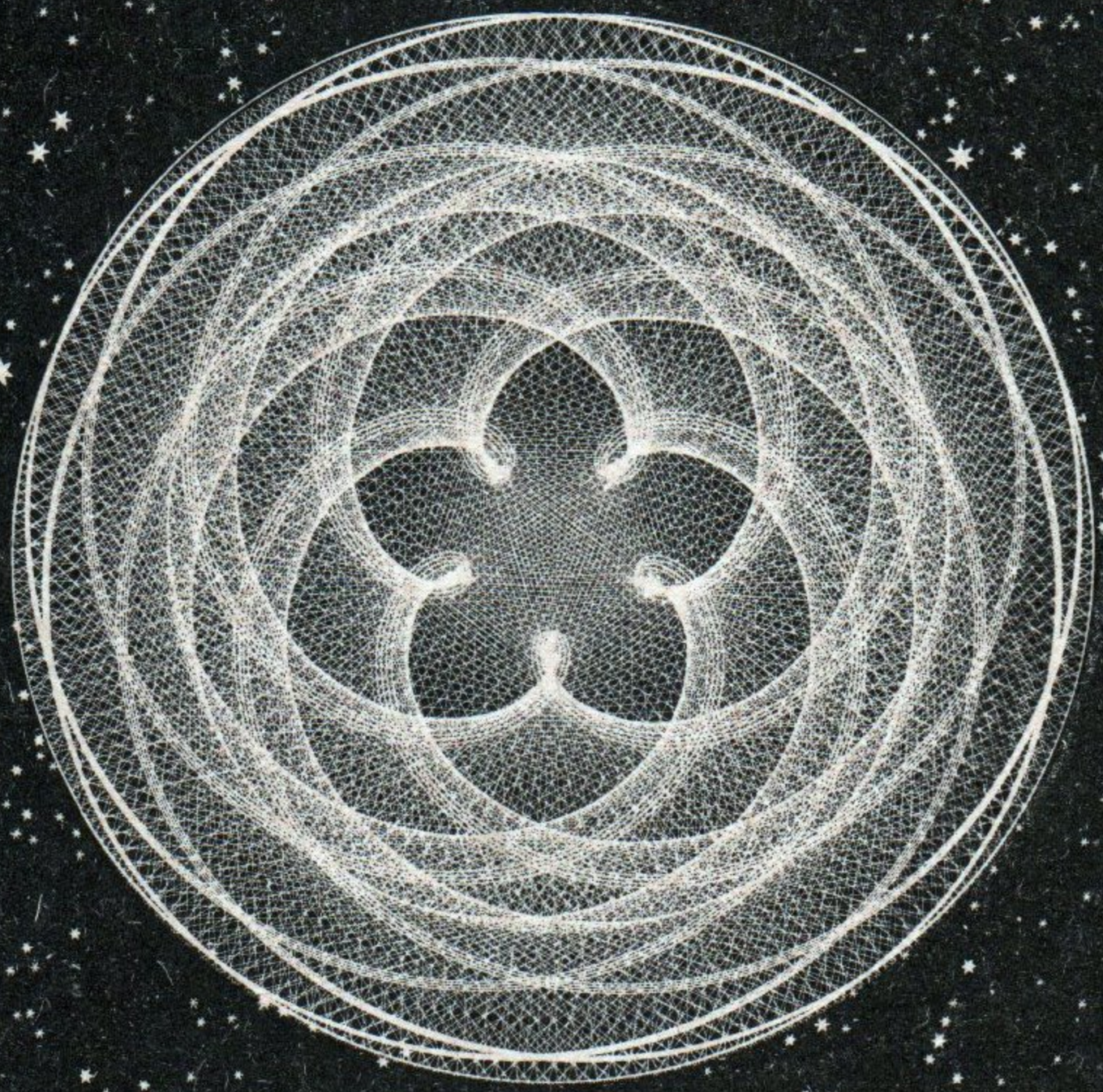
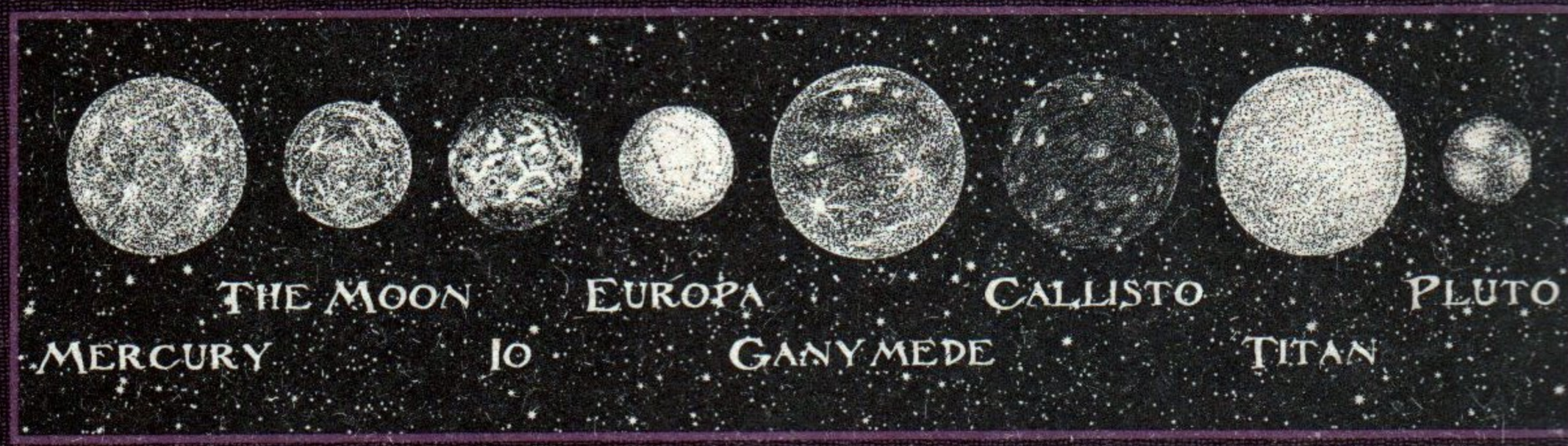
the ultimate sourcebook of cosmic pattern in the solar system

a little book of COINCIDENCE



John Martineau

space will never be the same again



Venus draws a pentagram around Earth every eight years.

Planets play out the slow Music of the Spheres.

Is there a hidden structure in the solar system?

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

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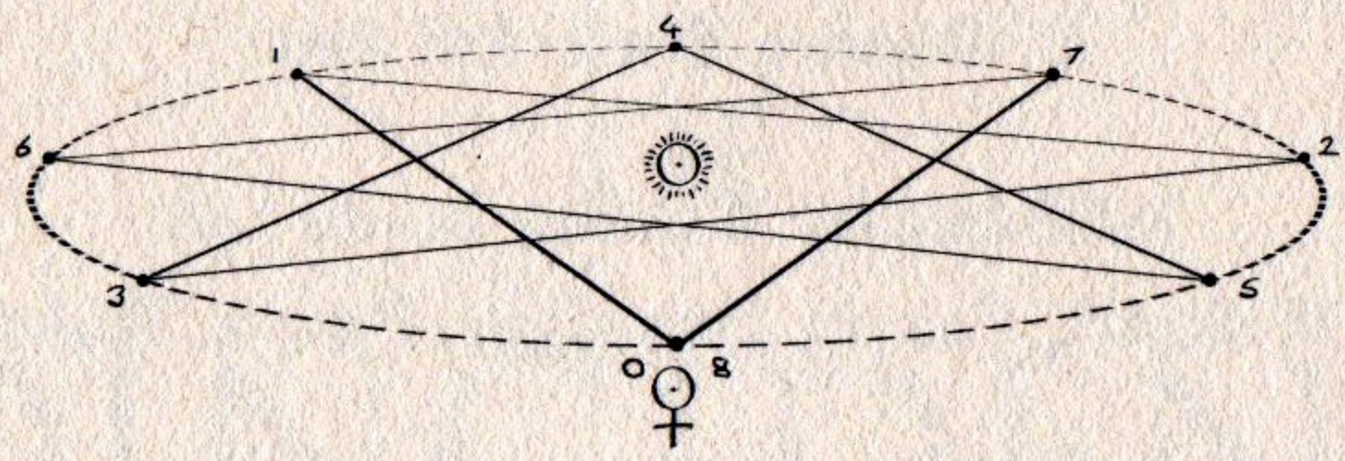

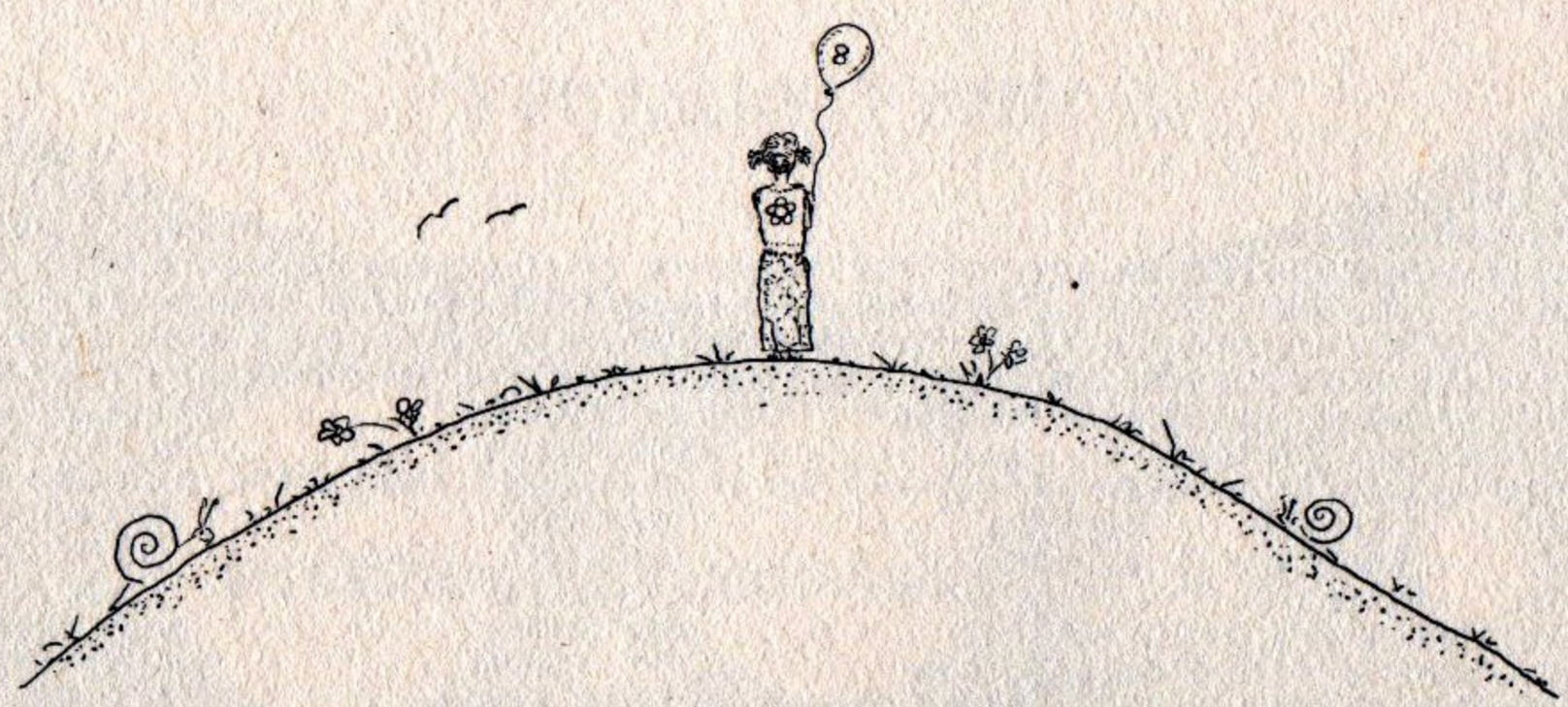

Climb up a hill at midday on your birthday every year.
Venus moves around the Sun to draw an octagram over eight years.

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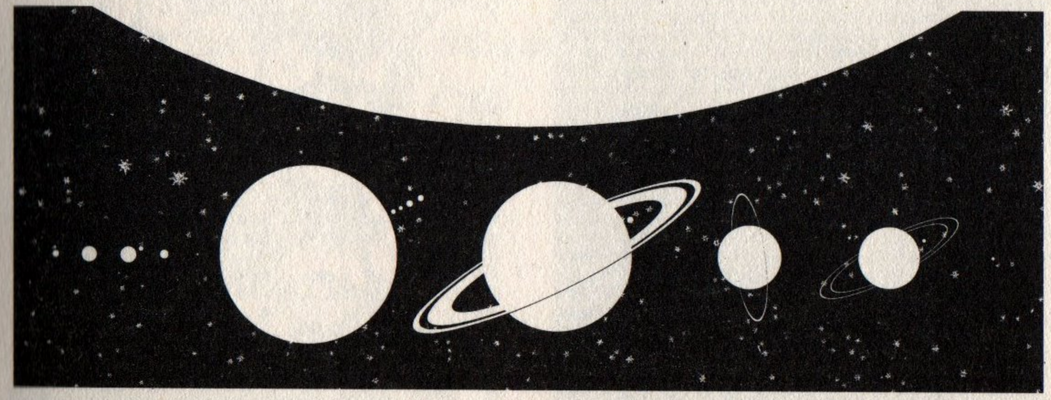
WOODEN BOOKS

A LITTLE BOOK OF COINCIDENCE



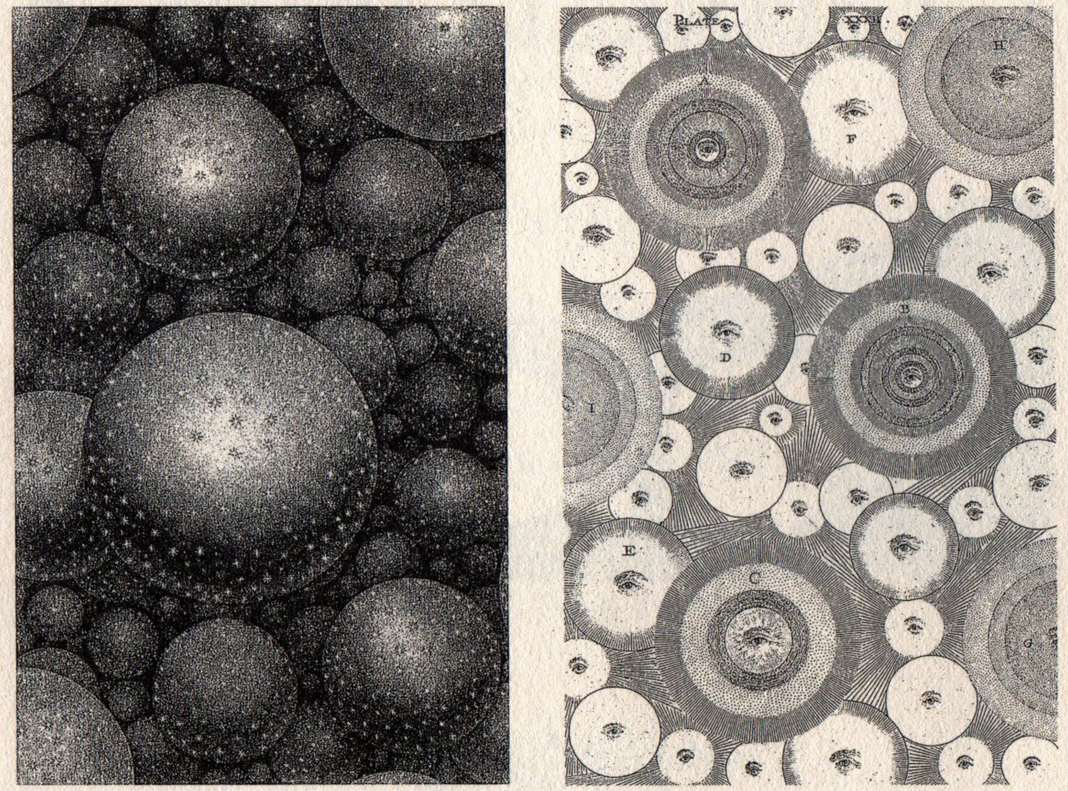
written and illustrated by

John Martineau

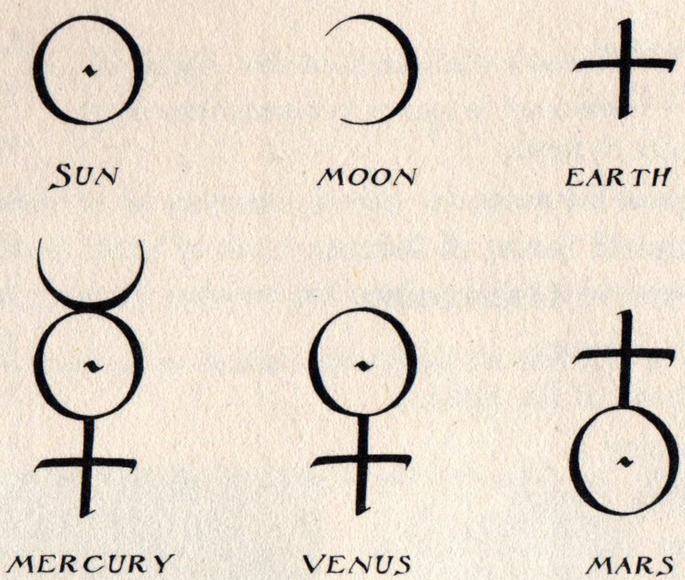
To people who have tragically grown up
in a world devoid of a magical cosmology.

