

nerdling



a zine of physics,
maths and sci-fi

Issue #5: October/November/December 2002

nerdling

made its official zinescene debut last week at the Newcastle Young Writers' Festival. It was a great chance to hang out with a whole bunch of other zinesters and catch the vibe of what's getting put out in independent photocopy press at the moment.

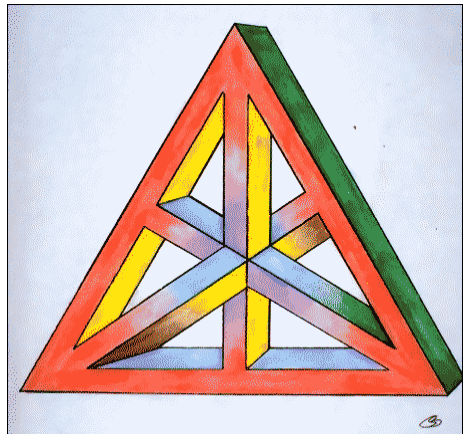
One product of the festival was the amazing kick of inspiration and motivation that ended up seeing this issue get put out so quickly. The other was being able to talk to and read stuff by cooking nerds, photography nerds, language nerds, literature nerds, sci-fi nerds. As J.F. Ghoul, the masked editor of Mexican-wrestling zine *Plan Dementia Wrestling Ghoul* put it:

“Your zine has made me discover something I previously did not know... I am a nerd! And it feels great! You have solidified the idea that it's okay to be a nerd and that being a nerd does not automatically label you as a social misfit. Most of my friends now are nerdy but cool—and I think it's that common thread that kinda draws us all together.”

Hurrah for the non-gender-specific-brotherhood of nerddom.

Speaking of which: did you know that Pythagoras' wife Theano wrote treatises on mathematics? Chicks in maths and physics have had a bit of a rollercoaster ride when it comes to acceptance into these fields throughout history. If anyone out there ever thinks they've been picked on for being a nerd, wait till you read what happened to the female Greek mathematician Hypatia, in the first instalment of our three-part series on women in physics and astronomy. Then check out a very different life's story when you read about Jane on page 12, and see the damage that can be wrought to one's family tree with nothing but a time machine.

We travel through time on page 6, with a look at how astronaut fashion has changed throughout the ages. And there's a very liberal dose of polyhedra in this issue. Did you know that Plato, Kepler and Socrates all believed that the universe was shaped like a dodecahedron? Or that a dodecahedron once motivated someone's murder? Read more on pages 21 and 24, and then, proving that **nerdling** is truly interactive, we've even given you instructions on page 4 for how to make your own. Put those electromagnetism notes to good use.



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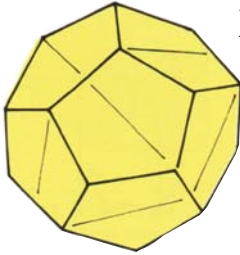
It's dodecahedra this week. Find out why it pays to never to be *too* good at geometry.

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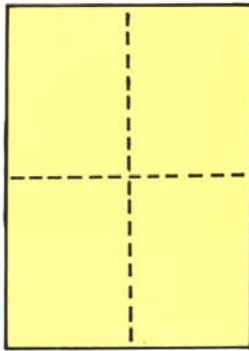
Here due to popular demand. Find out Plato's explanation of what *really* goes on when you've got a fever, and why the universe is twelve-sided.

Well, it's almost the end of the year, and the lectures haven't become any less boring. But surviving your lessons by folding icosahedra is sooo passé! That's why this issue **nerdling** brings you:

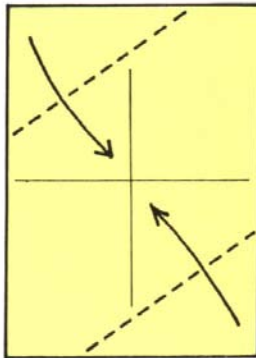


How To Fold a DODECAHEDRON From Your Lecture Notes

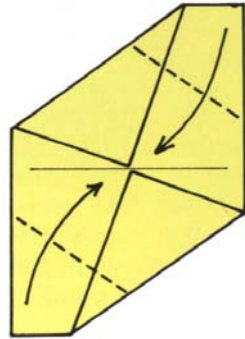
You will need: 12 sheets of A4 paper. The more boring the lecture notes, the better the dodecahedron will turn out. Electromagnetism notes are particularly useful for this purpose.



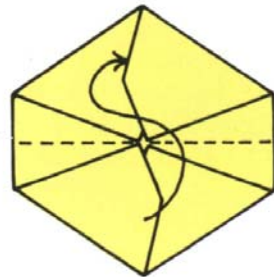
Take one of the rectangles and crease the centre lines vertically and horizontally.



Fold in two opposite corners, in valley folds, so that they meet at the centre.



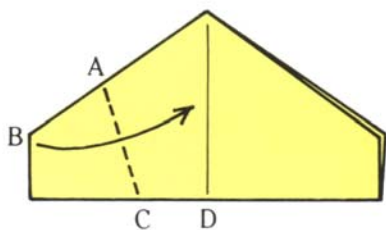
Fold the other two opposite corners to the centre, in the same way as above.



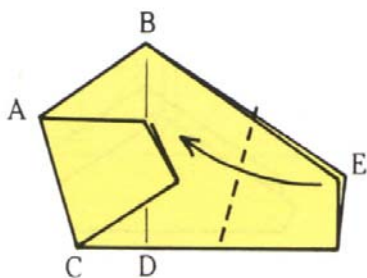
Fold the paper in half in a valley fold, interlocking the two inside flaps.



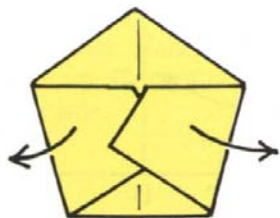
Flatten.



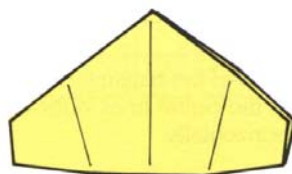
Fold point B in to the centre line so that AB is parallel to CD.



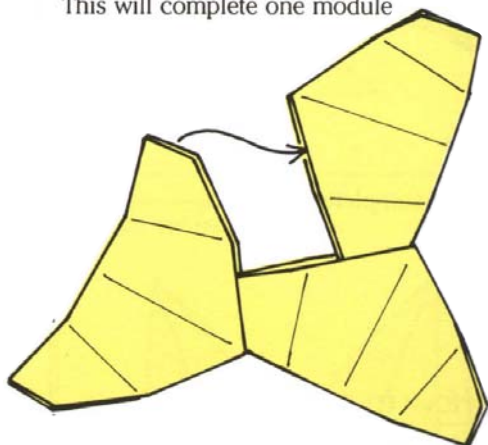
Fold point E in to the centre line overlapping the left flap.



Then open the two flaps.



This will complete one module



Take three modules and join them by tucking the flap of one into the pocket of the other (the diagram shows this in progress). When the third flap is tucked in, the form of the final structure will start to emerge.

