“SCIENCE” AND “NON-SCIENCE” WORLDS

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Born on 3 July 1978, Dr. Schwander studied Biology at the University of Lausanne with a main focus on Evolutionary Biology. During her Ph.D. (2003–07) at the same University, she studied caste differentiation in an ant species complex in which inter-specific hybrids develop into workers and non-hybrid individuals develop into new queens. During her postdoctoral training at Simon Fraser University (2007–09), she started investigating the transition from sexual reproduction to parthenogenesis and worked on the evolutionary history and population dynamics of a group of North American stick insects. The same topic is also the focus of her recent work, but for her time at the Wissenschaftskolleg as a member of the group “Social Insects as a Model System for Evolutionary Developmental Biology” she switched back to the research field of her Ph.D. – Address: Centre for Ecological and Evolutionary Studies, University of Groningen, 9751 NN Haren, The Netherlands. E-mail: tsa19@sfu.ca

I had the opportunity to join the Wiko in November for three months as a part of the John Maynard Smith prize awarded by the European Society for Evolutionary Biology. At the time I was a postdoctoral Fellow at Simon Fraser University in Canada, but I was hoping to come back to Europe in the spring (pending acceptance of a research proposal submitted to the Dutch Science Foundation). I liked the idea of a “transitional period” between labs where – in addition to working on my project at the Wiko – I could write up completed projects while being unable to distract myself with the start of new experiments. (I have a somewhat annoying tendency of generating too many different project ideas – "annoying" because as a postdoc, the "practical parts" of the experiments usually cannot be delegated.)

At the Wiko, I joined Rob Page and Manfred Laubichler's focus group "Social Insects as a Model System for Evolutionary Developmental Biology". Even though the name of the focus group may suggest that it falls within the field of my previous research, it turned out to be not quite the case. When trying to explain an example of phenotypic variation, my standard approach would be to think about ultimate factors and processes, with proximate mechanisms being somewhat secondary. The aim of the focus group, however, was to integrate knowledge from developmental genetics – detailed proximate mechanisms – with an evolutionary biology framework, in order to provide a more explicit and thus comprehensive model of phenotypic evolution. And, as revealed by work on queen versus worker developmental trajectories from Rob Page's lab, social insects can provide an elegant model for such an approach. Thus, thanks to the members of the social insect focus group, I ended up reading through much developmental biology literature – a very educational exercise. This was further extended during a workshop meeting at the Wiko, organized by the topic group, where the list of attendees, including names such as Bert Hölldobler, Mary-Jane West-Eberhard, and Ehab Abouheif, already reflects the merging of developmental biology and social insects.

Some of our discussions addressed the question of how complex gene networks and developmental cascades affect the distribution of phenotypic variation and how they could facilitate the evolution of novelties. This topic is loosely linked to a view much emphasized in recent years, that the first step towards the evolution of intra- and inter-specific variation would typically stem from environmentally triggered, developmental plasticity, as opposed to genetic variation among individuals. Thus, during one of the focus group discussions, Olof Leimar and I started thinking about where one could find explicit examples illustrating the two evolutionary sequences. We started looking for studies that documented the relative influence of genetic variation and plasticity on the expression of alternative phenotypes (for example, the queen and worker phenotypes in social insects, or male and female phenotypes in animals, or different colour morphs known within a single butterfly species). There are an almost infinite number of such studies, encompassing a wide range of organisms. The challenge was thus to find cases in which enough information would be available to infer whether, ancestrally, these phenotypes were controlled by environmental factors or by genetic differences among individuals. For this rather tedious task, we made great use of the Wiko library and we were able to build a literature collection that included book chapters and papers from somewhat obscure journals or older periods. The task ended up being consequential enough for me to come back to the Wiko, after my three months stay, for a week in the spring, to work with Olof on transforming the literature collection into a readable review.

Maybe not surprisingly, we found that there was evidence for both evolutionary sequences. There are nice examples in which genetically determined morphs are derived from pre-existing developmental plasticity. This is the case for many conspicuous left-right asymmetries. On the other hand, there are also well-supported cases in which environmentally controlled phenotypes are derived from pre-existing genetic polymorphisms, such as the long-winged and wingless morphs in certain beetle groups. The same evolutionary sequence also seems to be typical for colour polymorphisms, even though these traits can be associated with very different adaptations. Some of these tendencies may be directly explained by the developmental cascades underlying phenotype differentiation. Some cascades are easily modulated by variable environmental conditions, others may require genetic changes to generate new phenotypes. However, a more interesting perspective than identifying the first type of cue used for phenotype control may be to predict under which conditions plasticity and genetic polymorphism are beneficial and whether the frequency and direction of transitions that can be documented in empirical systems would fit these predictions. Another approach for studying how genetic polymorphisms and developmental plasticity generate and modify phenotypic variation would be to investigate intermediate steps in transitions from continuous phenotypic variation to discrete alternative phenotypes. This would require studying taxa related to species with alternative phenotypes, but in which the trait of interest displays continuous instead of discrete variation. I hope that our literature review, once it will be published, might help attract more studies to resolve some of the mechanisms underlying transitions between genetic and environmental control of phenotype differentiation.

Relative to the interdisciplinary exchange, the Tuesday colloquia and lunches also made me more conscious about apparent differences between the "science" and "non-science" worlds. There were two points I found to be the most striking. First, it is fundamental for us not to over-interpret data and we would earn much criticism for forcing preconceptions onto empirical observations. In the "non-science world" however, the observer's personal opinion on an ensemble of data appears to be at least as important as the data themselves, and therefore disentangling "accurate" from "wrong" is of no interest whatsoever. Second, a technical term in the exact sciences would simply be a label, with-out any value *per se*, that conveniently shortens a description. Outside the exact sciences however, semantics can be the major focus of an animated discussion. This is nicely illustrated by a debate following a colloquium given by Klaus Zuberbühler and Vincent Janik on communication in animals. Klaus Zuberbühler demonstrated how gibbons use a repertoire of calls to inform group members about an approaching predator. While I was trying to understand whether this behaviour might be a likely stepping-stone towards the evolution of a more complex language, the ongoing debate was on whether it was appropriate or not to refer to "syntax use" in this context.

Overall, my stay at the Wiko was not only rewarding in educational terms or direct scientific output; the long debates during coffee breaks, lunches, and the colloquia also broadened my view in many ways. When leaving the Wiko, I was inspired to set up experiments in which I could implement some of the discussion topics, such that I have started selection lines for higher and lower parthenogenesis rates and set up crossing experiments designed to determine the genetic architecture underlying different colour morphs in my stick insect model system … yet another set of exciting new experiments.