

the sourcebook for geometry and harmony in the planets

A LITTLE BOOK OF
COINCIDENCE
IN THE SOLAR SYSTEM



John Martineau



space will never be the same again



Is one Mercury day really exactly two of its years?
How come Venus draws a huge pentagram every eight years?
Do the planets hide a secret Harmony of the Spheres?

Packed with exquisite illustrations and amazing new research,
this wonderful book by rogue astronomer John Martineau
will instantly retune your cosmological circuits to the secret
patterns behind Life, the Universe and Everything.

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Small Books, Big Ideas

VENUS DRAWS A PENTAGRAM
around the Earth every eight years. The Moon squares the circle. Everything in the heavens moves around everything else, dancing to the Music of the Spheres.

The science of the cosmos has changed immeasurably since the Greek and medieval visions of circles of planetary spheres, and yet no modern theory exists to explain the cosmic coincidences that surround the Earth.

This small volume, containing illustrations from rare books as well as by the author, reveals the exquisite orbital patterns of the planets and the mathematical relationships that govern them. Is it all just a coincidence, or do the patterns perhaps explain the scientists?

John Martineau is the editor and publisher of Wooden Books. He lives in Glastonbury, UK.

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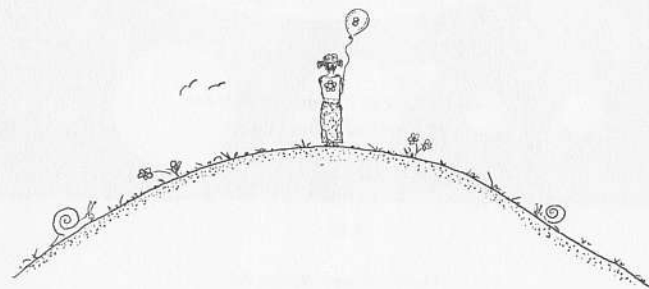
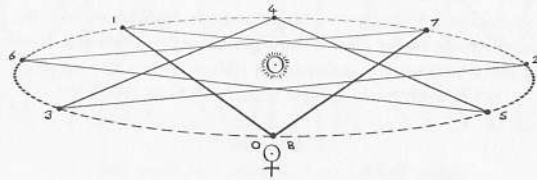
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*Climb up a hill at midday on your birthday every year and look at the Sun.
Each year Venus will be three-eighths of the way further round the Sun,
drawing a perfect octagram over eight years.*

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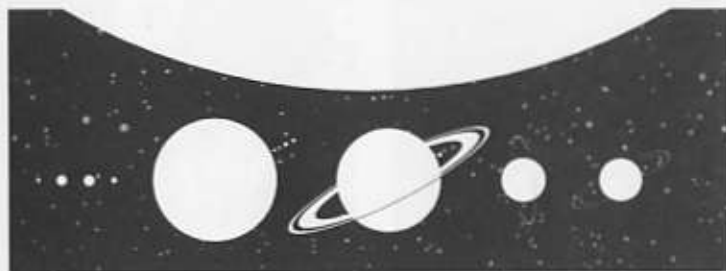
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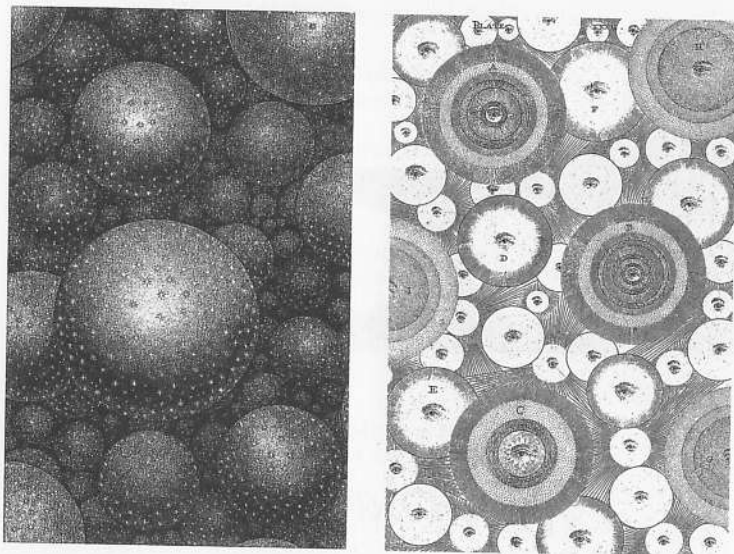
WOODEN
BOOKS

*To people who have tragically grown up
in a world devoid of a magical cosmology.*

*Thanks to the numerous friends and colleagues who
have contributed to this project over the years.*

Please keep crunching the numbers.

*Note: Percentages in brackets throughout the text refer to accuracies.
An accuracy of 99.9% is better than the narrowest line in this book.*



*Early visions of an infinite universe of solar systems hinted at
repeated structures like galaxies and parallel universes. From
Thomas Wright's "The Cosmos", 1750.*

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SUN



MOON



EARTH



MERCURY



VENUS



MARS



CERES



JUPITER



SATURN



URANUS



NEPTUNE



PLUTO

A useful set of glyphs for the planets drawn by calligrapher Mark Mills, each made from Sun, Moon and Earth and used throughout this book.

INTRODUCTION

Biological life is now thought to have appeared on this planet not long after its formation. It seems that the bacterial seeds for the process may have flown in on the tail of a comet or meteor. Speculation is again rife about life under the surface of Mars, on Jupiter's icy moon Europa and indeed anywhere the sacred substance of liquid water is known to exist.

The science of the cosmos has changed immeasurably since the Greek and medieval visions of circles of planetary spheres. But with great esoteric schemes out of fashion, and with dragons and unicorns dismissed, the Earth has become a modern mystery. No modern theory exists to explain the miracle of conscious life nor the cosmic coincidences which surround our planet. Why do the Sun and Moon appear the same size in the sky? Doesn't it strike you as odd? There are ancient answers to such questions, however, which presuppose some sort of perfection in creation, and they often invoke the liberal arts of music and geometry.

This book is not just another pocket guide to our solar system, for it suggests there may be fundamental relationships between space, time and life which have not yet been understood. These days we scan the skies listening for intelligent radio signals and looking for remote planets a little like our own. Meanwhile, our closest planetary neighbors are making the most exquisite patterns around us, in space and in time and no scientist has yet explained why. Is it *all just a coincidence*, or do the patterns perhaps explain the scientists ...

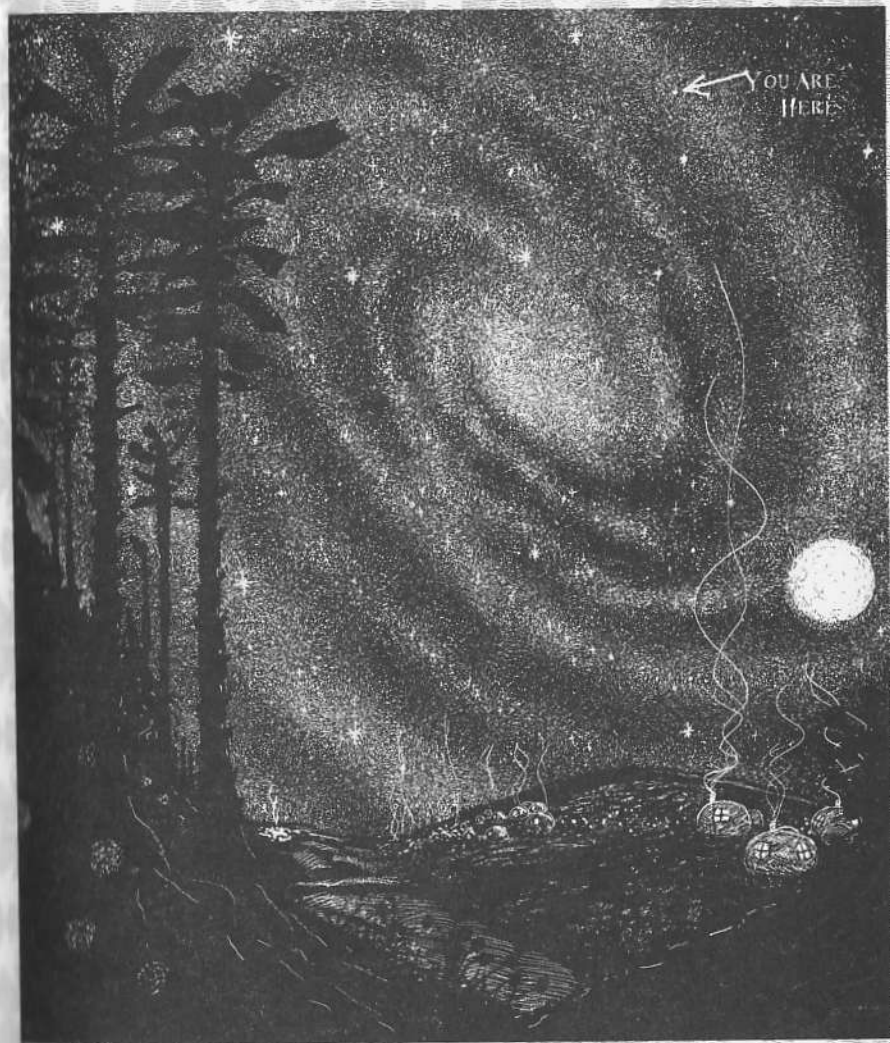
GALACTIC DUST

the well-tuned universe

There's a lot going on in the universe. As many star-filled galaxies pepper the bubble of our space-time horizon as there are grains of sand on a beach. There are as many stars in the visible universe as there are grains of sand on Earth. Our planet and we ourselves are made from reorganized smoky stardust, a fact long taught by ancient cultures. We now know that stardust itself is made simply from fizzballs, organized whirlpools of light, long ago squeezed together deep inside stars. We live in between the little and the large, in a time and a place in the universe where things have condensed, crystallized, built up and settled down.

Science still doesn't know whether conscious life is rare or common in the universe. Just how special are we and our Earth? Funnily enough, scientists are currently puzzling over the strange fact that the whole universe seems special. There is exactly enough material in the universe to make it, and the ratios between the fundamental forces and physical constants seem specifically tuned to produce an amazingly complex, beautiful, and enduring universe. Fiddle with any bit of it, even slightly, and you get a universe of black holes, insubstantial fizzballs, or other lifeless set-ups. Is this design or coincidence?

The story of the search for order, pattern and meaning in the cosmos is very old indeed. The planets of our solar system have long been suspected of hiding secret relationships. In antiquity students of such things pondered the "Music of the Spheres", the heavenly bodies singing their subtle and perfect harmonies to the adept. Today we have the simple precision of Kepler's, Newton's and Einstein's laws. Who knows what will come next?



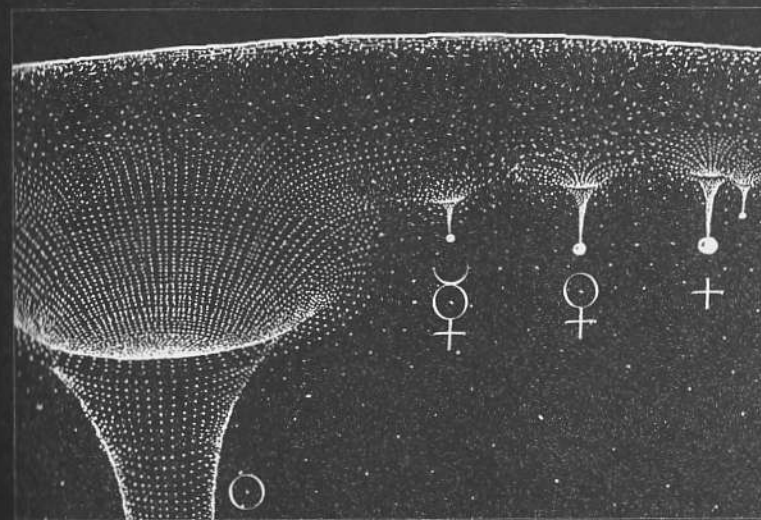
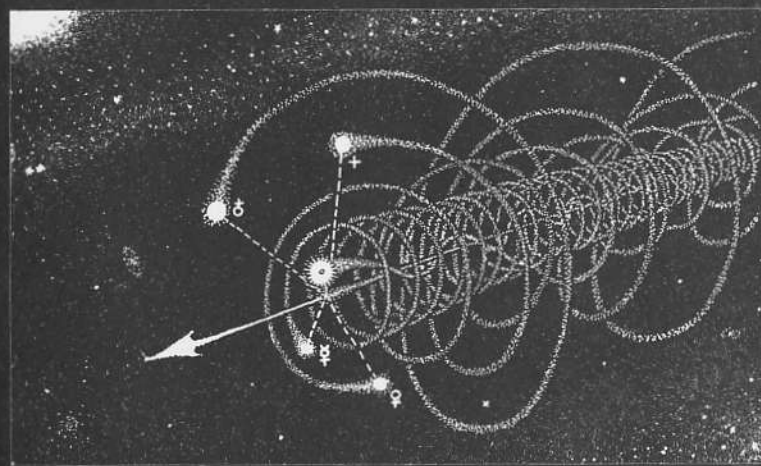
THE SOLAR SYSTEM

spirals everywhere

Our solar system seems to have condensed from the debris of an earlier version some five billion years ago. A Sun formed in the center and remaining materials were similarly attracted to each other to form small rocky asteroids. Lighter gases were blown out by the solar wind to condense as the four gas giants, Jupiter, Saturn, Neptune and Uranus while in the inner solar system asteroids grew into planets, the final pieces flying into place with more and more energy as the sizes grew (they all still have molten cores today from the power of these collisions). Eventually things became as they are now. Our solar system takes the form of a stable disk, a design now known to be relatively rare.

The plane of the solar system is tilted at almost exactly 60° to the plane of the galaxy so the planets actually corkscrew their way around the arm of the milky way. The picture (*opposite above, after Windelius & Tucker*) is a schematic of the motions of the four inner planets.

Another way to picture the Solar System is by thinking of space-time as a rubber sheet with the Sun as a heavy ball and planetary marbles placed on it (*opposite below, after Guy Murchie*). This is Einstein's model of the way matter curves space-time and helps visualize the force of gravity between masses. If we flick a frictionless pea onto our sheet, it can easily be captured by one of the marbles, or be spun around a few times and spat out, or settle into a fast spinning elliptical orbit halfway down any one of the worm-holes. Like a planet, the further the pea gets down the funnel, the closer it gets to the star and so the faster it must circle to stop itself going down the tube. Also, the faster it spins the heavier it gets and the slightly slower its clocks seem to run.

