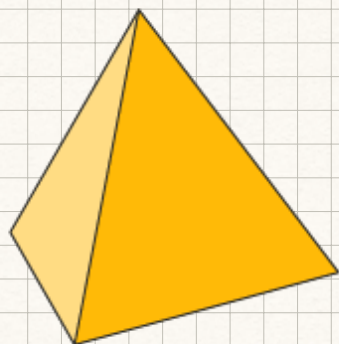
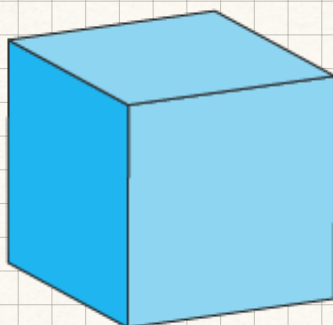


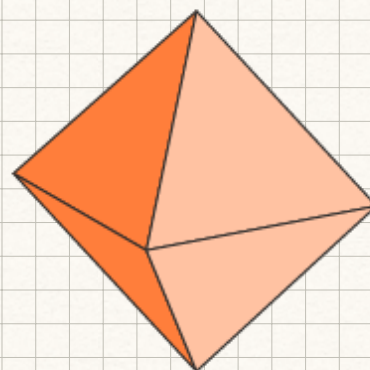
Platonic Solids



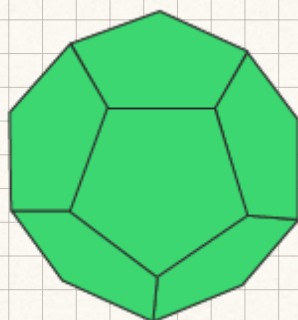
Tetrahedron



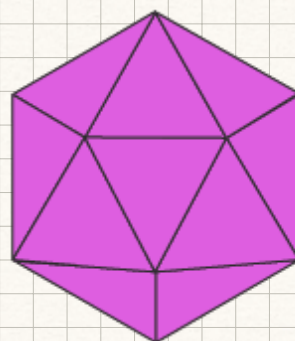
Cube



Octahedron



Dodecahedron



Icosahedron

Discussion Points on Polyhedra Activity

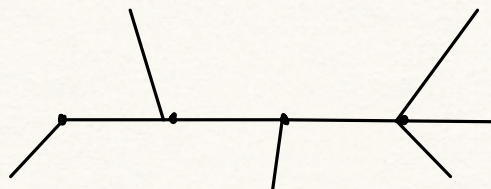
Mathematics Education 322---Modern Geometry

Dr. Barry Peratt

Directions: Below are a set of questions that arose during one class's exploration of the polyhedra. Most of these points would never have arisen because I would not have thought of them, had we not spent class time constructing the polyhedra. Another way to view this is as a list of concepts and facts that the students would most likely not have learned had they not been given the experience to construct the polyhedra but simply relied on me to think of every possible topic that should have been covered in this unit. Finally, note that most of the following topics can be meaningfully discussed in class because everyone in the class now has a common "experiential base" to use as a reference point for these ideas.

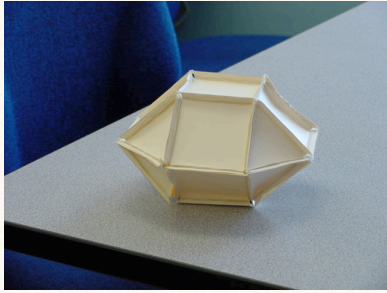
Issues that Arose in Class:

1. Can we construct polyhedra that use 3 different types of faces? (XIV) 3, 4, 7, 4 vs. 3², 4²
2. What does it mean, exactly, to say that each vertex configuration is "the same"? Are there some cases in which our notation limits our thinking? (II, XII, XIII, N, O)
3. Do regular and semi-regular polyhedra need to be convex? (I, III, IV, IX, X, XIV, XV, P, Q, R)
4. Is it easier to construct the polyhedra with the rubber bands on the inside or outside?
5. What is the easiest way to count the edges of a polyhedron?
6. For practical purposes, what happens when a corner has a defect of 0 degrees?
7. What kind of polyhedron can be built with all hexagons, ~~Mark?~~ Jack?
8. Can a vertex of pentagons have a defect of 0 degrees?
9. Can you create a vertex with a negative defect?
10. Can you fit seven triangles around a vertex?
11. If faces are offset, i.e. if one edge is shared by more than one face, would we still count this as a polyhedron?
12. If we put several polygons together to form one face, would we still count this as a polyhedron?
13. Do the faces of a polyhedron need to be flat? (III, V, VI)

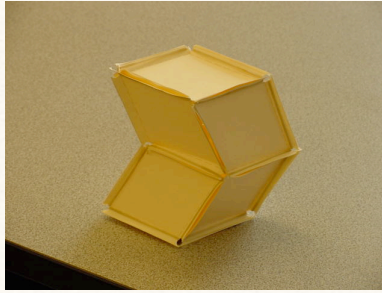


Polyhedra from the Class in Question

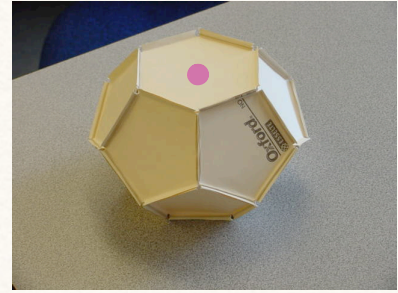
I



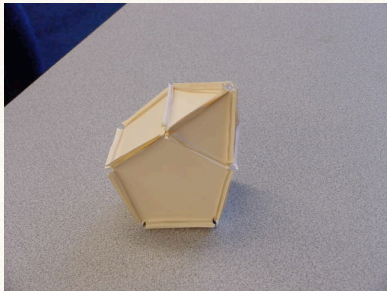
II



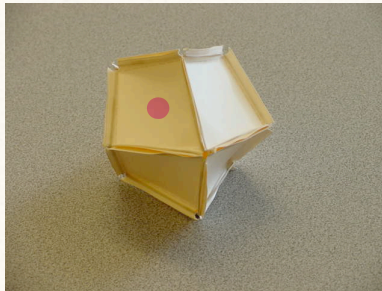
III



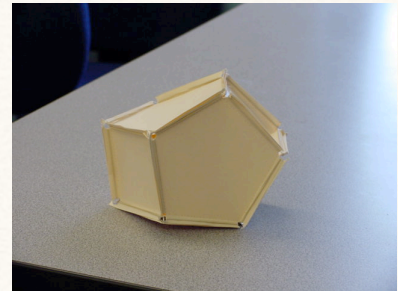
IV



V



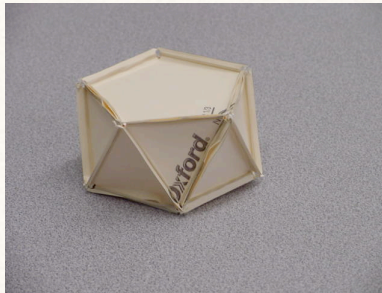
VI



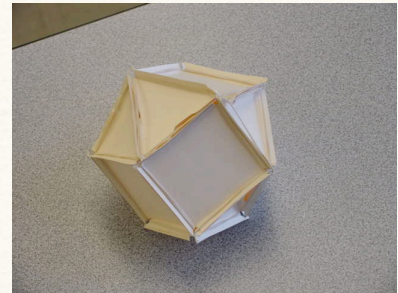
VII



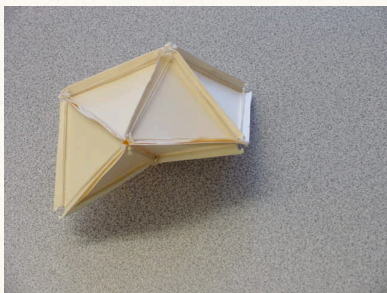
VIII



IX



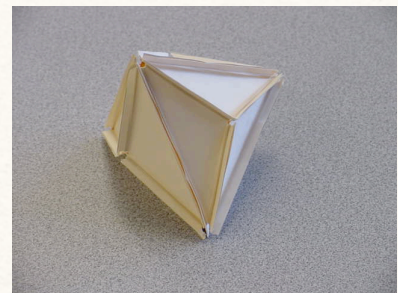
X



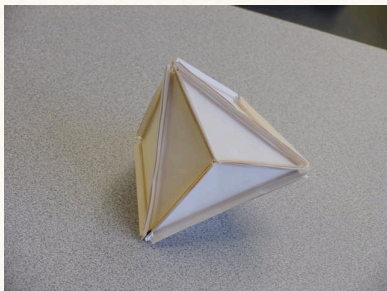
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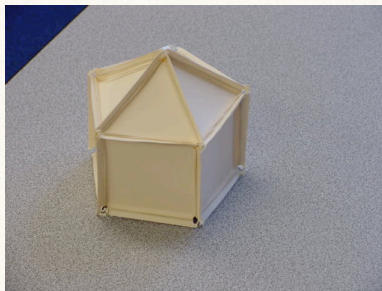
XII



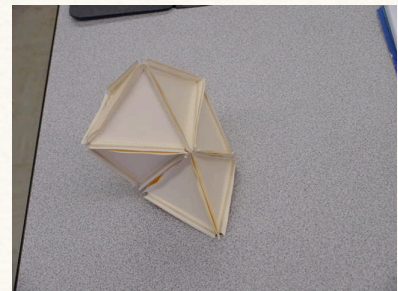
XIII



XIV



XV

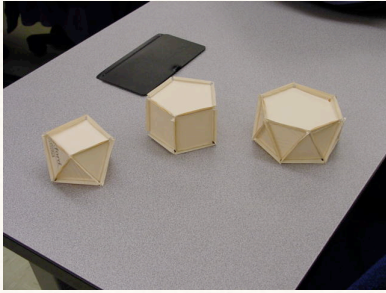


Issues that Arose in Other Years:

