introduction to workshop and this session’s issues) Hans Larsson Michael Caldwell
10:00 am – 11:30 am	Open discussion on session issues
11:30 am – 12:30 pm	Catered lunch
	<b>Session 2: Mechanisms of generating novel variants</b>
12:30 pm – 1:30 pm	Alan Love (Introduction to the session issues) Benedikt Hallgrímsson Richard Palmer
1:30 pm – 3:00 pm	Open discussion on session issues
3:00 pm – 3:30 pm	Coffee break
	<b>Session 3: Gaps between theoretical approaches</b>
3:30 pm – 4:30 pm	Todd Grantham (Introduction to the session issues) Manfred Laubichler Sean Rice
4:30 pm – 6:00 pm	Open discussion on session issues

- 8:00 pm Dinner at Langano Skies (all workshop participants)

## Sunday, Nov. 15

8:30 am – 9:00 am	Continental breakfast
	<b>Session 4: What kind of synthesis?</b>
9:00 am – 9:30 am	Rick Szostak (Introduction to the session issues)
9:30 am – 11:30 am	Open discussion on session issues Planning of future workshop and symposia
11:30 am – 12:30 pm	Catered lunch (sandwich style)

### Workshop participants:

U of Alberta: Ingo Brigandt, Michael Caldwell, Philip Currie, Jocelyn Hall, Sally Leys, Erin Maxwell, Richard Palmer, David Pilgrim, Rick Szostak, Rob Wilson

Students: Cheryl Mack, Catherine Clune-Taylor, Nicolas Bulot, Taylor Murphy

U of Calgary: Benedikt Hallgrímsson, Marc Ereshefsky, Jesse Hendrikse, Heather Jamniczky

Externals: Alan Love, Todd Grantham, Brian Hall, Hans Larsson, Manfred Laubichler, Sean Rice, Jason Robert

### Workshop structure:

Each of the four sessions consists to a substantial extent of discussion on the respective session topic. The issues to be discussed are illustrated by the readings circulated (list of readings below). To trigger discussion, each workshop session starts with an introduction by one of the organizers that summarizes issues from the readings / presents topics to be discussed, and brief talks (15-20 minutes) where scientists present their own research as it relates to the session topic. Workshop issues in a nutshell:

**Session 1:** The first step in the explanation of the origin of novelties is to get clear about whether a derived trait is homologous to (and thus a transformation of) an ancestral trait, or whether it is a genuine novelty and non-homologous to ancestral traits. While an anatomical structure's lower-level constituents (gene functions, cells, tissues, developmental processes) may have homologous ancestral precursors, the structure as such may not be homologous to any ancestral character. Different fields tie into this (paleontology, developmental genetics, ...). Different kinds of data bear on establishing phylogenies (classical characters, molecular character, stratigraphic data), but can conflict and are hard to integrate.

**Session 2:** Different mechanistic approaches of the generation of novelty address different issues: gene regulation, epigenetic interactions among cells and tissues, or environmental factors inducing novel phenotypes. Apart from the question of how to reconcile these approaches, we have to consider whether other considerations apart from development or other approaches are relevant (natural selection, functional morphology, etc). What novel concepts has evo-devo developed to account for novelty?

**Session 3:** There are two prominent gaps among different theoretical approaches that are germane to evo-devo and explanations of novelty. (1) The relation between macroevolutionary theory and microevolutionary models. (2) The relation between neo-Darwinism (population genetics) and evo-devo (developmental evolution).

**Session 4:** Evo-devo is viewed as a working toward a new 'synthesis'. Yet will it achieve an actual stable synthesis of different fields, or does it simply relate various individual ideas (from different approaches)? What sort of integration (if not a synthesis of fields) is necessary to account for novelty? What contributions do different approaches make? Was the Modern Synthesis a synthesis?

## Readings circulated to prime discussion issues

### Session 1: Determination of non-homology

#### Establishing phylogenetic trees (review essay; research paper):

Gura, Trisha (2000), "Bones, molecules ... or both?", *Nature* 406:230-233.

Delsuc, Frederic, Henner Brinkmann, Daniel Chourrout, and Herve Philippe (2006), "Tunicates and not cephalochordates are the closest living relatives of vertebrates", *Nature* 439:965-968.

#### Neural crest as a vertebrate novelty (review essay; research paper):

Stone, Jon R., and Brian K. Hall (2004), "Latent homologues for the neural crest as an evolutionary novelty", *Evolution & Development* 6:123-129.