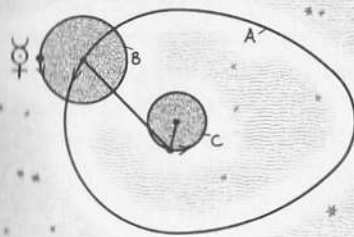
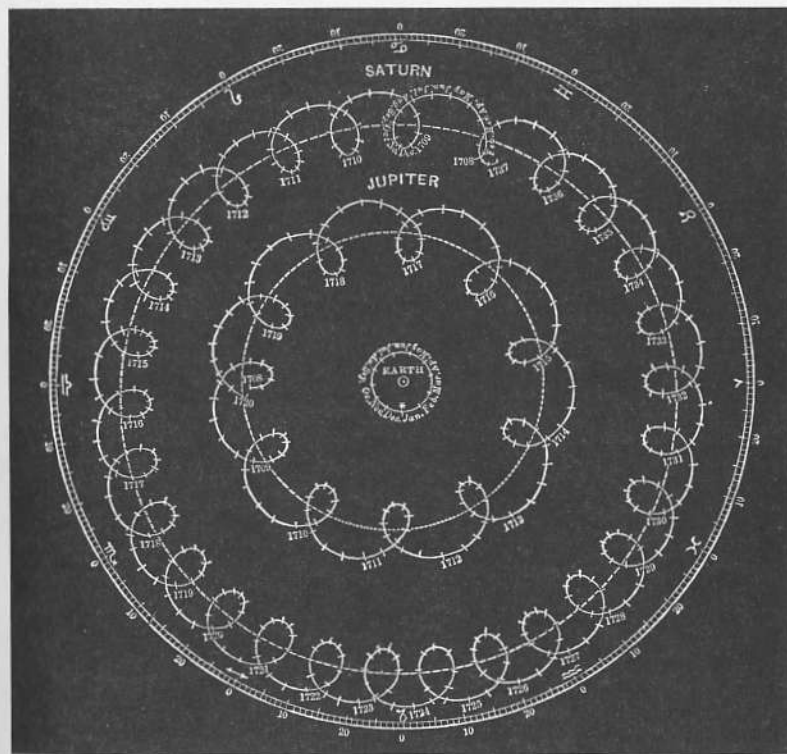
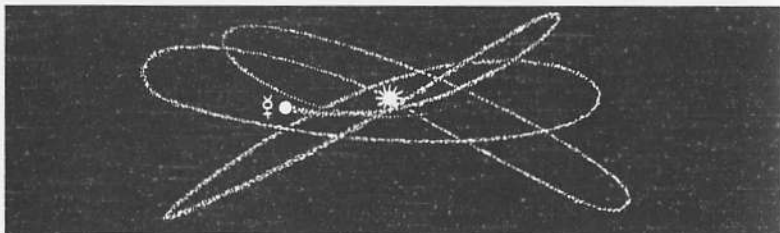


RETROGRADE MOTION

running kissing around

Anyone watching the sky with the naked eye from Earth will notice that, apart from the steadily moving Sun and Moon, there are five *wandering* stars, the five planets of antiquity. These, and the newly discovered planets, appear to move around the earth roughly following the Sun's annual circle, the *ecliptic* or *zodiac*. If only life was this simple! Watch planets for any length of time and, far from moving in any simple way, they lurch around like drunken bees, waltzing and whirling. Occasionally, when planets pass, or kiss, each appears to the other to *retrogress* or go backwards against the stars for a time. Spin round while whirling a stone on a string at arm's length and you'll get the idea.

The diagram below shows Mercury's pattern around a tracked Sun over a year as seen from Earth (after Joachim Schultz), and opposite we see Cassini's 18th century sketch of the movements of Jupiter and Saturn as seen from Earth. In ancient times hugely complex systems of circles and wheels were called into play to try to mimic these planetary motions (*opposite below*), culminating in the Ptolemaic system of 39 deferents and epicycles, used to model the motions of the seven heavenly bodies over two thousand years ago.



Until 400 years ago planetary motions were modelled using a 'deferent' (A) and an 'epicycle' (B). Other tricks refined the system - here a kind of crank (C) called a 'movable eccentric' produces an egg-shaped deferent for Mercury's dance.

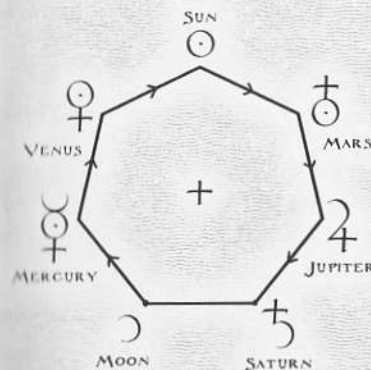
THE ANCIENT SECRET OF SEVENS

planets, metals and days of the week

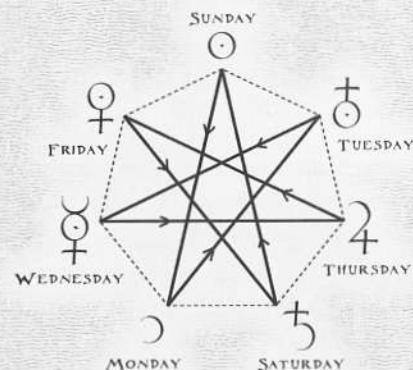
A short four hundred years ago the diagrams opposite formed the cornerstone of cosmological thought across the western world, as they had done for a few thousand years. Today, these emblems of the seven-fold system of antiquity appear as quaint reminders of an alchemical cosmology now buried beneath newly discovered planets and physical elements. Let us, however, take a quick look at the cosmology of our ancestors, and see what it can teach us.

There are seven clearly visible moving heavenly bodies (in antiquity these were the gods), and they may be arranged around a heptagon in order of their apparent speed against the fixed stars. The Moon appears to move the fastest, followed by Mercury, Venus, the Sun, Mars, Jupiter, and Saturn (*top left*). Each heavenly body was then assigned to a day, still clear in many languages (e.g., *Mercoledì* and *Mercredi* for Wednesday in Italian and French). The order of the days was given by a special heptagram (*shown top right*). In English, older names for the planets (or gods), were used, thus *Wotan's day*, *Thor's day*, and *Freya's day*.

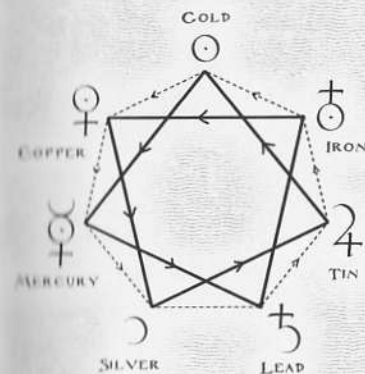
In antiquity the seven planets corresponded with the seven known metals, their compounds giving rise to color associations. Venus, for example, was tied with the greens and blues of copper carbonates. Students of alchemy would ponder these relationships as they forged ever more subtle things. Astonishingly, the ancient system also gives the *modern* order by *atomic number* of these metals! Follow a more open heptagram to give: Iron 26, Copper 29, Silver 49, Tin 50, Gold 79, Mercury 80, and Lead 82 (*lower left after Critchlow & Hinze*). The electrical conductivity sequence also appears round the outside starting with Lead.



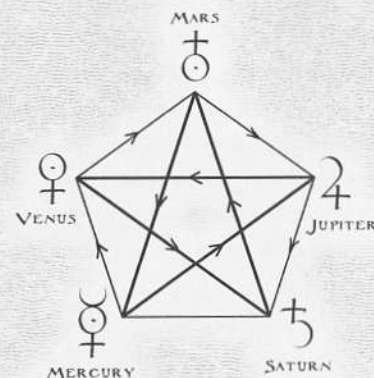
THE SEVEN HEAVENLY BODIES:
Start at the Moon and follow the arrows to give the 'Chaldean Order' of the spheres.



THE SEVEN DAYS OF THE WEEK:
French: *Lundi, Mardi, Mercredi, Jeudi, Vendredi...* follow the arrows again.



THE SEVEN METALS OF ANTIQUITY:
Start with Iron and follow the arrows to give elements of increasing atomic number.



THE FIVE WANDERERS:
Start with Mercury. Moving round the pentagon increases distance from the Sun.

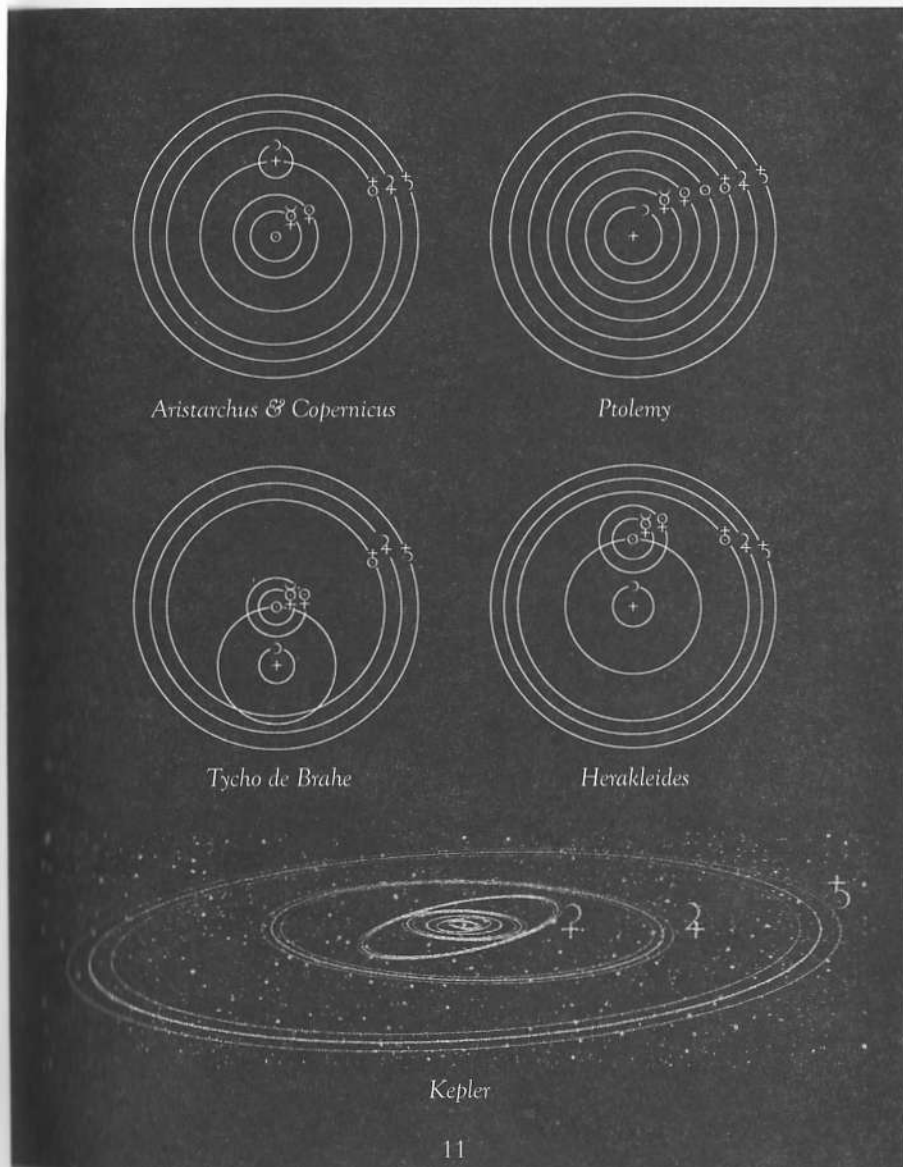
GEOCENTRIC OR HELIOCENTRIC

Earth or Sun at the center

The extraordinary Ptolemaic world of epicycles and deferents lasted a surprisingly long time. Despite its complexity it “saved appearances” and was even held to save souls. In ancient Greece ellipses, which would one day describe planetary orbits, were studied by early mathematicians such as Apollonius, and as early as 250 BC Aristarchus of Samos was proposing a system of planets orbiting the Sun. However, it was not to be, and for one and a half thousand years the Earth remained as we still experience it—a motionless body in the center of the universe, surrounded by whirling circles. The Ptolemaic system was handed from the Greeks to the Arabs, and then finally back to the West again.

Four ancient systems are shown (*opposite top, after Arthur Koestler*), and each sphere of each diagram is to be understood as having its own complex attachments of epicycles and eccentrics (*see page 7*). Copernicus, despite in 1543 placing the Sun in the center (*top left*), remained a convinced epicyclist, increasing the number of invisible wheels from the Ptolemaic 39 up to an amazing 48. In the late sixteenth century Tycho Brahe, against Kepler’s evidence, desperately tried to keep the Earth stationary in the center of the universe (*bottom left*), whilst an early Greek model by Herakleides, similar to a later version by Eriugina, attempted a compromise.

The modern model of the Solar System is pictured opposite (*below*). It shows the planets (including the largest asteroid, Ceres), orbiting the Sun in space. Each planet has an orbital shell, some thicker than others. This basic model was first conceived by Johannes Kepler in 1596 and it is to his ideas that we now turn.



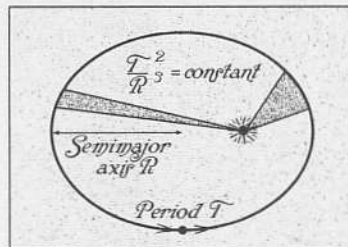
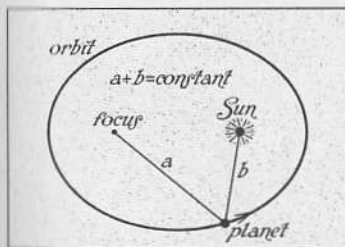
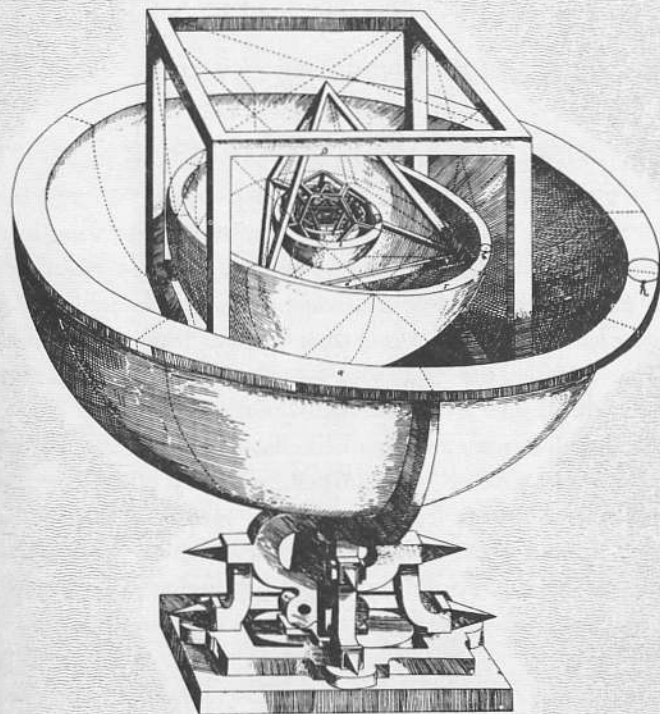
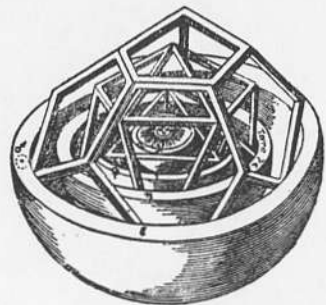
KEPLER'S VISIONS

ellipses and nested solids

Kepler noticed three things about planetary motion. First of all he determined that the orbits are ellipses (so that $a + b = \text{constant}$ opposite below), with the Sun at one focus. Secondly, he noticed that the area of space swept out by a planet in a given time is constant. Thirdly, he found that the period T of a planet (the length of time it takes to go round the Sun) relates to R , its semi-major axis (or average orbit), so that T^2/R^3 is a constant throughout the entire solar system.

Looking for a geometric or musical solution to the orbits, Kepler observed that six heliocentric planets meant five intervals. The famous geometric solution he tried was to fit the five *Platonic solids* between the six planetary spheres (opposite, with central detail below).

