RID – a love story

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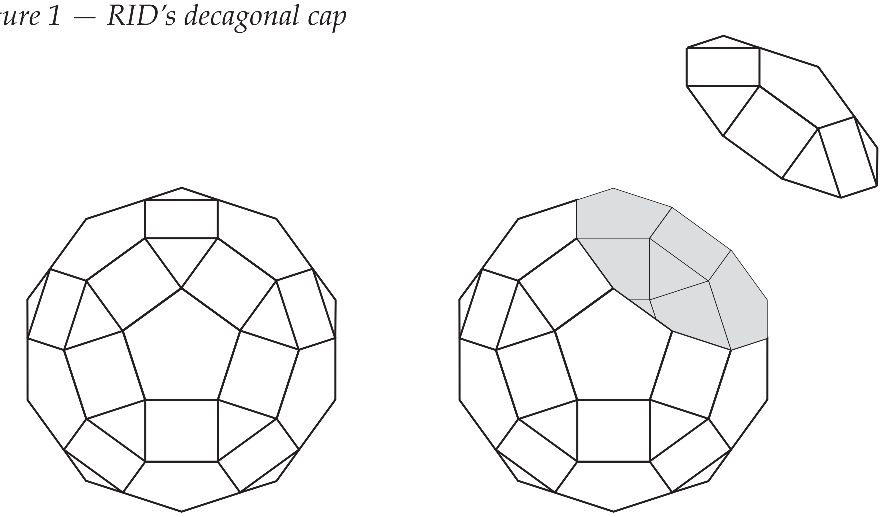
I have often associated with the rhombicosidodecahedron (RID). First in 1964 in Zurich, when Holly built one out of plastic toy panels that snapped together at their corners, and later when Zometool molded millions of these for their model hubs. These polyhedra are composed of 12 pentagons, 20 triangles, and 30 rectangles. They can be found within regular dodecahedra and icosahedra by truncation. The shape is notable for five-fold rotational symmetry.

The flexible flat plastic parts with snap-together corners were unremarkable until formed into shapes such as the RID. I was so captivated by this shape I made many with bristol board using a sharp knife and glue.

My attitude — formed as with all of us by our industrialized world of right angles and cubes — did not mean I had no interest in other polyhedra. I bought a copy of *Convex Figures and Polyhedra* by L A Lyusternik (Dover). Despite studying other symmetries my mind looked out of a box. In contrast soap bubbles are spheres and fuse with 120° angles. They are fascinating and familiar alternatives to cubes. Like bubbles, two RIDs could be joined by cutting off a decagonal cap, then joining them at the decagons.

Figure 1 — RID's decagonal cap

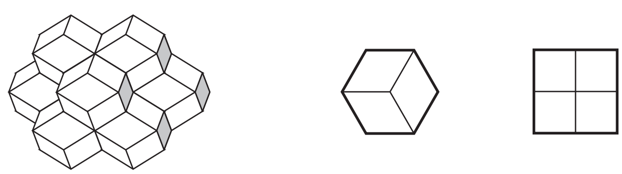


I was so enthralled by these forms, I assumed they were merely clumsy bubbles. Only later did I realize that these polyhedral bubbles did not fit. The fusing angles were not a perfect 120° as with the soap bubbles, but irrational angles of 116.56505°. This was cause for grief, betrayal by nature, by geometry. This was new for me. An uneven student, I was alternately excited and discouraged by science and mathematics, yet I had not encountered such disappointment in private investigations.

One solution for me with these irrational polyhedra was to fudge, to bend cardboard until the parts could be taped together. I knew better, calculated and noted the correct figures. What frustration! These polyhedra were off by a few degrees, and I had to make them fit. This bothered me, but I was so excited I didn't slow down and think for a couple of years.