Thanks to the numerous friends, colleagues and others who have contributed to this project over the years. Please keep crunching the numbers and sending ideas and miracles.

Note: Percentages in brackets throughout the text refer to accuracies.



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.



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 cosmic 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? There are ancient answers to such questions, however, and these invoke liberal arts like 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 neighbours 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 ...

Radnorshire, May 2001

Galactic Dust

the well-tuned universe

There's a lot going on in the universe. We can now see as many stars within our space-time horizon as there are grains of sand on Earth. Our planet and we ourselves are made from reorganised smoky stardust, a fact long taught by ancient cultures. We now know that stardust itself is made simply from fizzballs, organised 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, crystalized, built up and settled down.

We still have not evidence as to 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 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. 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*, today they experiment with the simple precision of Kepler's, Newton's and Einstein's laws. Who knows what will come next?

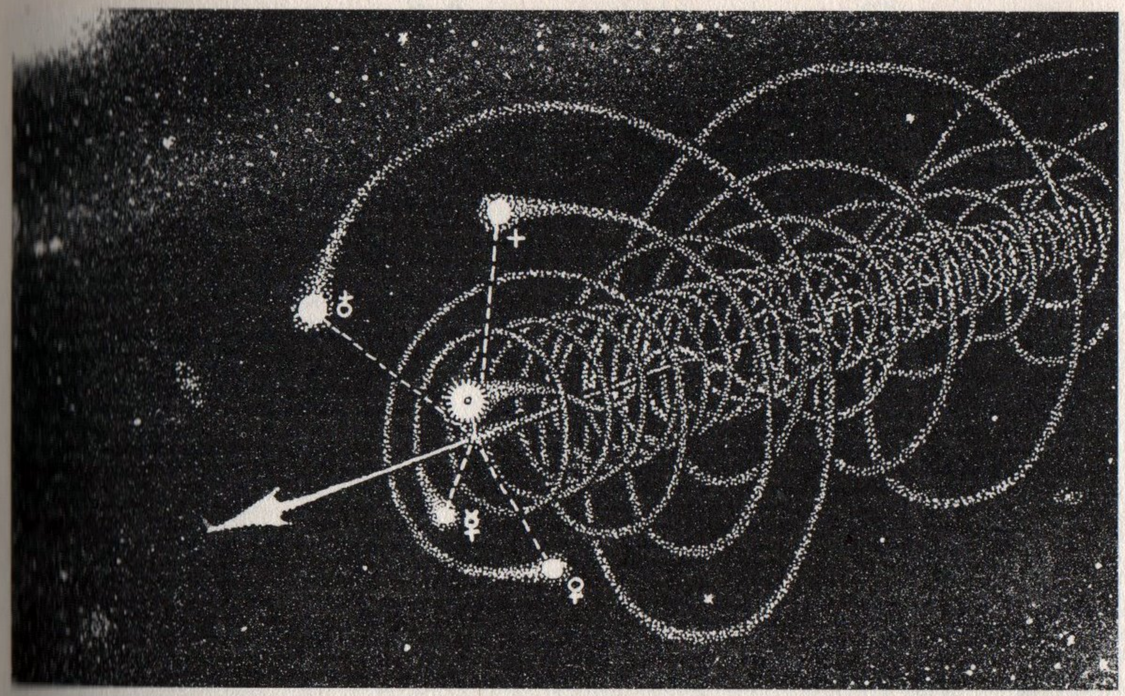
The Solar System

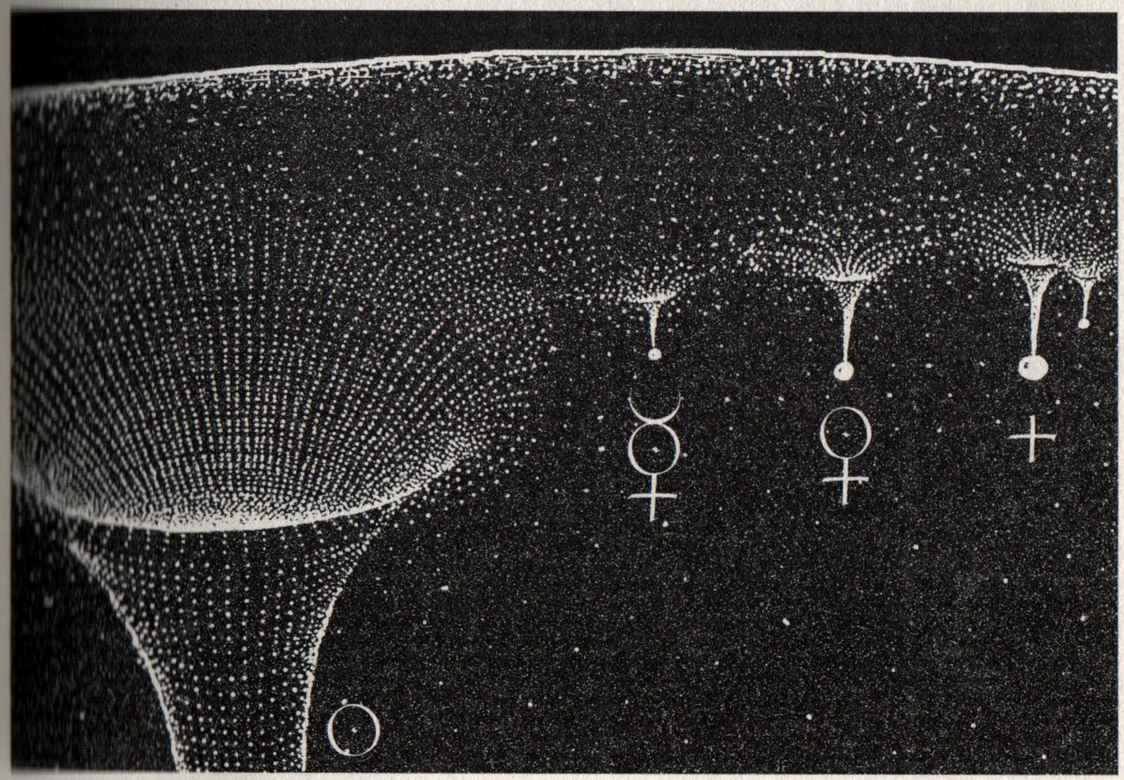
spirals everywhere

It is now thought that our solar system condensed from a disk of debris some five billion years ago to form a Sun. Remaining heavier materials were attracted to each other and pulled inwards to form small asteroids and rocky planets. Lighter gases were blown further out by the solar wind to condense as the four gas giants, Jupiter, Saturn, Neptune and Uranus. In the inner solar system asteroids grew into planets, pulling the final pieces into place with more and more energy (many remain hot inside today from the collisions). Eventually things became as they are now.

The plane of the solar system is tilted at 30° to the plane of the galaxy so our solar system actually corkscrews its way around the arm of the milky way. The picture (*opposite above, after Windelius & Tucker*) is 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 Murchie*). This is Einstein's model of the way matter curves space-time and helps visualise the force of gravity between masses. If we flick a tiny frictionless pea onto our sheet, it could 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 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 run.



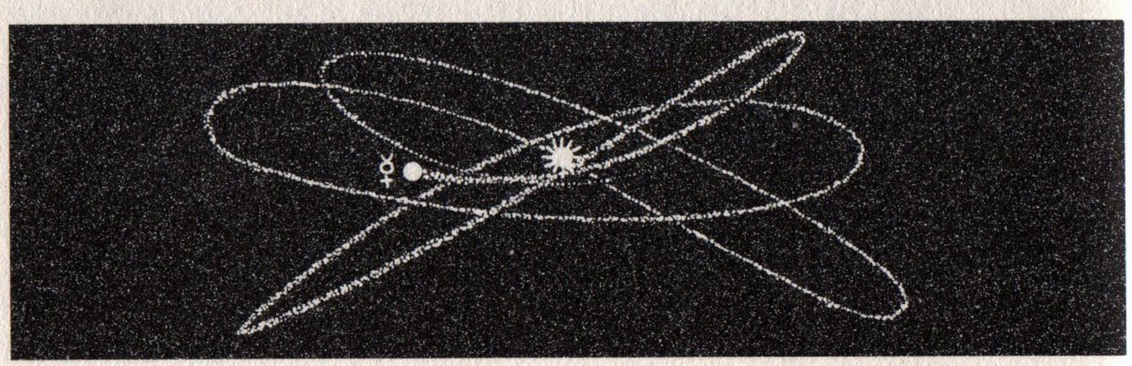


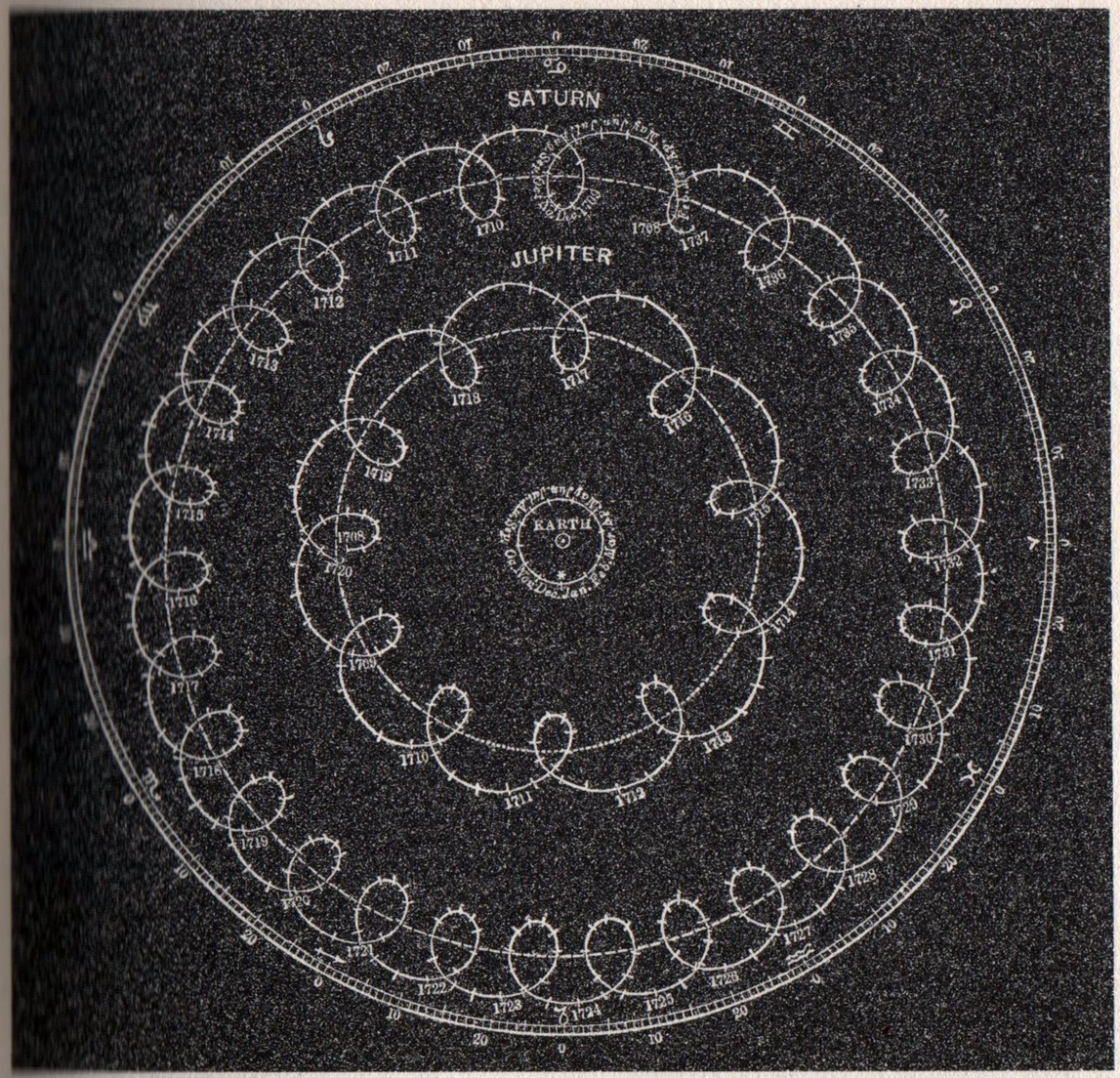
Retrograde Motion

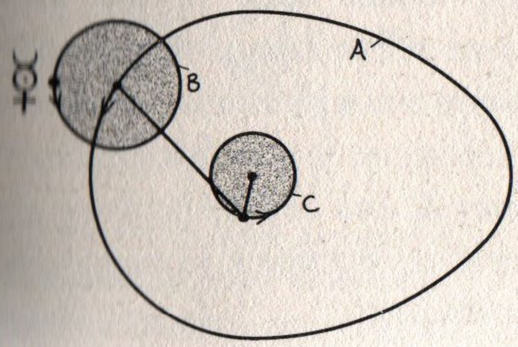
running kissing around

Anyone who watches the sky from Earth will notice that apart from the Sun and Moon there are five easily visible wandering stars. These are the planets, which seem to move around the earth roughly following the Sun's yearly circle, the *ecliptic* or the stars of the *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. As two planets pass, or kiss, each appears to the other to *retrogress* or go backwards against the stars for a certain length of time.

The diagram below shows Mercury's pattern around a tracked Sun over a year as seen from Earth (*after Schultz*), and opposite we see Cassini's early 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.

