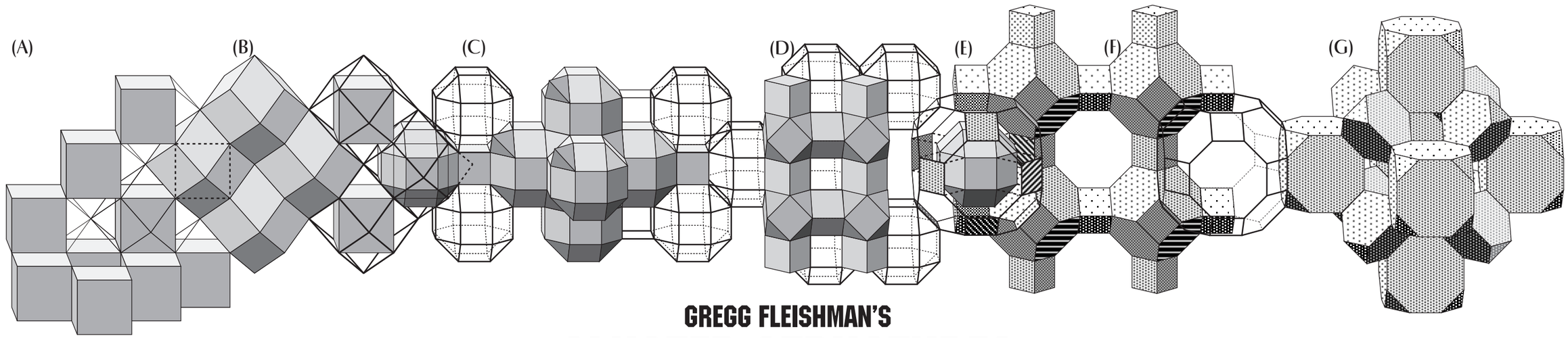
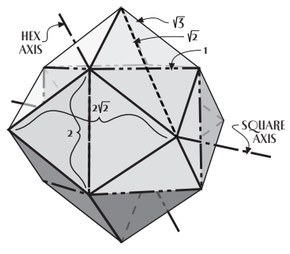
THINK BIG



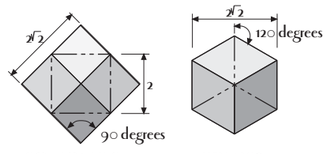
GREGG FLEISHMAN'S
CLUSTER-STRUCTURES
THE FUTURE OF BUILDING

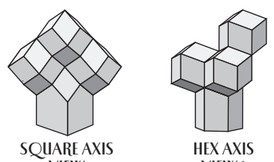
(A)
Imagine a checkerboard where the black squares are solid cubes and the white squares are empty cubes. Then place another layer on top with the solid cubes on top of the empty cubes, etc. This could be called a 3D checkerboard. Now draw four lines diagonally in the empty cubes. These all intersect at the centers and form pyramidal shapes off each face. If you expand the solid cubes into the pyramidal shapes adjacent to each face, you form modules with twelve diamond shaped faces we call the RHOMBICUBE. Originally called a Rhombic Dodecahedron, it is classed as a "Catalan" solid first described by an 18th century Flemish mathematician of that name.



The RHOMBICUBE
Rhombic Dodecahedron

(B)
Because the faces of these RHOMBICUBES are aligned at 45 degrees to the original cube faces, the exact dimensions of the faces can be determined easily by utilizing the PYTHAGOREAN THEOREM. Note that if we have constructed the diamonds using a two (2) unit cube, the short axis of each diamond is 2, the long axis is $2\sqrt{2}$ and the edge length is $\sqrt{3}$. Another interesting property of the module is that there are two orientations where cross sections result in regular square or hexagonal grids.