In recent years, far from diminishing Kepler's vision, Einstein's laws actually showed that the tiny space-time effects caused by Mercury's faster (and therefore heavier and time-slowed) motion when nearer to the Sun create a precessional rotation of the ellipses over thousands of years, thus reinforcing the reality of Kepler's shells over time.

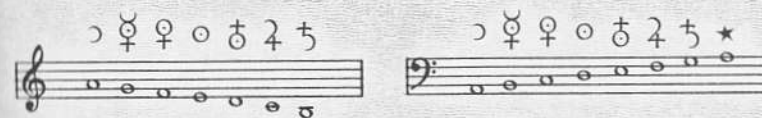


THE MUSIC OF THE SPHERES

planets playing in tune

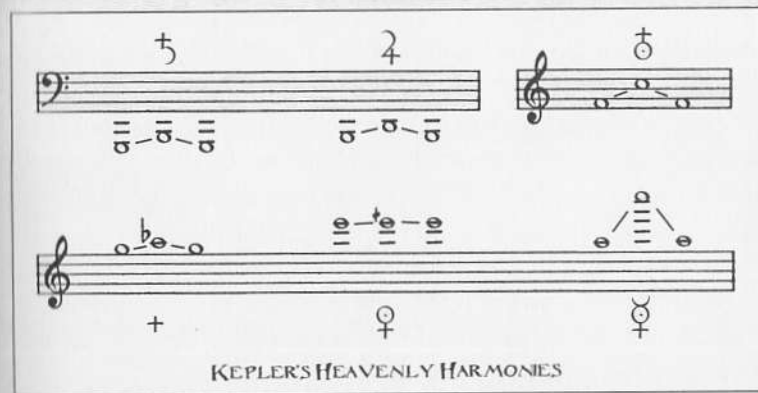
In antiquity the seven musical notes were assigned to the seven heavenly bodies in various symbolic arrangements (*opposite top*). With his accurate data, Kepler now set about precisely calculating these long-imagined *Harmoniae Mundi*. He particularly noticed that the ratios between planets' extreme angular velocities were all harmonic intervals (*opposite center, after Jocelyn Godwin*). Along these lines, in 1968, research by A. M. Molchanov revealed the entire solar system as a tuned quantum resonant structure, with Jupiter as the conductor of the orchestra.

Music and Geometry are close bedfellows and Carl von Weizsacker's 1948 pentagonal particle-cloud formation theory of the condensation of the planets (*illustrated lower opposite after Murchie & Warshall*) throws yet more dappled light on to these elusive orbits. It might appear fanciful, were it not for the fact that two nested pentagons (*below left*) define not only Mercury's orbital shell (99.4%), but the empty space between Mercury and Venus (99.2%), Earth and Mars' relative mean orbits (99.7%), and the space between Mars and Ceres (99.8%). Furthermore, three nested pentagons (*below right*) define the space between Venus and Mars (99.6%) and Ceres and Jupiter's mean orbits (99.6%). A coincidence.

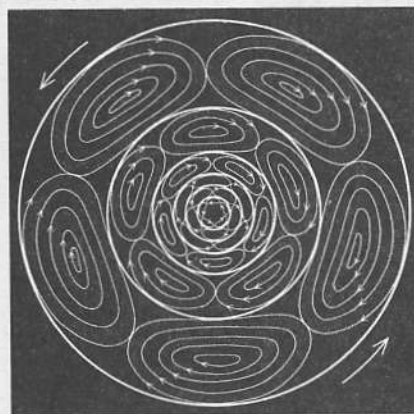
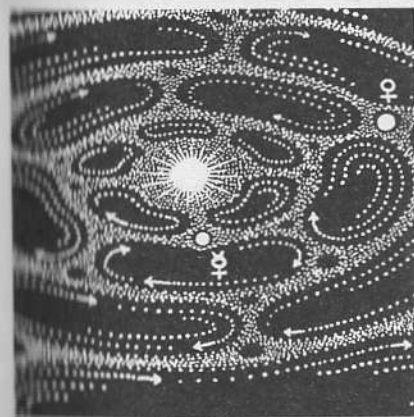


ANCIENT EGYPTIAN SYSTEM

CICERO - SCIPIO'S DREAM



KEPLER'S HEAVENLY HARMONIES



BODE'S LAW AND SYNODS

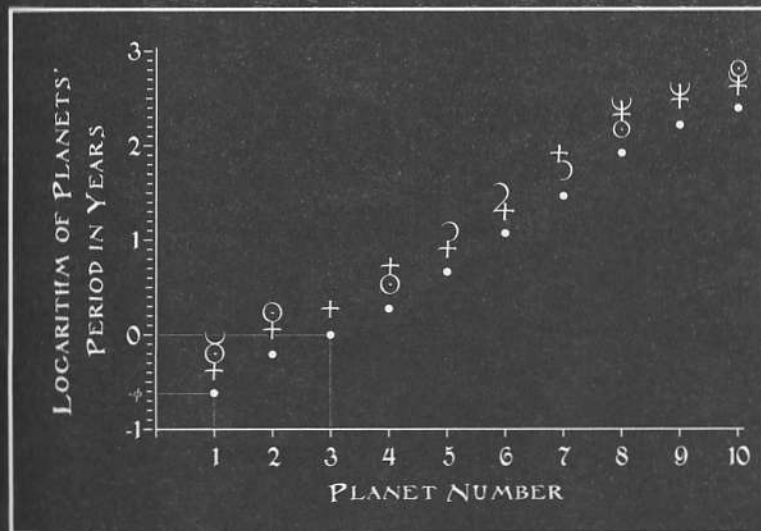
harmonics and rhythmic kisses

There have been numerous attempts to discover a simple pattern in the orbits and periods of the planets. A basic logarithmic graph shows clear underlying order in the planetary orbits (*opposite top after Ovendon & Roy*), and this also exists in various systems of moons.

A famous formula is the 1750 *Titius & Bode Rule*: Start with zero, then take the number 3 which is then doubled to give the series 0, 3, 6, 12, 24, 48, 96, 192 & 384. Now add four to each, giving 4, 7, 10, 16, 28, 52, 100, 196 & 388. These numbers fit the planetary orbital radii really quite well (except for Neptune). In particular the formula predicted a missing planet at 28 units between Mars and Jupiter, and on 1st January 1801 Giuseppe Piazzi discovered Ceres, the largest of the asteroids in the asteroid belt, in the correct orbit!

Planets' periods sometimes occur as simple ratios of each other, a famous example being the 2:5 ratio of the two largest, Jupiter and Saturn (99.3%). Further out, Uranus, Neptune and tiny Pluto are especially rhythmic and harmonic, displaying a 1:2:3 ratio of periods, Uranus' and Neptune's adding to produce Pluto's (99.8%).

Like a whirlpool, inner planets orbit the Sun much faster than outer planets and the table (*opposite below*) shows the number of days between two planets' kisses, passes or near approaches, properly called *synods*. Does Earth experience any harmonics? Well, we have two planetary neighbors, Venus sunside and Mars spaceside, and the figures reveal that we kiss Mars *three* times for every *four* Venus kisses (99.8%). So an ultraslow 3:4 rhythm or a deep musical fourth is being played around us *all* the time!



	♃	♂	+	♄	♅	♆	♁	♂	♃	
♃	∞	144.6	115.9	100.9	92.83	89.79	88.70	88.22	88.10	88.05
♂	144.6	∞	583.9	333.9	259.4	237.0	229.5	226.4	225.5	225.3
+	115.9	583.9	∞	779.9	466.7	398.9	378.1	369.7	367.5	366.7
♄	100.9	333.9	779.9	∞	1,162	816.5	733.9	702.7	694.9	692.2
♅	92.83	259.4	466.7	1,162	∞	2,744	1,991	1,777	1,728	1,712
♆	89.79	237.0	398.9	816.5	2,744	∞	7,252	5,045	4,669	4,551
♁	88.70	229.5	378.1	733.9	1,991	7,252	∞	16,570	13,100	12,210
♂	88.22	226.4	369.7	702.7	1,777	5,045	16,569	∞	62,890	46,440
♃	88.10	225.5	367.5	694.9	1,728	4,669	13,100	62,890	∞	179,800
♃	88.05	225.3	366.7	692.2	1,712	4,551	12,210	46,440	179,800	∞

THE NUMBER OF DAYS BETWEEN TWO PLANETS' KISSES

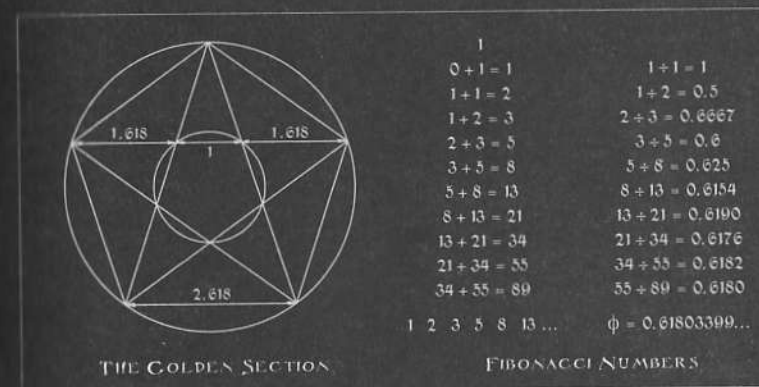
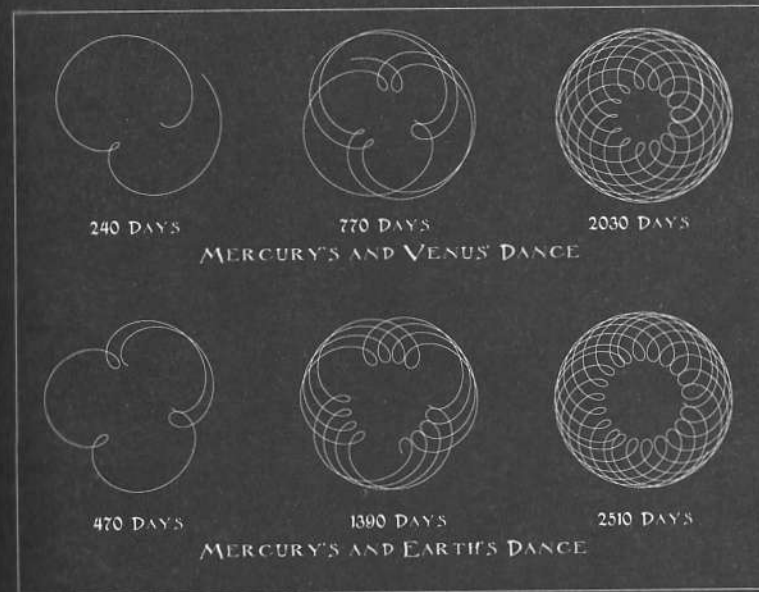
MAKING SENSE OF THE PICTURES

a few tips on things which appear in this book

Understanding how planets actually move as seen from Earth is not easy when you have been told from childhood that they all go round the Sun. Stop for a minute and think how it actually looks. Every day the Sun crudely moves across the sky from left to right (right to left in the southern hemisphere). But behind the blue sky the Sun is actually moving very slowly to the left across the stars (right in the southern hemisphere), taking a year to return to the same star. Meanwhile, the Moon likewise moves to the left across the stars, circling completely around in just a month, taking 27.3 days to return to a star, or 29.5 days to catch up with the Sun again. Look closer—Venus and Mercury are whizzing around the Sun, coming and going, as the Sun itself slowly trundles around its yearly circle.

Every pair of planets creates a *single* dance. It doesn't matter which of the two you stand on, your partner's dance around you will be the same. It is a shared experience. Imagine standing on Venus—from here the Sun moves faster against the stars and Mercury is in between, whirling round the Sun like a fairground waltzer. Seen from above the pattern looks like a waltz, similar to the dance Mercury makes around Earth (*opposite top*). Earth and Mercury kiss 22 times in 7 years, though the ancient Greeks also knew of a more accurate 46 year, 145 *synodic cycle*. Mercury and Venus are beautifully in tune after just 14 kisses.

In the pages which follow we will also meet the "golden section", Φ or *phi*. This is a constant found in every pentagram and also in the *Fibonacci* series of numbers (*shown opposite*). The golden section can appear as 0.618 (ϕ), 1.618 (Φ), or 2.618 (Φ^2), and is found throughout plant and animal life. As we shall see, it also occurs particularly around Earth.



THE INNER PLANETS

Mercury, Venus, Earth, and Mars

The solar system is divided by an asteroid belt into two distinct halves. The inner region sports four small rocky planets quickly orbiting the Sun, (*opposite center*) while in the outer region four huge gas and ice planets trundle slowly round.

The Sun is mostly Hydrogen and Helium. An element factory, it is also a giant superhot fluid geometric magnet, 15,000,000°C at its core, 6,000°C at the surface. It blows a particle wind through the entire solar system and its sunspots and huge solar flares affect electronics on Earth. In the diagram (*opposite top*) it's curvature is only just visible.

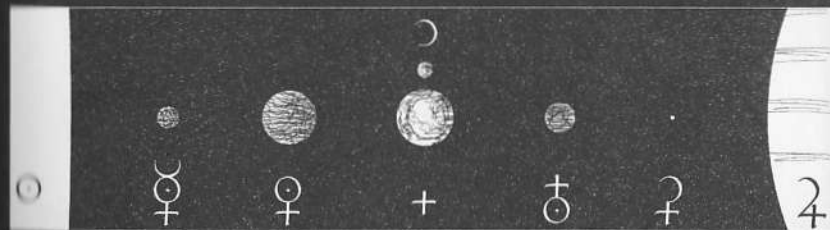
Mercury is the first planet. Mostly solid iron, it is a cratered, atmosphereless world, 400°C in the sunshine, -170°C in the shade.

Venus is second, a cloud-shrouded greenhouse world. On the surface the temperature is a staggering 480°C and the carbon-dioxide rich atmosphere is *ninety* times denser than Earth's. An apple here would be instantly incinerated by the heat, crushed by the atmosphere and finally dissolved in sulfuric acid rain.

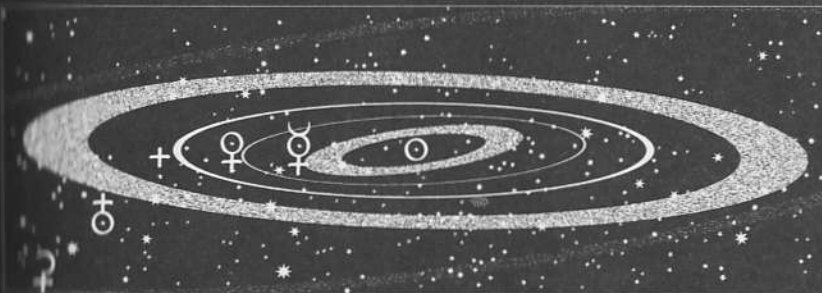
Earth is the third planet, the one with life and a single large Moon.

Mars is fourth, a rocky red world, just above freezing. Ice caps cover the poles under a thin atmosphere. River beds show that Mars once had rain, oceans and an atmosphere, but they are long gone now. Today dust storms regularly envelop the planet for days. Huge dead volcanoes, one three times larger than Mount Everest, stand witness to a bygone age. Mars has two tiny moons, Phobos and Deimos.