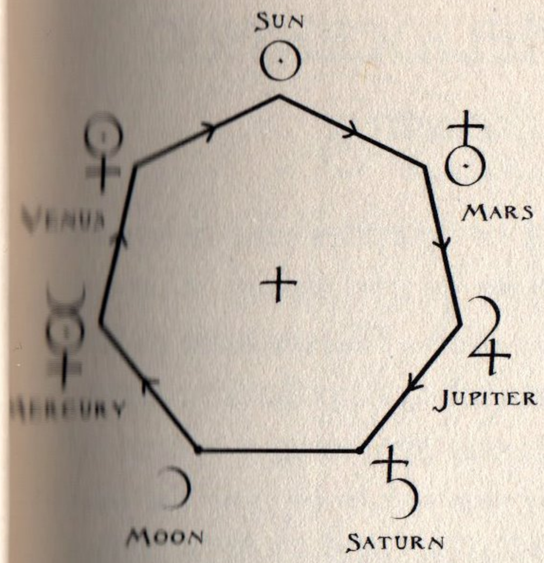
The Ancient Secret of Sevens

planets, metals and days of the week

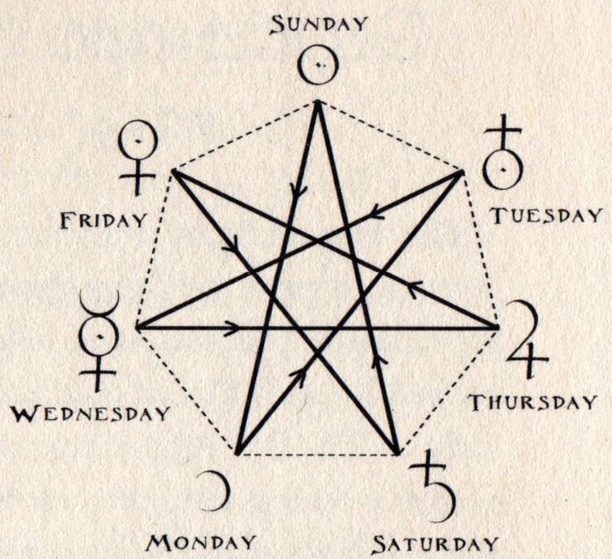
A short four hundred years ago the diagrams opposite formed the cornerstone of cosmological thought across the western world, as they had done for many thousands of years. Today these emblems of the seven-fold system of antiquity appear as quaint reminders of an alchemical cosmology now buried beneath newly discovered planets and physical elements.

There are seven clearly visible wandering heavenly bodies, and they may be arranged around a heptagon in order of their apparent speed against the fixed stars. The Moon appears to move fastest, followed by Mercury, Venus, the Sun, Mars, Jupiter and Saturn (*top left*). Planets were assigned to days, still clear in many languages, and the order of the days was given by the 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*.

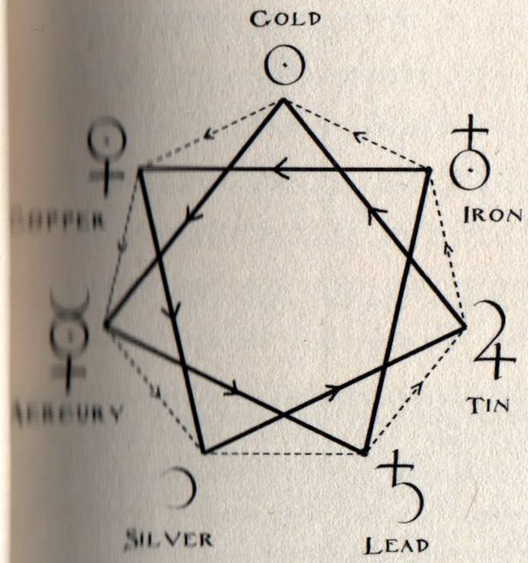
In antiquity seven metals were held to correspond with the seven planets, their compounds giving rise to colour associations. Venus, for example, was associated with the greens and blues of copper carbonates. Students of alchemy would often ponder these relationships as they forged ever more subtle things. Importantly, 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.



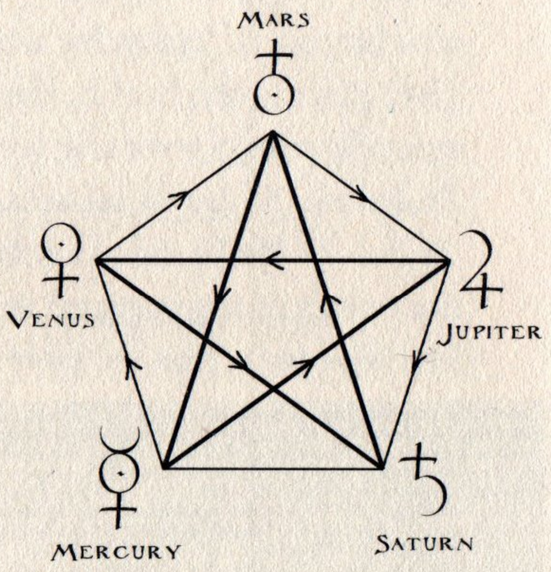
THE SEVEN HEAVENLY BODIES:
Start at the Moon and follow the arrows to give the 'Chaldean Order' of the spheres.



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.

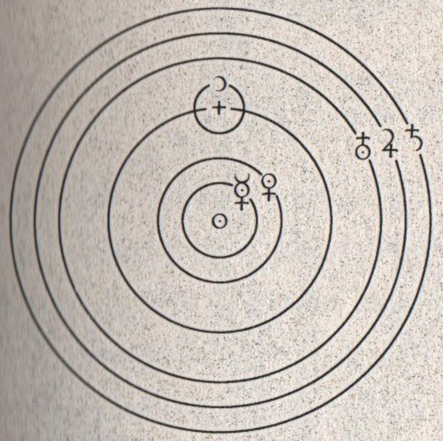
Geocentric or Heliocentric

Earth or Sun at the centre

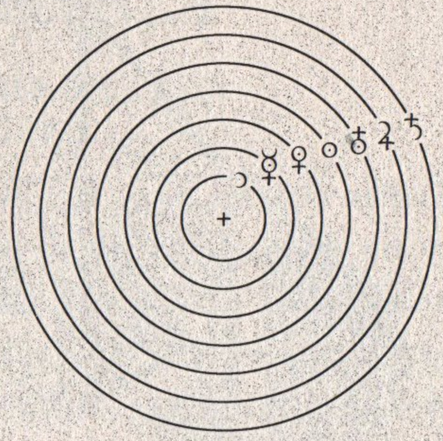
The extraordinary Ptolemaic world of epicycles and deferents lasted a surprisingly long time. Despite its complexity it 'saved appearances' and was even held to save souls. Ellipses were in fact studied by early Greek mathematicians such as Appollonius, and as early as 250 BC Aristarchus of Samos was 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 in the centre of the universe as the Ptolemaic system was handed down from the Greeks to the Arabs, and then back to the West again.

Four ancient systems are shown opposite (*after Koestler*), and each sphere of each diagram is to be understood as having its own attachment of epicycles and eccentrics. Copernicus, despite in 1543 placing the Sun in the centre (*top left*), remained a convinced epicycle man, increasing the number of invisible wheels from the Ptolemaic 39 up to an amazing 48. In the late sixteenth century Tycho de Brahe desperately tried to keep the Earth stationary in the center of the universe (*bottom left*), whilst an early Greek model, Herakleides', like a later version by Eriugina, attempted a compromise.

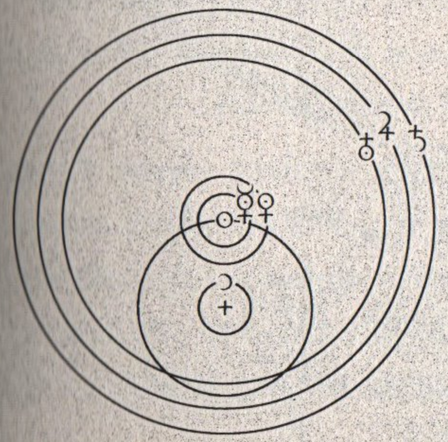
The modern model of the Solar System is shown opposite (*below*). It shows the planets (including an asteroid, Ceres), orbiting the Sun in space. Each planet has an orbital 'shell', some thicker than others. This basic model was first conceived by Johannes Kepler in 1596 and it is to his ideas that we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



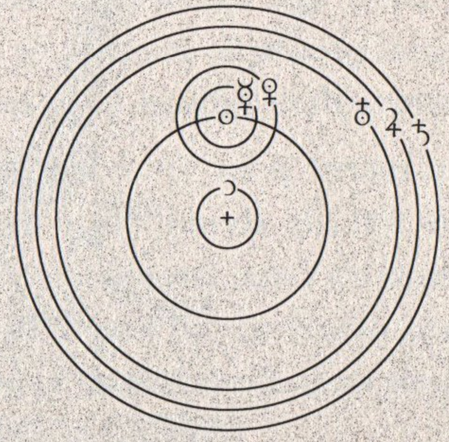
Aristarchus' & Copernicus' system



The Ptolemaic system



Tycho de Brahe's solution



Herakleides' system

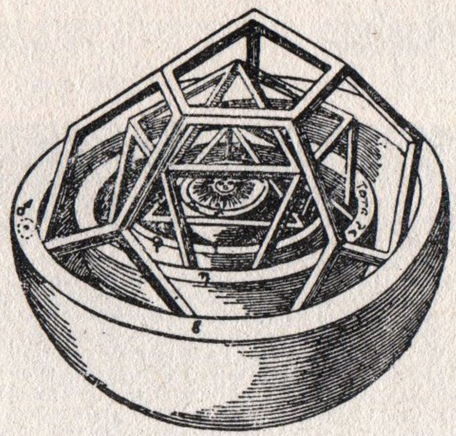
Kepler's Visions

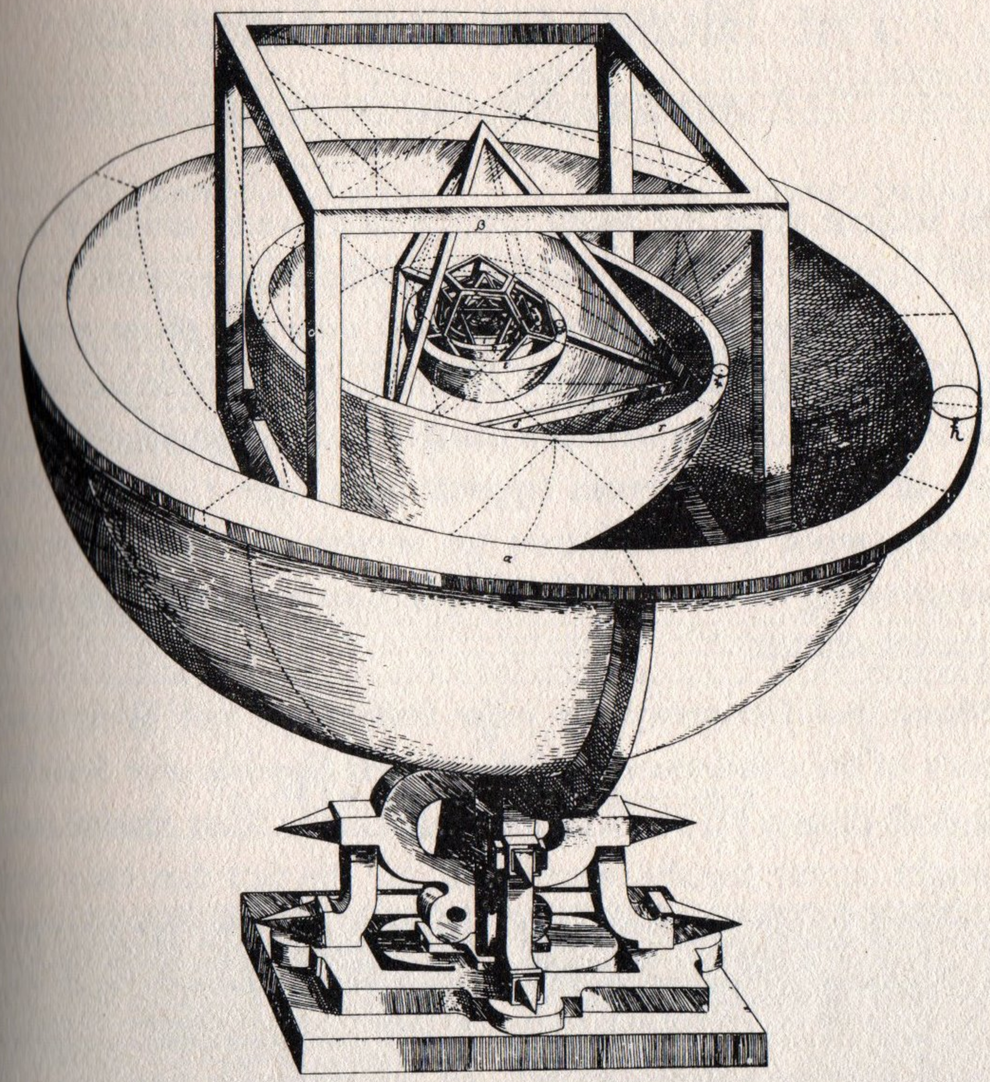
ellipses and nested solids

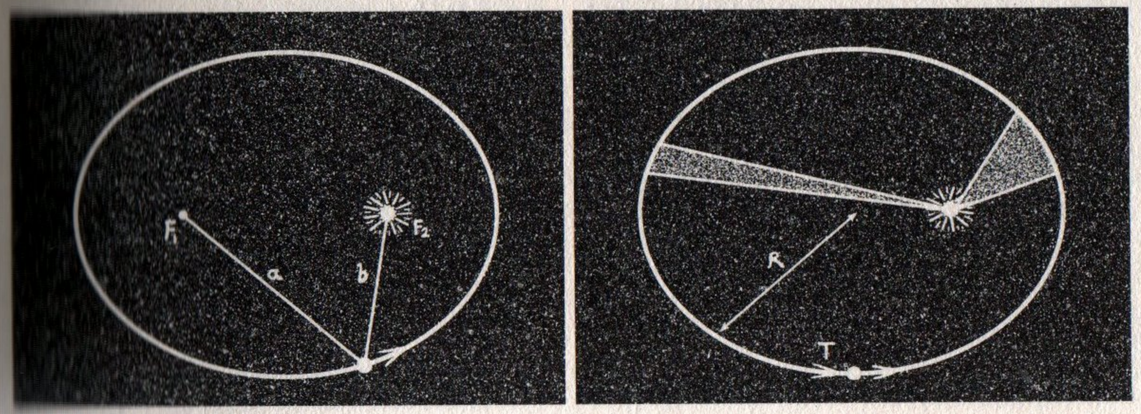
Kepler noticed three things about planetary orbits. Firstly that they are ellipses (*so that a + b = constant opposite below*), with the Sun at one focus. Secondly, that the *area* of space swept out by a planet in a given time is constant. Thirdly, that the period T of a planet relates to R, its semi-major 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 their spheres (*opposite, and detailed 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 affected the precessional rotation of the ellipses over thousands of years, thus reinforcing Kepler's shells.





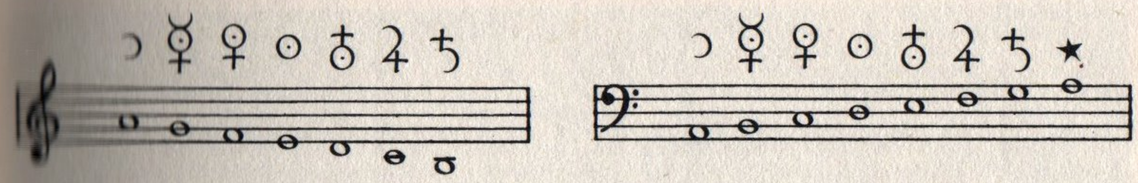


The Music of the Spheres

planets playing in tune

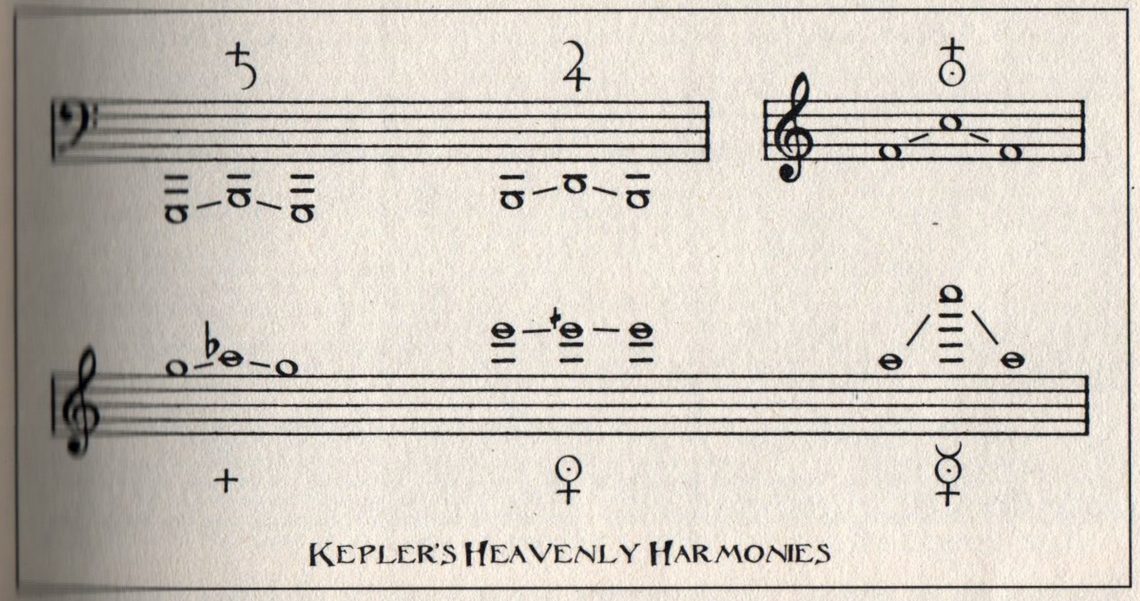
In ancient times the seven musical notes were assigned to the seven heavenly bodies in various symbolic arrangements (*opposite top*). With his accurate data, Kepler now set about precisely calculating these long imagined *Harmoniae Mundi*. He particularly noticed that the ratios between planets' extreme angular velocities were all harmonic intervals (*opposite center, after Godwin)*. More recently, work by Molchanov has shown that the entire solar system can be viewed as a 'tuned' quantum structure, with Jupiter as the conductor.

