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23. THE SPHERE PACKING PROBLEM

The centuries old problem of the most efficient way to pack spheres has been solved – we think. You’ve seen how the grocer stacks oranges – in a kind of lattice where the next layer sits in the “holes” formed by the layer below and so on. The problem is to find the most efficient way to pack them. Let’s make our definitions clear. We are talking about packing a huge, essentially infinite, volume with spheres (oranges, if you will). This problem was formally posed by Johannes Kepler, the astronomer and sometime cleric in 1611. Kepler posed the grocer’s orange packing as the most efficient. Obviously, there are spaces between the spheres, but the overall *density* of spheres is about 0.74. Stacking layers of spheres, one directly atop the other gives the much lower density of about 0.52.

Closest packing of spheres

This is a difficult problem that was reduced by Lazlo Toth in 1953 to a huge calculation on many specific cases. University of Michigan mathematician, Thomas Hales, developed in 1994 a five step plan to make the calculations suggested by Toth, and over a period of several years carried them out. The proof involves 250 pages of text and about 3 gigabytes of computer programs and data.

But is it really solved? Hales’ proof has been extremely difficult to verify. The published version of the proof will have the *unusual* editorial note stating parts of the paper have not been possible to check. Even still, a team of 12 reviewers worked hard for four years to verify the proof. The reviewers say they are almost certain it is correct.

LINKS

Sphere packing: <http://mathworld.wolfram.com/SpherePackina.html>
Kepler: <http://scienceworld.wolfram.com/biography/Kepler.html>