To complete your dodecahedron, keep inserting modules one by one. The only rule to follow is that a bottom edge (i.e. the one edge of each pentagon with no tabs or pockets) must always end up against another bottom edge.

When you're done, take a moment to marvel at how a pentagonal shape can be folded so simply from an A4 rectangle.

You can read more about the dodecahedron on pages 21 and 24.

A History of Astronaut Fashion

1930s: Buck Rogers blasts aliens in Natty Casual.

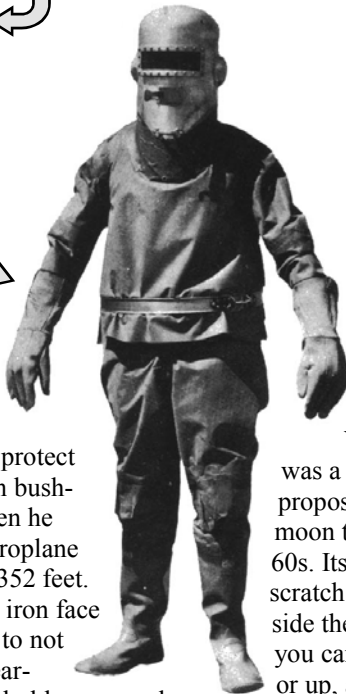
Who needs protection from lethal blasts of solar radiation and meteorites, when you could look fantastic in knee-high leather boots instead? Why worry about unbreathable toxic alien atmospheres, when you carry a box strapped to your chest with a tube coming out of it? And the frilly lace collar, of course, contains space-age water-cooling apparatus to regulate body temperature in the interplanetary void.



1934: Ned Kelly, Space Cadet

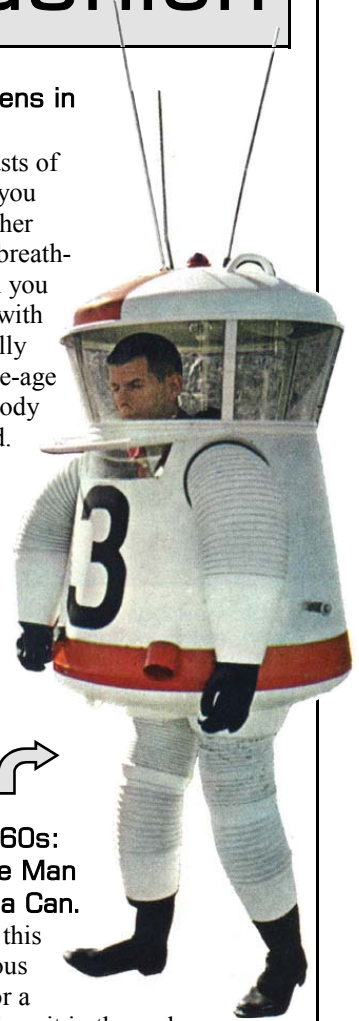
This suit was designed by B.F. Goodrich in 1934, to protect the famous Australian bush-ranger Ned Kelly when he sought to break an aeroplane altitude record of 47,352 feet. Thanks to his welded iron face plate, Kelly was able to not only withstand the near-space conditions, but hold up several stage coaches along the way.*

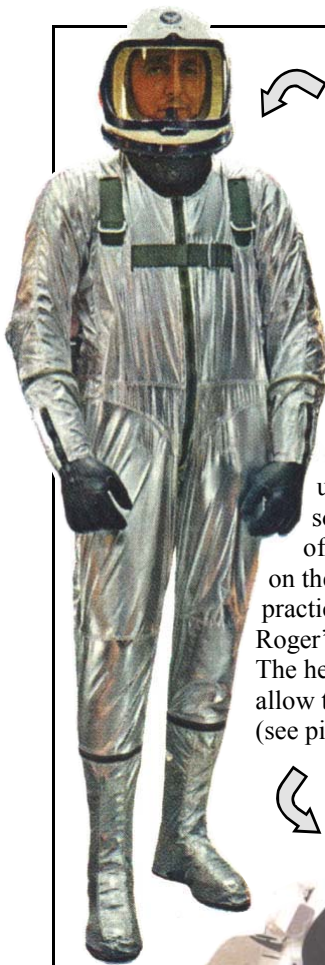
*n.b. this is all true.



1960s: The Man in a Can.

Yes, this was a serious proposal for a moon terrain suit in the early 60s. Its advantages are that you can scratch itches by bringing your arms inside the suit. Its disadvantages are that you can't sit down, you can't look down or up, and you look a bit like Kung Fu Chicken Noodle (see page 10). Oh, but at least the anti-bird wires coming out of your head will stop pigeons landing on you.



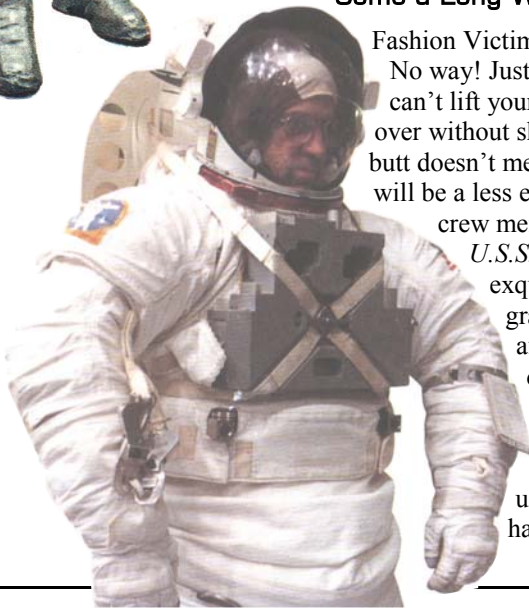


1961: Mercury Project sponsored by Alfoil

The space suit for Project Mercury was modeled after the first U.S. Navy Mark IV pressure suit used in high-speed flight. It was a four-layered suit with a padded helmet to prevent head injury. The silver alfoil look was an obvious choice due to its outstanding properties of (a) reflecting incoming heat radiation, and (b) looking kickarse futuristic.

Today: The Right Stuff

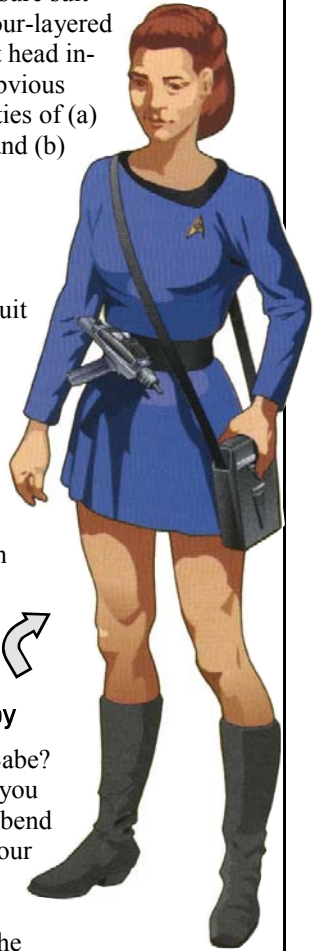
The EVA (extra-vehicular activity) suit used by modern astronauts is a sophisticated affair combining the best of Buck Rogers (note the strap-on pack on the front) with unfashionable yet practical technology which, unlike Buck Roger's outfit, will probably keep you alive. The helmet has been specially engineered to allow the wearing of nerd glasses underneath (see picture).



