NUS National University of Singapore | Department of Biological Sciences, Faculty of Science

SEMINAR

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Vertebrate Developmental Biology: from Mechanisms to Models

By **Michael Richardson**

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I discuss here our research on vertebrate developmental biology. One line is fundamental, and focuses on the developmental mechanisms underlying the evolution of 'reptiles'. The other line is applied, and develops alternative, innovative research models for compound screening. Although these lines sound quite distinct, I hope to show in this talk that they are closely related. Our work on the evolutionary development of 'reptiles' (including birds) uses comparative gene expression profiling in multiple species; it has helped cast light on the developmental origin of evolutionary novelties. Using sonic hedgehog expression as a marker for the embryonic dental lamina, we showed that the venom delivery system in snakes had probably evolved once only — at the back of the mouth. It then moved forwards to the front of the mouth, by differential growth of the embryonic head, during the evolution of two front-fanged lineages (vipers and cobras). This pattern of indirect development, where an ancestral developmental state is modified but not deleted, was also found by us in the reptilian limb. Using multiple gene expression profiling in embryos, we studied the loss of digits (fingers and toes) during reptile evolution. Again, despite the very different adult limbs, the embryonic limbs of all species showed strong conservation of digit formation at early stages. These studies of organ development in different species are not only fundamental in nature; they also provide underpinning for our applied research. That research aims to develop new screening models for drug discovery and drug safety. As it becomes increasingly problematic ethically, and in terms of cost, to screen large numbers of compounds using rodents, alternative whole animal models such as the zebrafish embryo and chicken embryo are gaining importance. We have developed and patented the first microfluidic system for culturing zebrafish embryos and using them for compound testing. Ultimately, we aim to develop this microfluidic approach to culture embryonic organ primordia such as limb buds, and use them instead of adult animals for drug screening. This is not yet a reality, but we are getting closer, as I will show.

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Artwork by Ann Nee, DBS, NUS