Let me defend such excitement, such misunderstanding as first steps. This is OK as long as they are corrected by further study or experience. What sense is there in knowing something or making something if you can't be excited? Even if you turn out to be wrong, how else can you live? Soon after dismay and grief over the pentagonal dodecahedron and its 116.56505° dihedral angles (Marc Pelletier reports a similar shock on finding the regular icosahedron could not be formed with 20 regular tetrahedra joined at the center), I became acquainted with the *rhombic dodecahedron*. This is a zonohedron with 120° dihedral angles and perfect packing. The cell of a beehive.

Figure 2 — Rhombic Dodecahedron
single space filler, with a hex profile and a square profile



Despite now knowing better I would not give up my mistaken fudging of the regular dodecahedron just as I don't regret 3 years in the US Army. Some things are imperfect, and knowing this is essential. An end to fudging, to extending faces as we did in the Drop City triple fused cluster of RIDs, came with zonohedra, as the rhombic dodecahedron. One breeds them to fit perfectly. They are constructed of lines and planes that have no choice.

My disappointment with regular pentagonal dodecahedra or Pelletier's with its dual the icosahedron cannot happen. Of course the failure of 12 regular dodecahedra to pack about a thirteenth, or 20 tetrahedra to fit together in an icosahedron remains, but let's find another way to use their symmetries. Switching from dismay over what they can't do to appreciate what they can is a choice I recommend. Don't tell the icosahedron or the dodecahedron what they should be.

Figure 3 — Three dodecahedra sharing an edge

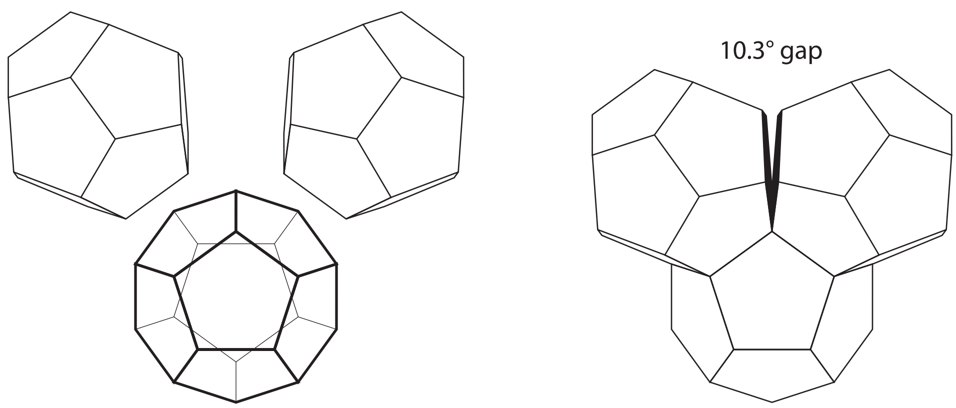
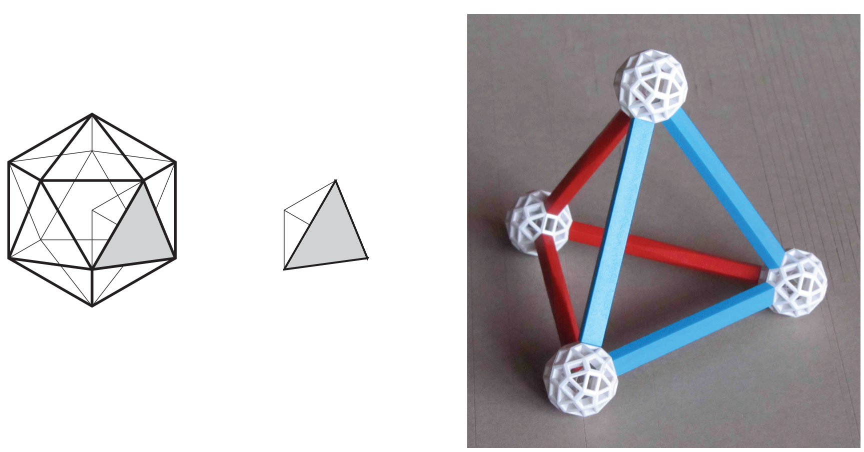


Figure 4 — Twenty tetrahedra fill the icosahedron. Unfortunately, they are not regular. The icosahedron's edge is 5% longer than its radius.