Music and Geometry are close bedfellows and Weizsacker's theory of the condensation of the planets (*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 define Mercury's shell (99.4%), 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%). Three nested pentagons define the space between Venus and Mars (99.6%) or Ceres and Jupiter's mean orbits (99.6%).

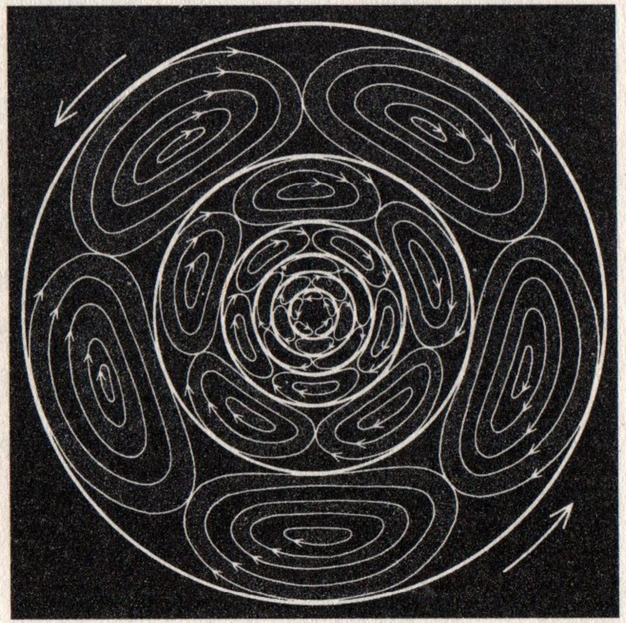


ANCIENT EGYPTIAN SYSTEM

CICERO - SCIPIO'S DREAM



KEPLER'S HEAVENLY HARMONIES



Bode's Law and Synods

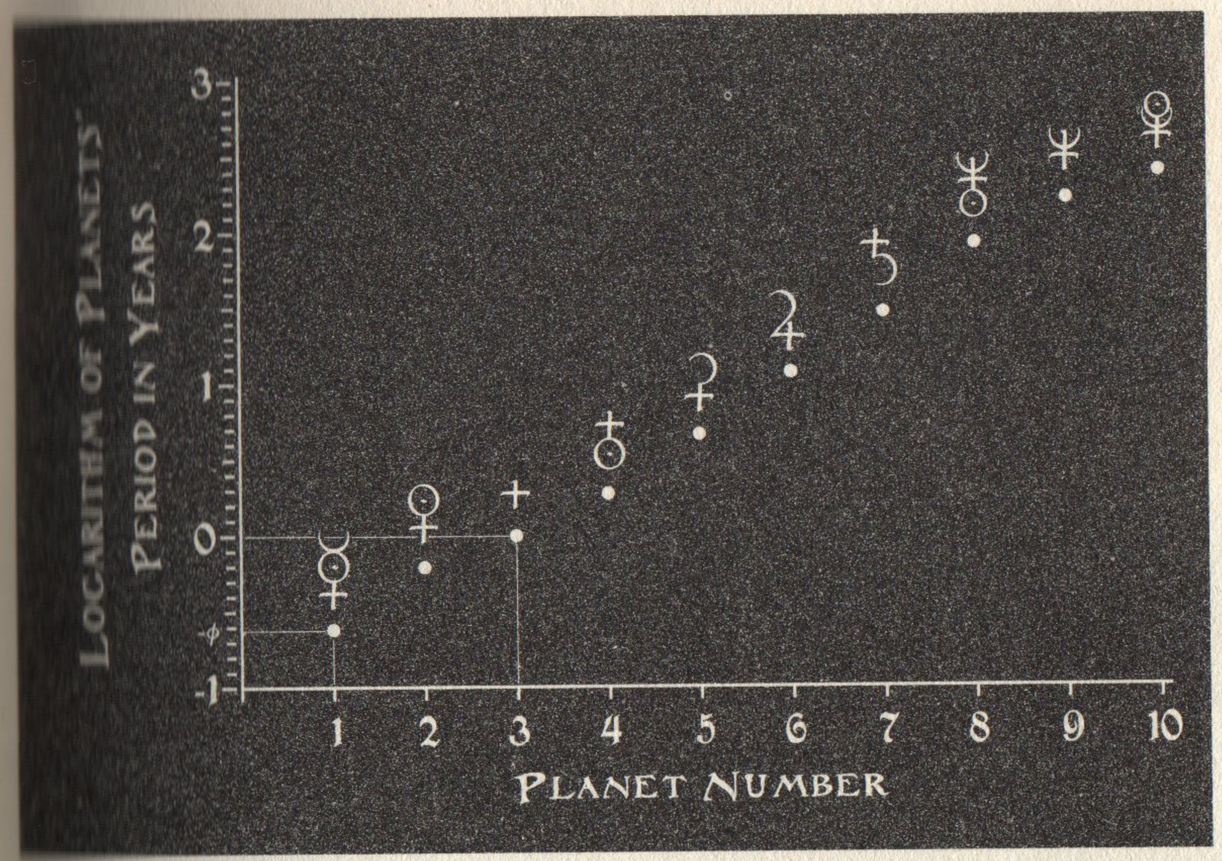
harmonics and rhythmic kisses

There have been numerous attempts to discover patterns in the orbits and periods of the planets. A basic logarithmic graph (*opposite top*) shows clear underlying order (*after Ovendon & Roy*).

A famous system is the 1750 *Titius & Bode Rule*: To the series 0, 3, 6, 12, 24, 48, 96, 192 & 384, four is added, giving 4, 7, 10, 16, 28, 52, 100, 196 & 388. These numbers fit the planetary orbital radii really quite well (except for Neptune). The formula even predicted a missing planet at 28 units between Mars and Jupiter and on 1st January 1801 Piazzi discovered Ceres, the largest of the asteroids in the asteroid belt, in the correct orbit.

The length of time it takes a planet to go once round the Sun is known as its *period*. Sometimes periods occur as simple ratios of each other, a famous example being the 2:5 ratio of Jupiter and Saturn (99.3%). 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 neighbours, 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 Inner Planets

Mercury, Venus, Earth and Mars

The solar system is divided by an asteroid belt into two halves. In the inner region four small rocky planets orbit the Sun, in the outer region four huge gas and ice planets slowly trundle round.

The Sun has still not given up its secrets. Mostly Hydrogen and Helium, and an element factory, it is also a giant fluid geometric magnet, 15 million°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.

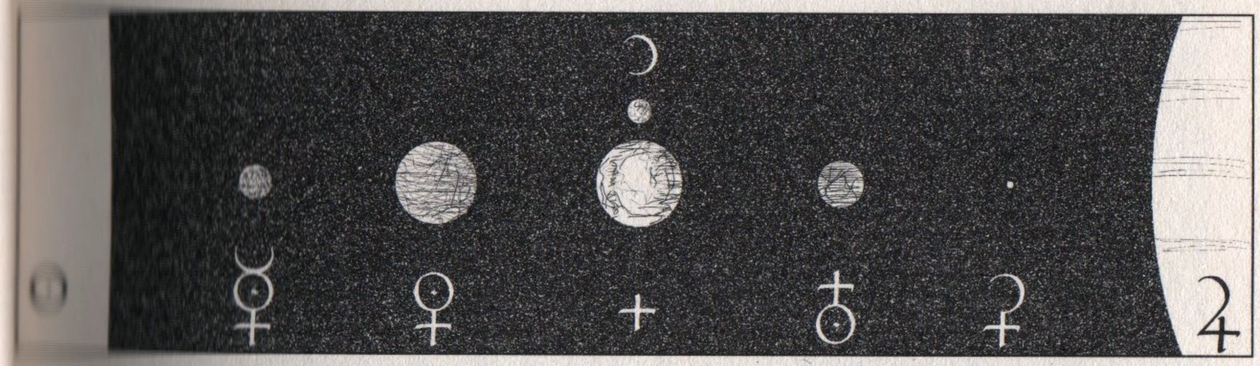
Mercury is the first planet. Mostly solid iron, it is a cratered, atmosphereless world, 400°C in the sunshine, -170°C in the shade.

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 sulphuric acid rain.

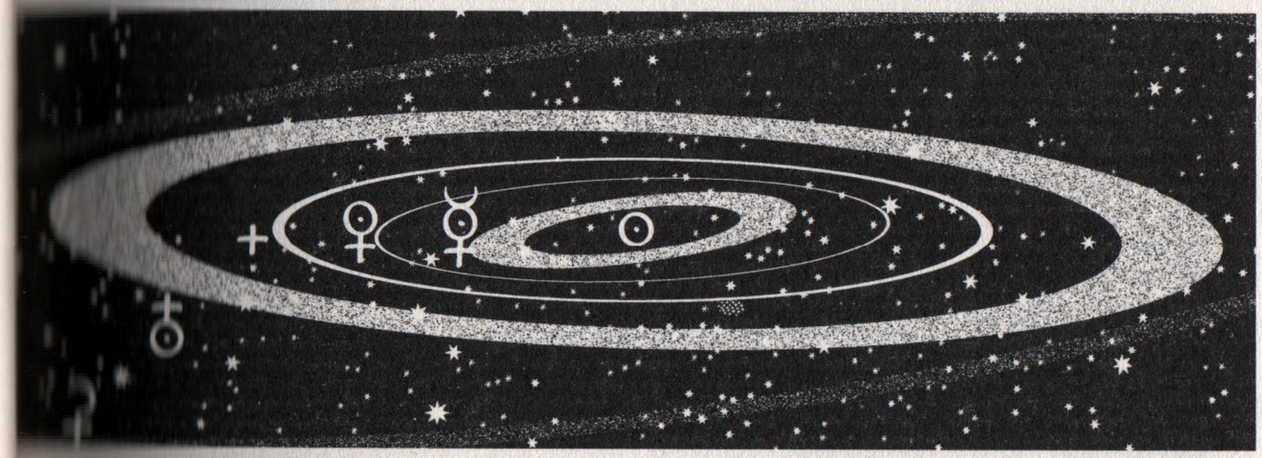
Earth is the third planet, the one with life and one Moon.

Mars is fourth, a rocky red world, just above freezing. Ice caps cover the poles under a thin atmosphere. River beds suggest that Mars may once have had oceans but they are long gone now and 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.

Beyond Mars is the Asteroid Belt, and, beyond that, the giants.

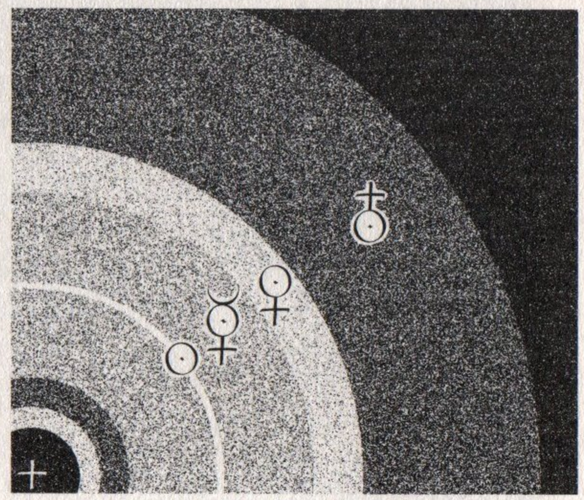


SIZES OF THE INNER PLANETS



TILTS AND ECCENTRICITIES OF THE ORBITS

SUN-CENTRED



EARTH-CENTRED

Mercury & Venus' orbits

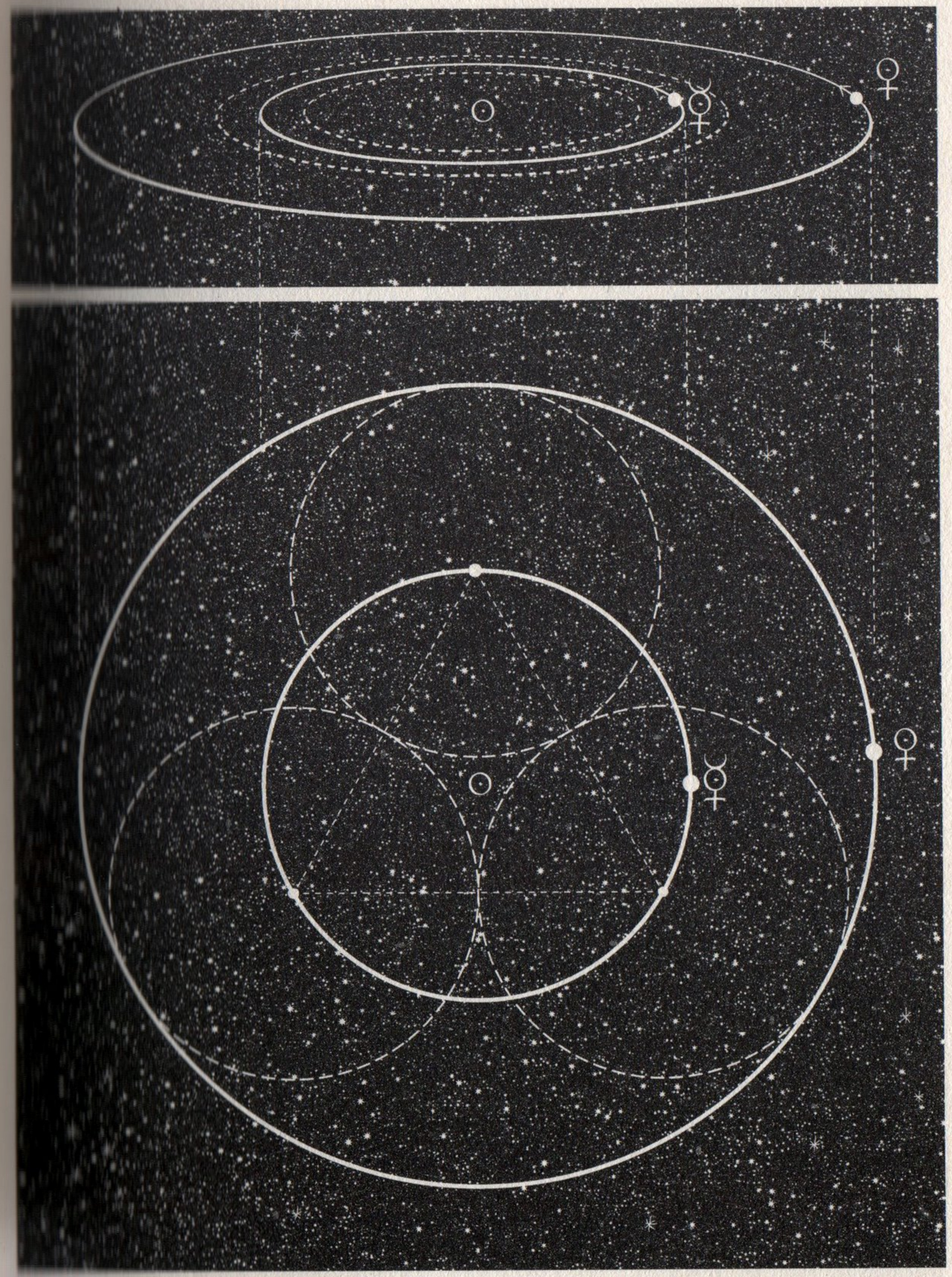
a very simple aide-memoire

There are few things more simple than a circle. With Kepler's discovery of the ellipses, and Newton and Einstein setting them spinning, the planetary orbits can be thought of as orbital 'circles', centred on the Sun, with the eccentricity thickening the circle slightly, or giving the spheres a shell (*see Kepler's diagram, page 13*).

