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Iterative Arrangements of Polyhedra – Relationships to Classical Fractals and Häüy Constructions.

In a previously described structure, half-scale cubes were iteratively arranged around a central cube to yield a complex fractal “crystal” with a regular-octahedron convex hull and infinitely many “facets”, each of which is essentially a Sierpinski triangle. In the present work, a Sierpinski triangle is shown to arise whenever half-scale polyhedra are iteratively arranged on three faces meeting at a vertex with three-fold rotational symmetry. In contrast, a regular array results when half-scale polyhedra are iteratively arranged on four faces meeting with four-fold rotational symmetry. These facts are used to predict which such arrangements will yield esthetically-pleasing results. The convex hulls of such constructs are the duals of the starting polyhedra for a variety of polyhedra. These arrangements can be thought of as Häüy constructions using a scaling factor of one half rather than one. One half is shown to be a special number for such scalings. When arrangements are made about vertices with five or six faces meeting with rotational symmetry, scaling factors of the square of the Golden mean and one third, respectively, result in fractals that can be described as a Sierpinski pentagon and a Sierpinski hexagon, the latter exhibiting Koch curves. (Received September 21, 2012)