(C)
When the points are cut off of the diamond faces uniformly, we have the TRUNCATED RHOMBICUBE (small rhombicuboctahedron). In addition to the twelve square faces in place of the diamond faces we have six square faces that relate to the original cube faces and eight triangles that occur inward from the original cube corners making a total of 26 faces. This form is classed as an Archimedean Solid, in which the faces are different though regular while the vertices are identical. It was rediscovered in the 15th century by Pacioli and even drawn by Leonardo. In the 20th century, post Buckminster Fuller, it was shown by several people that the TRUNCATED RHOMBICUBE, when placed in the 3D array, nests with others like itself plus a variety of similarly configured forms. In the basic checkerboard array it nests with cubes (C) and tetrahedrons (T).

This family of shapes, including the other different combinations following in Sections (D) thru (G) are called "Space Fillers" and were first comprehensively compiled by Robert E. Wilson in his "Handbook of Structure Part I: Polyhedra and Spheres", 1968, from Douglas Advanced Research Laboratories. The first TRUNCATED RHOMBICUBE by Fleishman dates to 1972. It was transformed to a rhombic dodecahedron and subsequently used in space filling arrays in 1995.

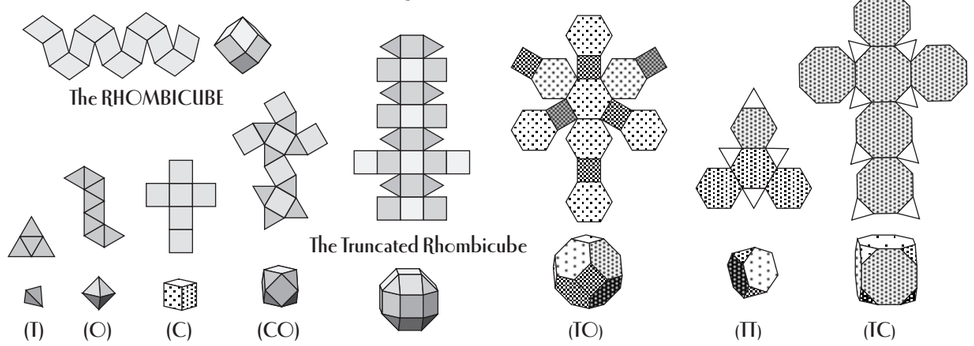
(D)
When the TRUNCATED RHOMBICUBES are placed as if the original solid cubes are more adjacent to one another, the smaller cubes occur off the angled faces and different larger fourteen faced forms with six squares and eight triangles, cuboctahedrons, now occur off the corners in between. The drawing indicates a framelike superstructure of these smaller forms when the larger T RHOMBICUBES are left as voided areas in between.

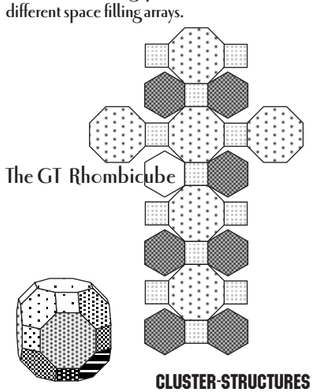
(E)
If we turn the six cubic faces of the TRUNCATED RHOMBICUBE into octagons and the eight triangle faces into hexagons we arrive at the GT (GREAT TRUNCATED) RHOMBICUBE. Notice how the twelve angled squares remain, but are spaced apart as if cubes had been inserted. This form also has 26 faces, the same as the TRUNCAED RHOMBICUBE.

(F)
The GT RHOMBICUBE can also be placed in either the tightly adjacent array or the checkerboard array as before. In the adjacent array (F) the small cubes again fit in between at the edges but a second fourteen faced form, a truncated octahedron (TO), fits at the corners. Again note that the drawing indicates a framelike superstructure with the larger GT RHOMBICUBES left as voided areas in between.

(G)
In the checkerboard array the spaces at the corners are filled with an eight faced form (TT), a truncated tetrahedron, and the originally empty cube spaces become a third fourteen faced form, a truncated cube (TC), with six octagons and eight triangles. If the hexagonal panel of the TT becomes a triangle, the TC's will meet edge to edge and octagons will fit in between. Including prisms, Wilson lists 20 different space filling arrays.

Forms of the RHOMBICUBE based cluster-structures





CLUSTER-STRUCTURES