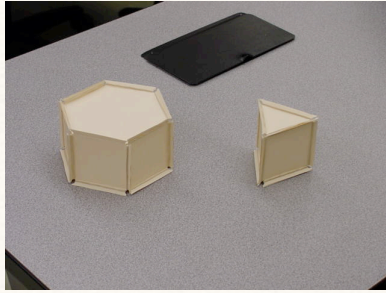
1. Can rhombuses be used to make drums (prisms and anti-prisms)? (A, B, C, D)
2. Is it possible that a certain vertex configuration can be constructed, but that it cannot be used to make a polyhedron? (5.5.4)
3. Are the criteria for regular and semi-regular solids redundant? That is, if we require all faces to be regular and all faces to be the same, won't the vertex configurations automatically be the same? (E, F, G, H)
4. Similarly, if we require that all faces be regular and that only two types of faces be used, won't the vertex configurations automatically be the same? (I, J, K, L, M)
5. When constructing a polyhedron of, say, all triangles, can't we just keep adding triangles forever?
6. If we allow irregular polygonal faces, is the number of polyhedra that we can build infinite?
7. Did you see that the icosahedron (vertices 3^5) consists of two pentagonal caps and a band of ten triangles?
8. Consider the following criteria:
 - Regular Polyhedron:** faces are regular polygons, faces are congruent, vertex configurations are the same.
 - Deltahedron:** faces are regular polygons, faces are congruent.
 - Semi-Regular Polyhedron:** faces are regular polygons, vertex configurations are the same.
 - Semi-Regular Duals:** vertex configurations are the same.How many semi-regular polyhedra are there?
9. Why is the cuboctahedron appropriately named?
10. Did you notice that many of the irregular polyhedra can be obtained by slicing off the corners of the regular polyhedra?
11. Did you notice that a cheap way to make irregular polyhedra is to construct "drums" whose top and bottom are any type of regular polygon and whose sides consist of triangles or squares?
12. Can you find the **cube inscribed in the dodecahedron?**
13. Can you find a **cross-section of a tetrahedron that is a square;** i.e., can you wrap a rubber band around the tetrahedron so that the rubber band is in the shape of a square?
14. Can you find a cross-section of a **cube that is a hexagon?**

Polyhedra from Other Years

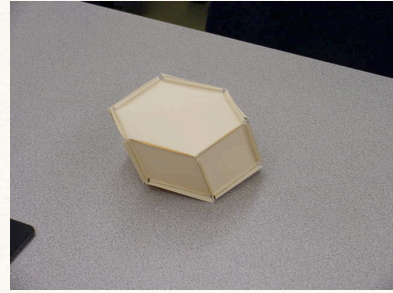
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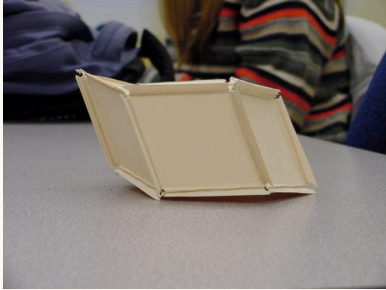
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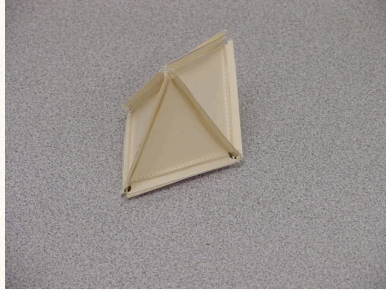
C



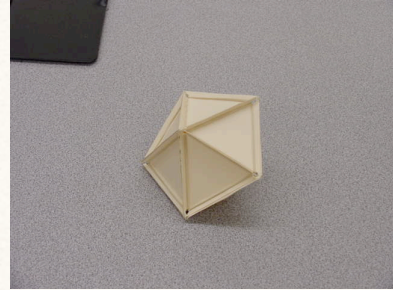
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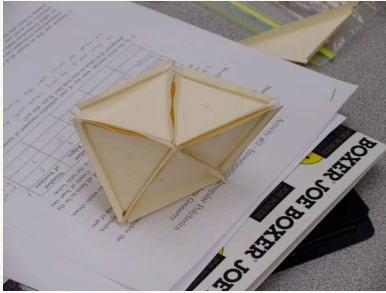
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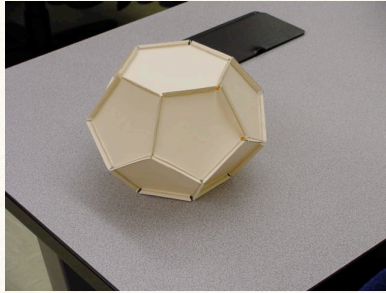
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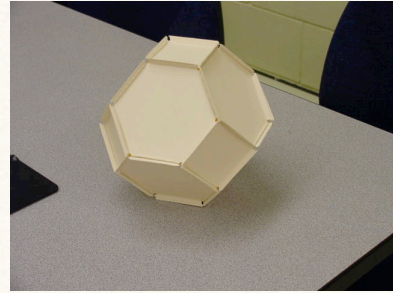
G



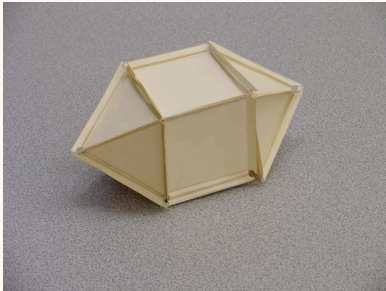
H



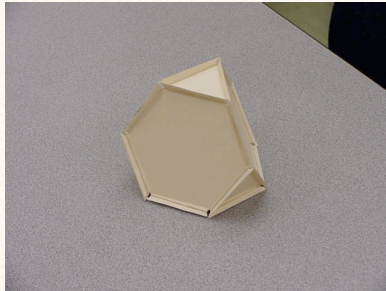
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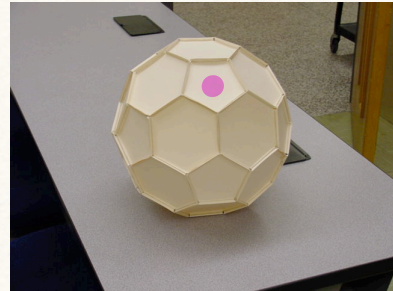
J



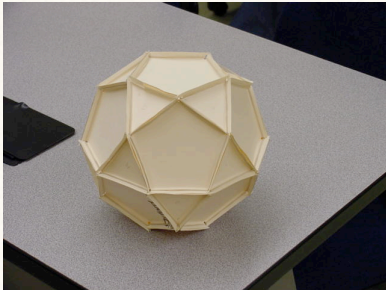
K



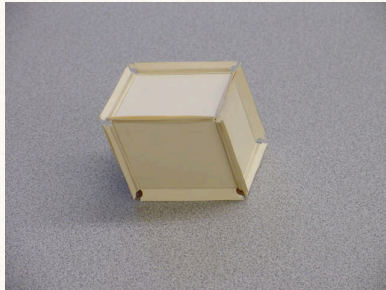
L



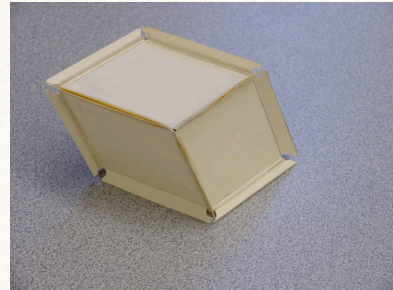
M



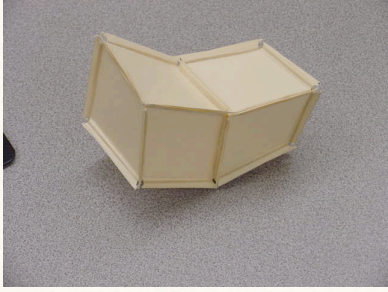
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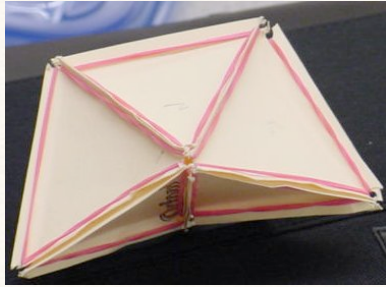
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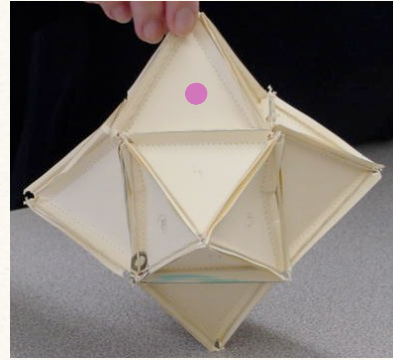
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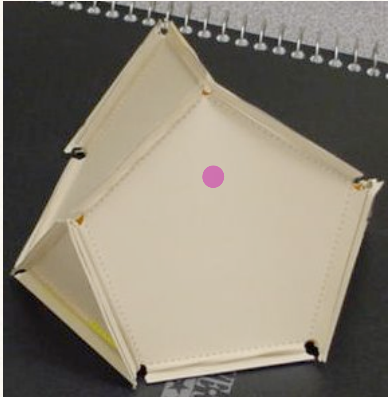
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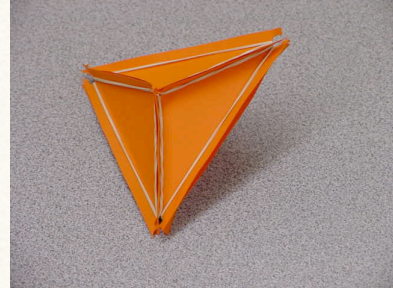
R



S



T

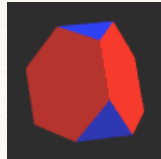


PLATONIC SOLIDS---REGULAR POLYHEDRA



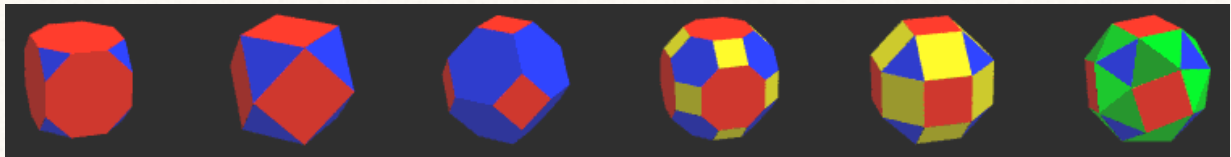
Tetrahedron Octahedron Icosahedron Hexahedron Dodecahedron