Beyond Mars is the Asteroid Belt, dominated by Ceres, and, beyond that is the realm of the giant outer planets.



SIZES OF THE INNER PLANETS



TILTS AND ECCENTRICITIES OF THE ORBITS OF THE INNER PLANETS



SUN-CENTERED



VIEW FROM EARTH

MERCURY & VENUS' ORBITS

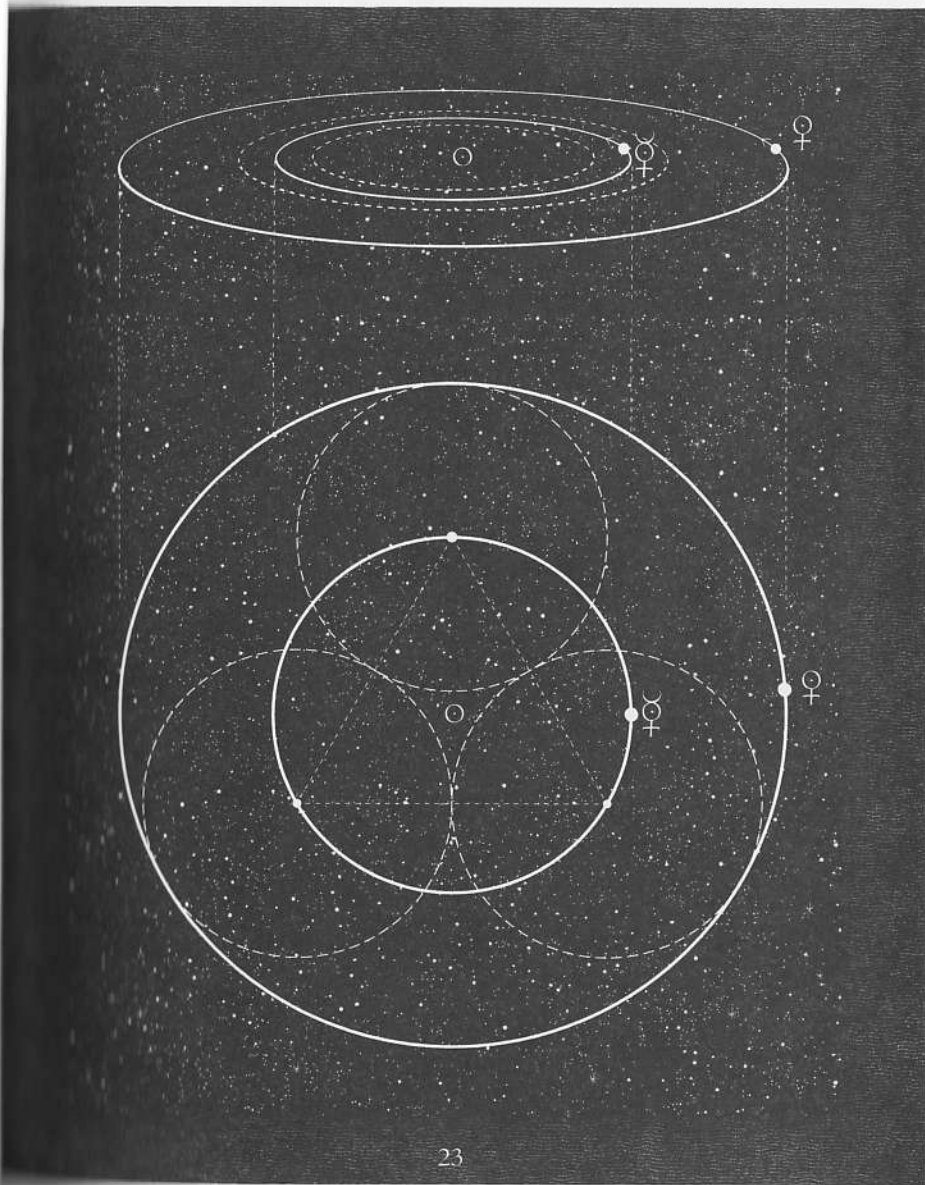
a very simple aide-memoire

All by itself, the very first planet of the solar system does something remarkable, for one Mercury *day* is exactly two of Mercury *years*, during which time the planet has revolved on its own axis exactly three times. The reason for this harmony is still unknown. A day is defined as the length of time it takes for a given feature on a spinning planet to point back at the Sun, a year is how long it takes for the Sun to pass in front of a given star, and the rotation period is how long it takes a given feature on the planet to line up with a star. In music the ratio 2:1 is known as the octave, and it is defined geometrically by an equilateral triangle.

One of the very first things you can do with circles is to put three of them together so that they all touch. Amazingly, the orbits of the first two planets of the solar system are hiding in this simple design, for if Mercury's mean orbit passes through the centers of the three circles then Venus' encloses the figure (*opposite*) (99.9%). Venus, goddess of love and beauty, has the most circular orbit in the entire solar system.

This is a simple trick to remember—you see it all around you all the time, in the home, in design, art, architecture and nature. Every time you pick up three glasses or push three balls together you create the first two planets' circular, or mean, orbits, to an extraordinary degree of accuracy. There must be a reason for this beautiful fit between the ideal and the manifest, but none is yet known. Perhaps some bright 21st century scientist will explain it—until then, it remains a beautiful coincidence.

Thus the very first planet plays the very first harmonies and draws one of the very first geometrical shapes to produce its neighbor. We have started with one, heard a two, and seen a three.



THE KISS OF VENUS

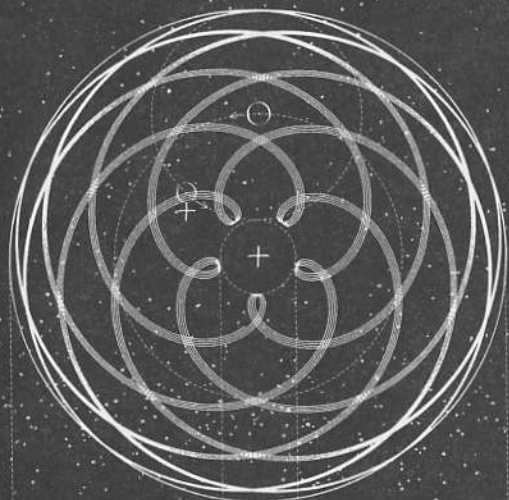
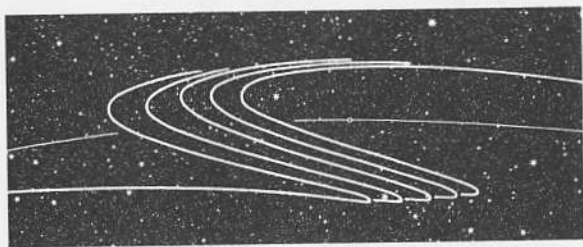
our most beautiful relationship

Other than the Sun and Moon, the brightest point in the sky is Venus, morning and evening star. She is our closest neighbor, kissing us every 584 days as she passes between us and the Sun. Each time one of these kisses occurs the Sun, Venus and the Earth line up two-fifths of a circle further around—so a pentagram of conjunctions is drawn, taking exactly eight years (99.9%) (or thirteen Venusian-years (99.9%)). Notice the Fibonacci numbers again, 5, 8 and 13, which govern most plant growth on Earth. The periods of Earth and Venus are also closely related as $\Phi:1$ (99.6%).

Seen from Earth this harmony appears as Venus whirling around the trundling Sun drawing an astonishingly beautiful pattern. In the diagram (opposite top) four eight-year cycles are shown, so 32 years. The small loops are made when Venus in her closest dazzling kiss seems briefly to reverse direction against the background Stars (shown below as seen from Earth).

The fivefold nature of Venus and Earth's dance extends to their closest and furthest distances from each other. Opposite below we see Venus' perigee and apogee defined by two pentagrams. The body of space one draws around the other is thus sized $1:\Phi^4$ (99.98%).

All these diagrams also apply to Venus' experience of Earth.



THE PERFECT BEAUTY OF VENUS

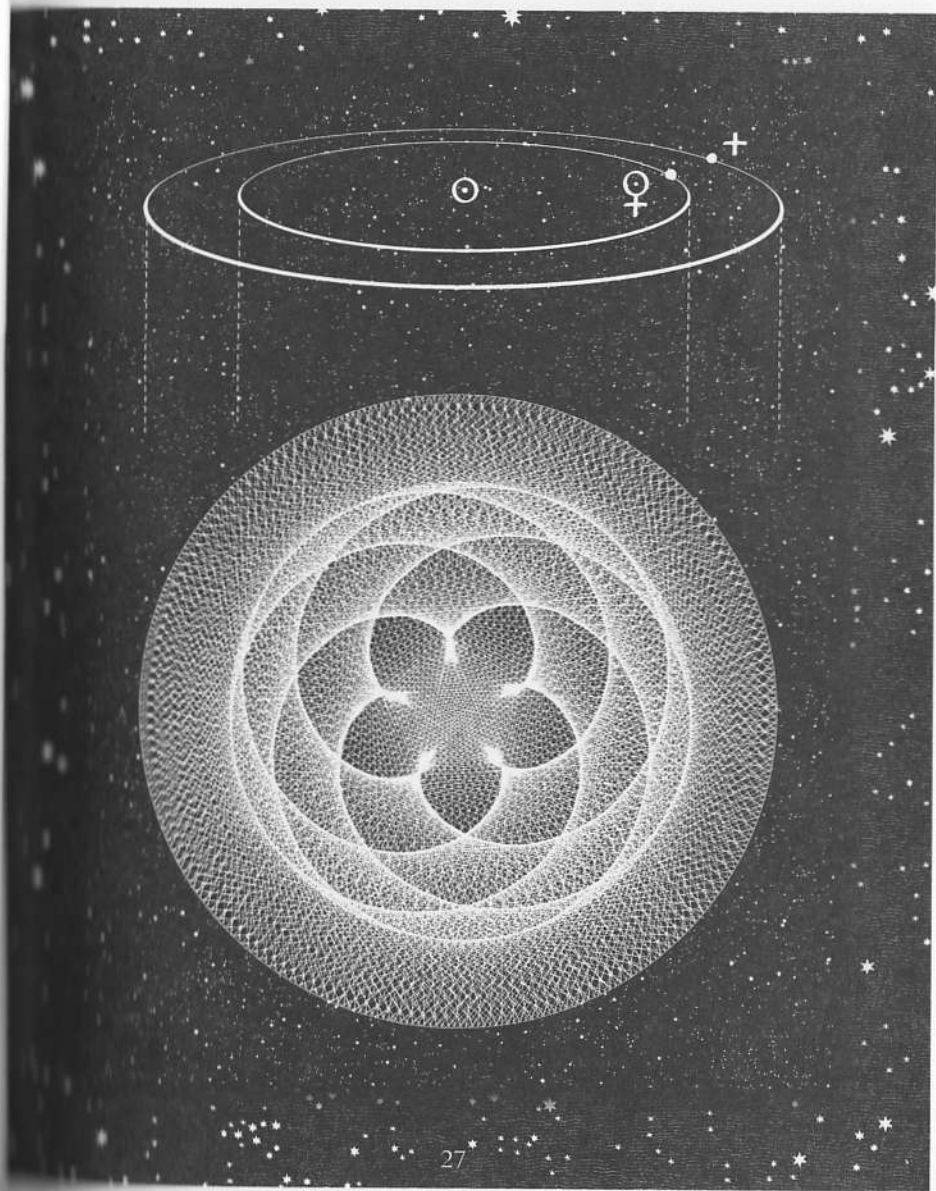
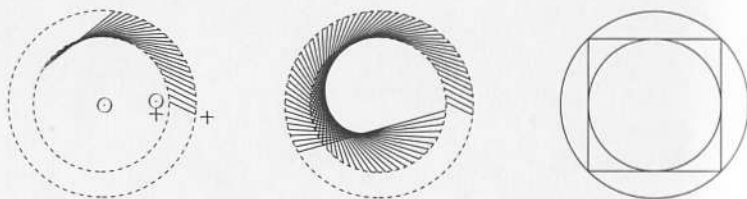
the things they don't teach you at school

With the Sun in the center, let us look at the orbits of Venus and the Earth. Every couple of days a line is drawn between the positions of the two planets (*below left*). Because Venus orbits faster she completes a whole circuit in the same time that the Earth barely manages half a circuit (*below center*). If we keep watching for exactly eight years the full pattern opposite emerges, the sun-centered version of the beautiful five-petaled flower on the previous page.

The ratio between Earth's outermost orbit and Venus' innermost orbit, i.e. their *home*, is intriguingly given by a simple square (*below right*) (99.9%).

Venus uniquely rotates extremely slowly on her own axis in the *opposite* direction to all other rotations in the solar system. Her rotation period is two-thirds of an Earth year (99.8%), a musical fifth, and the second most simple musical interval after the octave. This beautifully harmonizes with the dance opposite so that every time Venus and Earth kiss, Venus does so with her same face looking at the Earth.

Over the eight Earth years of the five kisses, Venus will have spun on her own axis twelve times in thirteen of her years (*from Kollerstrom*). All highly musical, quite exact, and very beautiful.



MERCURY AND EARTH

yet more phives and eights

Mercury and Earth's physical sizes are broadly in the same relation as their mean orbits! Various five and eight-fold overlays are shown opposite which proportion the orbits *and* sizes of the two planets.

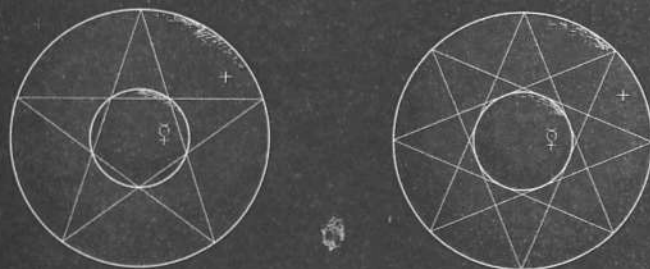
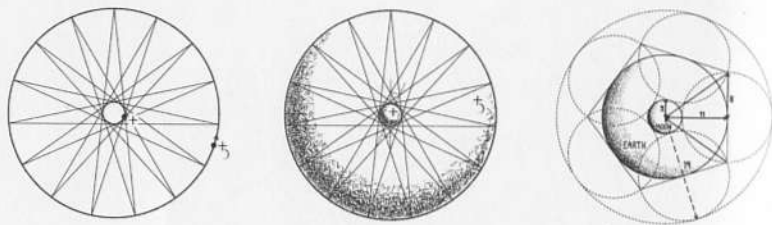
The diameter of Mercury's *innermost* orbit is suggested by the pentagram incircle (*center left*) (99.8%), which also happens to be the distance between the mean orbits of the two planets (99.8%).

Another diagram (*bottom right*) expands on the three touching circles of page 21. Eight circles centered on Venus' orbit produce Earth's mean orbit (99.8%)—the eight years of the five kisses perhaps?

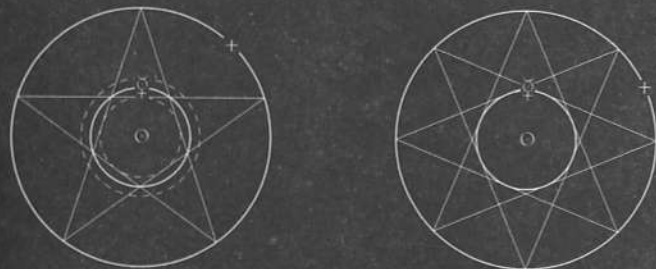
Mercury, Venus and Earth display other coincidences: Working in units of Mercury's orbital radius and period, Venus' period times Φ^2 is Earth's orbital radius squared (99.8%). Another one: Mercury's synodic year of 115.9 days is a Full Moon $\times \Phi^2 \times 3/2$ (99.8%) (*after Richard Heath*).

