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WORD WATCH

Plutoid
The new name for objects such as poor little Pluto, which was thrown out of the planet club by the International Astronomical Union in 2006. Sidelines thinks that is slightly nicer than the term 'dwarf planet', but also slightly unfair to Eris, the other officially recognized dwarf.

SCORECARD

Irony
Kansas State University's wind erosion lab was blown away by a tornado.

Iron
The rusty metal ranked only sixth in a list of the element names most often mentioned in songs. The top five in the study, which the author admits was more an ode to music and science than a comprehensive analysis, were silver, gold, tin, oxygen and copper.

NUMBER CRUNCH

1 million purpose-made Erector-set pieces are estimated to have been used to build a 'toy' skyscraper at the Rockefeller Center in New York by artist Chris Burden.

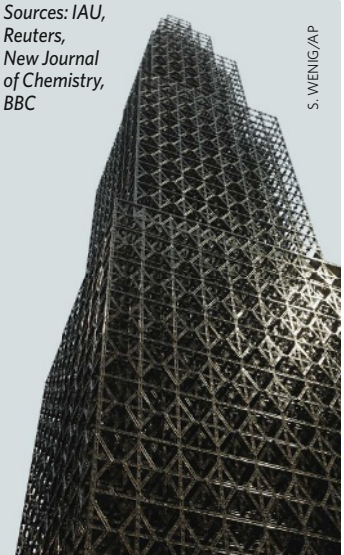
20 metres is the height of the giant building.

7,250 kilograms is its weight.

30 people with screwdrivers were needed to put it together.

1 year was about how long it took them to do it.

Sources: IAU, Reuters, New Journal of Chemistry, BBC



S. WENIG/AP

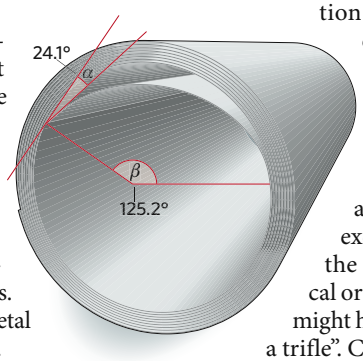
D. WHITEHEAD/CORBIS

Universal law of coiling

Ever noticed that when a piece of paper is rolled into a tube, the innermost part straightens away from the coil before touching down? Try it and see. A team of researchers has investigated this phenomenon and discovered that the precise shape of this rolled-up material is not only surprisingly subtle but also universal.

The angle that the innermost sheet makes with the coiled roll (α in the diagram) is always the same, say Enrique Cerda of the University of Santiago in Chile and his co-workers, about 24.1° — regardless of the thickness of the sheet or the width of the coil[1].

What's more, the angle subtended between this contact point and the place where the sheet first detaches from the coil's inner face (β) is always 125.2°. This universal shape confounds the intuition that stiffer sheets would have a different cross-sectional profile from flimsy ones. Rolled-up carpet, paper or metal will all adopt the same shape.



To prove it, Cerda's team measured the 'touchdown' angle for a thin slab of mica (a sheet-like mineral) and a strip of metal coiled within tubes of various widths. They found that the angles deviated from the predicted 24.1° by no more than about a degree.

"Universal angles have come up before in other situations that involve thin sheets and filaments," says Lakshminarayanan Mahadevan of Harvard University, who was not involved in the work. For example, he and Cerda have previously calculated the universal shapes of flat sheets confined in cylinders by conical deformation, as generated by pushing down on the sheet with a pencil tip[2]. Universal shapes arise, he says, "because of the strong constraints that geometry imposes on the possible deformations".

"This type of constraint occurs in other systems as well," Mahadevan explains. "For example, the characteristic size of a drop that breaks off from a stream of fluid always has a size that is comparable to the filament diameter, irrespective of the material of the fluid."

The work is the kind of basic mechanics that one might have expected to have been done already. It is true that the problem is mathematically daunting, involving the calculation of forces and torques that create mechanical equilibrium in a curved, elastic sheet pressing outwards against a confining tube. But Mahadevan says, "the question could have been addressed a long time ago, except for the fact that some of the equations require numerical or graphical solution — which might have slowed things down just a trifle". Cerda says that the phenomenon was well within the reach of eighteenth-century mathematics, but "it seems no one thought to ask".

The researchers say that analogous shapes should exist for coiled sheets in other confining geometries, such as cones or coiled fibres. The coiling of fibres might be relevant to the packing of DNA inside the protein capsules of viruses, and to the mechanisms of biological structures that provide cellular scaffolding. ■

Philip Ball

1. Romero, V., Witten, T. A. & Cerda, E. *Proc. R. Soc. A* doi:10.1098/rspa.2007.0372 (2008).
2. Cerda, E. & Mahadevan, L. *Proc. R. Soc. A* **461,** 671–700 (2005).