ARCHIMEDEAN SOLIDS---SEMI-REGULAR POLYHEDRA

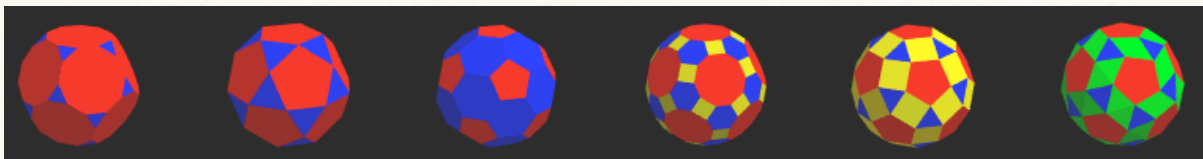


(SLICE)

Truncated Tetrahedron



Truncated Cube Cuboctahedron Truncated Octahedron Great Rhombicuboctahedron Rhombicuboctahedron Snub Cube



Truncated Dodecahedron Icosidodecahedron Truncated Icosahedron Great Rhombicosidodecahedron Rhombicosidodecahedron Snub Dodecahedron



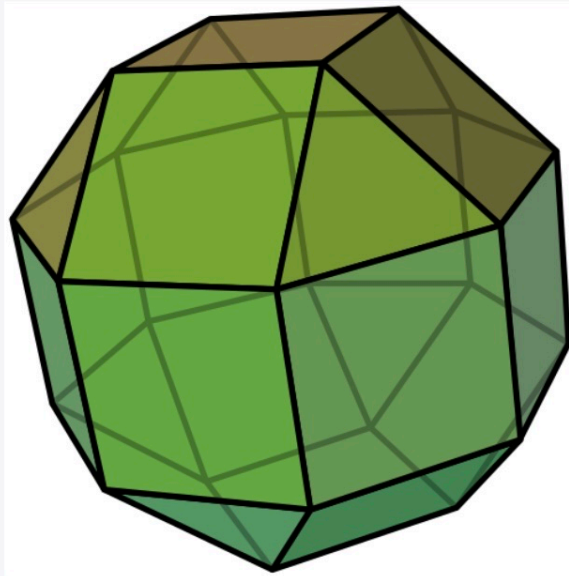
Infinite Class of Prisms



Infinite Class of Antiprisms

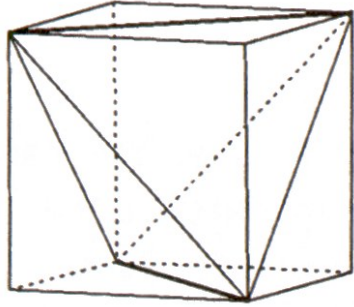
In **geometry**, the **elongated square gyrobicupola** is a polyhedron constructed by two **square cupolas** attaching onto the bases of **octagonal prism**, with one of them rotated. It is a **canonical polyhedron**. It is not considered to be an **Archimedean solid** because it lacks a set of global **symmetries** that map every vertex to every other vertex, unlike the 13 Archimedean solids. However, it was once mistakenly considered a **rhombicuboctahedron** by many mathematicians. For this reason, it is also known as the **pseudo-rhombicuboctahedron**, **Miller solid**,^[1] or **Miller–Askinuze solid**.^[2]

Elongated square gyrobicupola

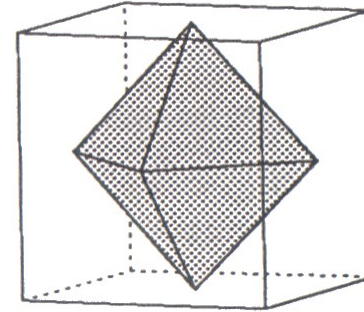


Type	Canonical, Johnson $J_{36} - J_{37} - J_{38}$
Faces	8 triangles 18 squares
Edges	48
Vertices	24
Vertex configuration	$8 + 16(3 \cdot 4^3)$
Symmetry group	D_{4d}
Dihedral angle (degrees)	square-to-square: 135° square-to-triangle:

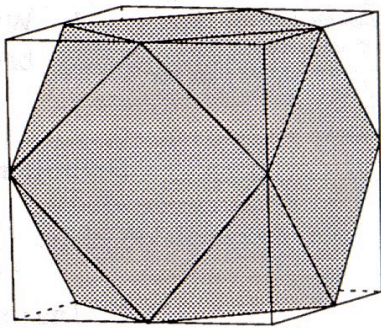
Examples of Polyhedra Inscribed in Other Polyhedra



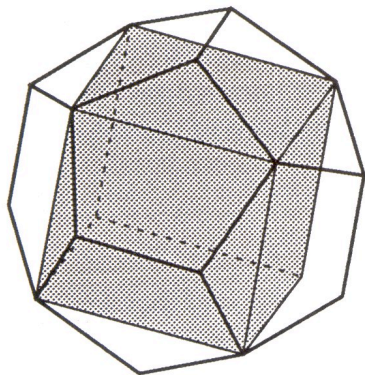
Tetrahedron Inscribed in a Cube



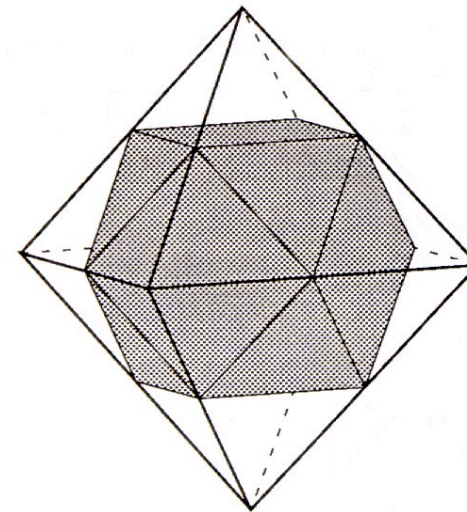
Octahedron Inscribed in a Cube as Its Dual



Cuboctahedron Inscribed in Cube



Cube Inscribed in a Dodecahedron



Cuboctahedron Inscribed in an Octahedron

Platonic Solids
from
different
points of view

truncated dodecahedron

T_5

Symbol $t\{5,3\}$

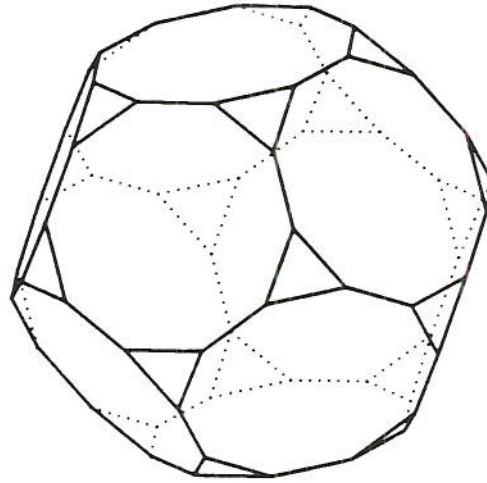
Dual triakis icosahedron

42 Faces $30\{3\} 12\{10\}$

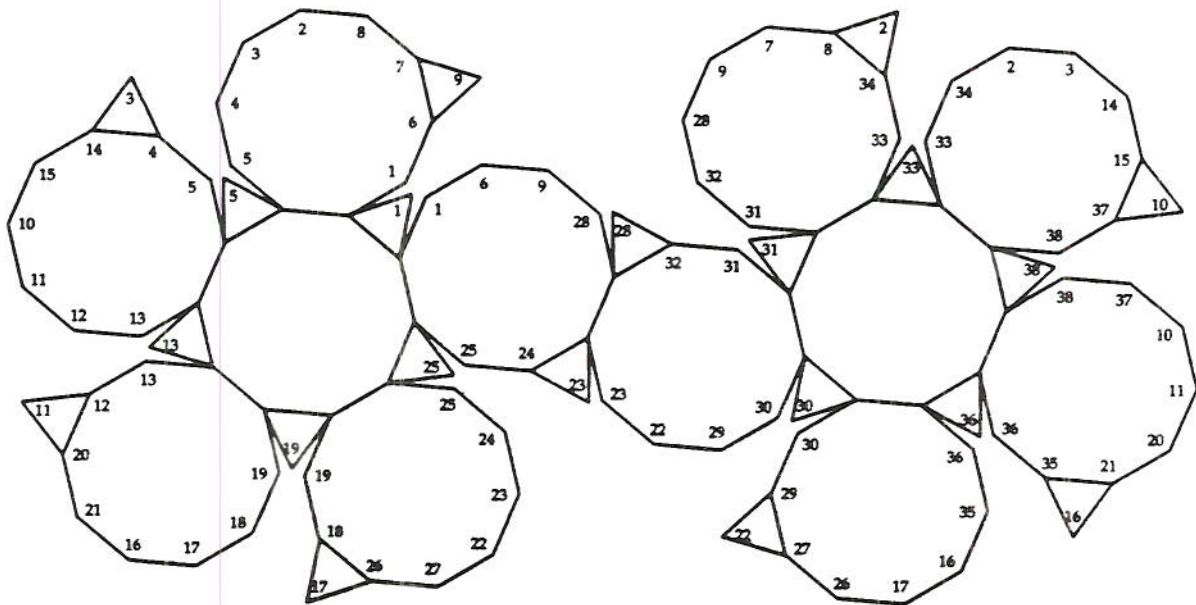
60 Vertices $60(3.10^2)$

90 Edges

Edge		Dihedral
$60\langle 3.10 \rangle$	B_5	$142^\circ 37' 21''$
$30\langle 10.10 \rangle$	D_5	$116^\circ 33' 54''$