Accustomed to one orthogonal system East West, North South, up and down, the Zometool user takes flight out of the nest with five interwoven orthogonal systems and more. This is a tool for enlightenment, for beauty, for understanding and not for proofs. One needn't prove beauty.

I turned away from a frustrating misunderstanding of the icosahedron and dodecahedron with their uneven pentagons and triangles to follow the 1937 work of Gerhardt Kowalewski. Though he claimed it was only a game, his *Bauspiel*, Kowalewski saw what others didn't, that Johannes Kepler's triacontahedron was a zonohedron (despite its 5-fold symmetry), and as such it decomposes into other perfect-fit zonohedra — something we were accustomed to doing with right angles and cubes. He demonstrated that the cube is but one of many forms that decompose, and so suggested what we were to do some 30 years later. Mixing games and abstractions we grasped forms because they were decorative, and so were guided to a geometric revelation. The geometric revelation is apparent when using the Zometool. It does not resolve the mind-body problem, only expands it. Let's hear it for the body, the fingers, and the plastic parts of the Zometool.

The Nobel Prize is given to thinkers. Kroto, Curl, Smalley, Hoffman, Fukui, Schectman thought about five-fold symmetry and the icosahedron. Fortunately, the same frontier they crossed with their minds can be demolished with the fingers and the Zometool. This shape- and color-coded system springs from the rhombicosidodecahedron (RID). There is no fudging, no bending, all perfect angles, perfect lengths.

Hey Kepler, check this out. Look what we found centuries later in your triacontahedron.

Figure 5 — Kepler's Rhombic Triacontahedron

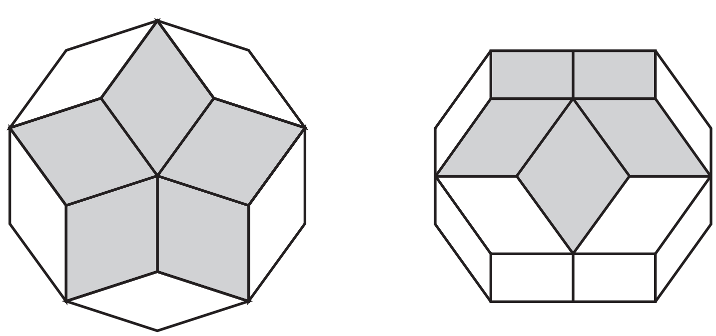
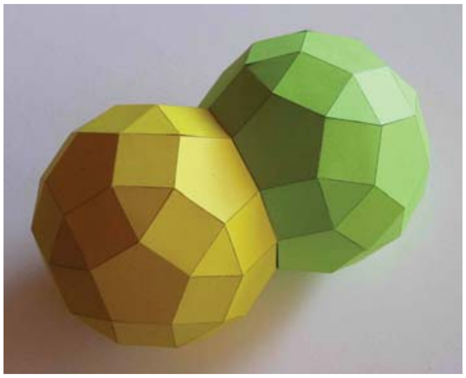


Figure 6 — Gap created by 3 fused RIDs



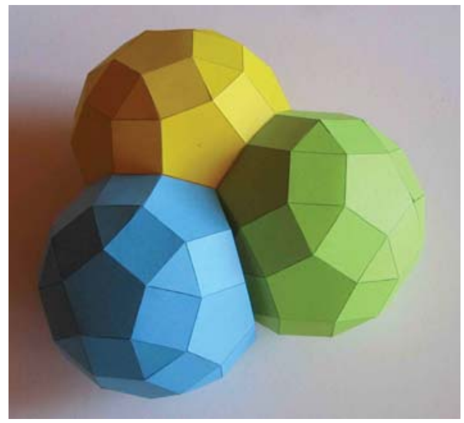


Figure 7 — The Drop City Trio of Fudged RIDs