47.3 *JEFFERY, J.E.*, BININDA-EMONDS, O.R.P., COATES, M.I., RICHARDSON, M.K., St George's Hospital Medical School, London, University of California at Davis, University College London, University of Leiden, The Netherlands.* Heterochrony in amniote evolution.

Heterochrony is thought to be a major link between developmental mechanisms and the emergence of phenotypic difference above the species level (macroevolution). Heterochronies affecting the timing of discrete events are of particular importance during organogenesis. Within vertebrates, this is the mid-embryonic period when the body plan is specified under the control of regulatory genes, and when major organ primordia develop. Previous studies have identified putative heterochronic changes (e.g. in somite formation) during this key period, but these have not been quantified or tracked systematically across evolutionary history. In part, this is due to the difficulties inherent in analysing comparative developmental data. We have developed a new protocol, based on 'event-pairing', for quantifying heterochrony and mapping it across the evolution of different animal groups. It improves upon earlier event-pairing methods by adding an *en bloc* comparison of the shifts along each branch of the tree. This can determine the shifts of individual events relative to all other developmental events surveyed, and can identify the stronger trends. Using data from vertebrates, we track timing shifts in embryonic organ development. These include delayed eye development in mammals and advanced heart development within the amniotes. We explore possible functional and adaptive explanations for these shifts (e.g. the evolution of endothermy). We also subject the data to a parsimony analysis to identify instances of convergence (homoplasy). In future, our approach may be adapted to analyse other forms of comparative dynamic data.

P1.74 *JENKINS, J.L.*, SWANSON, D.L., University of South Dakota, Vermillion.* Liver glycogen and freezing survival in the chorus frog (*Pseudacris triseriata*).

In freeze tolerant frogs, a principal component of freezing survival is the production and distribution of cryoprotectants (glucose or glycerol) from liver glycogen stores. The size of these stores limits the absolute amount of cryoprotectant produced during a freezing bout, consequently impacting freeze-tolerance. Additionally, in *R. sylvatica*, liver glycogen is depleted as a result of multiple freeze-thaw cycles. We froze chorus frogs for 2-3 24h bouts over the winter period of 1998 and 1999 to determine the energetic cost of freeze-thaw cycles in this species. Frogs surviving the initial freeze-thaw bout survived subsequent freezing bouts. However, in contrast to *R. sylvatica*, multiple freeze-thaw cycles failed to significantly reduce liver glycogen stores or change glycogen phosphorylase activity. Freezing survival was unexpectedly low, thus prompting a secondary investigation into the relationship between hepatic glycogen reserves, glucose mobilization and freezing survival in chorus frogs. In all cases freezing in *P. triseriata* resulted in significant increases in the levels of glucose in liver and muscle tissue. However, levels of cryoprotectant and liver glycogen of animals in the current study were significantly lower than in previous studies where freezing survival was better. Low levels of liver glycogen may be the explanatory factor for the decreased cryoprotectant levels and increased mortality. The frogs in this study showed a positive correlation between liver mass and liver glycogen. Currently, it is unclear if this correlation can be extended to body size, but such a relationship seems likely.

56.6 *JENNINGS, D.H.*, WEISS, S.L., MOORE, M.C., Arizona State University, Tempe.* Ontogenetic changes in embryonic yolk steroid content in tree lizards: transfer of hormones from the developing embryo to the yolk?

In oviparous vertebrates, hormones that accumulate in the yolk during gametogenesis regulate development and can affect a variety of morphological, physiological, and behavioral traits. We examined yolk steroid hormone content during embryonic development in male and female tree lizards, *Urosaurus ornatus*. Progesterone (P), testosterone (T), and estradiol (E2) were present in most newly laid eggs, whereas corticos-