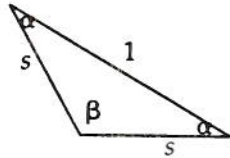
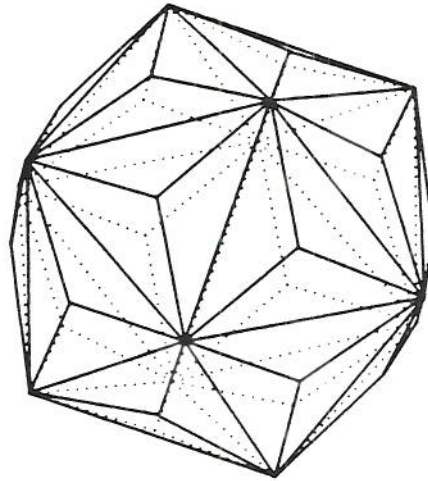


Net



triakis icosahedron $V3.10^2$

Dual truncated dodecahedron
60 Faces



$$\alpha = \cos^{-1} \frac{15 + \sqrt{5}}{20}$$

$$= 0.53198\ 20207\ 41966\ 09563\ (30^\circ\ 28'\ 49'')$$

$$\beta = \pi - 2\alpha$$

$$= 2.07762\ 86121\ 05861\ 04718\ (119^\circ\ 2'\ 22'')$$

$$s = \frac{10}{15 + \sqrt{5}}$$

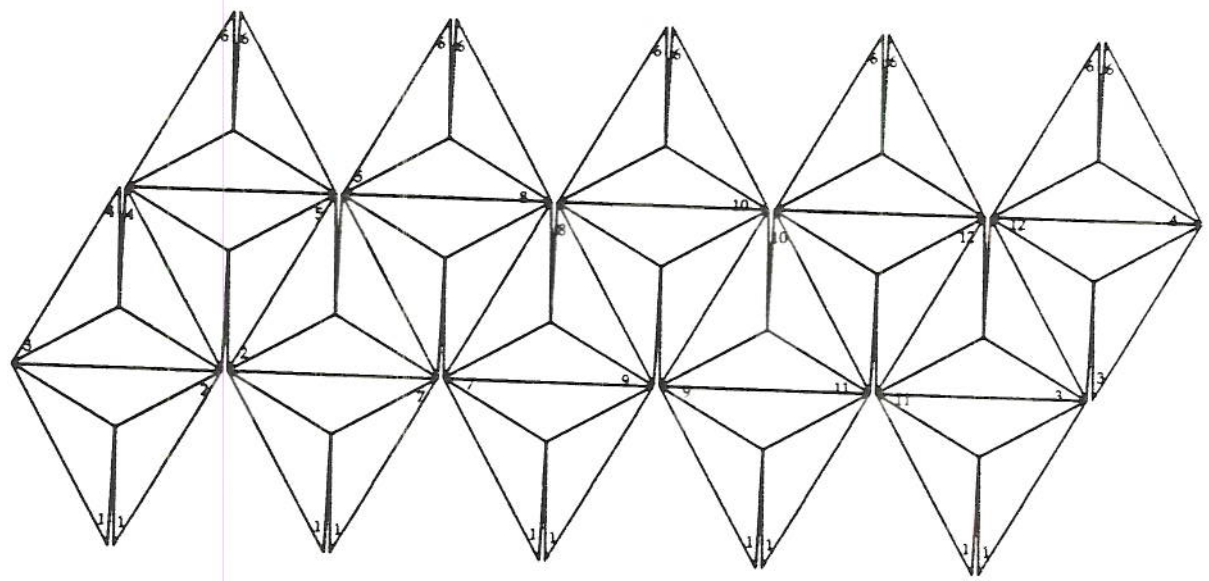
$$= 0.58017\ 87282\ 95464\ 10470$$

42 Vertices $30(F^3)\ 12(F^{10})$
90 Edges

$$\psi = \cos^{-1} \frac{-3(8 + 5\sqrt{5})}{61}$$

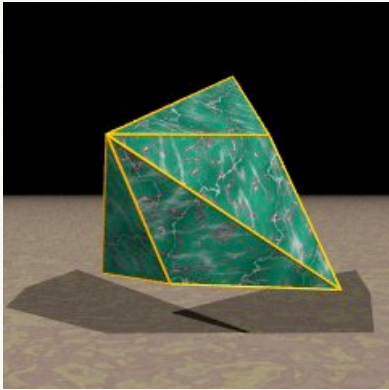
$$= 2.80321\ 78560\ 84805\ 96210\ (160^\circ\ 36'\ 45'')$$

Net

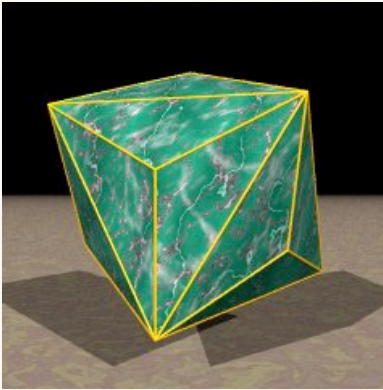


ARCHIMEDEAN DUALS

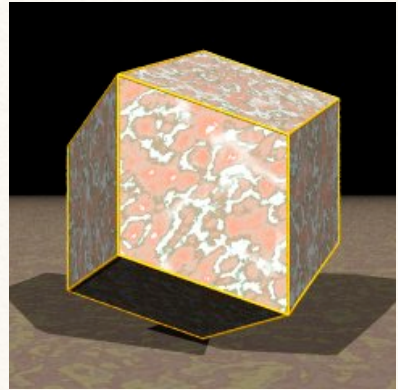
(Different V, Same F, Irregular Polygons) + TOY



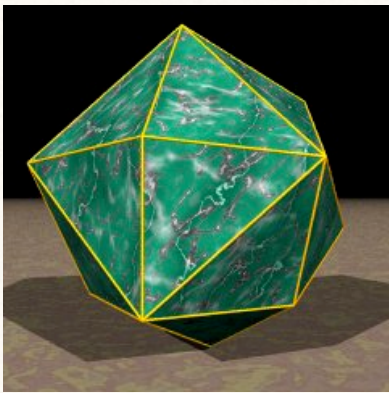
Triakistetrahedron
(Dual: Truncated Tetrahedron)



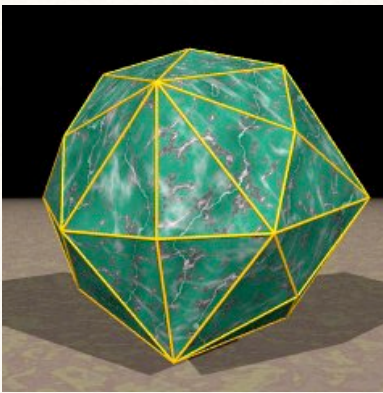
Triakisoctahedron
(Dual: Truncated Cube)



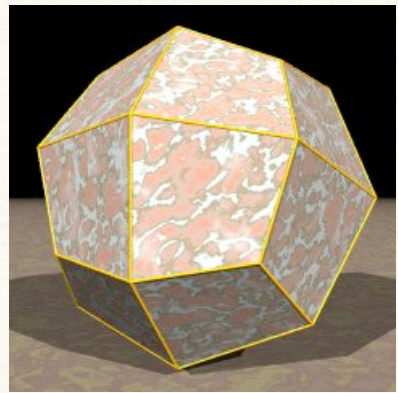
Rhombic Dodecahedron
(Dual: Cuboctahedron)



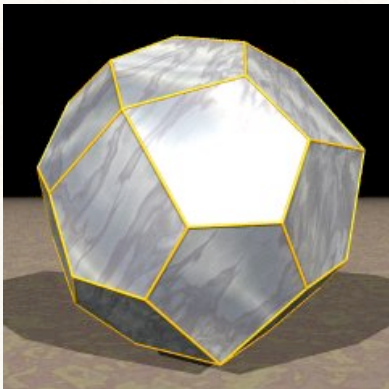
Tetrakisshexahedron
(Dual: Truncated Octahedron)



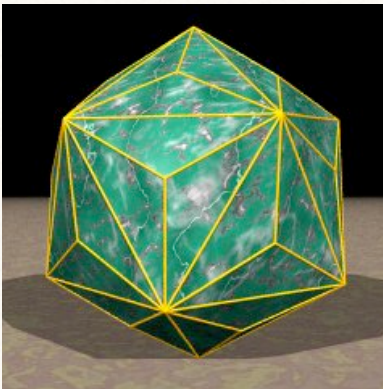
Disdyakisdodecahedron
(Dual: Great Rhombicuboctahedron)



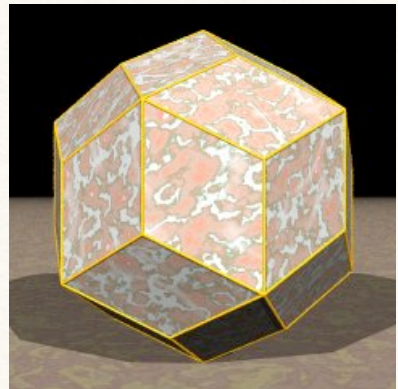
Deltoidal Icositetrahedron
(Dual: Rhombicuboctahedron)



Pentagonal Icositetrahedron
(Dual: Snub Cube)

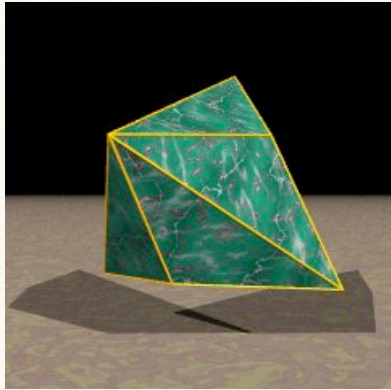


Triakisicosahedron
(Dual: Truncated Dodecahedron)

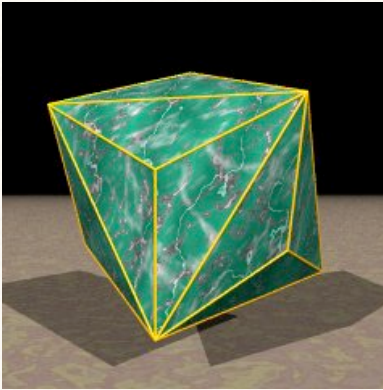


Rhombic Triacontahedron
(Dual: Icosidodecahedron)