In case you are interested, the only other instance of two planets' orbits picturing their relative sizes also involves Earth and is shown below, as Earth and Saturn's orbits and sizes are related by a fifteen-pointed star, which also produces the tilt of the Earth.

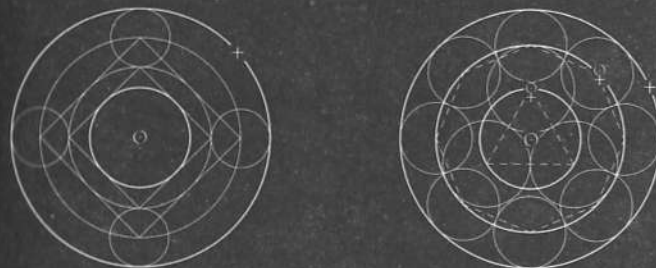
In case you think this is all pure lunacy then don't worry, it is, for we have now arrived at the Moon herself.



THE RELATIVE SIZES OF MERCURY AND EARTH DEFINED BY A PENTAGRAM OR AN OCTAGRAM (99.8%)



THE RELATIVE ORBITS OF MERCURY AND EARTH DEFINED BY THE SAME PENTAGRAM AND OCTAGRAM (99.8%)



OTHER MORE ACCURATE WAYS OF DRAWING THE INNER ORBITS (99.8%)

THE ALCHEMICAL WEDDING

three to eleven all round

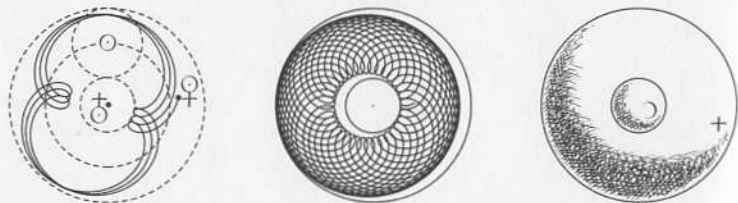
From the surface of the Earth, the Sun and the Moon appear the same size. According to modern cosmology this is “nothing but” a coincidence, but any ancient sage would have told you that the exquisite balance between these two primary bodies is proof of the perfection of creation.

In fact, the sizes of the Moon and Earth relate as 3 to 11 (99.9%). What this means is that if you draw down the Moon to the Earth, then a heavenly circle through the center of the Moon will have a circumference equal to the perimeter of an earthly square enclosing the Earth. The ancients seem to have known about this, and hidden it in the definition of the mile (*opposite, after John Michell & Dan Ward*).

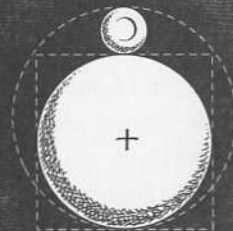
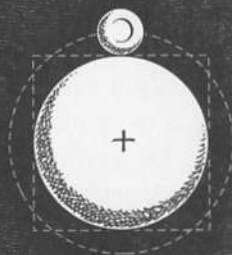
This Earth-Moon proportion is also precisely invoked by our two planetary neighbors, Venus and Mars (*Venus shown dancing round Mars below*). The closest:farthest distance ratio that each experiences of the other is, incredibly, 3:11 (99.9%). Our own 3:11 Moon-Earth system has coincidentally formed to the same ratio, orbiting between them.

3:11 happens to be 27.3%, and the Moon orbits the Earth every 27.3 days, also the average rotation period of a sunspot.

The Sun and Moon do seem very much the unified couple.



THE MOON, A TOTAL SOLAR ECLIPSE, AND THE SUN, AS SEEN FROM EARTH



THE SIZES OF THE MOON AND THE EARTH SQUARE THE CIRCLE. THE DASHED SQUARE AND CIRCLE ARE THE SAME LENGTH OF STRING.

MILES OF MOON AND EARTH

RADIUS OF MOON = 1080 MILES = 3 x 360 MILES
 RADIUS OF EARTH = 3960 MILES = 11 x 360 MILES
 DIAMETER OF MOON = 2160 MILES = 3 x 1 x 2 x 3 x 4 x 5 x 6 MILES
 RADIUS OF EARTH + RADIUS OF MOON = 5040 MILES
 = 1 x 2 x 3 x 4 x 5 x 6 x 7 = 7 x 8 x 9 x 10 MILES
 DIAMETER OF EARTH = 7920 MILES = 8 x 9 x 10 x 11 MILES
 THERE ARE 5280 FEET IN A MILE
 = (10 x 11 x 12 x 13) - (9 x 10 x 11 x 12)

CALENDAR MAGIC

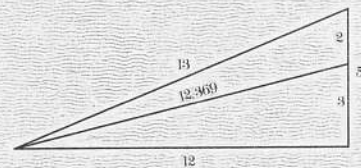
just three numbers do the trick

Imagine we want to discover the number of full moons in a year (somewhere between 12 and 13). Draw a circle, diameter thirteen with a pentagram inside. Its arms will then measure 12.364, almost the right number (99.95%). An even more accurate way of doing it is to draw the second Pythagorean triangle (after the 3-4-5), the 5-12-13, interestingly also the numbers of the keyboard, and of Venus (see page 26). Dividing the 5 side into its harmonic 2:3 gives a new length, $\sqrt{153}$, or 12.369, the number of full moons in a year (99.999%).

The Moon seems to beckon us to look further. We all know that six circles fit around one on a flat surface (giving the numbers six and seven). And twelve spheres pack perfectly around one in our familiar three-dimensional space (our familiar twelve and thirteen). We seem to be moving up in sixes. Could *eighteen* time-spheres fit around one in a fourth dimension of time to give the numbers eighteen and nineteen? Incredibly, all of the current major time cycles of the Sun-Moon-Earth system can be expressed as simple combinations of the numbers 18, 19 and the golden section (page 18). Its values added to the magic number 18 produce 18, 18.618, 19, 19.618 and 20.618, which then multiply together as shown opposite in the most uncanny and accurate way.

Robin Heath, who discovered the relationships displayed on this page, calls this feature of the Sun-Moon-Earth system *the evolutionary engine*. Is it meaningless coincidence or 21st century astrobiophysics?

Mathematician Benjamin Bryton recently simplified Heath's new expression for the solar year purely in terms of Φ and the structure of the musical scale, so $365.242 = \sum_{5,7,12} (\Phi^n + \Phi^{-n} + 1) = \sum_{6,8,13} (\Phi^n + \Phi^{-n})$.



TWO ANCIENT TECHNIQUES FOR FINDING THE NUMBER OF FULL MOONS IN A YEAR

18 YEARS = THE SAROS ECLIPSE CYCLE (99.53%)

(SIMILAR ECLIPSES WILL OCCUR AFTER 18 YEARS)

18.618 YEARS = REVOLUTION OF THE MOON'S NODES (99.99%)

(THE MOON'S NODES ARE THE TWO PLACES WHERE THE SLIGHTLY OFFSET CIRCLES OF THE SUN AND MOON'S ORBITS CROSS)

19 YEARS = THE METONIC CYCLE (99.99%)

(IF THERE IS A FULL MOON ON YOUR BIRTHDAY THIS YEAR - THERE WILL BE ANOTHER ONE ON YOUR BIRTHDAY IN 19 YEARS TIME)

THE ECLIPSE YEAR = 18.618 X 18.618 DAYS (99.99%)

(THE ECLIPSE YEAR IS THE TIME IT TAKES FOR THE SUN TO RETURN TO THE SAME ONE OF THE MOON'S NODES. IT IS 18.618 DAYS SHORT OF A SOLAR YEAR (99.99%). THERE ARE 19 ECLIPSE YEARS IN A SAROS)

12 FULL MOONS = 18.618 X 19 DAYS (99.81%)

(12 FULL MOONS IS THE LUNAR OR ISLAMIC YEAR)

THE SOLAR YEAR = 18.618 X 19.618 DAYS (99.99%)

(THE SOLAR YEAR IS THE 365.242 DAY YEAR WE ARE USED TO)

13 FULL MOONS = 18.618 X 20.618 DAYS (99.99%)

(13 FULL MOONS IS ANOTHER 18.618 DAYS AFTER THE SOLAR YEAR)

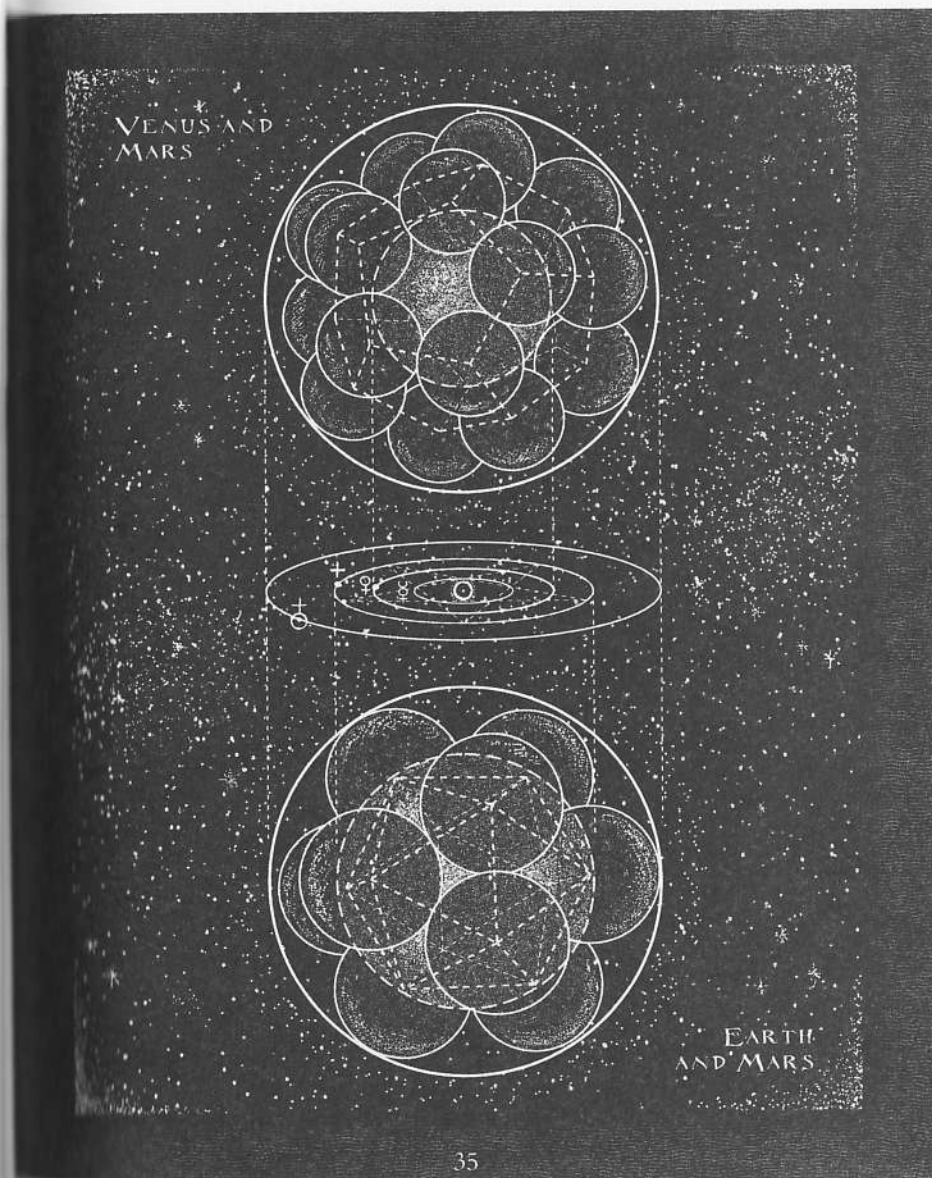
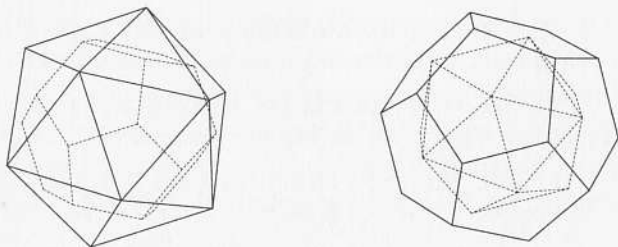
COSMIC FOOTBALL

Mars, Earth and Venus spaced

The next planet out from Earth is the fourth planet, Mars. Kepler had tried a *dodecahedron* spacing the orbits of Mars and Earth, and an *icosahedron* spacing Earth from Venus (see the engraving on page 12). Coincidentally, it turns out he was very close to the mark.

The dodecahedron (made of twelve pentagons) and the icosahedron (made of twenty equilateral triangles) are the last two of the five perfect polyhedra (the *Platonic Solids*). Rich in golden section relationships they form a dual pair, as each creates the other from the centers of its faces (*below*). Opposite, they appear in bubble form both suspended inside Mars' spherical orbit. The dodecahedron magically produces Venus' orbit as the bubble within (*opposite top*) (99.98%), while the icosahedron defines Earth's orbit through its bubble centers (*opposite below*) (99.9%).

In the ancient sciences the icosahedron was associated with the element of water, so it is appropriate to see it emanating from our watery planet. The dodecahedron represented the fifth element of *ether*, the life force, here enveloping lively Earth, and perfectly defined by its two neighbors.



THE ASTEROID BELT

through the looking glass

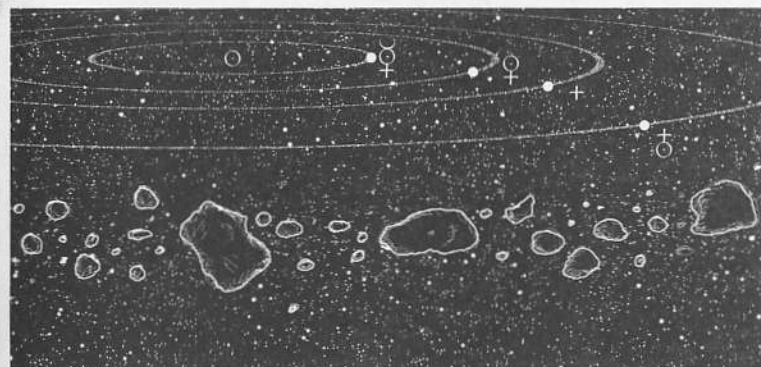
We have reached the end of the inner solar system. Beyond Mars lies a huge space, the other side of which is the enormous planet Jupiter. It is in this space that the Asteroid Belt is found, thousands of large and small tumbling rocks, silicaceous, metallic, carbonaceous and others. Like the gaps in Saturn's rings, there are spaces, termed *Kirkwood Gaps*, in the asteroid belt, cleared where orbital resonances with Jupiter occur. The largest gap is at the orbital distance which would correspond to a period of one third that of Jupiter.

The largest of the asteroids by a very long way is Ceres, comprising over one third of the total mass of all of them. She is about the size of the British Isles and produces a *perfect* eighteen-fold pattern with Earth (see page 57, top left image).

