down on the cake, a stress is applied on the grains. Such a normal stress tends to interlock the grains. This effect makes it harder to remove them: imagine how much harder it would be to pull billiard balls out of the bottom of a tall pile than just taking them from the top. But the sand cake is irregular; by chance, some of the grains carry more of the load, others less. The more lightly loaded grains are not locked together so tightly, and as the surface erodes, the less loaded, and therefore more weakly locked, grains are removed first.

Bruthans and colleagues used experiments and numerical analyses to show that natural sandstones can be sculpted essentially by the same mechanism. When grains of sandstone are removed — usually by wind erosion — the total cross-sectional area of sandstone available to bear the weight of the stone is reduced, and the increase in normal stress locks the remaining grains together more tightly. The remaining weight-bearing regions are thus more resistant to erosion, whereas those parts of the sandstone that bear less stress are preferentially eroded.

This feedback loop continues until the locking normal stress on the entire remaining grain structure is large enough to allow the grains to resist further erosion — or until the structure collapses. Bruthans *et al.* show that familiar natural forms in which the weight of stone is carried to ground emerge from this mechanism, and at the same time, the structure is defended against erosion.

This is self-organization at its best. Contrary to Michelangelo's idea, the sculpture is not present in the rock, but rather emerges from it through simple local interactions. Unlike the human sculptor, these interactions do not include a larger vision of the resulting pattern; rather, the fascination is in how the right combination of local dynamics and external constraints leads to the emergence of a pattern whose form surprises us precisely because it is not in any direct way contained in the generating processes[2].

Bruthans and colleagues present nothing more or less than a lovely and elegant formative mechanism for a lovely and elegant kind of landform. These natural sculptures have delighted countless visitors, some of whom must have paused to wonder where they come from. Here is an answer. The proposed feedback mechanism should be on the reading short list for anyone who enjoys the confluence of elegant science and natural beauty. ❒

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CLIMATE SCIENCE

Urban heat

More than half of the Earth's population are city dwellers. This concentration of humans in a relatively small space brings a variety of challenges, such as the supply of food and shelter and the disposal of sewage and waste. In a warming world, an accumulation of heat within urban areas has become problematic too: temperatures in cities often exceed those in the surrounding countryside by several °C, a phenomenon termed the urban heat island effect.

A number of factors contribute to the temperature difference. Urban spaces are more built-up and support less vegetation, so the air-cooling effects of water evaporation and transpiration by plants are reduced. Instead, rainwater is quickly funnelled off, frequently underground, and is therefore lost as a cooling agent. In addition, people in a city cook, heat or air-condition their homes and produce warmth in many other ways, which further increase urban surface temperature. Finally, rural areas tend to be more reflective, and therefore return the Sun's energy back to space more efficiently than cities. As a result, more heat is absorbed by urban artificial building materials, such as asphalt and concrete, than by rural natural vegetation. Again, temperatures in cities increase, compared with countryside in the same broad region.

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Lei Zhao and colleagues (*Nature* http://dx.doi.org/10.1038/nature13462; 2014) now suggest that yet another factor dominates the urban heat island effect, at least in humid climates and during the day. In these regions, heat is released to the lower atmosphere through convection more efficiently over the countryside than over cities. This effect can contribute temperature gradients of around 3 °C.

The researchers come to this conclusion by analysing climate model simulations and satellite data for 65 cities across North America and determining the contributions of the various factors, separately for day- and night-time.

It turns out that the relative importance of convection efficiency depends on the local background climate, that is, whether a city is located in a humid or arid environment. In a humid setting, rural areas will be characterized by lush vegetation, which is aerodynamically rough, whereas townscapes are comparatively smooth. In an arid climate, by contrast, sparser shrub- and grasslands are typically aerodynamically smoother than cities, so that the difference in convection efficiency actually reduces the urban heat island effect. Interestingly, the direct release of heat from human activities is vanishingly small in the simulations, but the researchers concede that this effect may not be represented well in their model.

Humans suffer more heat stress under high humidity. In the more humid regions of the globe, a retreat to the countryside would seem to be a good idea when a heatwave is rolling in.

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