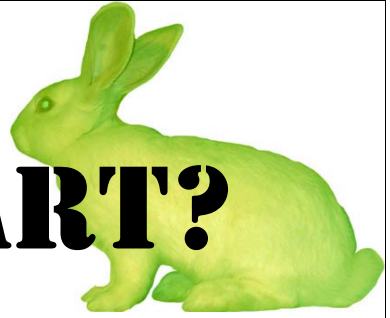
23rd Century: We've Come a Long Way, Baby

Fashion Victim Space Babe? No way! Just because you can't lift your arms or bend over without showing your butt doesn't mean you will be a less efficient crew member of the

U.S.S. Enterprise. Thanks to the exquisitely controlled atmosphere and gravity aboard ship, you can even afford to keep your favourite hair do (=bouffant or beehive), and the gun and boots show that even in the 23rd century people still pay homage to Buck Rogers. For the ultimate accessory: the power space handbag.



IS THIS ART?

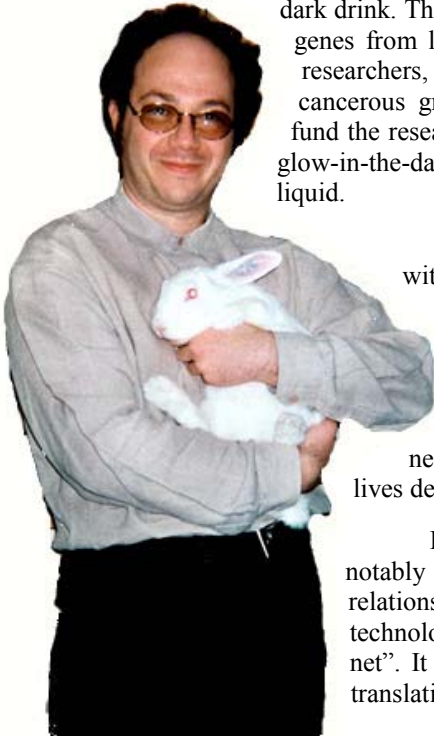


'Alba' is a genetically engineered albino rabbit. She contains a jellyfish gene that makes her skin, eyes and whiskers glow green when illuminated with light of wavelength 422 nanometers.

She was created by Eduardo Kac, an American professor of art and technology at the School of Art Institute, Chicago. He accomplished this by extracting green fluorescent protein (GFP) from a Pacific Northwest jellyfish, altering it to make it twice as bright, and injecting it into the fertilized egg of an albino rabbit in January 2000.

Kac describes Alba as "a new art form based on the use of genetic engineering to transfer natural or synthetic genes to an organism, to create unique living beings."

The idea for the project began when surgeon Bruce Bryan, while opening a beer during a black-out, began to wonder about the potential of a glow in the dark drink. This led to the eventual launch of a company to clone genes from luminous sea creatures. He, along with a team of researchers, aims to develop substances that could help identify cancerous growths in humans by making tumours glow. To fund the research, they are developing novelty products such as glow-in-the-dark champagne and water guns that squirt luminous liquid.

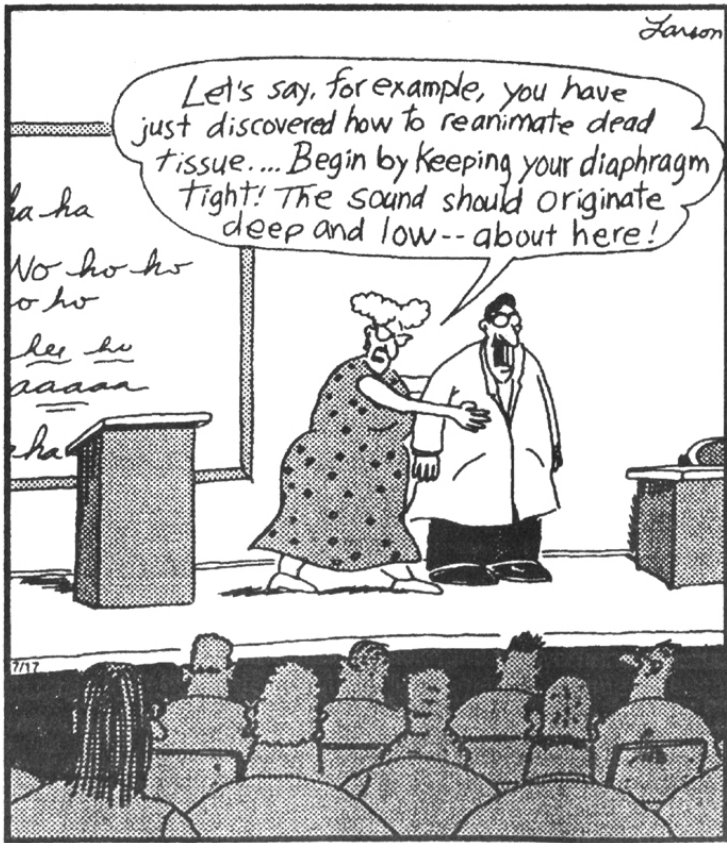


Kac picked up on the idea and produced Alba with the help of French genetic engineers. "GFP Bunny", as the artwork is titled, has raised many ethical questions and sparked international controversy about whether Alba should be considered art at all. "Transgenic art brings out a debate on important social issues surrounding genetics that are affecting and will affect everyone's lives decades to come," Kac says.

Kac has produced other transgenic artworks, most notably 'Genesis' in 1999, which "explores the intricate relationship between biology, belief systems, information technology, dialogical interaction, ethics, and the Internet". It consists of a synthetic gene that was created by translating a sentence from the biblical book of Genesis

into Morse Code, and converting the Morse Code into DNA base pairs according to a method devised by Kac. The sentence reads: "Let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth." Kac's website, www.ekac.org, says: "the sentence was chosen for what it implies about the dubious notion of divinely sanctioned humanity's supremacy over nature. The Genesis gene was incorporated into bacteria, which were shown in the gallery. Participants on the Web could turn on an ultraviolet light in the gallery, causing real, biological mutations in the bacteria. This changed the biblical sentence in the bacteria. The ability to change the sentence is a symbolic gesture: it means that we do not accept its meaning in the form we inherited it, and that new meanings emerge as we seek to change it."

Alba the glowing bunny died at age two and a half. The French scientists who engineered the rabbit are currently engaged in a debate with Kac over his alleged exaggeration of her glowing powers to the media.



In their final year, all research science students are required to take one semester of Maniacal Laughter.