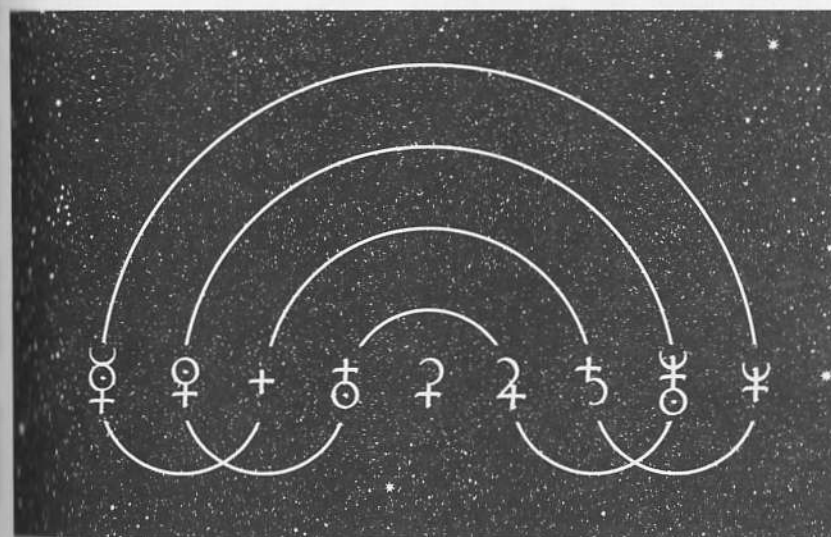
Bode's Law predicted something at the distance of the asteroid belt (see page 16), but it was Alex Geddes who recently discovered the extraordinary mathematical relationship between the four small inner planets and the four outer gas giants. Their orbital radii magically 'reflect' around the asteroid belt and multiply as shown below and as illustrated opposite to produce two enigmatic constants. Yet again we find ourselves peering at a simple pattern we cannot explain.

$$\begin{array}{ll} V_e \times U_r = 1.204 M_e \times N_e & V_e \times M_a = 2.872 M_e \times E_a \\ M_e \times N_e = 1.208 E_a \times S_a & S_a \times N_e = 2.876 J_u \times U_r \\ E_a \times S_a = 1.206 M_a \times J_u & (V_e \times M_a \times J_u \times U_r = M_e \times E_a \times S_a \times N_e) \end{array}$$

The asteroid belt is unlikely to be the remains of a small planet as no sizeable body could ever have formed so close to Jupiter.



THE ASTEROID BELT SEPARATES THE FOUR SMALL ROCKY INNER PLANETS FROM THE FOUR HUGE OUTER ONES



THE PATTERN OF GEDDES' MAGICAL MULTIPLICATIONS

THE OUTER PLANETS

Jupiter, Saturn, Uranus, Neptune, & beyond

Beyond the Asteroid Belt we come to the realm of the gas and ice giants, Jupiter, Saturn, Uranus and Neptune.

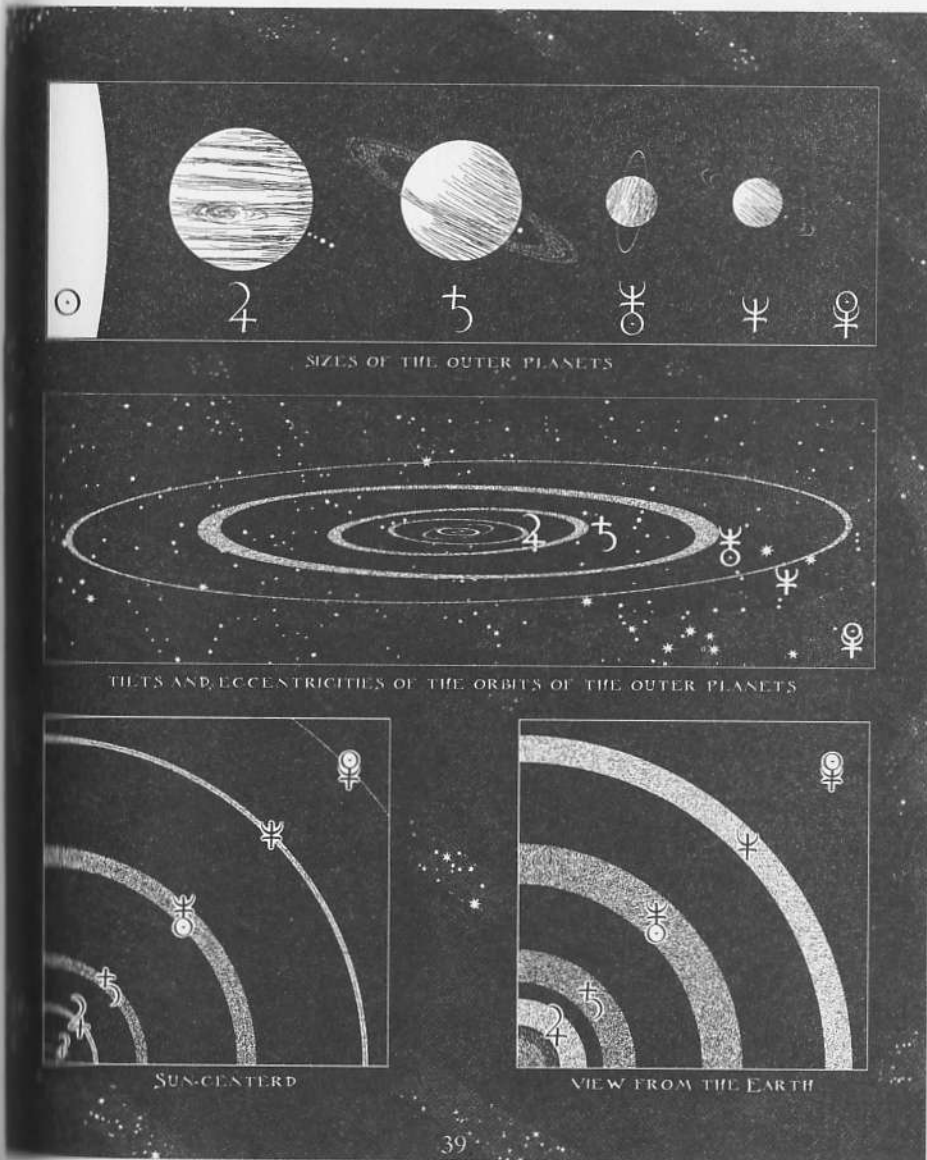
Jupiter is the largest planet, and its magnetic field is the largest object in the solar system. Despite its vast size it rotates on its axis in just 10 hours. 90% hydrogen, it is nevertheless built around a rocky core like all the giant planets. Metallic and liquid hydrogen surrounds this core. The famous red spot is a storm, larger than Earth, which has raged now for hundreds of years. Jupiter's moons are numerous and fascinating: One of the four largest, Io, is the most volcanic body in the solar system; another, Europa, may have warm oceans of water beneath its icy surface.

Saturn, with its beautiful system of rings, is the second largest planet. Its structure beneath its clouds is much the same hydrogen and helium mix surrounding a rocky core as Jupiter. A large number of moons have been discovered, the largest of which is Titan, a world the size of Mercury with all the building blocks for life except water and warmth.

Beyond Saturn is Uranus, which orbits on its side. Winds gust on the equator at six thousand times the speed of sound.

Next is Neptune, like Uranus, an ice world of water, ammonia and methane. Neptune's largest moon, Triton, has nitrogen ice caps and spews geysers of liquid nitrogen high into the atmosphere.

Finally, the tiny planet Pluto with its large moon Charon, and beyond, the primordial swarm of the Kuiper Belt, from where Pluto probably came. Eventually, stretching a third of the way to the nearest star, the sphere of icy debris of the Oort Cloud, home to the comets which occasionally rain towards the Sun, watering the inner planets.



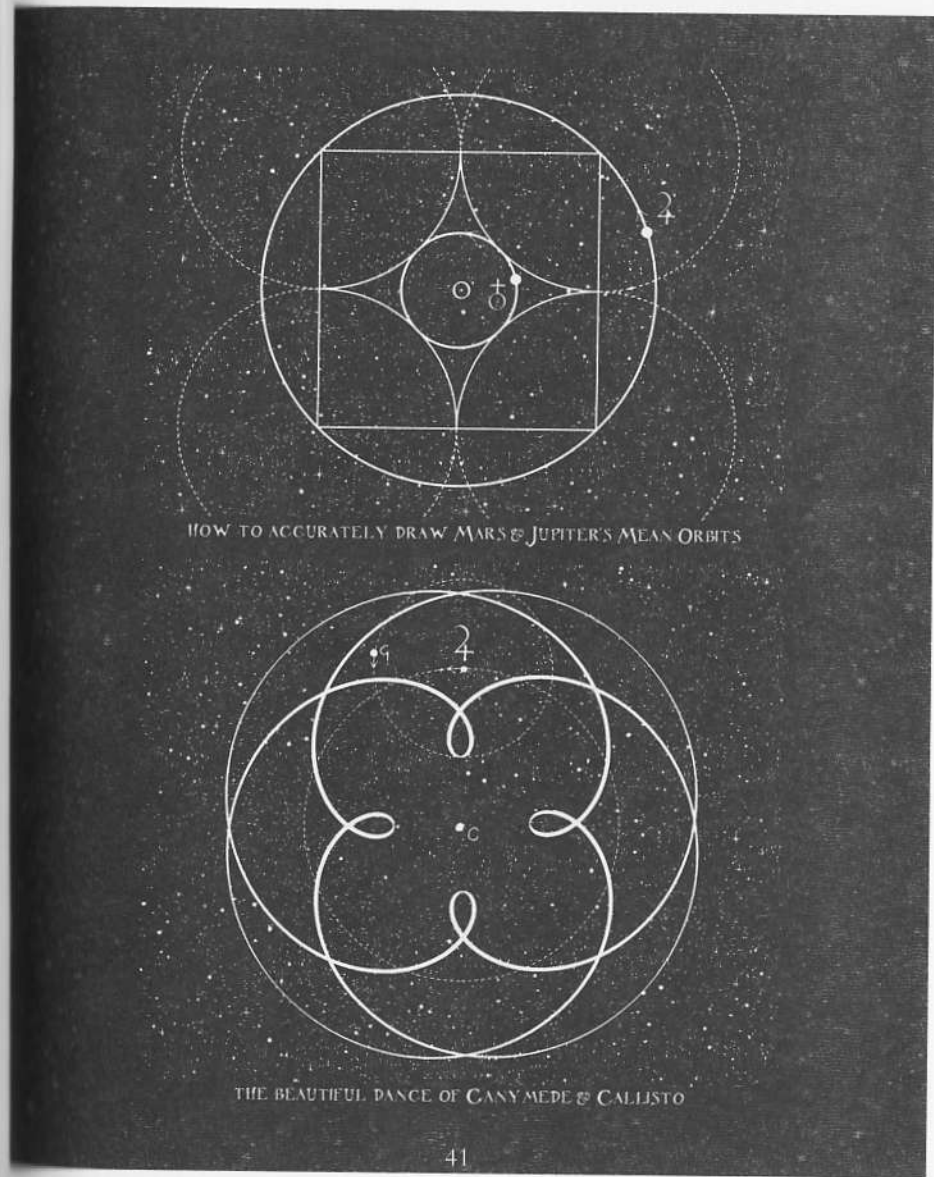
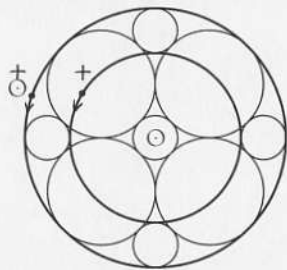
FOURS

Mars, Jupiter and massive moons

An asteroid belt and 340 million miles separate Mars' and Jupiter's orbits, a greater distance than Earth's entire orbit. Jupiter is the first and largest of the gas giants, the vacuum cleaner of the solar system. If Jupiter had gathered only slightly more material during its long and ongoing formation its internal pressures could have turned it into a star and we would have had a second Sun.

The top diagram opposite shows a simple way to draw the average orbits of Mars and Jupiter from four touching circles or a square (99.98%). Like the picture on page 23, it is an everyday proportion derived from packing circles. Shown below, on this page, is a pattern from the same family, which spaces Earth's and Mars' mean orbits (99.9%).

Jupiter has four particularly large moons, discovered by Galileo in 1610. The two largest, Ganymede and Callisto, are the size of the planet Mercury and produce one of the most perfect space-time patterns in the solar system. An observer living on either moon would experience the motion of the other in space and time as the beautiful harmonic fourfold diagram shown opposite.



OUTER MOONS

harmonic patterns

Four groups of moons orbit Jupiter. The first two groups have four moons each and look very like a small model of the whole solar system—four small inner bodies followed by four giants. This second group of four large moons, the *Galileans*, is divided into two rocky worlds, Io and Europa, followed by the two massive gas and ice moons the size of planets, Ganymede and Callisto (see *previous page*). The diagram below shows just how big some of these moons are.

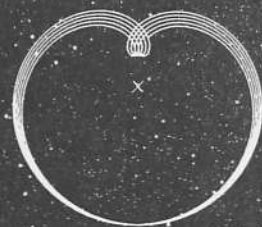
The predominance of the number four around Jupiter is striking. Each of the four groups has its own general moonsize, orbital plane, period and distance from Jupiter (the inclinations of the four orbital planes of the four groups even add up to a quarter of a circle (99.9%)).

Saturn has over thirty moons, most shepherding and tuning the amazing rings with the larger bodies tending to be far further out. Way beyond Saturn's rings are three moons—the gigantic Titan, tiny Hyperion, and, further out still, Iapetus.

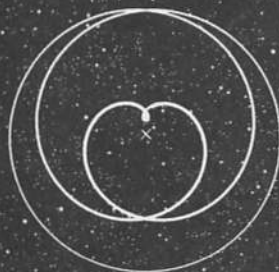
The picture opposite shows further harmonic patterns: two more from Jupiter's largest moons, two experienced by Saturn's outer moons and two from the outer planets of the solar system. Looking at these pictures one cannot but sense the harmony of these spheres.



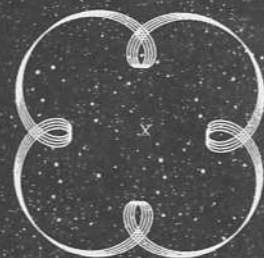
EUROPA & IO.