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. If Mercury's mean orbit passes through the centers of the three circles then Venus' encloses the figure (99.9%).

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 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, and these kinds of problems receive no attention; perhaps a bright 21st century scientist will find an answer. It is a 'coincidence'.

Venus (or Aphrodite or Freya) traditionally ruled love, harmony and beauty, and her orbit is the most perfectly circular of all the planets in the solar system. Mercury (or Hermes, Thoth or Wotan) was the ancient god of geometry, communication and initiation, and has a highly elliptical orbit (*Mercury's inner and outer distances from the Sun are shown dashed opposite top*).



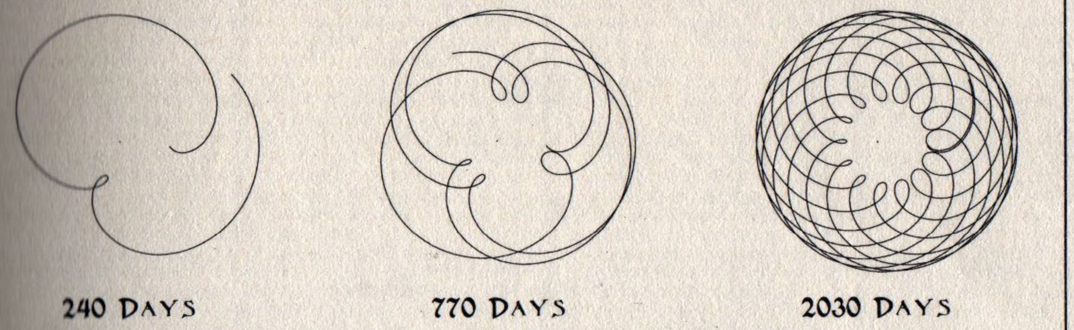
Making Sense of the Pictures

a few tips on things which appear in this book

Seen from Earth, day or night, the Sun moves slowly to the left against the stars (right in the southern hemisphere), taking a year to return to the same star. The Moon swiftly circles around in the same direction every month, taking 27.3 days to return to a star. Venus and Mercury oscillate around the Sun, coming and going, as the Sun itself slowly trundles around its yearly circle. Imagine standing on Venus! The Sun moves faster against the stars and Mercury is closer, whirling round the Sun like a fairground waltzer.

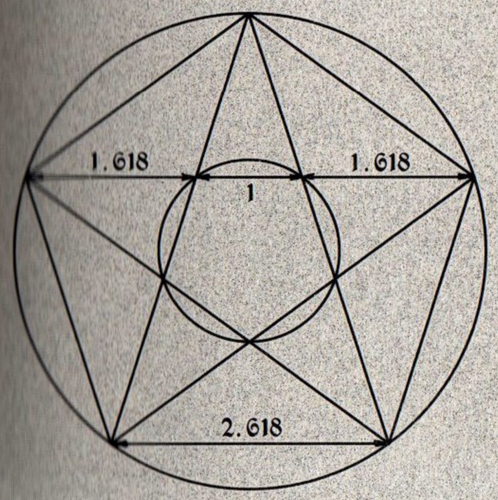
Every *pair* of planets creates a *single* dance. It doesn't matter which of the two you stand on, your partner's dance around you will be the same. It is a shared experience. Mercury's evolving waltzes with Earth and Venus are shown (*opposite top*). Earth and Mercury roughly kiss 22 times in 7 years, though the ancient Greeks also knew of a more accurate 46 year, 145 synod cycle. Mercury and Venus are beautifully in tune after just 14 kisses.

Shown opposite below is the Golden Ratio, ϕ or *phi*, which we will meet again. It is found throughout every pentagram and in the Fibonacci series of numbers (*shown opposite*), where the ratio between successive pairs of numbers gives closer and closer approximations to it. The Golden Ratio is essentially 0.618, but since one *divided* by it is 1.618 (which is the same as *adding* one to it), and 1.618 *times* 1.618 equals 2.618 (the same as adding one more), it often takes all these values. The Golden Ratio is found throughout organic lifeforms - it is the signature of life.



MERCURY'S AND VENUS' DANCE

MERCURY'S AND EARTH'S DANCE



1

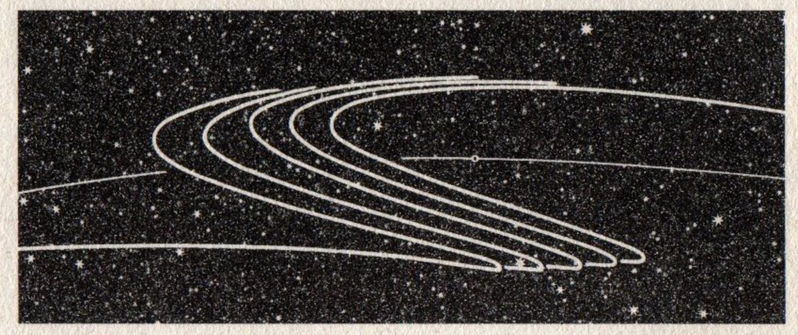
0 + 1 = 1	1 ÷ 1 = 1
1 + 1 = 2	1 ÷ 2 = 0.5
1 + 2 = 3	2 ÷ 3 = 0.6667
2 + 3 = 5	3 ÷ 5 = 0.6
3 + 5 = 8	5 ÷ 8 = 0.625
5 + 8 = 13	8 ÷ 13 = 0.6154
8 + 13 = 21	13 ÷ 21 = 0.6190
13 + 21 = 34	21 ÷ 34 = 0.6176
21 + 34 = 55	34 ÷ 55 = 0.6182
34 + 55 = 89	55 ÷ 89 = 0.6180
55 + 89 = 144	89 ÷ 144 = 0.6181
1 2 3 5 8 13 ...	ϕ = 0.61803399...

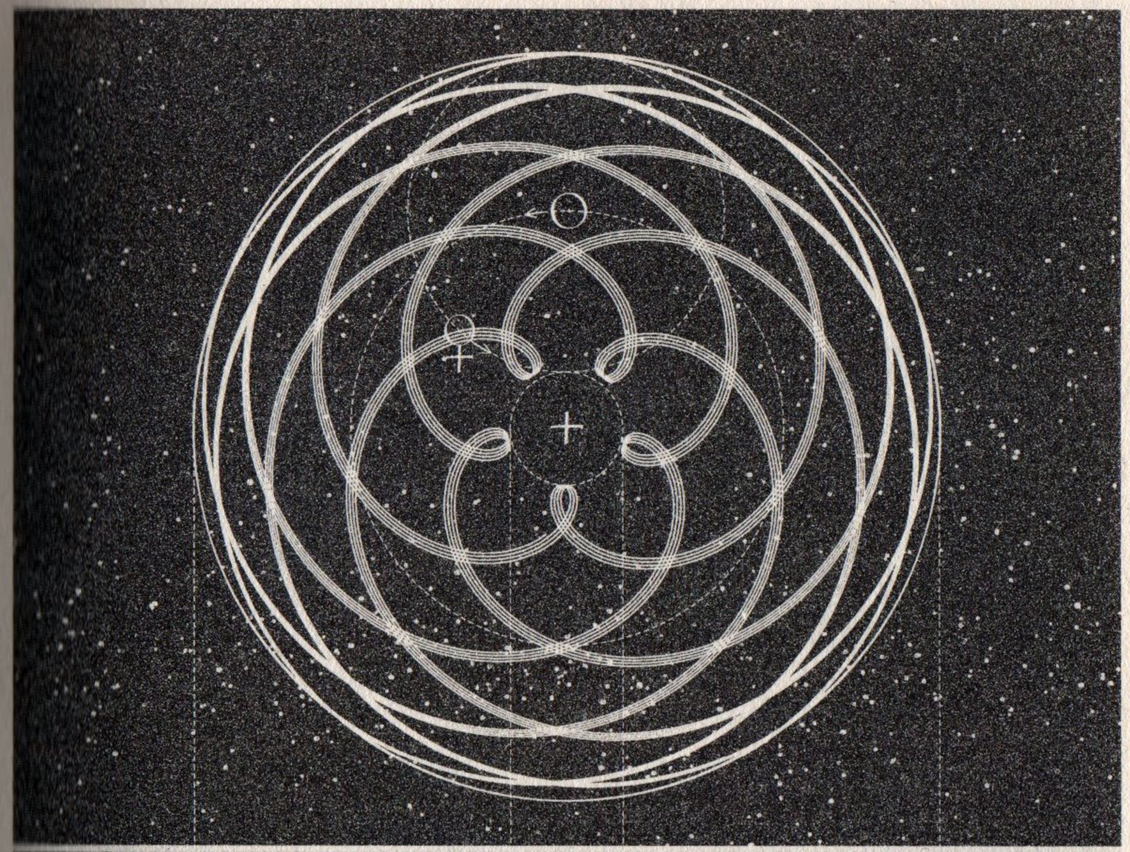
The Kiss of Venus

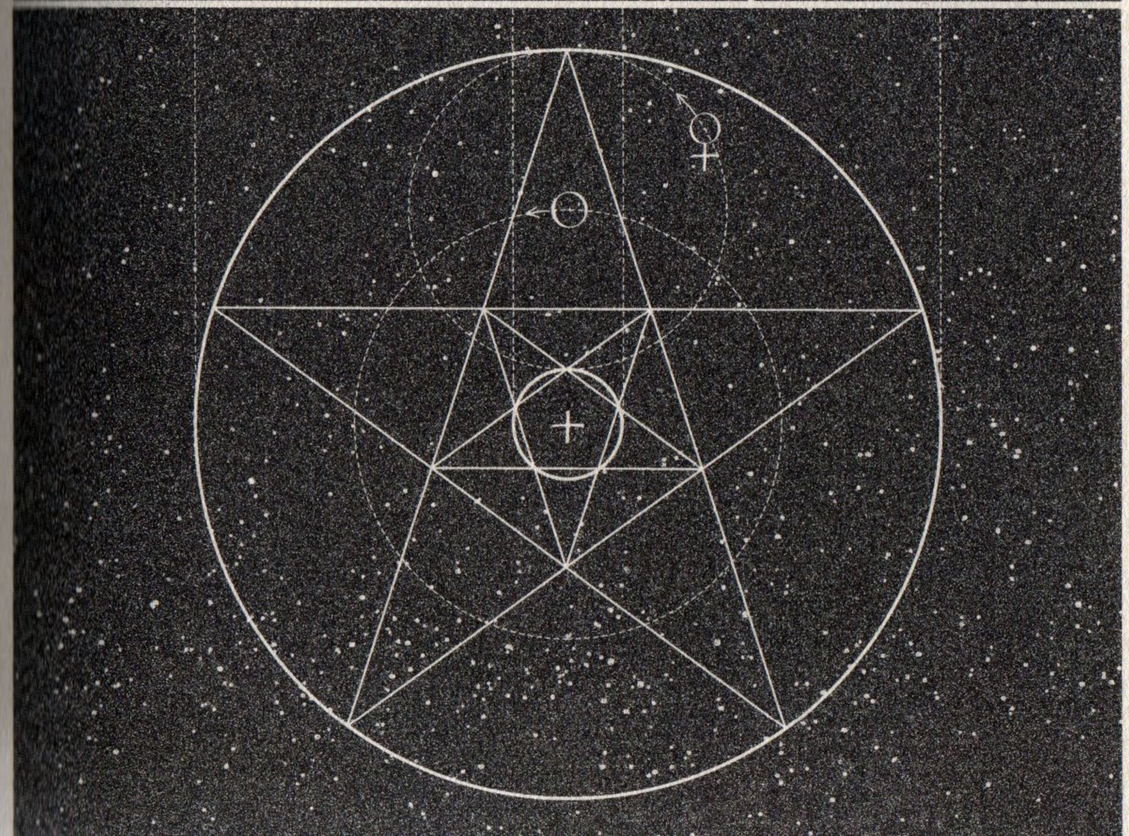
our most beautiful relationship

Other than the Sun and Moon, the brightest point in the sky is Venus, morning and evening star. She is our closest neighbour, 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 the starry zodiacal circle - so a pentagram of conjunctions is drawn. Seen from Earth the Sun moves round the zodiac while Venus whirls around the Sun drawing an astonishing pattern over exactly eight years (99.9%) (or thirteen Venusian-years (99.9%)). Small loops are made when Venus in her dazzling kiss seems briefly to reverse direction against the background Stars (*shown below as seen from Earth*). Notice the Fibonnacci numbers we have just met, 5, 8 and 13. The periods of Earth and Venus are also loosely related as 1.618:1 (99.6%).

This 'phi'-fold nature of Venus and Earth's dance extends to their closest and furthest distances from each other. Opposite we see Venus' *perigee* and *apogee* defined by two pentagrams, 2.618:1 (99.9%). All these diagrams *also* apply to Venus' experience of Earth.







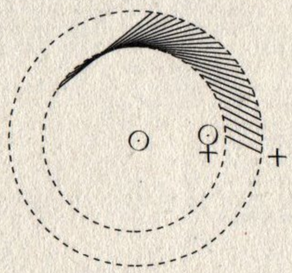
The Perfect Beauty of Venus

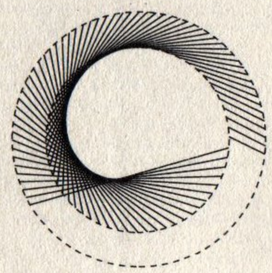
the things they don't teach you at school

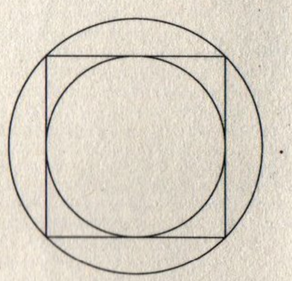
With the Sun in the centre, let us look at the orbits of Venus and the Earth. Every couple of days a line is drawn between the two planets (*below left*). Because Venus orbits faster she completes a whole circuit in the same time that the Earth completes just over a half-circuit (*below centre*). If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