The Lister and Rimmer Awards

For Good and Bad Pop Science

October/November/December 2002



A Rimmer Award to journalist Greg Ray, for beginning his Newcastle Herald column on the 11th of October with the statement “I believe in unseen forces”. Riiiiight. Does that mean he doesn’t believe in gravity or electro-magnetism? Or perhaps he means a ‘seen’ force is one whose *effects* can be seen. But if there are no effects, how can the force manifest itself? Hmm.



A Lister Award to Melbourne mexican-wrestling zine “Plan Dementure Wrestling Ghoul” for exposing the world of Kaiju Big Battel, the wrestling/entertainment code where the products of evil genetic experiments team up with mutant polyhedra to try and take over the world. My money’s on Dr Cube and his rogue ally Kung Fu Chicken Noodle.

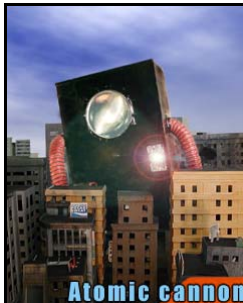


Eargernoi is the lab rat with the ear on his back, rescued from a ‘mutant experience at Massachusetts Institute of Technology splice lab’. Apparently he’s one of the good guys.



Dr Cube, the baddest bad guy. An evil scientist who rules the world through ‘genetics and monster hybridisation’. As you do. Why his head is a giant box is as yet unexplained.

Atomic Cannon is a huge disposable camera ‘two thousand feet taller than skyscraper is’, who blinds his enemies with ‘special atomic-style flash’. O...kay.



Kung-Fu Chicken Noodle. Created when a soup canner, depressed due to over-work during the Y2K crisis, threw himself into the machinery and came out as.. this. Kicks arse with his giant cleaver.



I am not making this stuff up. It is entertainment for *adults* and the action is played out in wrestling rings in Manhattan. Don’t believe me? Visit **Kaiju Big Battel** at www.kaiju.com or **Plan Dementure Wrestling Ghoul** at www.geocities.com/wrestling_ghoul.



Anyone who is not shocked by the quantum theory does not understand it.

— Niels Bohr

I think I can safely say that no-one understands quantum mechanics.

— Richard Feynman

Nature is not only queerer than we suppose, it is queerer than we can suppose.

— J.B.S.Haldane

Often times Archimedes' servants got him against his will to the baths, to wash and anoint him, and yet being there, he would ever be drawing out of the geometrical figures, even in the very embers of the chimney. And while they were anointing of him with oils and sweet savors, with his fingers he drew lines upon his naked body, so far was he taken from himself, and brought into ecstasy or trance, with the delight he had in the study of geometry.

—Plutarch

People like us, who believe in physics, know that the distinction between past, present and future is only a stubbornly persistent illusion.

— Albert Einstein

Listen, there's a hell of a universe next door: let's go!

— e. e. cummings

Jane

The most confusing family
tree in sci-fi

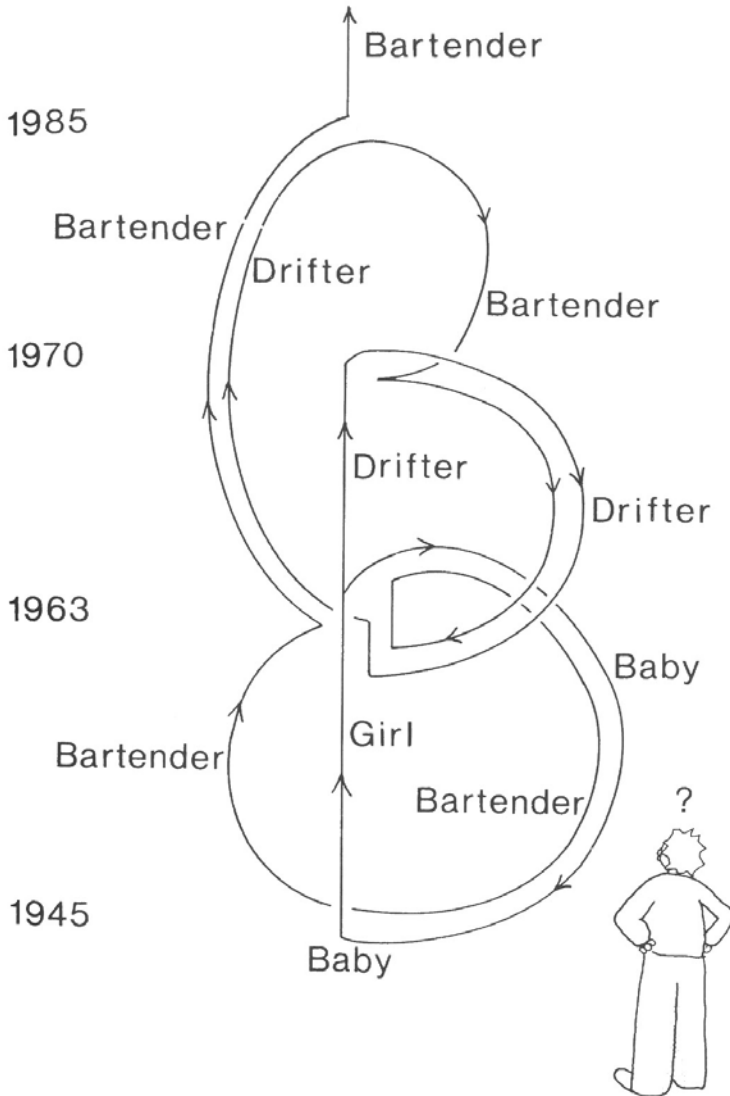
A summary of Robert Heinlen's
short story "All You Zombies-"; Extracted from the book
Hyperspace" by Michio Kaku

A baby girl is mysteriously dropped off at an orphanage in Cleveland in 1945. "Jane" grows up lonely and dejected, not knowing who her parents are, until one day in 1963 she is strangely attracted to a drifter. She falls in love with him. But just when things are finally looking up for Jane, a series of disasters strike. First, she becomes pregnant by the drifter, who then disappears. Second, during the complicated delivery, doctors find that Jane has both sets of sex organs, and to save her life, they are forced to surgically convert "her" to a "him". Finally, a mysterious stranger kidnaps her baby from the delivery room.

Reeling from these disasters, rejected by society, scorned by fate, "he" becomes a drunkard and drifter. Not only has Jane lost her parents and her lover, but he has lost his only child as well. Years later, in 1970, he stumbles into a lonely bar, called Pop's Place, and spills out his pathetic story to an elderly bartender. The sympathetic bartender offers the drifter the chance to avenge the stranger who left her pregnant and abandoned, on the condition that he join the "time travelers corps." Both of them enter a time machine, and the bartender drops off the drifter in 1963. The drifter is strangely attracted to a young orphan woman, who subsequently becomes pregnant.