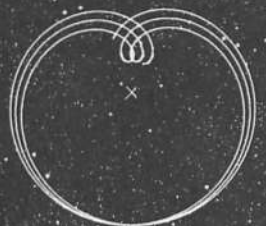
EUROPA & GANYMEDE



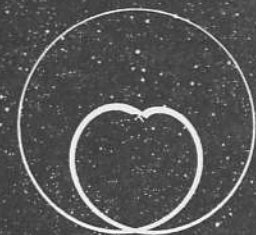
TITAN & HYPERION



TITAN & IAPETUS



URANUS & NEPTUNE



NEPTUNE & PLUTO

JUPITER'S GIANT SEAL

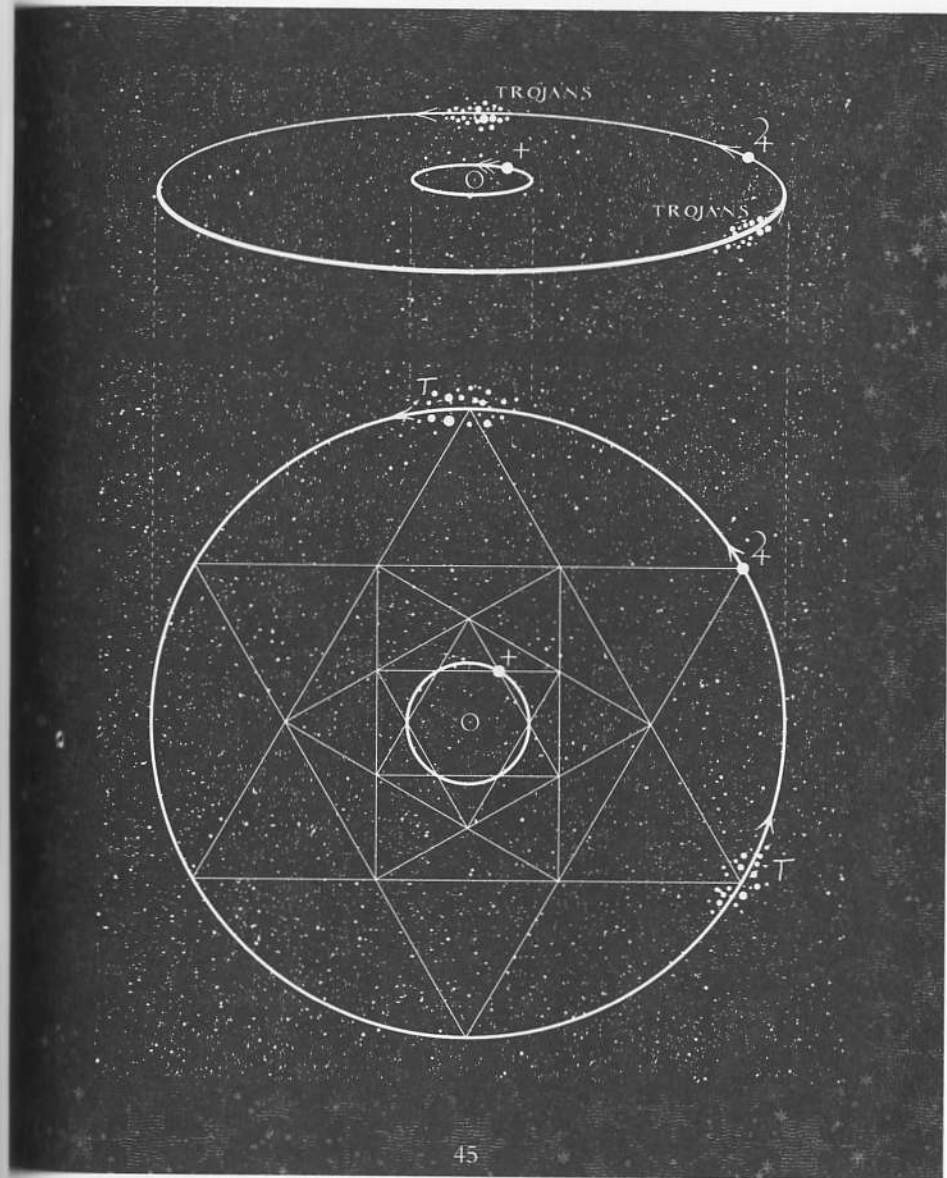
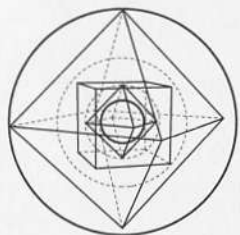
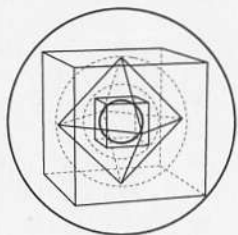
huge hexagrams and affirmatory asteroids

Jupiter, the largest planet, was once king of the ancient gods, Zeus to the Greeks. A delightful feature of its orbit is its pair of asteroid clusters, the *Trojans*, which move round Jupiter's orbit, 60° ahead of it and 60° behind (*opposite*). This threesome perpetually rotates round the Sun as though held in place by the spokes of a wheel. The Trojan clusters occur at *Laplace Points*, where Sun, Jupiter, and the Trojans forming gravitationally balanced equilateral triangles.

Just for the fun of it, if we now join the spokes as shown opposite then three hexagrams can be seen to produce Earth's mean orbit from Jupiter's (99.8%)—a very easy trick to remember. Earth and Jupiter's relative orbits are thus hiding in every crystal.

Exactly this same proportion may again be created by spherically nesting three cubes, three octahedra, or any threefold combination of them inside the sphere of Jupiter's orbit (*two possibilities shown below*), the tiny sphere in the middle is Earth's orbit.

The display of hexagonal geometry is not limited to Jupiter. Recent photographs of Saturn's north pole have revealed a strange hexagonal feature, 15,000 miles across, which extends 60 miles into its clouds.



THE GOLDEN CLOCK

Jupiter and Saturn seen from Earth

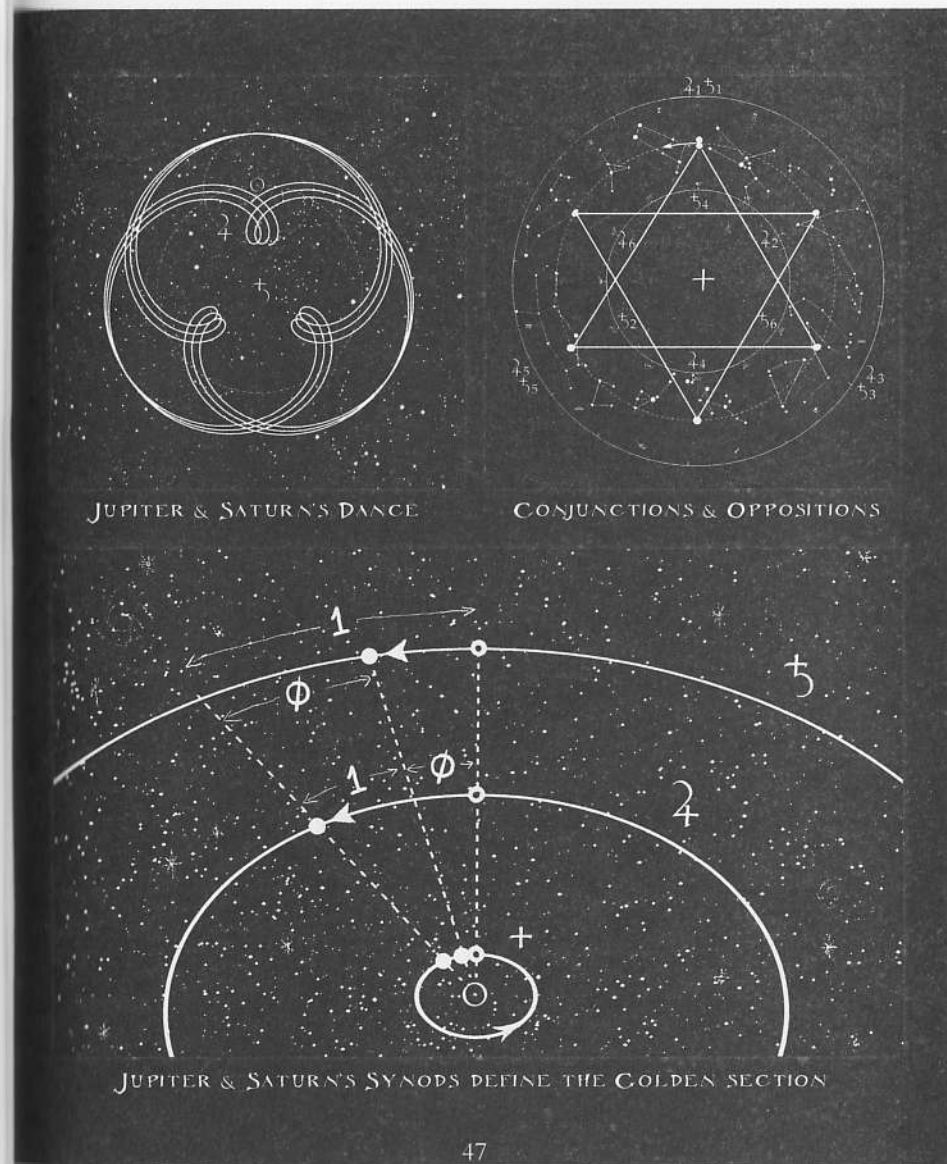
Jupiter and Saturn are the two largest planets of the solar system and ruled the outer two spheres of the ancient system. In Greek mythology, Saturn was Chronos, the Lord of Time.

The two giants dance around each other beautifully in a 5:2 period-ratio waltz (*opposite top left*). The beautiful three-fold harmonic is immediately apparent, spinning slowly because of the slight miss in the harmony. From Earth, this pattern is seen as both a triangle of conjunctions, 20 years apart, and as another opposing triangle of oppositions, which together form a hexagram (*top right*).

Jupiter and Saturn do some incredible things when seen from Earth. The crude lower diagram opposite shows one of these. We start with the three planets in a vertical line before setting them off. Earth orbits much faster than the outer planets and makes a whole annual circuit of the Sun (365.2 days) before lining up with slow Saturn again for a synod after 378.1 days. Three weeks later it lines up with Jupiter (after 398.9 days). The golden section is defined here in time and space to a very high accuracy (99.99%). It should come as no surprise to discover the two giants of our solar system reinforcing the proportion of life on Earth.

Another enigmatic harmony is more calendrical. Many religious calendars use the lunar year of 12 lunar months as their fundamental cycle, the Jewish and Islamic calendars being two examples. This lunar year, 354.4 days in length, relates to Jupiter's synodic year as 8:9 (99.9%), and to Saturn's as 15:16 (99.9%) (*after Richard Heath*). Again these two ratios are fundamental in music, as the tone and half-tone respectively.

The Earth and Moon thus derive life and music from the giants.



OCTAVES OUT THERE

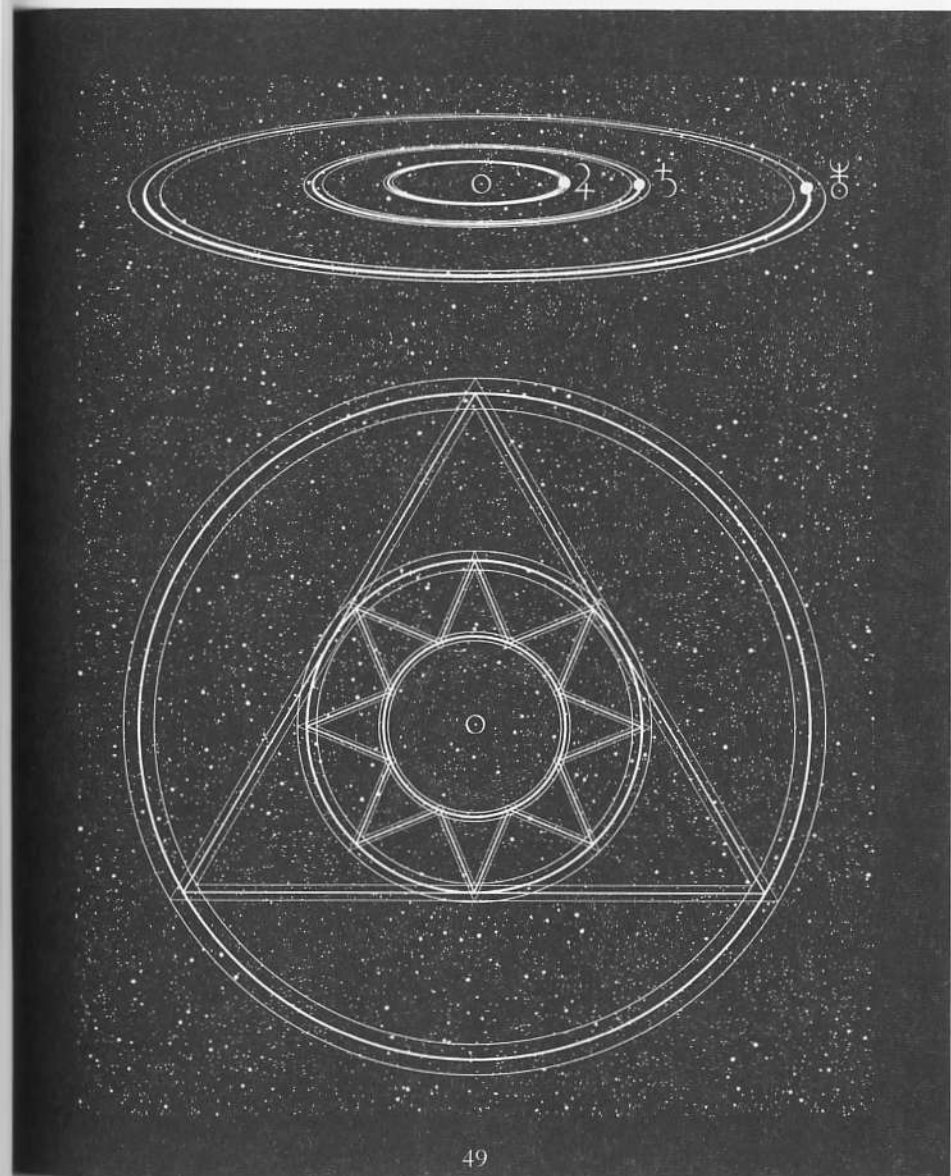
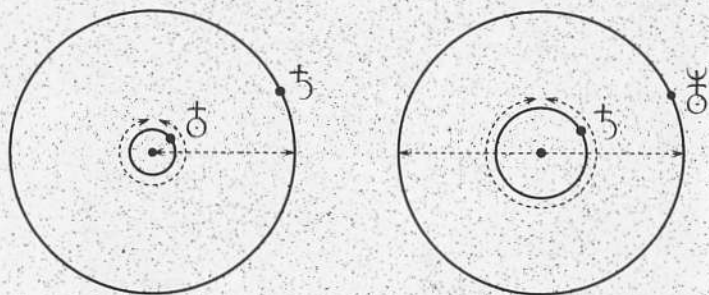
threes and eights again

If you ever want to incorporate Jupiter, Saturn and Uranus' orbits into a window or floor design the diagram opposite might help. An equilateral triangle and an octagram proportion the outer, mean and inner orbits of the three largest planets. Tiny inaccuracies are visible but the fit is excellent overall, memorable, and adequate for many practical purposes. It is a spiky inversion of the touching circles solution for the first three planets (*see page 29, lower right*).

One way of depicting the musical octave (a halving or doubling of frequency or wavelength), is by an equilateral triangle, as the inscribed circle has a diameter half that of the containing circle.

Interestingly, Jupiter and Saturn's orbits are in the proportion 6:11 (99.9%), double the 3:11 ratio between the Moon and Earth (*see page 30*).

Saturn's orbit also happens to invoke π or 'pi' - twice (*below*). Its radius is the circumference of Mars' orbit (99.9%) and its circumference the diameter of Neptune's orbit (99.9%). You can now draw the solar system.



