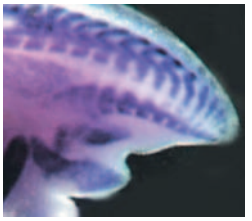
In this issue

By Jane Bradbury

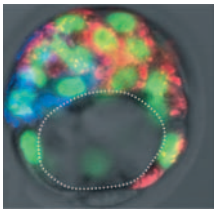
A tale of caudal musculature

During avian and mammalian embryogenesis, the cloaca forms a common opening to the digestive, urinary and reproductive systems, which, in mammals, subsequently develops into separate openings to each system. Valasek and co-workers now reveal that the skeletal muscles surrounding the cloaca develop from leg muscle cells in both chicks and mice (see p. 447). The researchers show that chick cloacal muscle originates from somites 30-34, a domain that overlaps the one giving rise to leg muscles. By marker gene analysis, they show that chick and mouse cloacal muscles derive from the ventral muscle mass of the hind limb. Further labelling, genetic and surgical experiments lead the researchers to conclude that in both species (and presumably humans), myogenic precursors migrate from the somites into the pelvic limb, where they extend towards the midline, only then differentiating into cloacal/perineal muscles.



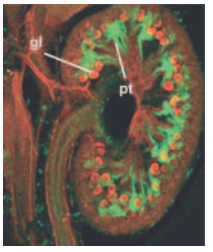
Early embryonic inequalities

The cells in early mouse embryos are generally thought to have equivalent developmental properties until at least the eight-cell stage. On p. 479, Piotrowska-Nitsche and colleagues challenge this idea by showing for the first time that four-cell stage mouse blastomeres have different developmental properties that depend on their embryonic origin. In most two-cell mouse embryos, one cell divides meridionally and the other divides equatorially or obliquely with respect to the second polar body. The researchers report that chimaeras made entirely of specific equatorially or obliquely derived four-cell stage blastomeres show developmental abnormalities – those made from the most vegetal blastomeres are most severely affected. By contrast, chimaeras made from meridionally derived blastomeres develop normally. However, when individual blastomeres are surrounded by blastomeres from random positions, they contribute to all embryonic lineages. Thus, although four-cell stage blastomeres all have full developmental potential, they differ in their developmental properties.



Encapsulating kidney capsule functions

Kidney morphogenesis depends on defined zones of induction (at its edge) and differentiation (in its interior) that lead to its final radial pattern. Levinson and colleagues now report (see p. 529) that deletion of the transcription factor *Foxd1* in mice causes the loss of these zones and the delayed formation and disorganisation of the nephrogenic and ureteric compartments by disrupting the normal formation of the renal capsule. In *Foxd1*-null mutant embryos, a single layer of *Foxd1*-positive stroma in the renal capsule is replaced by a thicker, heterogeneous cell layer, in which some cells express *Bmp4*. This induces ectopic Smad signalling in the nephron progenitors, disrupting their early patterning and, through reciprocal signalling interactions, inducing ureteric tree patterning. Thus, the renal capsule not only delineates the kidney but also acts as a barrier to inappropriate exogenous signals while providing endogenous signals needed for normal radial patterning.

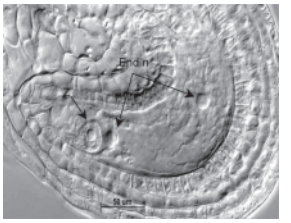


XPACE4: regulating TGFβ signalling by cleavage

Mesoderm specification in early *Xenopus* embryos involves several TGFβ family members, including zygotically expressed nodal-related (Xnr) proteins 1-6 and maternally inherited Vg1. On p. 591, Birsoy et al. report that maternal XPACE4, a pro-protein convertase enzyme, plays an important role in embryonic patterning by regulating the production of a subset of mature TGFβ proteins during *Xenopus* development. The researchers show that XPACE4 is stored as maternal mRNA in the mitochondrial cloud and vegetal hemisphere of the oocyte, and that XPACE4 activity is required for the endogenous mesoderm-inducing activity of vegetal cells before gastrulation. The researchers also provide a comprehensive survey of the effect of XPACE4 depletion on the cleavage spectra of seven TGFβs – Xnr1-3, Vg1, Xnr5, Derrière and ActivinB – present in embryo lysates and blastocoel fluids. They report that XPACE4 cleaves Xnr1-3 and Vg1 but not Xnr5, Derrière or ActivinB.

Delving deeper into plant reproduction

During their life cycle, plants alternate between haploid gametophytes – male pollen grains and female embryo sacs – and diploid sporophytes, the flowering plants in angiosperms. Until now, the genes and pathways involved in gametophyte formation in flowering plants have been largely unknown. On p. 603, Pagnussat and colleagues remedy this situation by identifying by sequence numerous genes involved in female gametophyte development and function in *Arabidopsis*. In a large-scale screen of *Ds* transposon insertion lines, the researchers identify 130 *Arabidopsis* mutants with defects in embryo sac formation, fertilisation, early embryo development and other aspects of female gametophyte development and function. This comprehensive overview of the genes involved in female gametophyte production and function, which uncovered an unexpectedly large number of genes that are maternally required for embryonic development, will facilitate future studies into the pathways involved in flowering plant reproduction.



protocadherin15 links sight and sound

Specialised apical structures in the sensory receptors in the eye and the ear detect light and mechanical stimuli, respectively. Sensory receptors seem to have evolved from a common ancestor, and mutations in some of the genes that are required for both sight and hearing cause Usher syndrome, a human syndrome of visual and acoustic-vestibular defects. Seiler and co-workers now report that *protocadherin15* (*PCDH15*), a gene mutated in Usher syndrome, is duplicated in zebrafish (see p. 615). They show that the zebrafish auditory/vestibular mutant *orbiter* has a mutation in *pcdh15a*, an orthologue of *PCDH15*, and that morpholino-based depletion of a second orthologue, *pcdh15b*, causes a visual defect. The researchers conclude that during evolution, duplicated *pcdh15* genes acquired functions that maintain the structural integrity of the specialised apical surfaces of different sensory receptors. Zebrafish, they add, provide a new model for Usher syndrome.