The bartender then goes forward 9 months, kidnaps the baby girl from the hospital, and drops off the baby in an orphanage back in 1945. Then the bartender drops off the thoroughly confused drifter in 1985, to enlist in the time travelers corps. The drifter eventually gets his life together, becomes a respected and elderly member of the time travelers corps, and then disguises himself as a bartender and has his most difficult mission: a date with destiny, meeting a certain drifter at Pop's Place in 1970.

The question is: Who is Jane's mother, father, grandfather, grandmother, son, daughter, granddaughter, and grandson? The girl, the drifter, and the bartender, of course, are all the same person. These paradoxes can make your head spin, especially if you try to untangle Jane's twisted parentage. If we draw Jane's family tree, we find that all the branches are curled inward back on themselves, as in a circle: Jane is an entire family tree unto herself!



Warning Labels Mandated by 20th Century Physics

As safety experts and concerned citizens, we applaud the recent trend towards legislation that requires the prominent placing of warnings on products that present hazards to the general public. Yet we must also offer the cautionary thought that such warnings, however well-intentioned, merely scratch the surface of what is really necessary in this important area. This is especially true in light of the findings of 20th century physics.

We are therefore proposing that, as responsible professionals and science enthusiasts, we join together in an intensive push for new laws that will mandate the conspicuous placement of suitably informative warnings on the packaging of every product in every category offered for sale. Our suggested list of required warnings follows.

WARNING: This Product Warps Space and Time in Its Vicinity.

WARNING: This Product Attracts Every Other Piece of Matter in the Universe, Including the Products of Other Manufacturers, with a Force Inversely Proportional to the Distance Between The Objects.

CAUTION: The Mass of This Product Contains the Energy Equivalent of 85 Million Tons of TNT per Net Ounce of Weight.

HANDLE WITH EXTREME CARE: This Product Contains Minute Electrically Charged Particles Moving at Velocities in Excess of Five Hundred Million Miles per Hour.

CONSUMER NOTICE: Because of the "Uncertainty Principle," It Is Impossible for the Consumer to Find Out at the Same Time Both Precisely Where This Product Is and How Fast It Is Moving.

ADVISORY: There is an Extremely Small but Nonzero Chance That, Through a Process Known as "Tunneling," This Product May Spontaneously Disappear from Its Present Location and Reappear at Any Random Place in the Universe, Including Your Neighbour's Domicile. The Manufacturer Will Not Be Responsible for Any Damages or Inconvenience That May Result.

READ BEFORE OPENING: According to Some Suggested Versions of a Grand Unified Theory, the Primary Particles Constituting This Product

May Decay to Nothingness Within the Next Four Hundred Million Years.

THIS IS A 100% MATTER PRODUCT. In the Unlikely Event That This Merchandise Should Contact Antimatter in Any Form, a Catastrophic Explosion Will Result.

PUBLIC NOTICE AS REQUIRED BY LAW: Any Use of This Product, In Any Manner Whatsoever, Will Increase the Amount of Disorder in the Universe. Although No Liability is Implied Herein, the Consumer Is Warned That This Process Will Ultimately Lead to the Heat Death of the Universe.

NOTE: The Most Fundamental Particles in This Product Are Held Together by a "Gluing" Force About Which Little Is Currently Known and Whose Adhesive Power Can Therefore Not Be Permanently Guaranteed.

ATTENTION: Despite Any Other Listing of Product Contents Found Hereon, the Consumer Is Advised That, in Actuality, This Product Consists of 99.9999999999% Empty Space.

NEW GRAND UNIFIED THEORY DISCLAIMER: The Manufacturer May Technically Be Entitled To Claim That This Product Is Ten-Dimensional. However, the Consumer Is Reminded That This Confers No Legal Rights Above and Beyond Those Applicable to Three-Dimensional Objects.

COMPONENT EQUIVALENCY NOTICE: The Subatomic Particles (Electrons, Protons, etc.) Comprising This Product Are Exactly the Same in Every Measurable Respect as Those Used in the Products of Other Manufacturers, and No Claim to the Contrary May Legitimately Be Expressed or Implied.

HEALTH WARNING: Care Should Be Taken When Lifting This Product, Since Its Mass, and Thus Its Weight, Is Dependent on Its Velocity Relative to the User.

IMPORTANT NOTICE TO PURCHASERS: The Entire Physical Universe, Including This Product, May One Day Collapse Back into an Infinitesimally Small Space. Should Another Universe Subsequently Reemerge, the Existence of This Product in That Universe Cannot Be Guaranteed.

NERDLING ZINE ADVISES: This Classic Piece of Literature is Sourced From http://www.cs.berkeley.edu/~laura/humor/warning_labels.html. We Know Some Of You May Have Already Seen It. We Accept No Liability for the Results of Such an Occurrence .

Women in Astronomy

Part I: Fear and Loathing in Ancient Greece



All of Jupiter's moons are named after them, Venus is personified as one, and even the largest crater on Mars' moon Phobos has one as its namesake – yet *women* are extremely underrepresented in the field of astronomy today. So where have all the astronomerettes gone? And why worry anyway?

a saga of murder,
censorship, spirituality,
intrigue, misunderstanding and heroism—
all with a healthy dash
of arguments about little green men and futuristic cyborg-fembots
in catsuits.

This issue, **nerdling** brings you the first chapter of a three-part series on women in astronomy. The series will start in ancient Greece, where we blame it all on Pythagoras and Aristotle, and where the gruesome murder of Hypatia marked the death of the great era of Greek science. Part II will look at the truly dismal Dark Ages, and then at the 17th and 18th centuries, where you had to be a sister or a wife of an astronomer to learn anything, and where a woman named Nicole was the first to calculate the date of return of Halley's comet. And then, in Part III, we'll take a look at the state of things today—a time when Jocelyn Bell and Caroline Shoemaker are household names, but other female astronomers are made to sign statements that their babies have 'not shown

any undue interest in the sensitive parts of the laboratory' where they work.

The tale of women in astronomy is a saga of murder, censorship, spirituality, intrigue, misunderstanding and heroism— all with a healthy dash of arguments about little green men and futuristic cyborg-fembots in catsuits. Here is Part I. Read on.



What percentage of mathematicians would you say are women? What about biologists? And what about physicists?

Guess what: in 1990, almost half of all bachelors degrees in mathematics and statistics were awarded to women. In the biological and life sciences, 41% of graduates were women. But in physics, women constitute only 9 percent of the total physics workforce and only 3 percent of full physics professors. In Germany, the

ratio of men to women who complete PhDs in physics is 13 to 1.

So: it's probably not a valid argument to say that women are turned off astronomy or physics due to the maths involved, or the scientific method in general. Why then are there so few women physicists? To start our investigation, we go back to the dawn of Western culture in sixth-century B.C. Greece, and dig up some dirt on our old mate Pythagoras.

Pythagoras of Samos wasn't really all that bad, on the face of it. After all, he pioneered the idea that mathematics is a key to reality, to which we owe our modern scientific views. He was also known to have allowed women into

Pythagoreanism was a bit like a modern-day Mills & Boon... and the subtext was to be damaging to women for the next two and a half thousand years.

his inner circle of intellectuals, and his wife Theano is said to have written treatises on cosmology.

