**BDRC SEMINAR SERIES: Tissue tectonics and the emergence of pattern during complex morphogenesis**

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As cells proceed through development, information contained in the genome is expressed in a context-dependent manner. This must be regulated precisely in both space and time to generate patterns of gene expression that set-up the spatial coordinates of tissue and organ primordia that build the embryo.

 Our current understanding of pattern formation relies on the concept of positional information, the idea that cells receive instructive signals that impart a spatial coordinate system to generate pattern. While this model works very well in static cell populations with minimal cell rearrangement, it becomes challenging when considering dynamic morphogenetic processes such as gastrulation. Furthermore, pattern formation in gastrulation is highly flexible to alterations in the size, scale and spatial rearrangement of cells in both experimental and evolutionary situations.

 I will introduce two new concepts to the field of developmental genetics that will help resolve these long-standing problems of pattern regulation, evolvability and self-organisation. Firstly, tissue tectonics emphasises the role that multi-tissue interactions play in relaying information from changes at the organ and organism level to the regulation of gene regulatory networks (GRNs) at the cell level. Secondly, pattern emergence considers how extracellular signals act to control the dynamics of autonomous GRN activity, rather than as instructive signals to direct cell fate transitions. In this sense, pattern formation should not be seen as a downstream output of organisers and their responding tissues, but rather as an emergent property of their dynamic interaction. These concepts will be illuminated with examples from our recent work on explants from early zebrafish embryos and the comparative analysis of neuromesodermal progenitors.

BIO:

 Ben started his independent research group in 2016 within the Department of Genetics, University of Cambridge. He is currently supported by a Wellcome Trust/Royal Society Sir Henry Dale fellowship. The lab applies live and quantitative imaging techniques to investigate how cell fate decisions are orchestrated in space and time during axis patterning in zebrafish embryos. His lab is interested in how such fundamental differences in embryo size, cell number and energy supply have influenced the interpretation of conserved regulatory networks and patterning mechanisms by individual cells. The central aim of his research is to uncover the mechanisms that confer information across biological scales. This might be through the generation of emergent properties such as pattern formation and morphogenesis. Alternatively, they might be mechanisms of downward causation, such as the impact of multi-tissue mechanical interactions on the regulation of cell fate decision making at the single cell level.