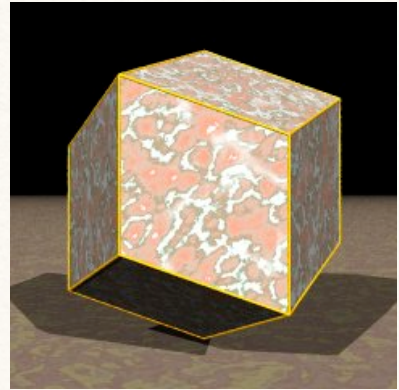
ARCHIMEDEAN DUALS



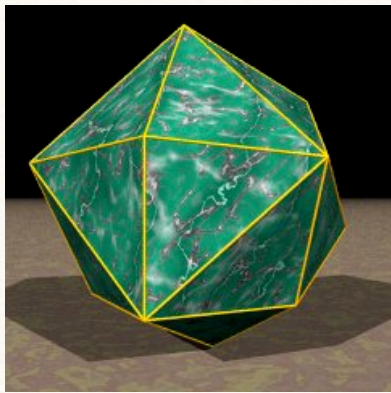
Triakistetrahedron
(Dual: Truncated Tetrahedron)



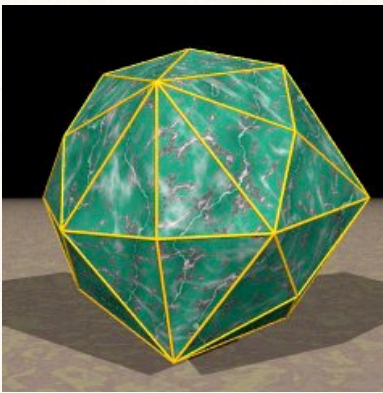
Triakisoctahedron
(Dual: Truncated Cube)



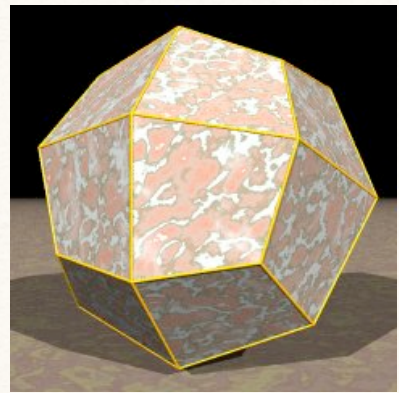
Rhombic Dodecahedron
(Dual: Cuboctahedron)



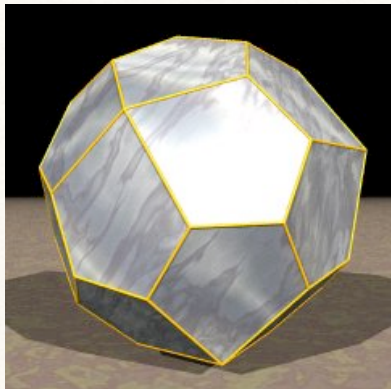
Tetrakisshexahedron
(Dual: Truncated Octahedron)



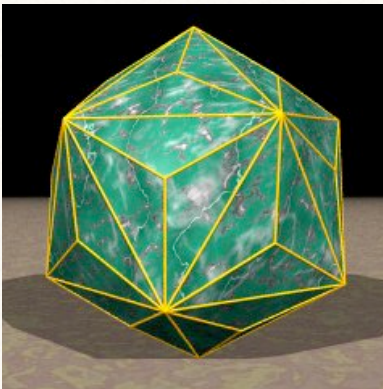
Disdyakisdodecahedron
(Dual: Great Rhombicuboctahedron)



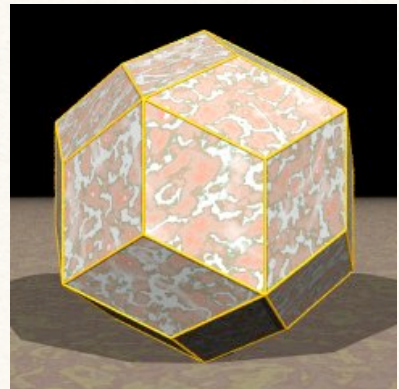
Deltoidal Icositetrahedron
(Dual: Rhombicuboctahedron)



Pentagonal Icositetrahedron
(Dual: Snub Cube)



Triakisicosahedron
(Dual: Truncated Dodecahedron)



Rhombic Triacontahedron
(Dual: Icosidodecahedron)

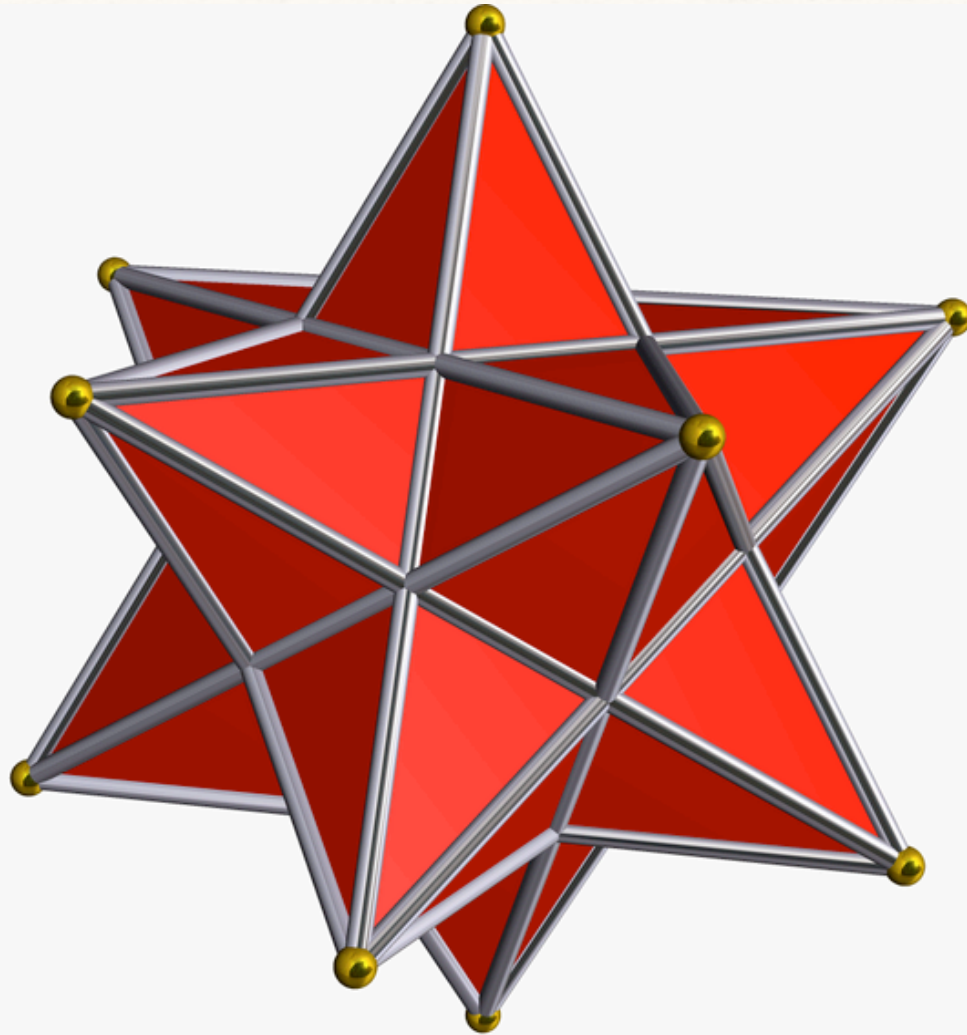
Stellated Polyhedra

Here is a stellated rhombicuboctahedron. Rather than simply extending the faces, a taller pyramid-like structure is placed on each face. The result is a beautiful stellar object that is traditionally used by the Moravians (a denomination of Christians originating in Moravia, a slavic country bordering Poland).



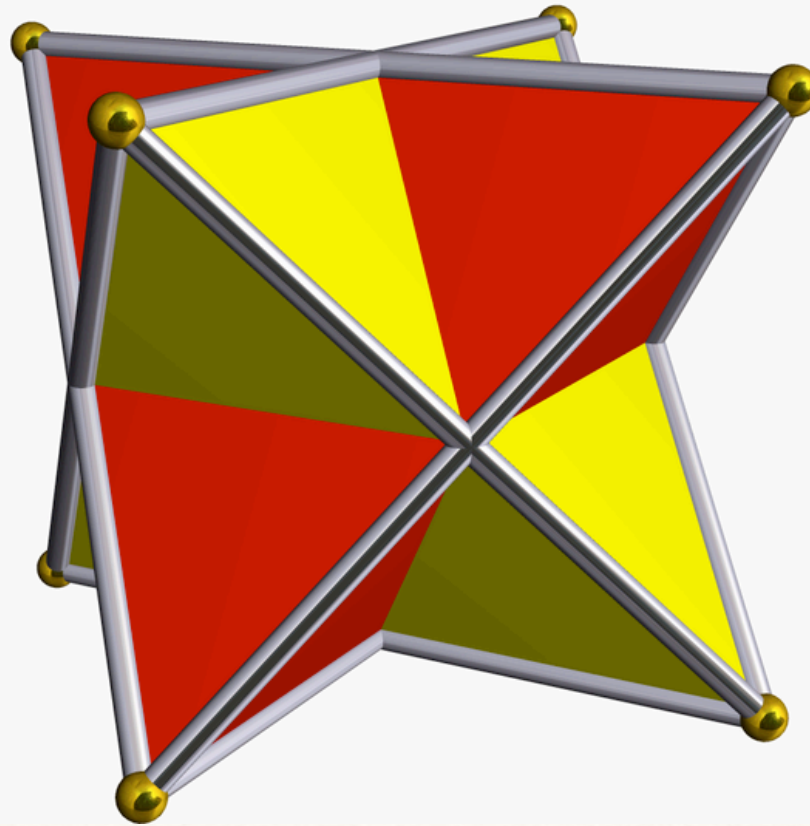
Stellated Polyhedra Solids

Properly, stellation is accomplished by extending the sides of an existing polyhedron until they intersect to form “pyramid-like” solids atop each face. Often, the polyhedra which result can be interpreted as compound polyhedra – i.e. two inter-penetrating polyhedra.