But Pythagoreanism was a bit like a modern-day Mills & Boon. At first glance, it seems that the women characters are doing alright, sticking up for themselves and their rights and generally having a good time—but it's when you start looking at the subtexts that you notice things are going a bit wrong. With Pythagoreanism, the subtext was to be damaging to women for the next two and a half thousand years.

The thing was, Pythagoreanism was primarily a religious movement. In between mucking around with right-angled triangles and musical frequencies, Pythagoras was preaching ideas about reincarnation and the soul. As with ancient Greek mythology in general, he believed that the heavens and the intellect were 'male', and earthly concerns were 'female'. But he also had a famous fixation with integers, and thought that they were transcendental, pure and *godly*—meaning, in a nutshell, that mathematics was male. Thus, even though women were able to study mathematics, the implication was that they had to strive to be less 'female' (concerned with earthly matters) and aspire to 'masculinity' (the realm of the psyche and intellect).

Science writer Margaret Wertheim says that the lack of women in modern astronomy is due to Pythagoras' association between God, the heavens, and

In 1990, almost half of all bachelors degrees in mathematics and statistics were awarded to women. But in physics, women constitute only 9 percent of the total physics workforce.

Even though women were able to study mathematics, they had to strive to be less 'female' and instead aspire to masculinity, which was the supposed realm of the psyche and intellect.

the male mind. She argues that astronomy, astrophysics and cosmology have been considered “quasi-religious” activities ever since, and says that “the ‘priestly’ culture... had served as an *additional* and very powerful barrier” to women in these fields.

Plato, in the 5th and 4th centuries B.C., continued on from Pythagoras to a large extent, and also believed that women should be educated. Mathematicians know him best for the five polyhedra, the Platonic Solids, which Plato believed were so fundamental and perfect that they made up everything in the cosmos. But it’s this notion of the “Platonic Ideal” that continues our insidious subtext.

Plato said that nothing earthly and real can every be truly perfect—the sun might look like it’s a circle, but up close it has ragged edges; at first glance humans appear to be symmetrical, but if we look closer we see differences between our right and left. He believed that true perfection, and the ideals we should all be striving for, are only possible in mathematical constructions. Thus, once again, ‘male’ mathematics is equated with God. Scientist Alicia Ostriker holds Plato responsible for “the hatred of science, in that he invented dualism, the notion that ideally we should experience our selves, our souls, our essences, as separate from nature.”

This is a pretty interesting point, because a lot of the reasons people don’t like science today boil down to exactly this notion. Nuclear and biological weapons, machines that pollute the atmosphere, communications technology that erodes human interactions—people see science in a bad light because quite often it is applied with little or no regard to the ‘earthly’ concerns of society, community or environment. A lot of our problems today date back to this Platonic idea of distancing science from humanity, of separating the ‘male’ from the ‘female’. This is actually one of the main arguments today for bringing more women back into science.

“They stripped her stark naked: they raze the skin and rend the flesh of her body with sharp shells, until the breath departed from her body: they quarter her body and burn them to ashes.”

A lot of our problems today date back to this Platonic idea of distancing science from humanity, of separating the ‘male’ from the ‘female’.

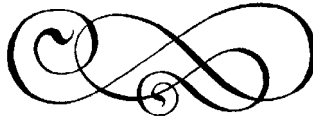
But we can’t get too carried away and blame all our 21st century woes on Plato. We’ve got to save up all our wrath for the guy who deserves it: Aristotle.

Aristotle was Plato’s student, and the most powerful and influential of Greek philosophers. He did not hold the same views on gender equity as his mentor. In fact, he was responsible for initiating a period of misogyny where women were seen as being less than fully human. It was into this environment that **Hypatia**, the first great female astronomer, was born.

Hypatia was born in the year 370 in Alexandria. She was taught by her father in astronomy and mathematics, and she too became a teacher of these subjects. In a time when people were being persecuted more and more for their religious beliefs, she made her household open to everyone as a forum for learning and debate. In addition to this, she made contributions to her father's astronomical texts and made compilations of data on the positions of heavenly bodies. She also designed and built several scientific instruments, including a plane astrolabe used for calculating time and measuring the positions of the sun, stars, and planets. She was known to not only be intelligent but also beautiful, eloquent and modest.

Around this time, pro-Christian sentiments were rising in Greece, and Hypatia and others who followed the scientific philosophies of Plato and Pythagoras were persecuted and forced to convert to Christianity. Hypatia refused to do this.

In 415, she was attacked by a mob of Christian zealots and beaten to death. In the account of a fifth-century author: "They stripped her stark naked: they raze the skin and rend the flesh of her body with sharp shells, until the breath departed from her body: they quarter her body: they then bring her quarters unto a place called Cinaron and burn them to ashes." Hypatia's murder has come to symbolise the demise of the great era of Greek mathematical science.



Between Hypatia's death and the renaissance in the 17th century, the western world went through the period of time known as the Dark Ages. Part II, in the next issue of **nerdling**, will look at how this period of time affected women in science, and how it was not until the era of Copernicus that the ancient philosophies of Pythagoras were rediscovered— that is, that importance was once again placed on mathematical and scientific thought— and women started to participate in astronomy once more.



Science and Beauty

Richard Feynman, Physicist:

“You can recognise truth by its beauty and simplicity. When you get it right, it is obvious that it is right—at least if you have any experience—because usually what happens is that more comes out than goes in... The inexperienced, the crackpots, and people like that, make guesses that are simple, but you can immediately see that they are wrong, so that does not count. Others, the inexperienced students, make guesses that are very complicated, and it sort of looks as if it is all right, but I know it is not true because the truth always turns out to be simpler than you thought.”

Henri Poincare, Mathematician:

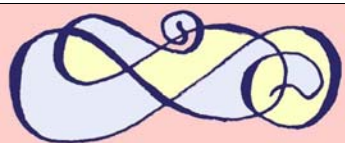
“The scientist does not study Nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If Nature were not beautiful, it would not be worth knowing, and if Nature were not worth knowing, life would not be worth living.”

John Keats, Poet:

“Beauty is truth, truth beauty, — that is all
Ye know on earth, and all ye need to know. “



more otherworldly messages from the ghost of Plato



dodecahedron

* pythagoras

➡ feared ⚡
the dodecahedron
because it was
constructed from
pentagons

*
which cannot be
tessellated on a plane.

* *
when his pupil
➡ HIPPASUS ⚡
disclosed the
secret of the
dodecahedron
they drowned
him in the ocean.

* * * *
He is probably the
only man to be
executed
for being too good
at geometry. *

Socrates & Kepler
agreed with

* plato *
that the shape of
the COSMOS
was a dodecahedron

* * *
aristotle
thought this was
a load of crap

➡ but ⚡
that's youth
rebelliousness
* for you *

*
Kepler, when
25, asked his patron
for funds to build a
jewelled *
* solid gold
cup depicting the
planets, with the
earth's orbit nested
in a dodecahedron.