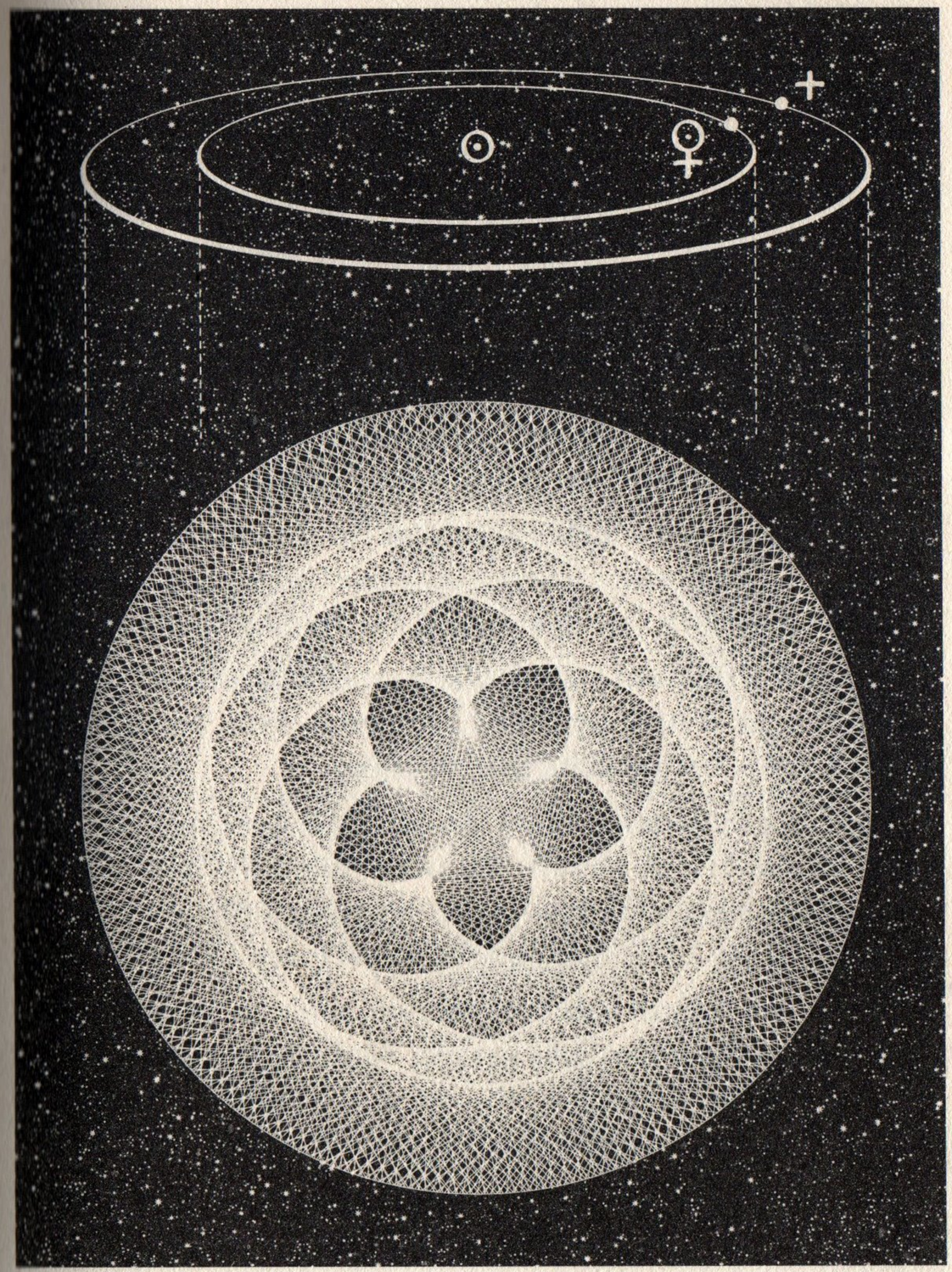
The ratio between Earth's outer orbit and Venus' inner orbit, i.e their *home*, is intriguingly given by a square (*below right*) (99.9%).

Venus rotates extremely slowly on her own axis in the opposite direction to most rotations in the solar system. Her day is precisely two-thirds of an Earth year, a musical fifth. This exactly harmonises 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 exact and very beautiful. Mercury also displays a harmonious calendar as its day is two of its years, a musical octave!









Mercury & Earth

yet more phives and eights

Mercury and Earth's physical sizes are in the same relation as their mean orbits! The same is true of Earth and Saturn. Various five and eight-fold overlays are shown opposite which proportion the orbits *and* relative physical sizes of Mercury and Earth.

The diameter of Mercury's *innermost* orbit is suggested by the pentagram incircle (*centre left*) (99.5%) and also happens to be the distance between the mean orbits of the two planets (99.7%).

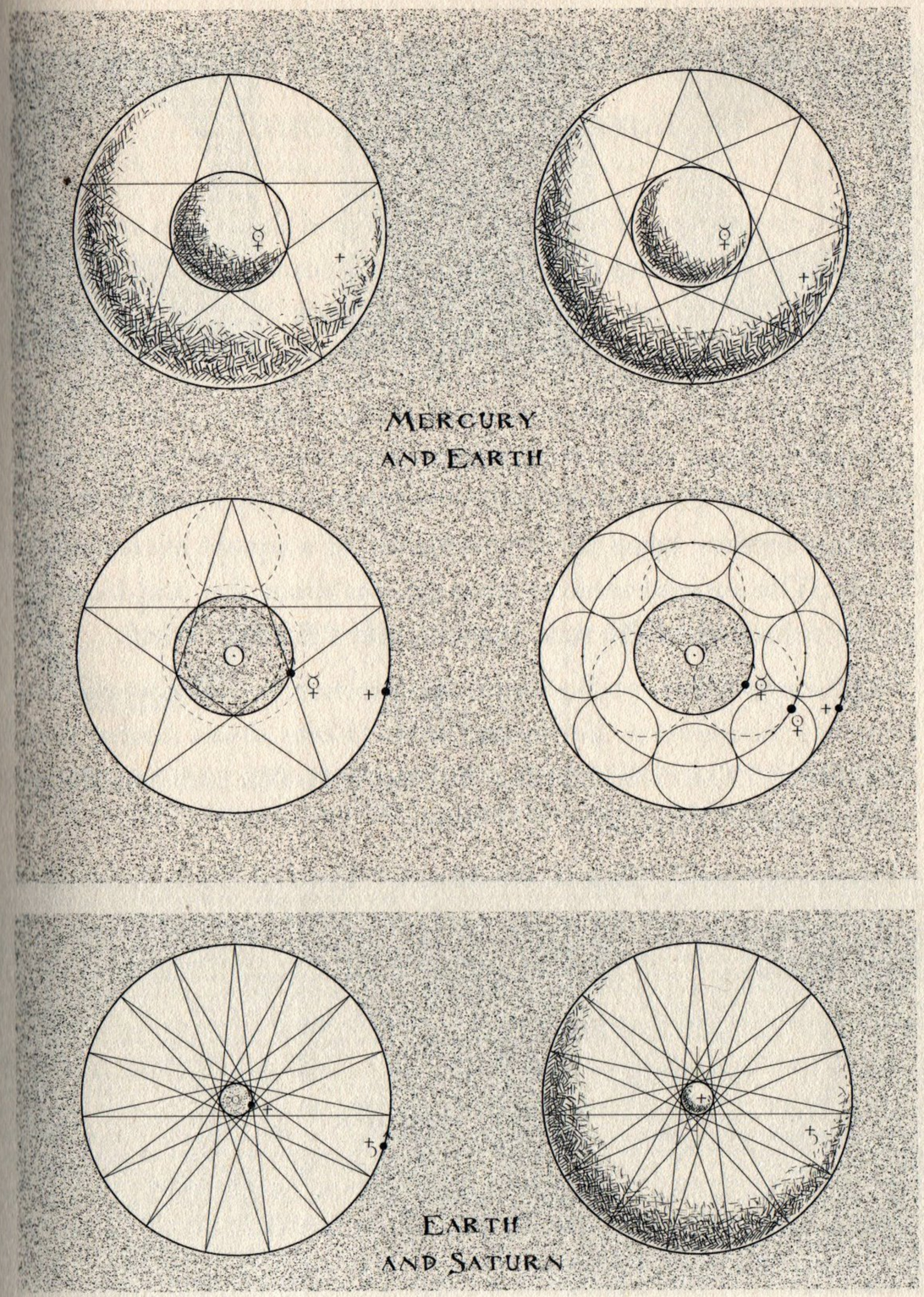
The diagram centre right expands on the three touching circles of page 21. Eight circles centred on Venus' orbit produce Earth's mean orbit (99.99%) - the eight years of the five kisses perhaps?

Mercury, Venus and Earth display a peculiar coincidence: If we work in units of Mercury's orbit and period, then Venus' period times 2.618 is Earth's orbital radius squared.

Mercury's dance around Earth produces its synodic year of 115.9 days. Richard Heath recently discovered that this is 2.618 times a musical fifth times a full moon (99.9%). (A musical fifth is 3:2; 2.618 is ϕ^2, or 1.618x1.618; there is a full moon every 29.53 days).

Earth's and Saturn's relative orbits *and* sizes can be given by a fifteen-pointed star (*lower row opposite*), which further produces the tilt of the Earth. Saturn also takes the same number of years to go round the Sun as there are days between full Moons (99.8%).

So many coincidences ... part of a pattern, or pathalogical lunacy? Well hold on, for it is to the Moon that we now turn ...



The Alchemical Wedding

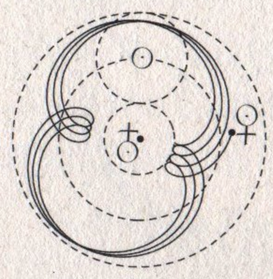
three to eleven all round

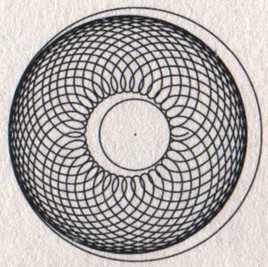
From the surface of the Earth, the Sun and the Moon appear the same size. According to modern muggle cosmology this is 'just' a coincidence. In ancient times the balance between these two primary bodies was seen as proof of the perfection of creation.

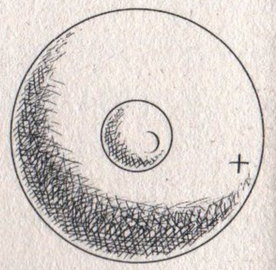
The size of the Moon compared to the Earth is 3 to 11 (99.9%). What this means is that if you draw down the Moon to the Earth, then the circle through the center of the heavenly Moon will have a circumference equal to the perimeter of a square enclosing the Earth. The ancients seem to have known about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

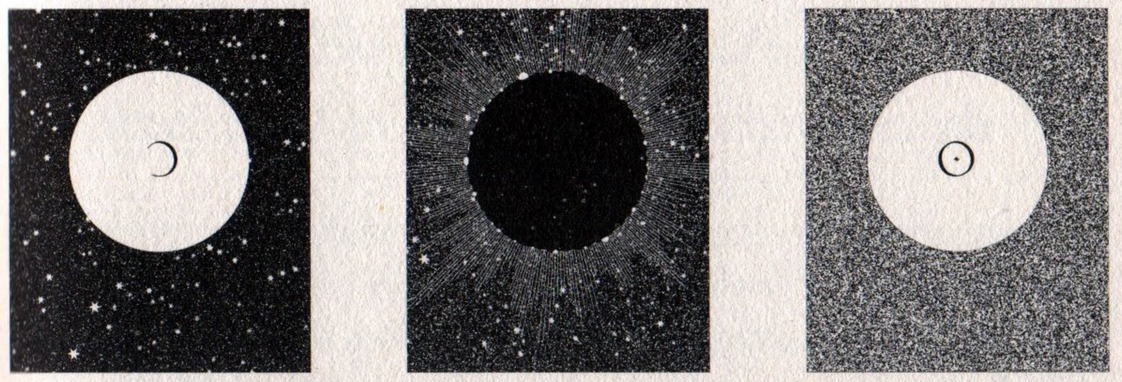
The Earth-Moon proportion is also precisely invoked by our two planetary neighbours, Venus and Mars (*Venus shown dancing round Mars below*). The closest:farthest distance ratio that each experiences of the other is, incredibly, 3:11 (99.9%).

Now 3:11 is 27.3% and the Moon orbits the Earth every 27.3 days ... the average rotation period of a sunspot is also 27.3 days. The Sun and Moon do seem very much the unified couple.

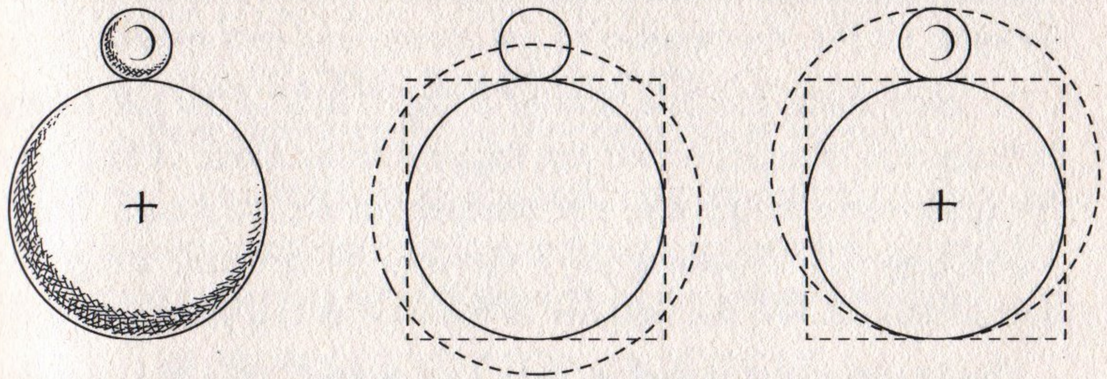








The Moon, a total solar eclipse and the Sun, as seen from Earth



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

Diameter of Moon = 2160 miles = 6 x 360 = 18 x 1 x 2 x 3 x 4 x 5

Radius of Earth = 3960 miles = 11 x 360 = 33 x 1 x 2 x 3 x 4 x 5

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

Diameter of Earth = 7920 miles = 8 x 9 x 10 x 11

There are 5280 feet in a mile
= (10 x 11 x 12 x 13) - (9 x 10 x 11 x 12)

Calendar Magic

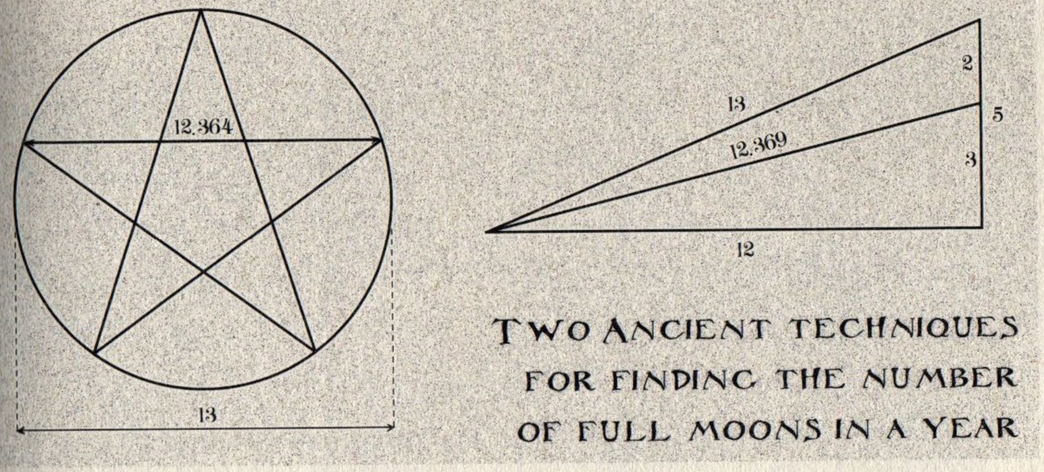
the astonishing discoveries of Mr. Heath

Recent work by Robin Heath has revealed simple geometrical and mathematical tools which suggest order and form within the Sun-Moon-Earth system. 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, the number of full moons in a year (99.95%).

An even more accurate way of doing it is to draw the second Pythagorean triangle, which just happens to be made of 5, 12 and 13 again, interestingly also the numbers of the keyboard, and of Venus (*page 26*). Dividing the 5 side into its harmonic 2:3 gives a new length 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 (6 and 7). Twelve spheres pack perfectly around one in our familiar three-dimensional space (12 and 13 again). We seem to be moving up in sixes. Could *eighteen* time-spheres fit around one in a fourth dimension of time? Incredibly, all of the current major time cycles of the Sun-Moon-Earth system are simple combinations of the numbers 18, 19 and the Golden Section (*see page 22*).

The Golden Section is evident in the pentagram, the icosahedron, the dodecahedron and all living things. The orbits of the four inner planets all display its presence. Its values 0.618, 1, 1.618 and 2.618 added to the magic number 18 produce 18, 18.618, 19, 19,618 and 20.618, which then multiply together as shown opposite.