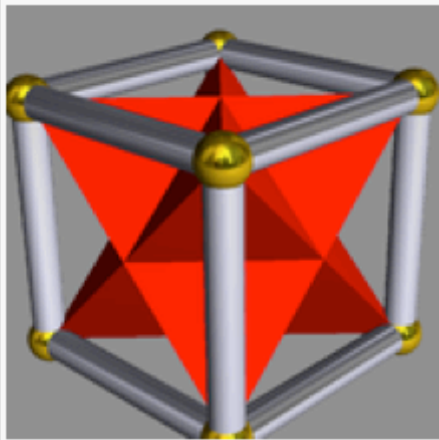


Stellated Polyhedra

Named after Kepler, the stellated octahedron is also called the “Stella Octangula.” It can be viewed as two inter-penetrating polyhedra, but is also has a relationship to the dual of the octahedron, which is the cube, as shown on the next page.

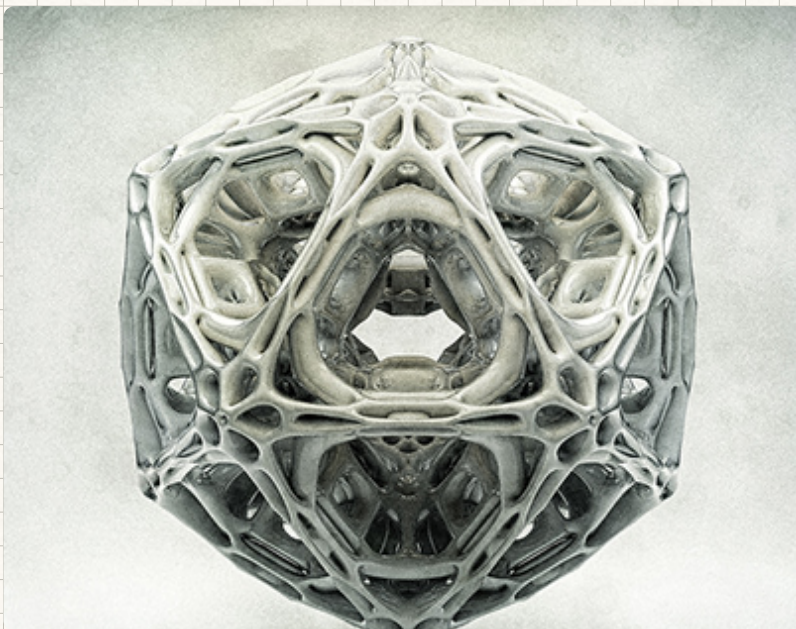
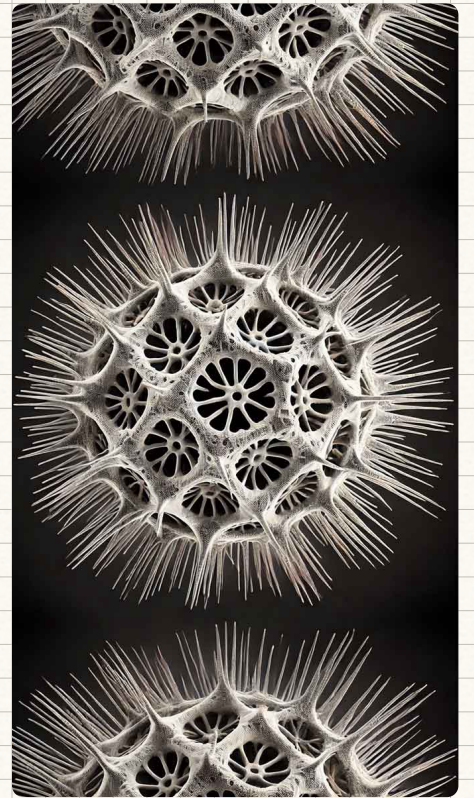
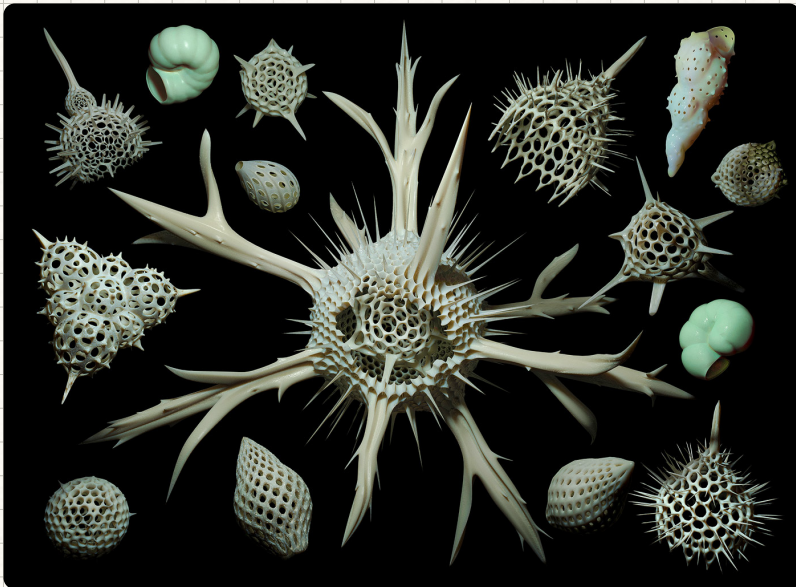


Stellated Polyhedra



It is the only fully symmetric faceting of the cube







The Roman dodecahedron Brian Campbell found in East London

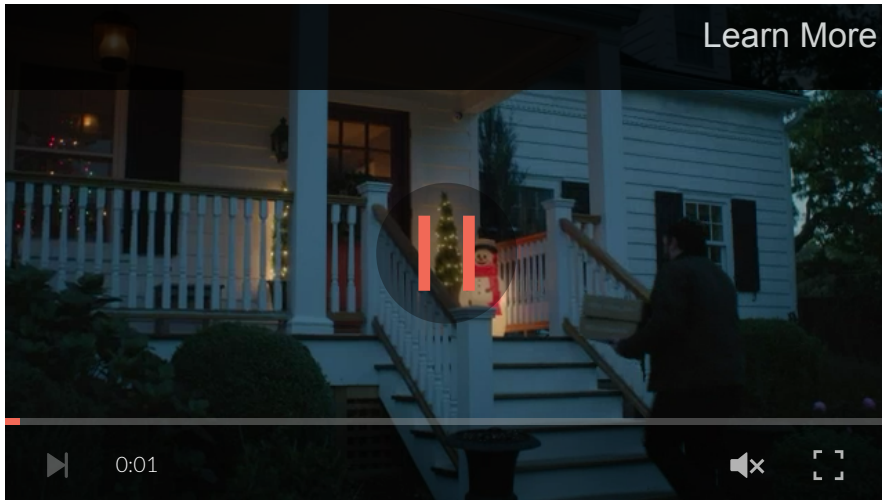
BRIAN CAMPBELL

STONES, BONES, AND WRECKS

The Mysterious Bronze Objects That Have Baffled Archaeologists for Centuries

BY TOM METCALFE

AUGUST 6, 2018

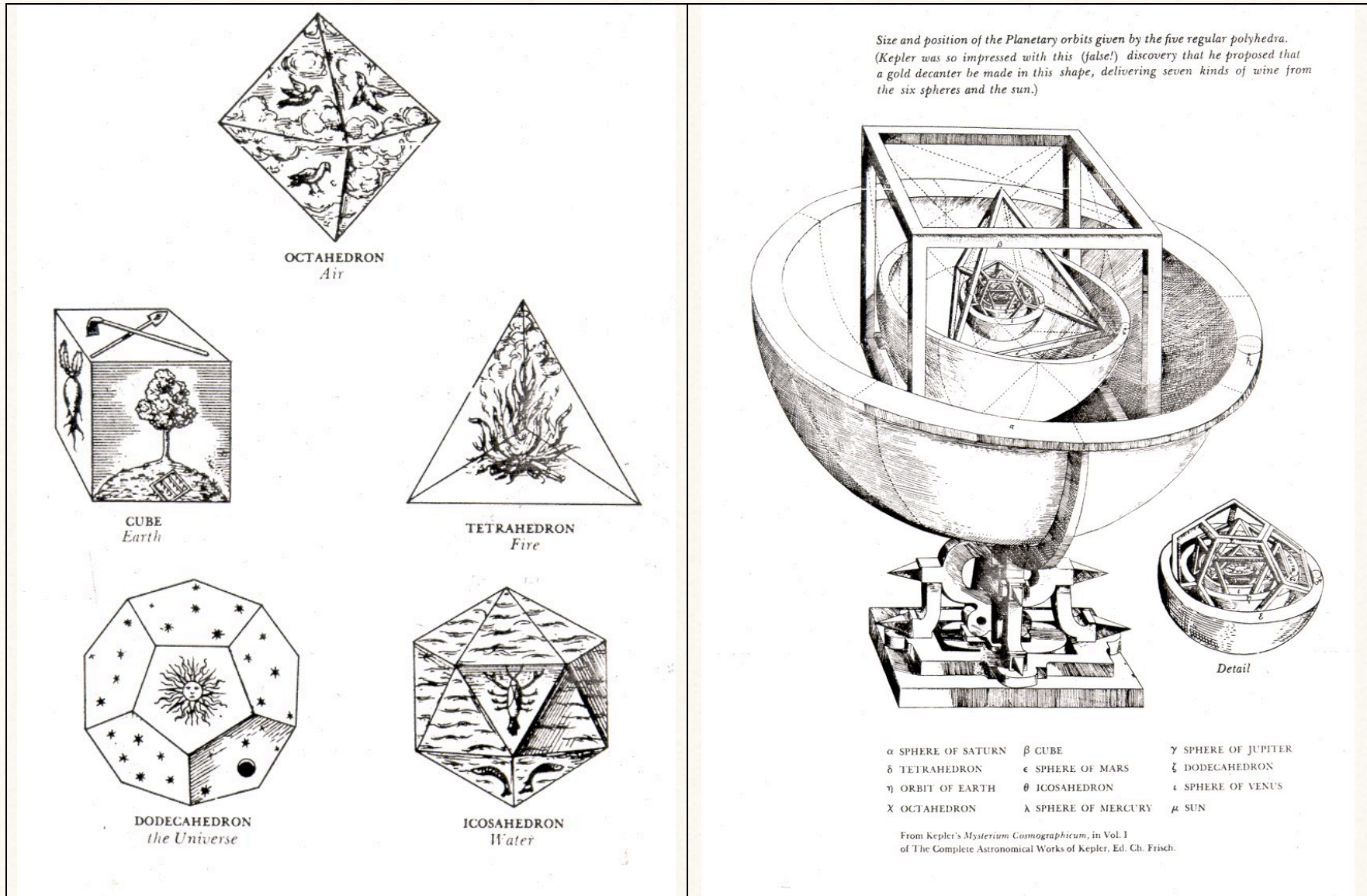


One August day in 1987, Brian Campbell was refilling the hole left by a tree stump in his yard in Romford, East London, when his shovel struck something metal. He leaned down and pulled the object from the soil, wondering at its strange shape. The object was small—smaller than a tennis ball—and caked with heavy clay. “My first impressions,” Campbell tells Mental Floss, “were it was beautifully and skillfully made ... probably by a blacksmith as a measuring tool of sorts.”