Jeffery, William R., Allen G. Strickler, and Yoshiyuki Yamamoto (2004), "Migratory neural crest-like cells form body pigmentation in a urochordate embryo", *Nature* 431:696-699.

#### Tetrapod digits as a novelty (review essay; research paper):

Wagner, Günter P., and Hans C. E. Larsson (2006), "Fins and limbs in the study of evolutionary novelties", in Brian K. Hall (ed.), *Fins into Limbs: Evolution, Development, and Transformation*, Chicago: University of Chicago Press, 49-61.

Boisvert, Catherine A., Elga Mark-Kurik, and Per E. Ahlberg (2008), "The pectoral fin of *Panderichthys* and the origin of digits", *Nature* 456:636-638.

#### Avian digit homology (review essay; research paper):

Wagner, Günter P. (2005), "The developmental evolution of avian digit homology: an update", *Theory in Biosciences* 124:165-183.

Xu, X., J.M. Clark, J. Mo, J. Choiniere, C.A. Forster, G.M. Erickson, D.W.E. Hone, C. Sullivan, D.A. Eberth, S. Nesbitt, Q. Zhao, R. Hernandez, C.-k. Jia, F.-l. Han, and Y. Guo. (2009). "A Jurassic ceratosaur from China helps clarify avian digital homologies", *Nature* 459:940-944.

### Session 2: Mechanisms of generating novel variants

#### Overview essay:

Müller, Gerd B., and Stuart A. Newman (2005), "The innovation triad: an EvoDevo agenda", *Journal of Experimental Zoology (Molecular and Developmental Evolution)* 304B:487-503.

#### Developmental genetics (review essay; research paper):

Davidson, Eric H. , and Douglas H. Erwin (2006), "Gene regulatory networks and the evolution of animal body plans", *Science* 311:796-800.

Sauka-Spengler, Tatjana, Daniel Meulemans, Matthew Jones, and Marianne Bronner-Fraser (2007), "Ancient evolutionary origin of the neural crest gene regulatory network", *Developmental Cell* 13:405-420.

#### Epigenetics (review essay; research paper):

Newman, Stuart A., and Gerd B. Müller (2005), "Origination and innovation in the vertebrate limb skeleton: an epigenetic perspective", *Journal of Experimental Zoology (Molecular and Developmental Evolution)* 304B:593-609.

Hallgrímsson, Benedikt, D. E. Lieberman, W. Liu, A. F. Ford-Hutchinson, and F. R. Jirik (2007), "Epigenetic interactions and the structure of phenotypic variation in the cranium", *Evolution & Development* 9:76-91.

#### Phenotypic plasticity and environmental induction (review essay; research paper):

West-Eberhard, Mary Jane (2005), "Phenotypic accommodation: adaptive innovation due to developmental plasticity", *Journal of Experimental Zoology (Molecular and Developmental Evolution)* 304B:610-618.

Palmer, A. Richard (2004), "Symmetry breaking and the evolution of development", *Science* 306:828-833.

## Session 3: Gaps between theoretical approaches

### Macroevolution vs. microevolution:

Erwin, Douglas H. (2009), "Microevolution and macroevolution are not governed by the same processes", in F. Ayala and R. Arp (eds.), *Contemporary Debates in the Philosophy of Biology*: Wiley-Blackwell.

Grantham, Todd A. (2007), "Is macroevolution more than successive rounds of microevolution?", *Palaeontology* 50:75-85.

### Developmental evolution vs. population genetics:

Laubichler, Manfred D. (2009), "Evolutionary developmental biology offers a significant challenge to the neo-Darwinian paradigm", in F. Ayala and R. Arp (eds.), *Contemporary Debates in the Philosophy of Biology*: Wiley-Blackwell.

Wagner, Günter P. (2007), "How wide and how deep is the divide between population genetics and developmental evolution?", *Biology and Philosophy* 22:145-153.

Wagner, Günter P., and Hans C. E. Larsson (2003), "What is the promise of developmental evolution? Part III: the crucible of developmental evolution", *Journal of Experimental Zoology (Molecular and Developmental Evolution)* 300B:1-4.

## Session 4: What kind of synthesis?

Love, Alan C. (2008), "Explaining evolutionary innovations and novelties: criteria of explanatory adequacy and epistemological prerequisites", *Philosophy of Science* 75:874-886.

Brigandt, Ingo (forthcoming), "Beyond reduction and pluralism: toward an epistemology of explanatory integration in biology", *Erkenntnis*.

[optional: Szostak, Rick (2002), "How to do interdisciplinarity: integrating the debate", *Issues in Integrative Studies* 20:103-122.]