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

18 YEARS = THE SAROS ECLIPSE CYCLE (99.83%)
(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 MOONS 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 (99.82%)
(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)

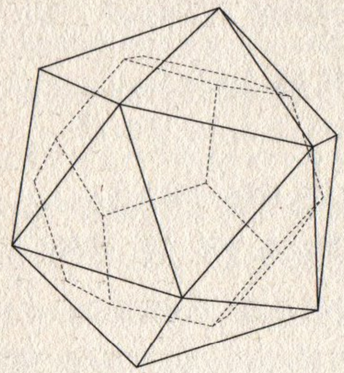
Cosmic Football

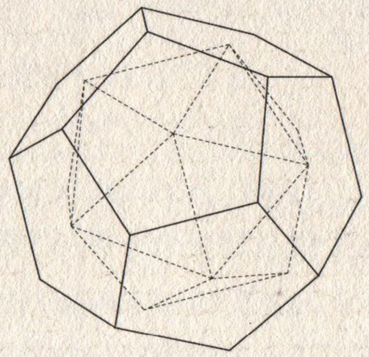
Mars, Earth and Venus spaced

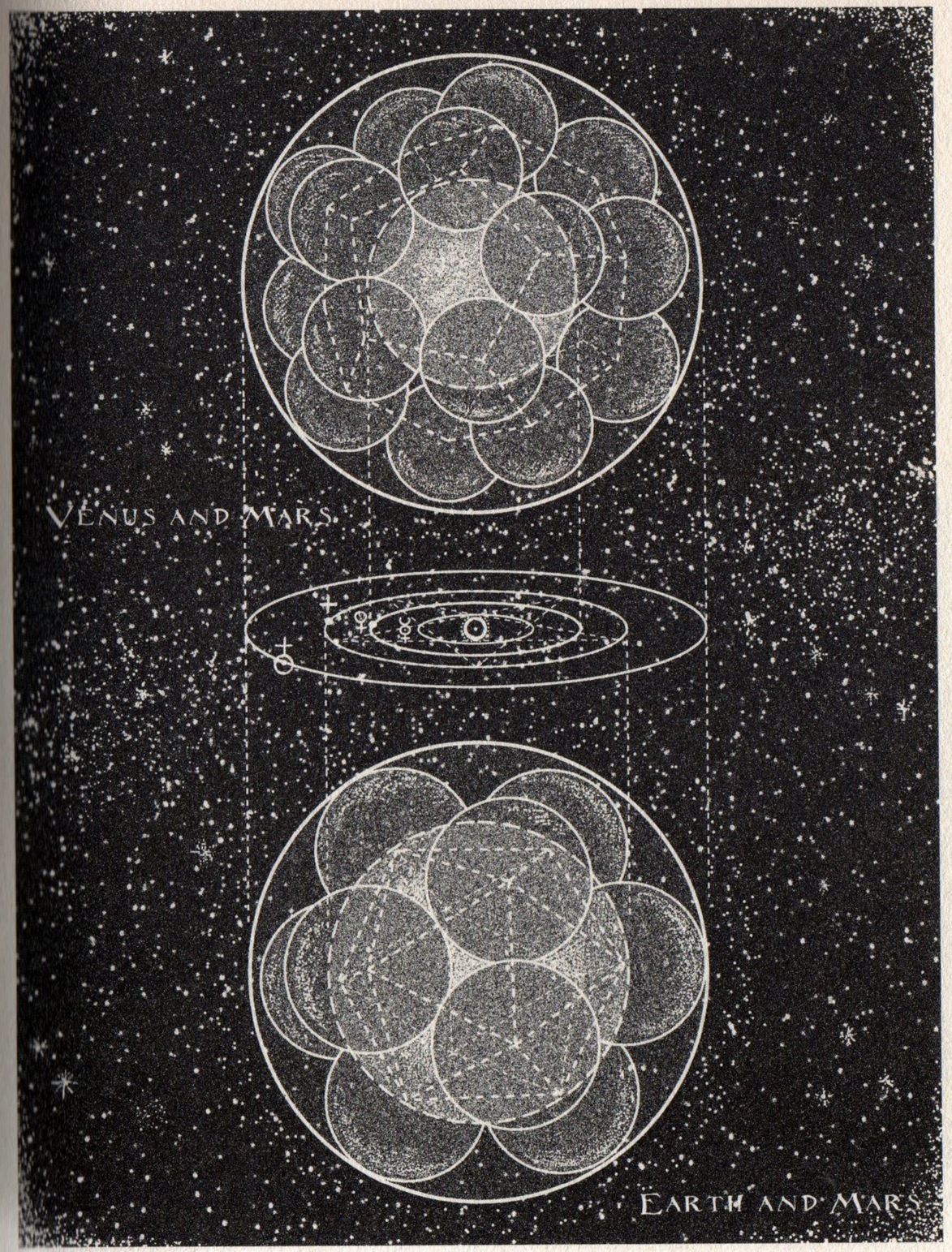
The next planet out from Earth is the fourth planet, Mars. Kepler had tried a *dodecahedron* spacing the orbits of Mars and Earth and an *icosahedron* spacing Earth from Venus (*see page 12*), and, coincidentally, it turns out he was very close to the mark.

The dodecadron (made of twelve pentagons) and the icosahedron (made of of twenty equilateral triangles) are the last two of the five perfect polyhedra (the *Platonic Solids*). They form a pair, as each creates the other from the centres of its faces (*below*). Opposite, they appear in bubble form 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 centres (*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 *aether*, the life force, here enveloping lively Earth, and defined by its neighbours.







The Asteroid Belt

through the looking glass

We have reached the end of the inner solar system. Beyond Mars lies a particularly 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. 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 56*).

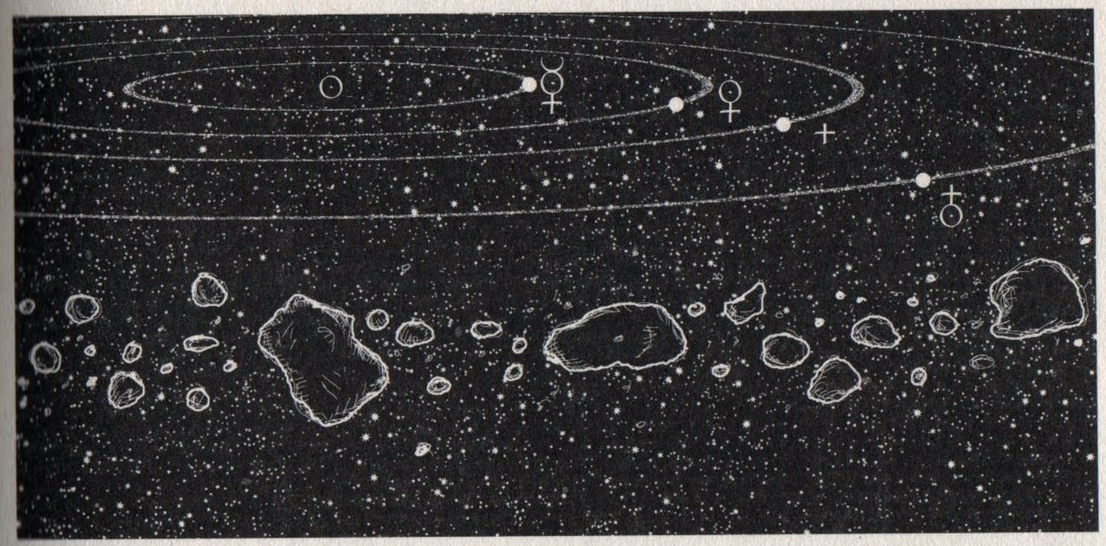
Bode's Law predicted something at the distance of the asteroid belt (*see page 16*), but it was Alex Geddes who recently discovered the weird mathematical relationship between the four small inner planets and the four outer gas giants. Their orbital radii magically 'reflect' about the asteroid belt and multiply as shown below and opposite to produce two enigmatic constants.

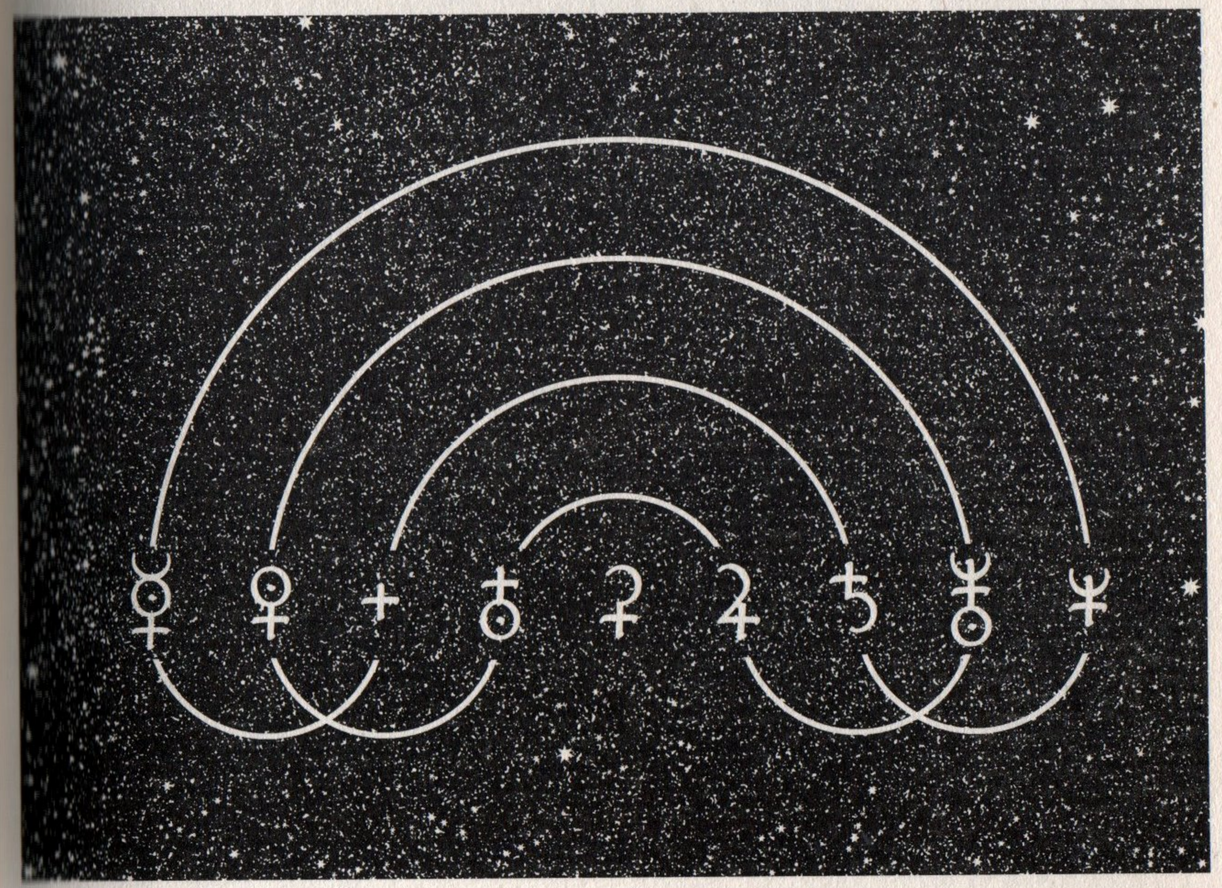
$Ve \times Ur = 1.204\ Me \times Ne$ $\qquad$ $Ve \times Ma = 2.872\ Me \times Ea$

$Me \times Ne = 1.208\ Ea \times Sa$ $\qquad$ $Sa \times Ne = 2.876\ Ju \times Ur$

$Ea \times Sa = 1.206\ Ma \times Ju$ $\qquad$ $(Ve \times Ma \times Ju \times Ur = Me \times Ea \times Sa \times Ne)$

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 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.

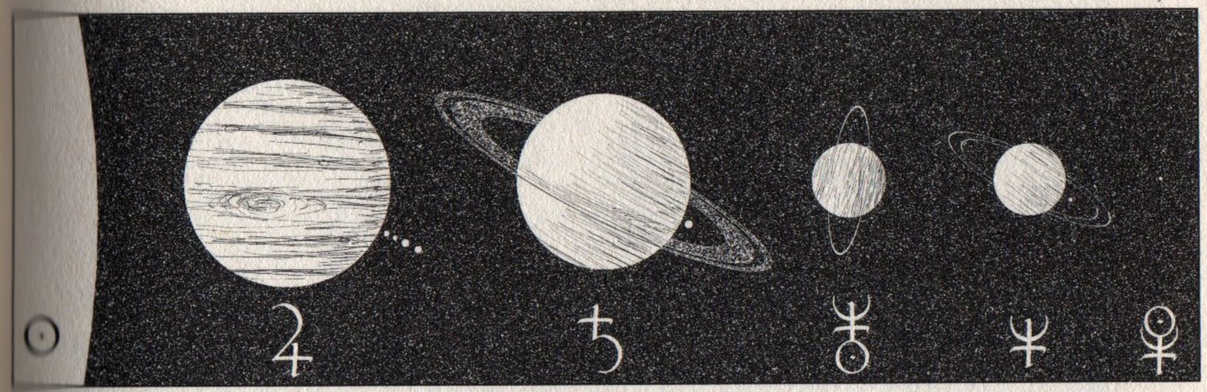
Jupiter is the largest planet, and its magnetic field is the largest object in the solar system. 90% hydrogen, it is neverless built around a rocky core like all the giant planets. Metallic hydrogen and then liquid hydrogen surrounds this core. The famous Red Spot is a storm, larger than Earth, which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

The next planet is Saturn, with its beautiful system of rings. Saturn's structure beneath its clouds is much the same hydrogen and helium mix 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.

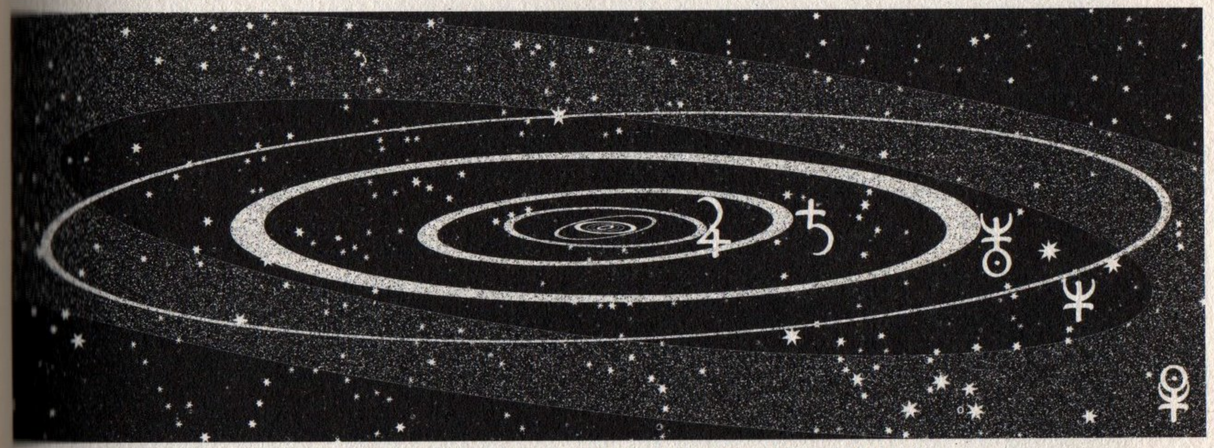
Beyond Saturn is Uranus, which orbits on its side. Winds gust on the equator at six thousand times the speed of sound.

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

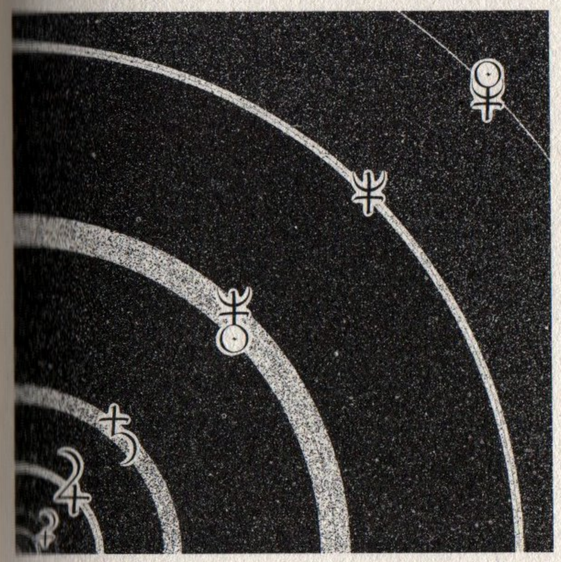
Finally, tiny Pluto, and, beyond that, the primordial swarm of the Kuiper Belt. Then, stretching a third of the way to the nearest star, the sphere of icy debris and comets of the Oort Cloud.