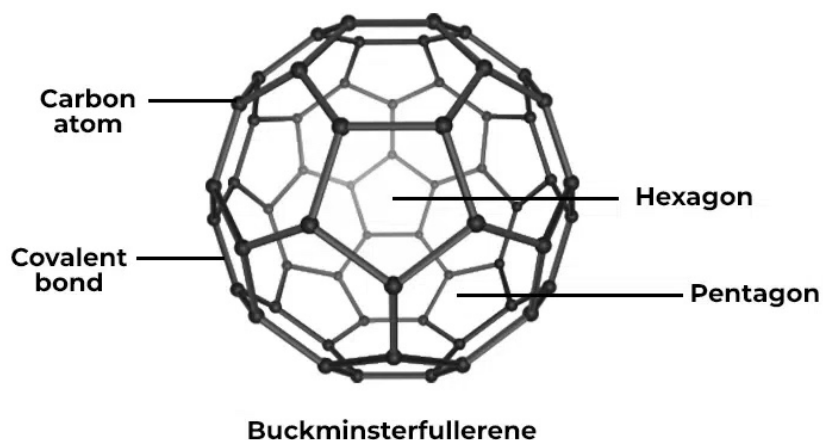
Campbell placed the artifact on his kitchen windowsill, where it sat for the next 10 or so years. Then, he visited the Roman fort and archaeological park in

Plato and Kepler on the Regular Polyhedra

Plato associated the regular polyhedra with the basic elements of the universe, while Kepler believed they held the key to the orbits of the (6 known) planets



"Plato wrote about them in the dialogue Timaeus c.360 B.C. in which he associated each of the four classical elements (earth, air, water, and fire) with a regular solid. Earth was associated with the cube, air with the octahedron, water with the icosahedron, and fire with the tetrahedron. There was intuitive justification for these associations: the heat of **fire** feels sharp and stabbing (like little tetrahedra). **Air** is made of the octahedron; its minuscule components are so smooth that one can barely feel it. **Water**, the icosahedron, flows out of one's hand when picked up, as if it is made of tiny little balls. By contrast, a highly nonspherical solid, the hexahedron (cube) represents "**earth**". These clumsy little solids cause dirt to crumble and break when picked up in stark difference to the smooth flow of water. Moreover, the cube's being the only regular solid that tessellates Euclidean space was believed to cause the solidity of the Earth." (Wikipedia)



Chemists predict structures of 'natural' fullerenes

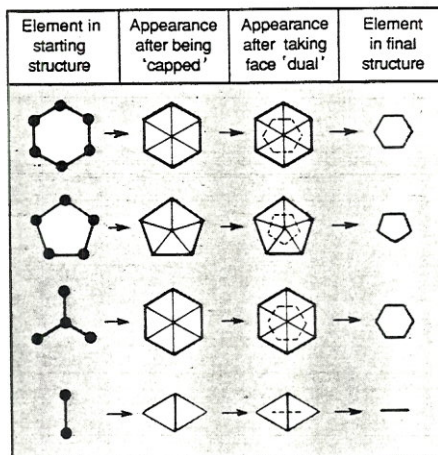
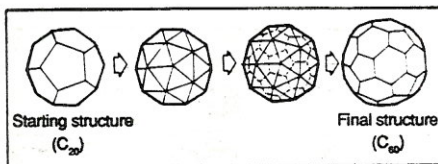
EVER since the discovery of buckminsterfullerene, the football-shaped molecule which contains 60 carbon atoms, chemists have been racing to make larger "fullerenes". However, once a new fullerene has been discovered, determining its structure is difficult. The distinctive "hollow cage" form chosen by nature may be one of thousands of different possible structures.

Now two British chemists have developed simple rules to predict the structures of fullerenes with more than 60 carbon atoms. Their predictions are allowing other chemists to identify new members of the family of fullerenes as they are made in the laboratory.

Patrick Fowler of the University of Exeter and David Manolopoulos of the University of Nottingham have used simple chemical theory to devise a set of rules for predicting the most stable, and hence the most likely, structures for any number of carbon atoms.

A first requirement is that carbon atoms must use up all four of their outermost electrons when they bond together to form a stable molecule. In a fullerene, three electrons from each carbon atom are used up in bonds to neighbouring atoms. The remaining electron sits in an "orbital" which is perpendicular to the surface of the cage structure. The orbitals can overlap in what are known as pi molecular orbitals, in which the electrons are "delocalised" over the whole of the cage.

In the 1930s, the theorist Erich Hückel developed a simple way of calculating the relative energies of these kinds of orbitals. A Hückel calculation for buckminsterfullerene, or C_{60} , confirms that the football structure is the most stable of 1760 different ways in which 60 carbon atoms can combine to form a single cage-shaped molecule.



Leapfrog construction: first, draw a point at the centre of each pentagon and hexagon in the starting structure, and join it up to each vertex or atom; the procedure is known as "capping". Next, join the centres of each new triangle to make a new structure called the "face dual". Finally, remove the original sides and vertices. By applying these rules to a known structure, it is possible to generate the structure of an unknown fullerene with three times as many atoms. For example, the unique football structure of C_{60} can be generated from C_{20} which consists only of pentagons

Supersonic threat to ozone layer

FEARS that high-flying aircraft, or "Super Concorde", might damage the ozone layer may have been confirmed by a team of German researchers. Their calculations show that a new generation of supersonic transports (SSTs) would produce "a substantial enhancement in the potential ozone destruction" above the northern hemisphere. This would more than cancel out the effect of measures—agreed internationally but not yet fully implemented—to safeguard ozone.

Thomas Peter, Christoph Brühl and Paul Crutzen, of the Max Planck Institute for Chemistry in Mainz calculated the effect on the ozone layer of a fleet of 600 SSTs flying at either an altitude of 22 kilometres or between 17 and 20 kilometres, which is in line with studies announced recently by NASA.

The key to the development of the Antarctic ozone hole, and to depletion of ozone in the stratosphere above the Arctic, is now known to be the formation of polar stratospheric clouds (PSCs), which contain ice particles. These provide the surfaces on which so-called heterogeneous chemical reactions take place. According to the calculations of Peter and his colleagues, the presence of nitrogen oxides (NOx) and water vapour (H₂O) from the exhausts of

high flying aircraft will stimulate the production of PSCs in the northern winter.

Peter and his colleagues point out that if the Montreal agreement to limit the release of chlorofluorocarbons—chemicals that damage the ozone layer—is implemented, the amount of chlorine in the stratosphere will be reduced by about 1 per cent a year during the early 21st century. If, however, advanced SSTs are developed, in line with the NASA scenario (presented at a workshop in Virginia Beach early in 1991), and they cruise at an altitude of between 21 and 24 kilometres, 3 per cent more PSCs will form in the crucial December-February period. Even for an SST fleet cruising at between 17 and 20 kilometres at a speed of Mach 2.4, the PSCs would increase by 2 per cent a year (*Geophysical Research Letters*, vol 18, p 1465).

According to the researchers, this "would lead to a strongly increased risk of heterogeneous ClOx (chlorine oxide) production and ozone depletion". The team concludes that "the large-scale development of aircraft operations with the emission characteristics outlined in [the NASA] scenarios may well go against the spirit of recent international agreements to protect the ozone layer." □

Using Hückel's theory as a guide, Fowler discovered that fullerenes which are larger than C_{60} can be split into three "magic number" series. In the first series, the number of atoms, n , in a cage-shaped molecule whose formula is C_n , is given by $n = 60 + 6k$, where k can be zero or any integer except 1. Fowler has dubbed these "leapfrog" structures, because it is possible to work out each one from a smaller cage containing one-third as many carbon atoms. A geometrical construction must be used which "leaps" over an intermediate structure (see Figure).

The other two series correspond to carbon "cylinders" with $n = 70 + 30k$ and $n = 84 + 36k$, where k is zero or a positive integer.

Fowler applied these simple rules to a closed cage of 84 carbon atoms. Although it could have more than 30 000 possible structures, he was able to reduce this number to just three. One structure is a carbon cylinder ($84 + 36k$ with $k = 0$), while the other two are leapfrog structures based on the two possible structures of a 28-atom cage. Of these, one is particularly interesting to chemists because it is "chiral", meaning that it exists in distinct left- and right-handed forms that are mirror images of each other. Such molecules may be useful as "chiral catalysts", capable of distinguishing between the left- and right-handed forms of other molecules.

Recently, chemists in California succeeded in isolating a small amount of C_{84} . Their studies suggest that nature may prefer the chiral structure, although the leapfrog structure might also be present. They are carrying out further experiments to clarify the picture.