But he soon found
out that the
government
didn't support the
sciences back then,
➡ either ⚡



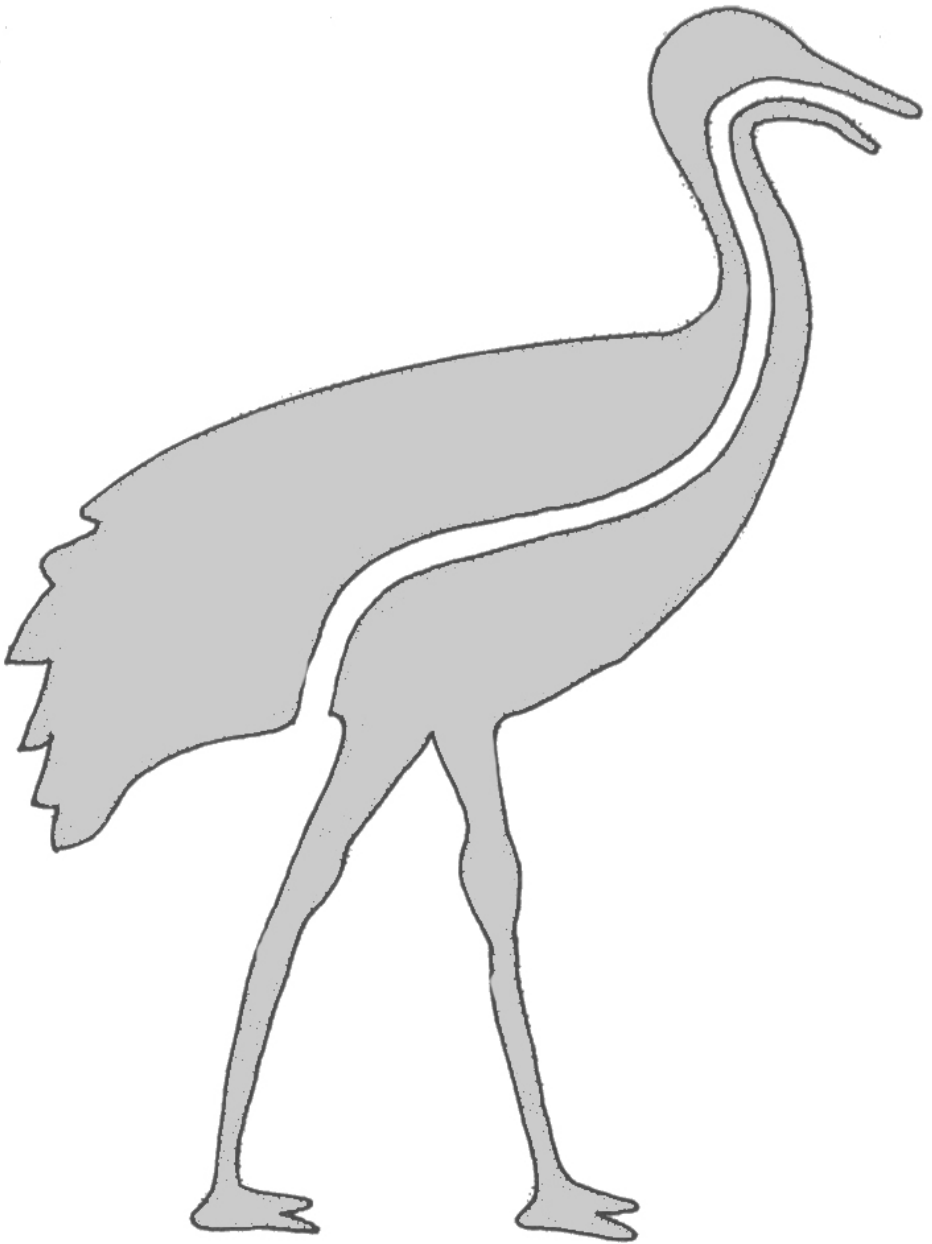


Figure 2.5. A two-dimensional being cannot eat. Its digestive tract necessarily divides it into two distinct pieces, and the being falls apart.

Ridiculous Sci-Fi Alien Species of the Month



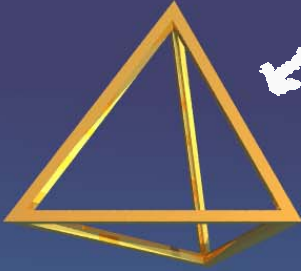
dale /deɪl/ *n.* a valley, esp. in northern England. [OE *dæl* f. Gmc]

dalek /'dɑːlek/ *n.* a member of a race of hostile alien machine-organisms which appeared in the BBC television science-fiction serial *Dr Who* from 1963. [invented word, named after an encyclopedia volume covering the alphabetical sequence *dal-lek*]

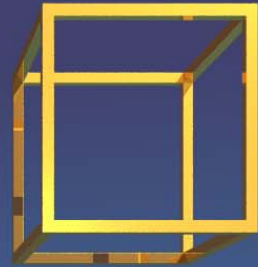
dalesman /'deɪlzmən/ *n.* (*pl.* **-men**) an inhabitant of the dales in

THE PLATONIC SOLIDS

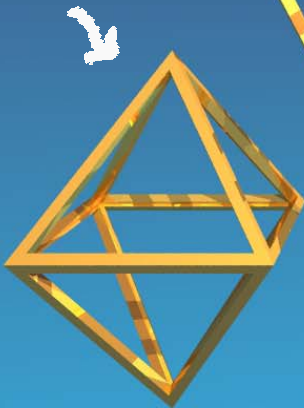
tetrahedron



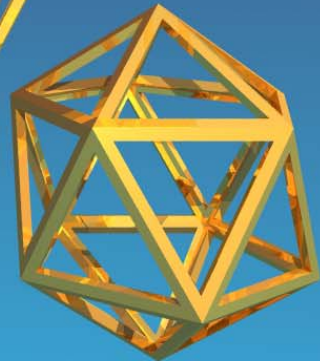
cube



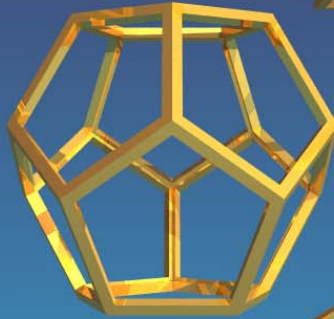
octahedron



icosahedron



dodecahedron



Everyone is infatuated with the Platonic Solids. Kepler was mad about them and thought they defined the orbits of the planets around the sun. Plato got so excited he believed they were the building blocks of matter itself. Leonardo da Vinci flipped out and sketched them all over his notes. Escher went totally mental with them. And the **nerdling** staff are practically having an apoplexy restraining ourselves from filling every issue with polyhedra, lovely, gorgeous polyhedra...

