unprecedented in their severity? Another consideration in this debate is the unusual climate over that time that has dried fuels and created conditions conducive to the ignition and spread of fire[5]. Current fires, driven by strong winds, have burned both open and closed forests, ignoring conventional wisdom about fire behaviour. This conventional view is that closed, fuel-laden forests should experience severe stand-replacing fires, whereas open forests should be relatively fire resistant.

Understanding how present-day fires are influenced by climate requires information both on past fire conditions and on climate variability. If fire activity is a predictable consequence of the interconnectedness of climate, fire and vegetation, then in the Rocky Mountains we can expect fire regimes typical of a warmer, drier climate in the future[6].

Our knowledge of fire history in low-elevation pine forests is based largely on analyses of fire scars on living and dead trees[7]. Most tree-based studies offer information about the past 500 years or so, but are biased towards surface fires that scar, but do not kill, trees. Charcoal records from lake sediments extend the fire chronology back several millennia; however, these studies generally focus on montane and subalpine forests[8].

Pierce *et al.*[1] offer an alternative data set for studying past fire regimes at low elevations — the record of fire-related sedimentation, preserved as accumulations of rock, soil and wood known as debris-flow deposits. Severe fires can remove ground litter and reduce infiltration of water; following that, storms and melting snow in spring can initiate landslides that deposit fire-related sediment in valley bottoms[9] (Fig. 1). In contrast, the geomorphological effects of low-severity surface fires are less dramatic, because of a more discontinuous burn pattern and lesser impact on the soil.

Pierce *et al.* determined the age of charcoal particles in different types of debris-flow deposits, and established a chronology of fire-related erosion for the past 8,000 years. Their data suggest that fire-related debris flows were associated with warm, dry periods, such as the Medieval Climate Anomaly (roughly AD 950–1350), when grass cover was sparse and fires were severe. In contrast, during cooler, wetter periods, such as the Little Ice Age (AD 1350–1900), dense grass cover supported frequent surface fires and there were only comparatively minor episodes of sedimentation.

Two points that emerge from this study[1] are worth mentioning. First, fire is influenced by climate variations that occur on several timescales, and shifts in fire regimes affect the various factors — vegetation, and hydrological and geomorphological processes — that stabilize or destabilize landscapes. In a given year, fire occurrence and severity are governed by particular weather patterns and their influence on fuel moisture, ignition conditions and fire behaviour[10]. Fire-related geomorphological events are determined by the fire intensity, as well as the subsequent weather and the characteristics of the mountain slopes involved. On inter-annual timescales, fuel availability and slope stability are affected by variations in climate arising from atmosphere–ocean interactions, such as the El Niño–Southern Oscillation. On longer timescales, alternation of wet and dry periods during past centuries and millennia has shifted pine-forest ecosystems between surface-fire and crown-fire regimes and, in turn, has shifted the character of post-fire sedimentation.

Second, recent fires in low-elevation forests near sizeable human populations have led to calls for draconian tree and understorey thinning. Yet the investigations of Pierce *et al.*[1], and tree-ring studies[11–13], suggest that fire activity in these forests has varied in the past and includes episodes of severe crown fires and large debris flows. We should consider this long-term perspective before embracing one-size-fits-all management strategies. And in the future, we need to be guided by a firm understanding of both the relationship between fires, climate and landscape processes on different timescales, and the interactions between climate and land-management activities in shaping fire regimes. ■

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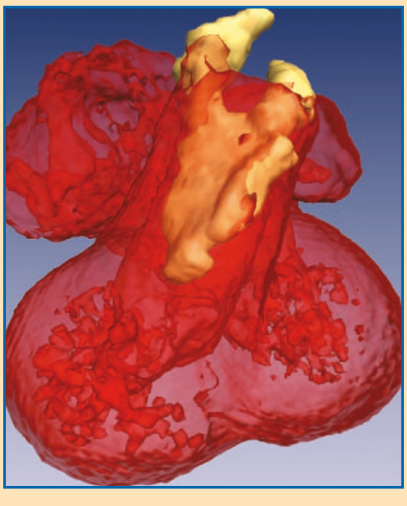
**Cardiovascular biology**

## How genes know their place

Embryonic development is largely a matter of switching on the right genes, in the right place, and at the right time — it's no use activating heart-manufacturing genes in the limbs, for instance. Elsewhere in this issue (*Nature* **432,** 107–112; 2004), Benoit G. Bruneau and colleagues describe a protein that keeps heart-specific genes in their place.



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Using mice, the authors first discovered that the protein in question, named Baf60c, is initially expressed only in the developing heart. Investigating further, they found that completely eliminating Baf60c from mouse embryos led to major cardiac defects (and early death). Knocking out about 50% of the protein led to somewhat milder, although still ultimately fatal, problems, such as an abnormally straight and split outflow tract (the yellow area in this picture).

Why do these problems occur? Baf60c is part of a complex that controls the accessibility of genes by interacting with transcription factors — proteins that regulate gene expression. So perhaps, without Baf60c, heart-specific genes cannot gain access to the transcriptional machinery and therefore remain inactive. Indeed, Bruneau and colleagues found that many genes that are characteristic of different aspects of heart development are not expressed when Baf60c is eliminated, including various genes involved in the formation of the outflow tract. Moreover, in *in vitro* studies, the authors showed that Baf60c enhances the interaction between Brg1, a key component of the complex in which Baf60c is found, and certain heart-specific transcription factors.

So, at early stages of development, Baf60c seems to ensure that a complex that alters the structure of DNA — and hence its accessibility to proteins that activate genes — is targeted specifically to genes that are needed for heart development. This mechanism might also work in other tissues, with proteins other than Baf60c providing the necessary specificity. And the findings might bear on human disease: the defects caused by a partial lack of Baf60c are somewhat similar to those seen in some people with congenital heart defects. It remains to be seen, however, how the heart-specific expression of Baf60c is achieved in the first place.

**Amanda Tromans**