The glue that builds bristles

An actin cable is the sum of its parts, according to Guild et al. (page 1069), who find that short bundles of actin filaments are grafted together to form extra long actin cables in fly bristle cells.

Bristle cells, which can reach lengths of up to 400 μm, are initially supported by an assembly of multiple short stretches of polarized actin bundles. By looking closely at these bundles as they break, the authors see that individual modules of short bundles are assembled by a grafting-like mechanism. In bent cables, the modules separated slightly to reveal the tapered ends of overlapping bundles, suggesting that the modules are not connected by simple end joining.

The group found that two initially unconnected bundles are joined as one extends over the end of the adjacent bundle. Overlapping bundles are then grafted together by fascin and forked, cross-linking proteins that also bundle individual actin filaments. The grafts are hidden by the addition of more filaments to the original bundles, so that the entire cable appears to be one continuous, smooth entity.

The total length of short cellular extensions, such as microvilli in intestinal cells or stereocilia in ear hair cells, may be determined by the length of a single actin cable. But overlap and grafting probably create a long yet flexible cable that can either curve, as do bristle cells, or contract by sliding, as do actin cables in fly nurse cells.

More order in DNA

On page 981, Shopland et al. identify a new level of nuclear organization that positions highly transcribed DNA and chromosome segments near proteins needed for mRNA maturation.

Splicing factors and other proteins that process newly made transcripts accumulate in nuclear speckles called SC-35 domains. Shopland et al. find that these domains associate with R-bands, which are cytologically visible, gene-rich, and highly transcribed chromosome regions. Transcripts from both linked and unlinked genes were found within a given SC-35 domain. This shared usage indicates that the domains are not simply spots of RNA metabolic factors at an especially active locus, but are rather organized domains that may promote efficient transcript processing. Clustering of genes with numerous individual components of the large transcription and mRNA processing complexes probably hastens complex assembly and thus increases the efficiency of mRNA maturation.

Certain hyperactive genes may be targeted to or nucleate SC-35 domain formation and then promote the association of the neighboring chromosomal region with the domain. The highly transcribed COL1A1 gene was consistently associated with a domain, although sequences within the same R-band also contacted the domain ~80% of the time. The organization of DNA to optimize the association of active gene regions with SC-35 domains may be the best explanation yet for the evolutionary origins of R-bands versus gene-poor G-bands.

Finding the axon

If you’ve seen one microtubule, you’ve seen them all. Not true, according to Nakata and Hirokawa, who demonstrate on page 1045 that a unique set of microtubules is crucial for protein targeting in neurons.

In neurons, vesicle trafficking must be unusually precise to move proteins efficiently to the axonal plasma membrane, because the entrance to the axon is so narrow. This precision is now shown to be directed by a set of densely packed microtubules extending from the cell body into the proximal portion of the axon. These microtubules preferentially bind KIF5, the motor that carries axon-bound post-Golgi vesicles.

The unique chemical nature of the microtubules that attracts KIF5 is not yet clear. In addition to an unusually high turnover rate (the inhibition of which redistributed axon-directed transport), the population had higher levels of the tip-binding protein EB1. Although it is possible that EB1 somehow directs KIF5 binding, the authors believe this is not the case. They suggest instead that posttranslational modification of tubulin or cross-linking proteins may be involved. Although the KIF5-binding microtubule population was noted only in neurons, other cell types (e.g., motile fibroblasts or activated T cells) may use different microtubule/kinesin pairs to regulate polarized vesicle trafficking.