So, for our mental health and your reading pleasure, for the next few issues we're going to do a regular thing on the Platonic Solids: on how they turn up everywhere in nature, from viruses to pollens to seedpods; how they've been used in art right back to the ancients; all the really neat ways they're related to each other, and all the really nifty geometrical properties of them. Cooooo.

This issue we'll ease you into it with a short introduction to get you up to speed—and then it's full tilt into Plato's mad reasoning of why we're all made up of these little blokes. For the full interactive experience, gather up your lecture notes and make your own Platonic Solid models as per the instructions on page 4 and in Issue 1. Don't worry about needing your notes for exams. This is **much** more important.

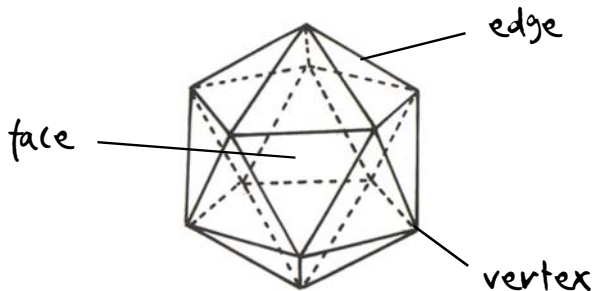
CHAPTER 1: INTRODUCTION

The Platonic Solids are special types of *polyhedron*. A polyhedron is just a solid figure with flat, polygonal sides.

There are the only three terms you will have to learn when talking about polyhedra: faces, edges and vertices. The *faces* are the flat, polygonal sides; the *edges* are where they intersect, and the points where three or more edges intersect are called *vertices*.

A *regular* polyhedron is one whose faces are identical regular polygons, i.e. every face is the same shape, and that shape has all sides and angles equal.

Only five regular solids are possible. They are the cube, the tetrahedron, the octahedron, the icosahedron and the dodecahedron. These have come to be known as the Platonic Solids.



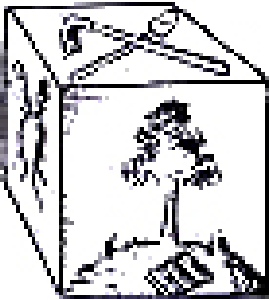
CHAPTER 2: THE ELEMENTS

The ancient Greeks believed that all things were composed of four basic elements: earth, air, fire and water. This idea is attributed to Empedocles in the 5th century BC, who was a disciple of Pythagoras. Empedocles thought that forces such as love and hate acted upon these elements, combining and separating them into infinitely varied forms.

He believed also that no change involving the creation of new matter is possible; only changes in the combinations of the four existing elements may occur. As such, he pre-empted modern chemistry by two millennia.

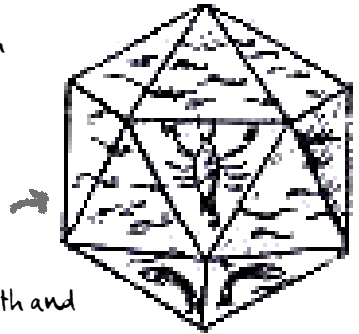
However, it was Plato who, only a few decades later, ascribed a polyhedron to each element. Since he believed that geometry was the highest form of perfection, it was natural to him that the universe should be based on these forms.

Shown below are the five solids with the elements they're linked to. The pictures are by Kepler, who was also a polyhedron fanatic.



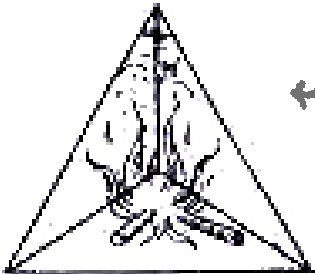
CUBE = EARTH

The cube is the obvious choice to represent earth because it stacks so neatly and solidly, suggesting the immobility of rock.



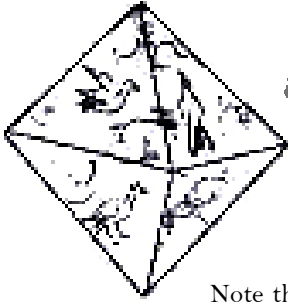
ICOSAHEDRON = WATER

The icosahedron represents water, because its large, smooth and heavy shape suggests the way water always flows to the lowest point in a valley



TETRAHEDRON = FIRE

Fire is the smallest, most pointed and lightest among the elements, Plato reasoned, because it can invade and destroy everything so easily. It is natural then, that it be linked to the smallest and most pointed of the solids.



OCTAHEDRON = AIR

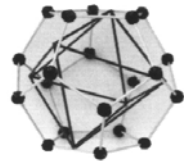
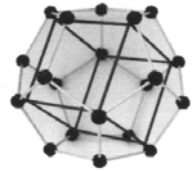
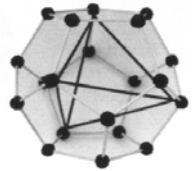
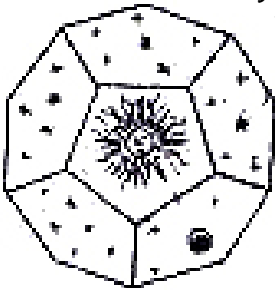
Air stands between fire (the sun or lightning) and water (the ocean), so it is natural that the octahedron, which in size falls between the tetrahedron and icosahedron, should represent air.

Note that fire, air and water are all represented by solids with triangular faces, and hence can all be changed into one another by taking them apart and reassembling them. This corresponded with what the Greeks observed in nature: if water is warmed by fire, it produces air; if air loses fire in the form of lightning, then rain results.

The human body is also composed of these elements, according to Plato. If you have a fever, it is because you've got too much 'fire' and the tetrahedra are invading and spiking your brain. You drive the tetrahedra out by displacing them with icosahedra, i.e. using cool water on your forehead.

DODECAHEDRON = THE COSMOS

There was one solid left over—the dodecahedron. Plato believed that it described the shape of the cosmos. This was for several reasons: firstly, the dodecahedron was seen as being mystical and heavenly due to the fact that the pentagon (unlike the triangle or square) cannot be used to cover a flat plane without any gaps, yet it can be used to form a three-dimensional shape. Secondly, every other Platonic Solid can be inscribed neatly into the dodecahedron (see the figure at right), suggesting it makes a neat container for everything else in the cosmos. Also, the twelve sides corresponded to the twelve signs of the zodiac.



The pictures to the right show how (from top to bottom) the tetrahedron, cube and octahedron fit neatly (are 'inscribed') in the dodecahedron. The tetrahedron and cube have vertices corresponding to vertices of the dodecahedron; the octahedron is formed by joining up centres of edges of the dodecahedron. The icosahedron, not shown here, is inscribed by linking up the centres of each face. This is a special relationship between solids, known as duality. Can you see that the cube and octahedron are also dual solids, and the tetrahedron is its own dual?



WARNING

Some quantum physics theories suggest that when the reader is not directly observing this zine, it may cease to exist or will exist only in a vague and undetermined state. The publishers take no responsibility for loss or injury sustained as a result.

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