THE STARRY SIGNATURE

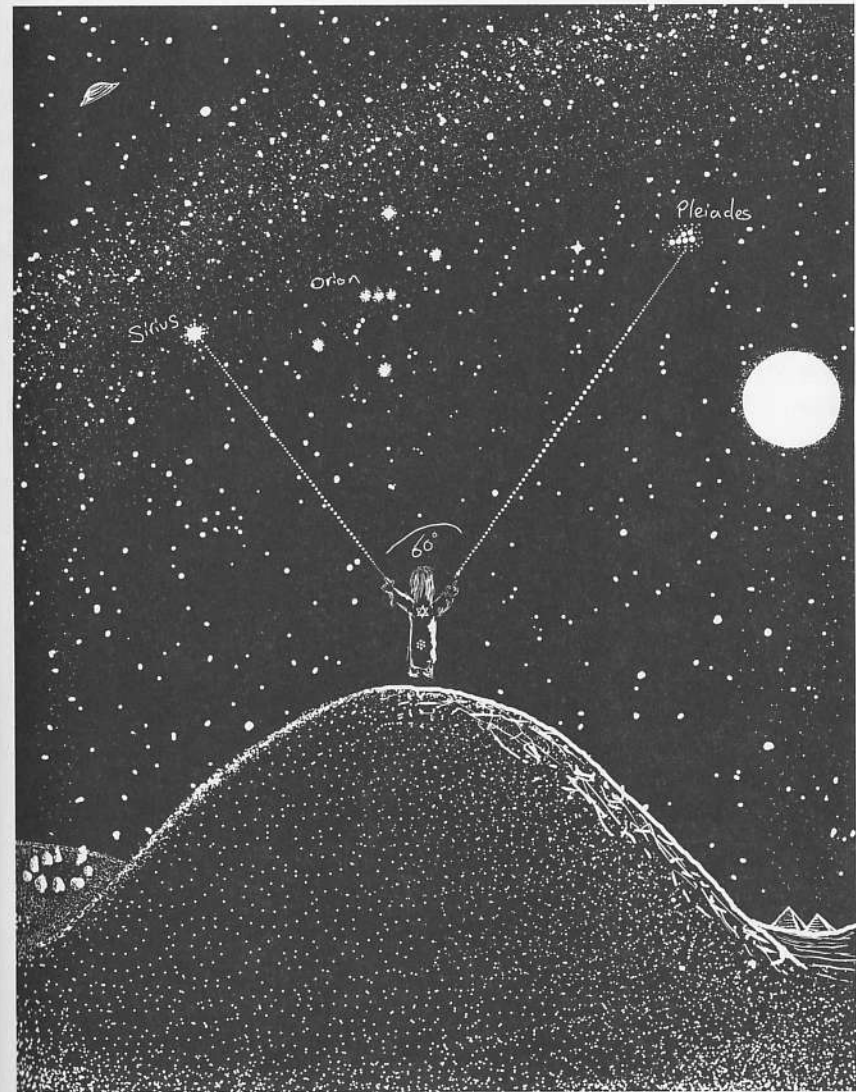
circumstantial evidence for life on earth

Despite all the scientific discoveries over recent centuries we are possibly today as far from understanding what we are doing here as the ancients were from being able to build a pocket calculator. The ancient philosophers, however, pondered consciousness deeply, and hinted that life, or the soul, was particularly akin to the fine arts of geometry and music. Through these arts they carefully investigated the relationship between “The One” and “The Few”, for in music there are only so many notes in tune, and in geometry only so many shapes that fit. Kepler, Newton, Einstein, and others to this day have looked for simple and beautiful relationships in nature, and then expressed them as equations whenever they could.

This book has shown simple and beautiful examples of harmony and geometry in the solar system. The golden section, long associated with life, and conspicuously absent from most modern equations, plays lovingly around Earth. Does this in some way have something to do with why we are here, when we are here, and what we might really be, and if so could these techniques be used to locate intelligent life in other solar systems?

If you ever need reminding that there may be a little more magic to our origins than modern cosmology can yet offer, then just remember the kiss of Venus, and the sage words of John Donne:

*“Man hath weav'd out a net, and this net throwne
upon the Heavens, and now they are his owne.
Loth to goe up the Hill, or labor thus
to goe to Heaven, we make Heaven come to us.”*



SUN & PLANETS

	Perihelion (10 ⁶ km)	Mean Orbit (10 ⁶ km)	Aphelion (10 ⁶ km)	Eccentricity	Inclination of Orbit (degrees)	Perihelion Longitude (degrees)	Orbital Period (days)	Tropical Year (days)
<i>The Sun</i>	☉	-	-	-	-	-	-	-
<i>Mercury</i>	☿	46.00	57.91	0.205631	7.0049	77.456	87.969	87.968
<i>Venus</i>	♀	107.48	108.21	0.006773	3.3947	131.53	224.701	224.695
<i>The Earth</i>	+	147.09	149.60	0.016710	0	102.95	365.256	365.242
<i>Mars</i>	♂	206.62	227.92	0.093412	1.8506	336.04	686.980	686.973
<i>Ceres</i>	♁	446.60	413.94	0.0789	10.58	???	1680.1	1679.5
<i>Jupiter</i>	♃	740.52	778.57	0.048393	1.3053	14.753	4,332.6	4,330.6
<i>Saturn</i>	♄	1,352.2	1,433.5	0.054151	2.4845	92.432	10,759.2	10,746.9
<i>Chiron</i>	♅	1,266.2	2,050.1	0.38316	6.9352	339.58	18,518	18,512
<i>Uranus</i>	♁	2,741.3	2,872.46	0.047168	0.76986	170.96	30,685	30,589
<i>Neptune</i>	♆	4,444.4	4,495.1	0.0085859	1.7692	44.971	60,190	59,800
<i>Pluto</i>	♇	4,435.0	5,869.7	0.24881	17.142	224.07	90,465	90,588

MOONS (a selection)

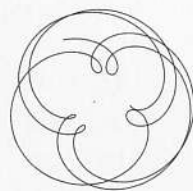
	Name of Satellite	Mean Orbital Radius (10 ³ km)	Orbital Period (days)	Eccentricity of Orbit	Inclination of Orbit (°)	Diameter (mean) (km)	Mass (10 ¹⁸ kg)	
<i>Earth's</i>	+	<i>The Moon</i>	384.8	27.3217	0.0549	5.145	3,475	73,490
<i>Mars's</i>	♂	<i>Phobos</i>	9,378	0.31891	0.0151	1.08	22.4	0.0106
		<i>Deimos</i>	23,459	1.26244	0.0005	1.79	12.2	0.0024
<i>Jupiter's</i>	♃	<i>Io</i>	421.6	1.7691	0.004	0.04	3,643	89,330
		<i>Europa</i>	670.9	3.5512	0.009	0.47	3,130	47,970
		<i>Ganymede</i>	1,070	7.1546	0.002	0.21	5,268	148,200
		<i>Callisto</i>	1,883	16.689	0.007	0.51	4,806	107,600
<i>Saturn's</i>	♄	<i>Tethys</i>	294.66	1.8878	<0.001	1.86	1,060	622
		<i>Dione</i>	377.40	2.7369	0.0022	0.02	1,120	1,100
		<i>Rhea</i>	527.04	4.5175	0.0010	0.35	1,528	2,310
		<i>Titan</i>	1,221.8	15.945	0.33	0.33	5,150	134,550
		<i>Iapetus</i>	3,561.3	79.330	0.0283	14.7	1,436	1,590

Rotation Period (hours)	Average Day Length (hours)	Equatorial Diameter (km)	Polar Diameter (km)	Axial Tilt (degrees)	Mass (10 ²⁴ kg)	Volume (10 ¹² km ³)	Surface Gravity (m/s ²)	Surface Pressure (bars)	Temp. (mean) (°C)
600 - 816	-	1,392,000	1,392,000	7.25	1,989,100	1,412,000	274.0	0.000868	5505
1407.6	4222.6	4,879.4	4,879.4	0.01	0.3302	0.06083	3.70	negl.	167
-5832.5	2802.0	12,103.6	12,103.6	177.36	4.8685	0.92843	8.87	92	464
23.934	24.000	12,756.2	12,713.6	23.45	5.9736	1.08321	9.78	1.014	15
24.623	24.660	6794	6750	25.19	0.64185	0.16318	3.69	0.007	-65
9.0744	9.0864	960	932	var.	0.00087	0.000443	negl.	negl.	-90
9.9250	9.9259	142,984	133,708	3.13	1,898.6	1,431.28	23.12	100+	-110
10.656	10.656	120,536	108,728	26.73	568.46	827.13	8.96	100+	-140
5.8992	5.8992	208	148	???	0.000006	0.000024	negl.	negl.	???
-17.239	17.239	51,118	49,946	97.77	86.832	68.33	8.69	100+	-195
16.11	16.11	49,528	48,682	28.32	102.43	62.54	11.00	100+	-215
-153.29	153.28	2390	2390	122.53	0.0125	0.00715	0.58	negl.	-223

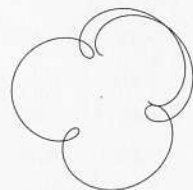
MOONS (continued)

	Name of Satellite	Mean Radius Orbit (10 ³ km)	Orbital Period (days)	Eccentricity of Orbit	Inclination of Orbit (°)	Diameter (mean) (km)	Mass (10 ¹⁸ kg)	
<i>Uranus's</i>	♁	<i>Miranda</i>	129.39	1.4135	0.0027	4.22	235.7	66
		<i>Ariel</i>	191.02	2.5204	0.0034	0.31	578.9	1,340
		<i>Umbriel</i>	266.30	4.1442	0.0050	0.36	584.7	1,170
		<i>Titania</i>	435.91	8.7059	0.0022	0.14	788.9	3,520
		<i>Oberon</i>	583.52	13.463	0.0008	0.10	761.4	3,010
<i>Neptune's</i>	♆	<i>Proteus</i>	117.65	1.1223	0.0004	0.55	193	3
		<i>Triton</i>	354.76	-5.8769	0.000016	157.35	2,705	21,470
		<i>Nereid</i>	5,541.3	360.14	0.7512	7.23	340	20
<i>Pluto's</i>	♇	<i>Charon</i>	19.6	6.3873	<0.001	<0.01	1,186	1,900

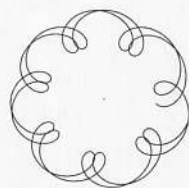
Only the major moons of the gas giants are given. In 2001 there were 28 known moons around Jupiter, 30 around Saturn, 21 around Uranus and 8 around Neptune. There are probably many more. There are 29.5306 days between full moons on Earth. Cosmology can seriously improve your health.



MERCURY - VENUS



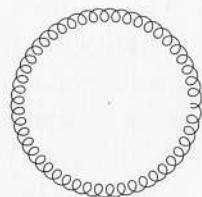
MERCURY - EARTH



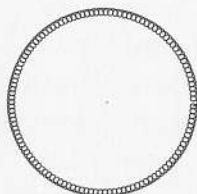
MERCURY - MARS



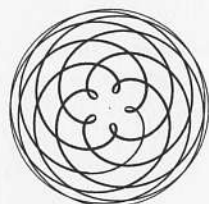
MERCURY - CERES



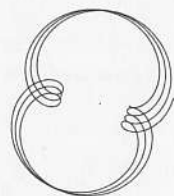
MERCURY - JUPITER



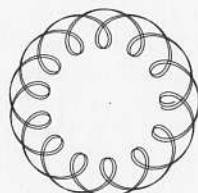
MERCURY - SATURN



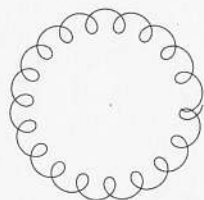
VENUS - EARTH



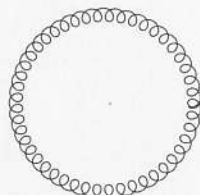
VENUS - MARS



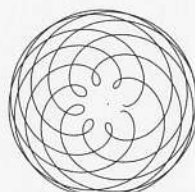
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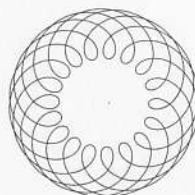
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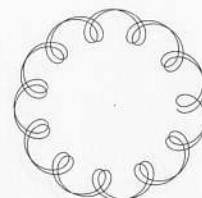
VENUS - SATURN



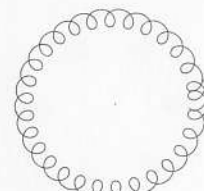
EARTH - MARS



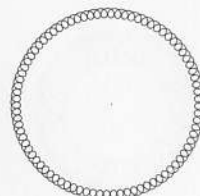
EARTH - CERES



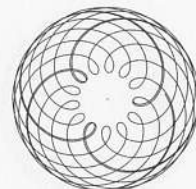
EARTH - JUPITER



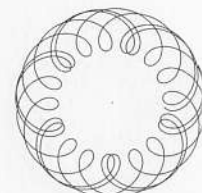
EARTH - SATURN



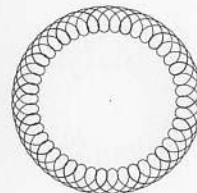
EARTH - URANUS



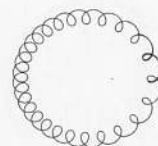
MARS - CERES



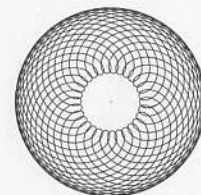
MARS - JUPITER



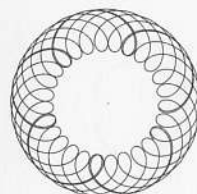
MARS - SATURN



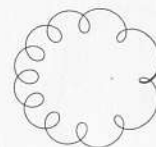
MARS - CHIRON



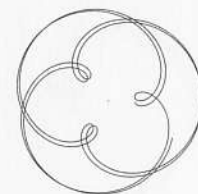
CERES - JUPITER



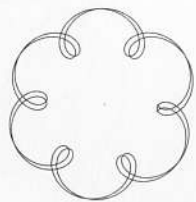
CERES - SATURN



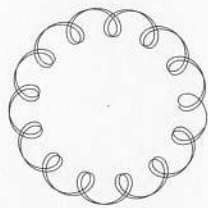
CERES - CHIRON



JUPITER - SATURN



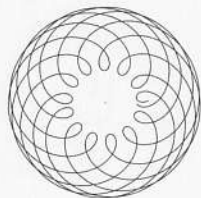
JUPITER - URANUS



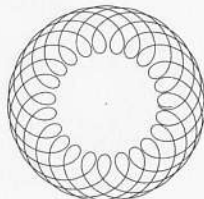
JUPITER - NEPTUNE



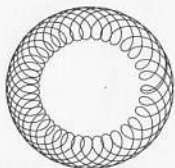
JUPITER - PLUTO



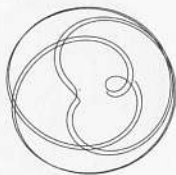
SATURN - URANUS



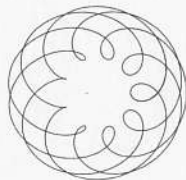
SATURN - NEPTUNE



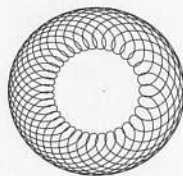
SATURN - PLUTO



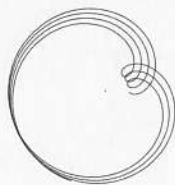
CHIRON - URANUS



CHIRON - NEPTUNE



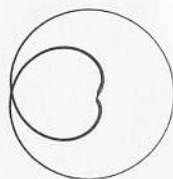
CHIRON - PLUTO



URANUS - NEPTUNE



URANUS - PLUTO



NEPTUNE - PLUTO