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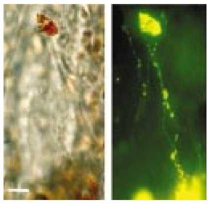
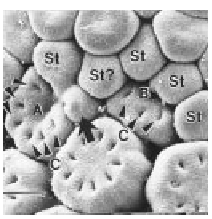
## John Bryant takes a closer look at some of this month's Original Articles



### Plastids at the end of their tether

The green fluorescent protein (GFP) from the jellyfish, *Aequorea victoria*, is proving its worth as a label that can be detected non-invasively in living cells. It can provide information on sub-cellular localizations of proteins, on the spatial distribution of expression of particular genes, on the activity of gene promoters and enhancers, and on the development and physiology of organelles. Thus, the targeting of GFP to plastids has revealed dynamic filamentous structures called stromules that grow out from plastids and may provide a linkage between plastids. At other times, stromules may retract. The physiological significance of stromules is not understood but they clearly illustrate how the development of new tools leads to new understanding, even in areas previously well-researched. It is to plastids that **Kevin Pyke and Caroline Howells at Nottingham University, UK (pp. 559–566)** have applied GFP imaging. They investigated the chloroplasts in tomato leaf epidermis, the very variable plastids in leaf trichomes and the chromoplasts in tomato fruit. It is on the latter that we focus here. In green fruit, the pericarp cells contain numerous functional chloroplasts that do not extrude stromules. As ripening progresses, the photosynthetic pigments and proteins are lost, lycopene (the red carotenoid pigment) is accumulated and stromules begin to appear as string-like extensions from the plastids. At maturity, the deposition of lycopene crystals may be extensive enough to deform the plastids, while the development of stromules is truly spectacular. These now form long strings or even networks, associated with clusters of chromoplasts, and form interconnections between individual chromoplasts. Many of the stromules have a beaded appearance and the presence of GFP in these beads suggests that they represent foci of material being transported within the stromules. The authors suggest that plastids may coordinate their activities via networked communication. GFP has thus opened up a whole new area for research.




### Sex change involves one for one swap

Many of us were introduced to homeotic genes via homeotic mutants in drosophila in which, for example, legs grow in the place of antennae. It is tempting, given current emphasis in the literature, to imagine that the term was invented by molecular biologists. However, as we are reminded by the French–Canadian team led by **Denis Barabé (pp. 579–578)**, it is actually based on the morphological phenomenon of homeosis, the replacement of one organ by another, first described in the 19th century. In the words of a certain film actor, 'Not a lot of people know that'. The flowers of the genus *Philodendron* are ideal for investigating homeosis. In each inflorescence, female flowers form near the base and male flowers near the apex. However, the transition is not abrupt: there is a gradual transition from femaleness to maleness via several intermediate forms. Immediately below the male flowers are sterile males with non-productive stamens (staminodes); between these and the female flowers are atypical bisexual flowers with both carpels and staminodes. In these atypical flowers, staminodes tend to predominate towards the male end of the inflorescence and carpels towards the female end of the inflorescence. The authors have carried out a detailed analysis of the atypical flowers. They note that when carpels and staminodes occur in the same flower, they are in the same whorl. In progressing from femaleness to maleness, carpels are replaced by staminodes on a one for one basis. These findings are reinforced by the occasional presence of structures intermediate between carpels and staminodes. This is a fascinating example of a morphogenetic gradient and leads us to speculate on the nature of the positional information. Furthermore, the gradient involves clear examples of homeosis and provides the authors with an ideal system for studying expression of genes involved in floral organ identity.

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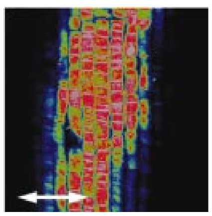
### Hormone breakdown may restore balance

Abscisic acid (ABA) in seeds is involved in desiccation tolerance, in regulating storage product synthesis and in imposing dormancy, either transiently, to prevent precocious germination, or over the longer term. The ABA involved in these processes is probably synthesized in the embryo itself. However, the embryo and endosperm can also respond to ABA from exogenous sources, including maternal tissue. Indeed, the latter is, in many species, the source of high concentrations of ABA during environmental stress. However, ABA arriving at the wrong time can be disastrous. In maize, ABA inhibits cell division in the endosperm; if this happens early in seed development the kernels fail to develop properly. This may explain why kernels at the apex of the ear (the younger kernels) are more vulnerable to environmental stress than are basal kernels. The story is taken up by **Wang *et al.* (Cornell University, USA**; **pp. 623–630)**. They withheld water from maize plants from 1 d after pollination up to 6 d after pollination, after which the plants were re-watered. Apical and basal kernels were analysed for ABA and its metabolites. In both positions, kernels accumulated more ABA in stressed plants than in control plants, but the increase was much greater in apical kernels (seven-fold, compared with three-fold). On re-watering, kernels in both positions lost ABA rapidly, reaching control levels within 24 h, but at all times during the experimental treatment apical kernels had more ABA than basal kernels. The loss of ABA was due both to oxidative catabolism and to efflux. The ABA lost by efflux was again oxidized, mostly in the placenta (where ovules are anchored in maternal tissue). Thus, the ABA concentration in these early kernels results from a dynamic balance of transport and metabolic processes. We must agree with the authors that this situation, so relevant to grain yield in stress conditions, ‘merits further investigation’.



### Focusing on orientation gives clue to relationships

Cellulose may well be the most abundant polysaccharide in the world; it occupies this proud position because it is a major component of plant cell walls. Deposition of cellulose must allow for cell elongation; changes in the orientation of the microfibrils within the wall are said to be important in allowing for and then resisting elongation. However, it may be more complex than this, as shown by **Sven Kerstens and Jean-Pierre Verbelen at the University of Antwerp, Belgium (pp. 669–676)**. They selected 57 angiosperm species from 29 different families. In plants from each species, the cellulose in epidermal cells from the root elongation zone was stained using the fluorescent dye, Congo Red, and the orientation of the microfibrils determined by polarizing confocal microscopy. Three different patterns were observed. The least common is seen in the palms (Arecaceae), plants which lack a properly defined elongation zone, where microfibril orientation is apparently random. All the other species investigated exhibit a true elongation zone but, rather unexpectedly, two completely different patterns of microfibril organization are seen. In 23 out of the 27 families, the orientation is predominantly transverse to the root axis. However, in three families, Poaceae, Juncaceae and Cyperaceae (all from the Poales tribe within the monocots), the orientation of microfibrils in epidermal cells throughout the root elongation zone is parallel to the direction of growth. This is not seen in other plant families, even from within the tribe Poales. The authors suggest that we may need a re-think of the role of cellulose orientation in cell elongation. However, they add that there is a very clear link between current views on phylogeny within the Poales and the regulation of cellulose deposition. Bioinformatics has many roles, including the provision of information on taxonomic relationships. It also has many guises amongst which we may now include cellulose microfibril orientation.

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