The situation for C_{78} is clearer, however. Out of 21 822 different possible structures, Fowler and Manolopoulos have found that only one structure fits the bill. This is a leapfrog structure based on C_{26} . The chemists hope that experimentalists will soon confirm their prediction.

Although Fowler's rules can be applied to fullerenes which fit the magic number sequences, there are some, such as C_{76} , which do not. For this molecule, it is necessary to search through all the possible structures to find out which is the most stable.

Manolopoulos developed a computer program to do this. The program "unwraps" each possible structure into a spiral strip of pentagons and hexagons. Then, using Hückel's theory, it calculates the relative energies of its pi-molecular orbitals.

Manolopoulos simplified the task by excluding any structure which has adjacent pentagons. The reason for this is that the strain in a cage molecule with adjacent pentagons is so great that it cannot be stable.

Manolopoulos applied his program to C_{76} and found that just two structures with isolated pentagons are possible. He predicts that one is uniquely stable. This structure also happens to be chiral. Its existence was recently confirmed by experimentalists (*New Scientist*, Science, 14 September).

The chemists' success gives them confidence that their simple rules can be used to unlock the geometrical mysteries of these exciting new molecules. They are now looking at the structures of larger fullerenes, including C_{90} and beyond. **Jim Baggott**

NSF's First "Director's Award for Distinguished Teaching Scholars" Honors Seven Educators

Awards highlight excellence and promise in both research and education

Last November 8, the National Science Foundation took a further step to encourage scientists, mathematicians, and engineers to apply their talents to education, inside the classroom and out, by bestowing the first Director's Awards for Distinguished Teaching Scholars. In a ceremony at the National Academy of Sciences, in Washington, D.C., five men and two women, whose research excellence has been shared liberally through education efforts among their student bodies and with the public at large, were recognized for their work. Each will receive \$300,000 over four years to continue and expand their work beyond their institutions. The recipients were selected through a national competition based on their outstanding accomplishments. Each awardee submitted a proposal that focused on efforts to improve undergraduate education that show the promise of impact beyond the awardee's institution.

The recipients were Arthur B. Ellis (University of Wisconsin-Madison), Leah H. Jamieson (Purdue University), Gretchen Kalonji (University of Washington), Eric Mazur (Harvard University), Joseph O'Rourke (Smith College, Mass.), H. Eugene Stanley (Boston University) and Carl E. Wieman (University of Colorado), winner of the 2001 Nobel Prize in Physics.

NSF Director Rita Colwell, who presented the awards, has encouraged scientists and engineers to be involved in education, both in the classroom on subjects in which these scientists are already well-versed, or by engaging students and citizens on contemporary issues. She said the new awards should further stimulate broader efforts. Dr. Colwell spoke about the background of the award and of the NSF's goal of "investing in people, ideas and tools," notably pointing out the Foundation's "three core strategies": developing intellectual capital, integrating research and education, and promoting partnerships.



Professor Joseph O'Rourke is holding a polyhedron all of whose faces are rectangles, but which nevertheless has dihedral angles not multiples of $\pi/2$.

"This award embodies our priority to recognize the outstanding contributions of scientists and engineers to the leading edge of scientific knowledge at the same time they are advancing the frontiers of education in science, mathematics, engineering and technology," Colwell said. An interdisciplinary panel reviewed nearly 70 proposals from universities and colleges, with almost 25 percent submitted by women.

"These awards are far-reaching because they will foster innovative educational developments. They will increase and expand awareness of career opportunities in science and engineering. And they will further enhance connections between fundamental research and undergraduate education," said Judith Ramaley, NSF's assistant director for education and human resources. "These distinguished scholars are doing much to improve sci-

ence and mathematics education to benefit non-majors as well as majors in science and engineering. In addition, they are raising to a higher level knowledge and literacy of the general public, which is very important to the nation's future prominence in science, engineering and technology."

The keynote address at the ceremony was given by John H. Marburger, III, who was appointed Director, White House Office of Science and Technology Policy last October. Dr. Marburger is a physicist who has taught physics and electrical engineering at USC and served as Dean of the College of Arts and Sciences. In the light of the events of September 11, he spoke about an aspect of university life that "needs to be widely understood as our society struggles to respond to the vicious acts of terrorism" that the nation experienced. "Universities function properly only in an open society," he said. Dr. Marburger pointed out three reasons that make this possible: the dynamism inherent in research universities; the absolute standards that are embodied in the work of research communities, which foster an atmosphere of excellence; and the "army of brilliant immigrants, visitors, and foreign collaborators" who all contribute to the making of a literate and free society.

Dr. Marburger emphasized that "every university needs to work out for itself how it will meet the responsibilities to the larger society during these troubled times," he said, and how to engage its neighbors and elected representatives in frank discussions about such issues as a university's role in enforcing immigration laws, allowing access to some weapons or "means of terrorism," and restrictions on certain fields of study. Once the discussion has begun, he said, "many more questions will arise." He made a point of mentioning the Administration's goal of investing in education, "especially in science and mathematics...to enhance pre-

ci: "the kind of performance being re- wa "l" by the NSF.

Dr. Joseph O'Rourke, a member of the MAA who received his B.S. and M.S. in mathematics from St. Joseph University, has coauthored numerous publications with undergraduates, teaches courses on Computer Literacy, How the Internet Works, and Issues on Artificial Intelligence for nonscience majors. His textbook *Computational Geometry in C* is used widely by undergraduates and practitioners in the industry.

Dr. O'Rourke has been called one of the "founding fathers" of the computational geometry community, initiating the ACM Symposium on Computational Geometry series. Many in the field have used his books for both research and teaching purposes and read his series of Computational Geometry Columns (in SIGACT News and IJCGA). He garnered the Director's Award for his work in adapting the research on folding and unfolding computational geometry for use by students and teachers from sixth grade through graduate school. His project provides an opportunity to demonstrate to students that computer science, mathematics, and engineering are fun, comprehensible, and related to real-world problems.

Computational Geometry

According to Professor Joseph O'Rourke, in his text, *Computational Geometry in C*, computational geometry "is the study of algorithms for solving geometric problems on a computer." One list of topics that has been frequently suggested for computational geometry includes polygon partitioning; geometric intersection problems; convex hulls; Voronoi Diagrams; arrangement of lines, planes, and hyperplanes; geometrical searching; motion planning; and Art Gallery problems.

Computational geometry is a relatively new area of computer science, but its applications already have had a far-reaching and significant impact. Michael Shamos's 1978 doctoral dissertation is widely considered to be the foundation document in this area.

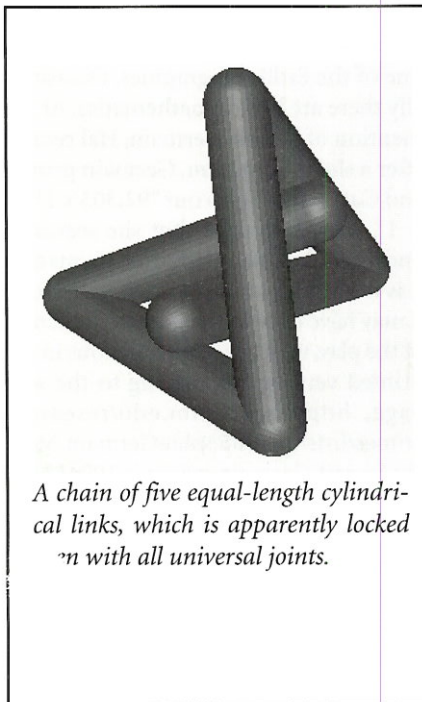
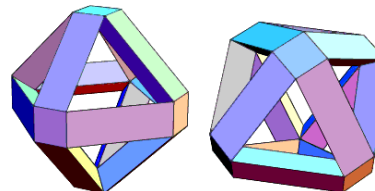
Today, in prestigious and diverse research centers around the world such as Bell Labs, Xerox Palo Alto Research Center, DEC Systems Research, The Weizmann Institute of Science, INRIA-Rocquencourt, ETH Zentrum and McDonnell Douglas Aircraft, computational geometers are designing algorithms to solve problems on the cutting edge of technology. Examples of this work in-



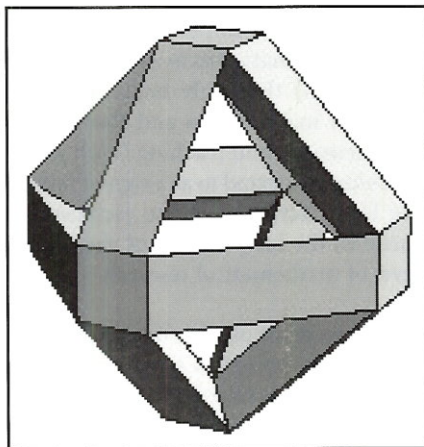
NSF Director Rita Colwell presented the awards for the Distinguished Teaching Scholars.

clude the contour meshing design of a plane's wing, the programming of a robot to avoid obstacles, and constrained navigation in virtual reality environments.

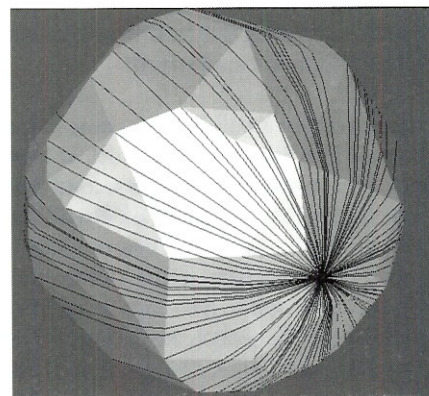
Dr. O'Rourke's website can be found at <http://cs.smith.edu/~orourke>. ■



A chain of five equal-length cylindrical links, which is apparently locked in a configuration with all universal joints.



The polyhedron below is built entirely from rectangles, but none of its dihedral angles are multiples of $\pi/2$, i.e., it is not an orthogonal polyhedron.



Shortest paths on the surface of a convex polyhedron. It shows the shortest paths from one source point to every vertex on a polytope whose 100 vertices are on a sphere

Images courtesy of Dr. O'Rourke's website.