SIZES OF THE OUTER PLANETS



TILTS AND ECCENTRICITIES OF THE ORBITS



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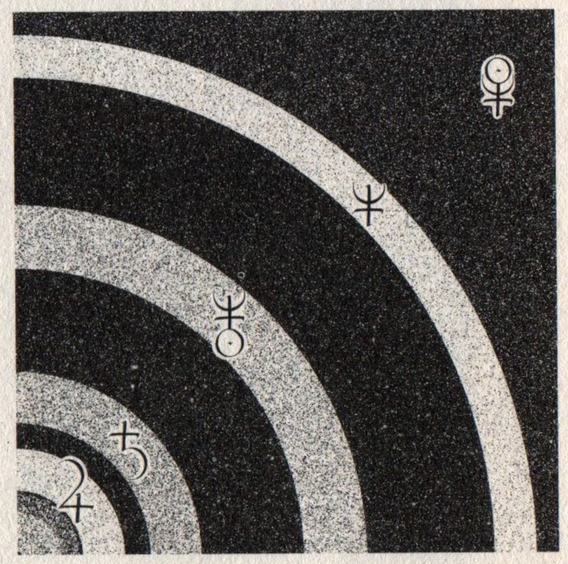


EARTH-CENTRED

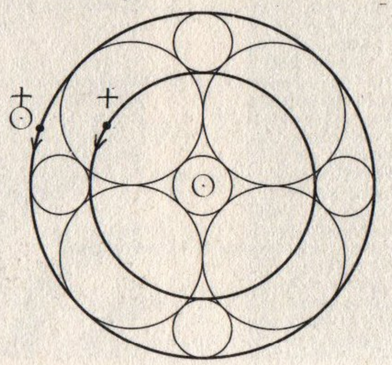
Fours

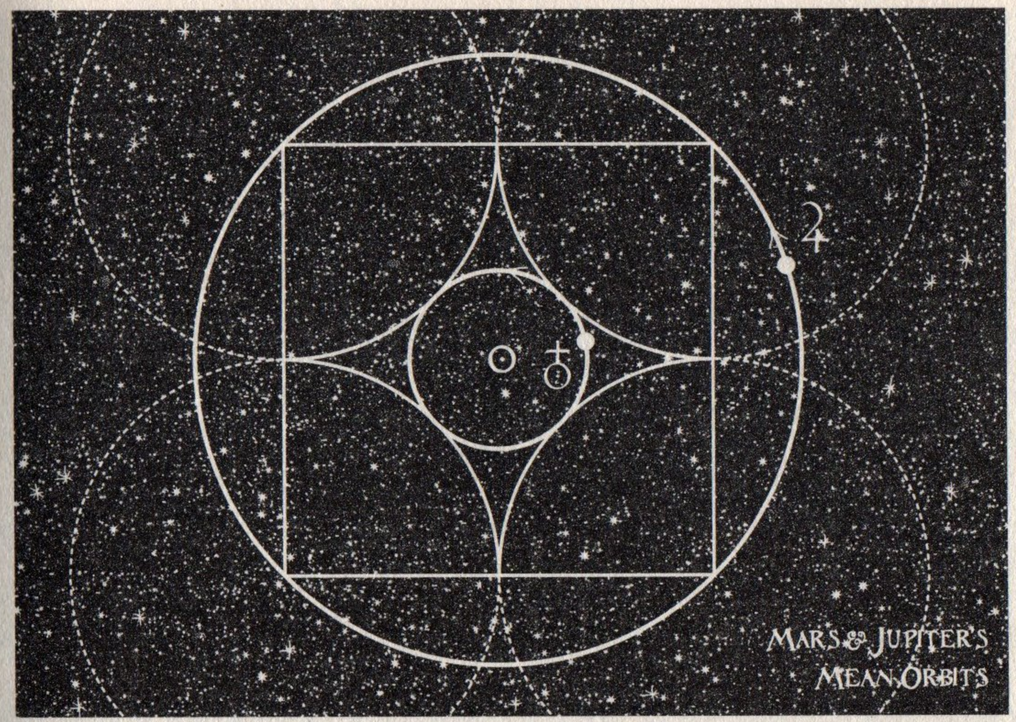
Mars, Jupiter and massive moons

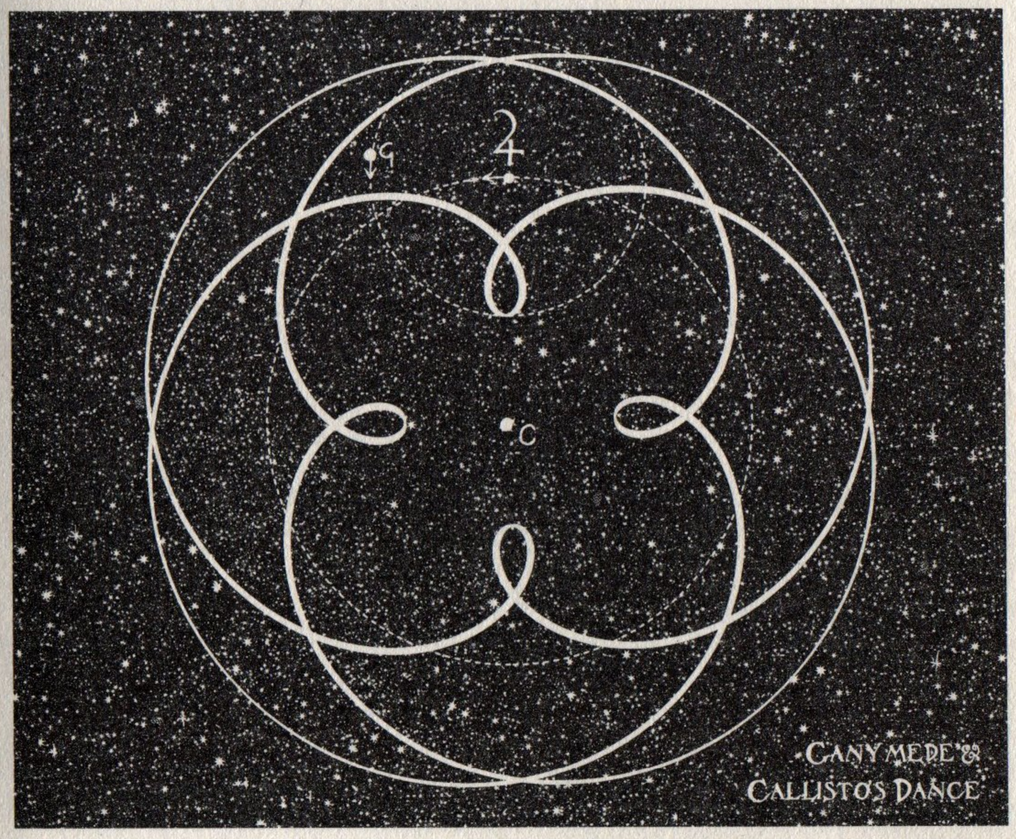
An asteroid belt and 550 million km separate Mars' and Jupiter's orbits, a greater distance than Earth's orbit. Jupiter is the first and largest of the gas giants, the vacuum cleaner of the solar system. If Jupiter had gathered only slightly more material during its long and ongoing formation its internal pressures would have turned it into a star and we would have had a second Sun.

The top diagram opposite shows a really simple way to draw the orbits of Mars and Jupiter from four touching circles or a square (99.98%). It is a proportion commonly seen in church windows and railway stations. Shown below, on this page, is a pattern from the same family, which spaces Earth's and Mars' orbits (99.9%).

Jupiter has four particularly large moons. 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 motions of the other in space and time as the beautiful fourfold diagram shown opposite.







Outer Moons

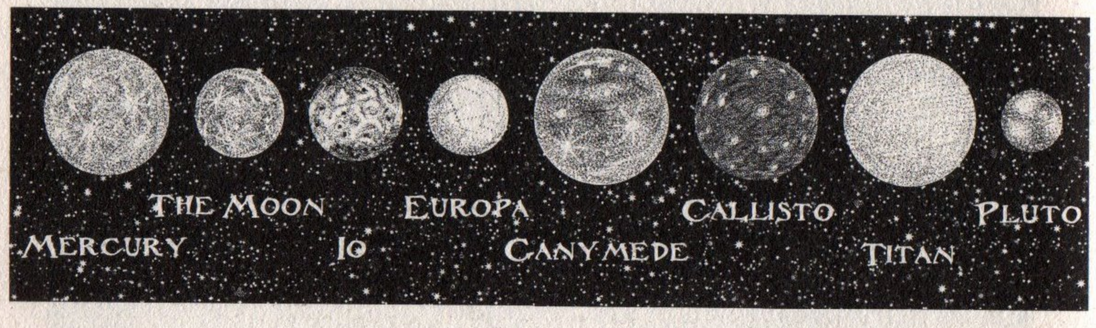
harmonic patterns

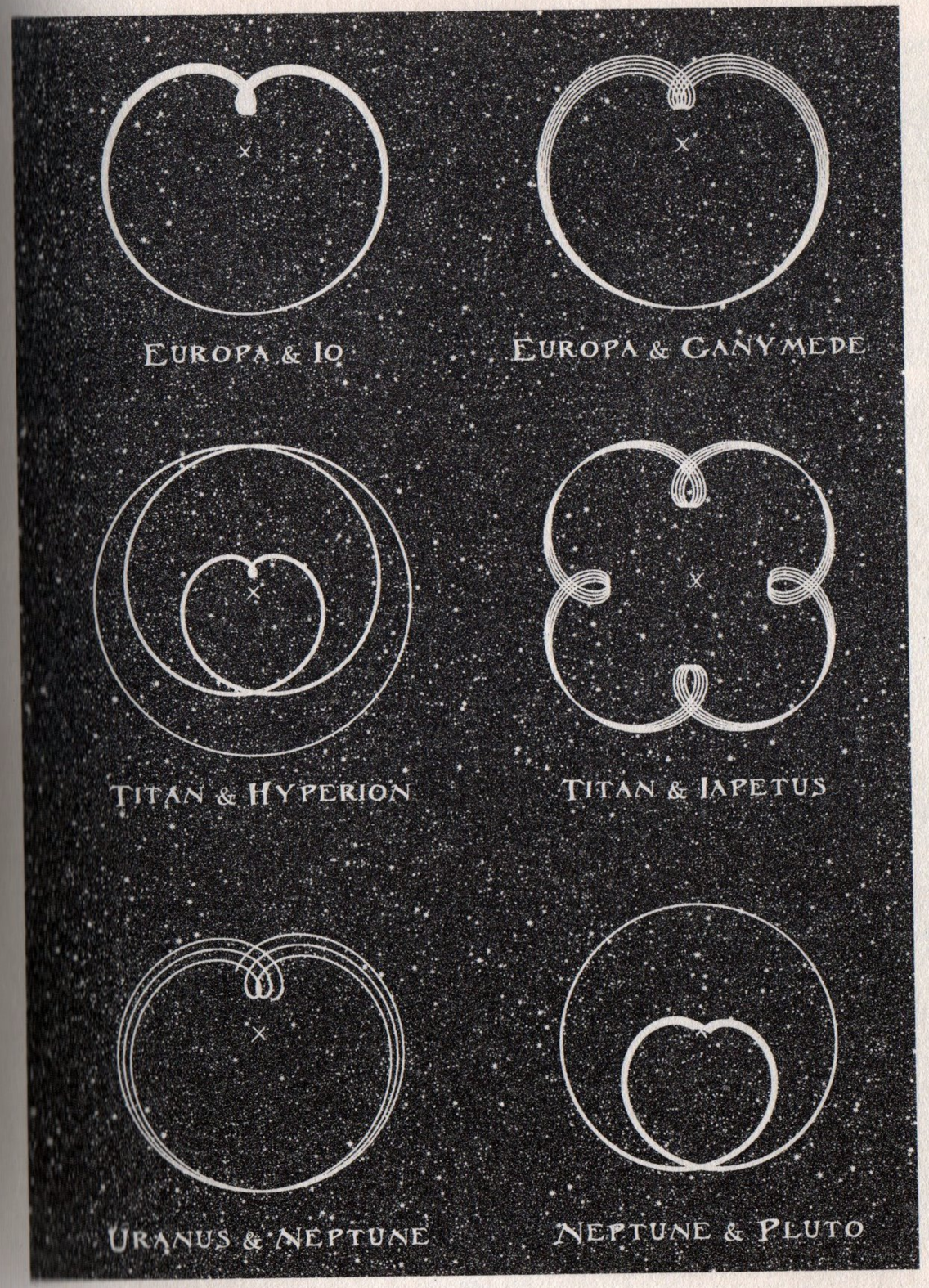
Four groups of moons orbit Jupiter. The first two groups each have four moons and they look very like a model of the whole solar system - four small inner bodies followed by four giants. The second group of four large moons, the *Galileans*, is further divided into two small rocky worlds, Io and Europa, then two gas and ice moons the size of planets, Ganymede and Callisto.

The grouping into fours is very striking indeed. 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 further out. Far beyond Saturn's rings, however, are three moons - the gigantic Titan, tiny Hyperion and, further out still, Iapetus.

The picture opposite shows further harmonic patterns: two from Jupiter's largest moons, two experienced by Saturn's outer moons and two created by the outer planets of the solar system.





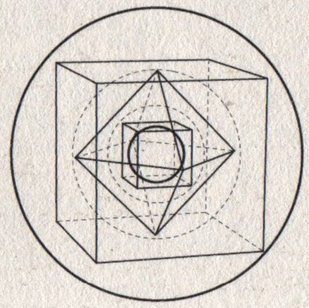
Jupiter's Giant Seal

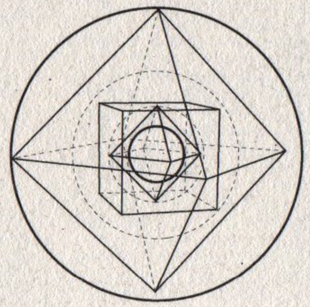
huge hexagrams and affirmatory asteroids

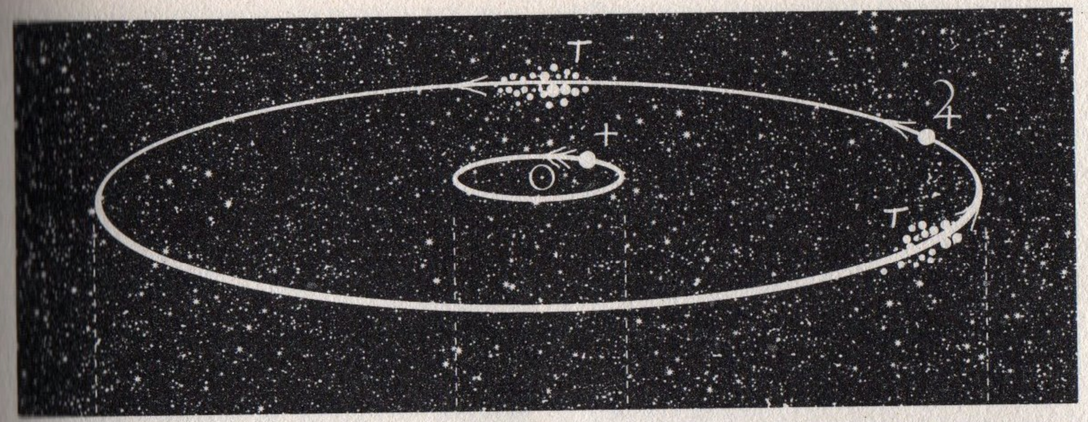
Jupiter, the largest planet, was king of the ancient gods. A delightful feature of its orbit is its pair of asteroid clusters. *The Trojans* are two groups of asteroids which move round Jupiter's orbit, 60° ahead of it and 60° behind (*opposite*). This partnership perpetually moves round the Sun as though held in place by the spokes of a wheel. The positions of the Trojan clusters are known as the *Laplace Points*, with Sun, Jupiter and Trojans forming gravitationally balanced equilateral triangles.

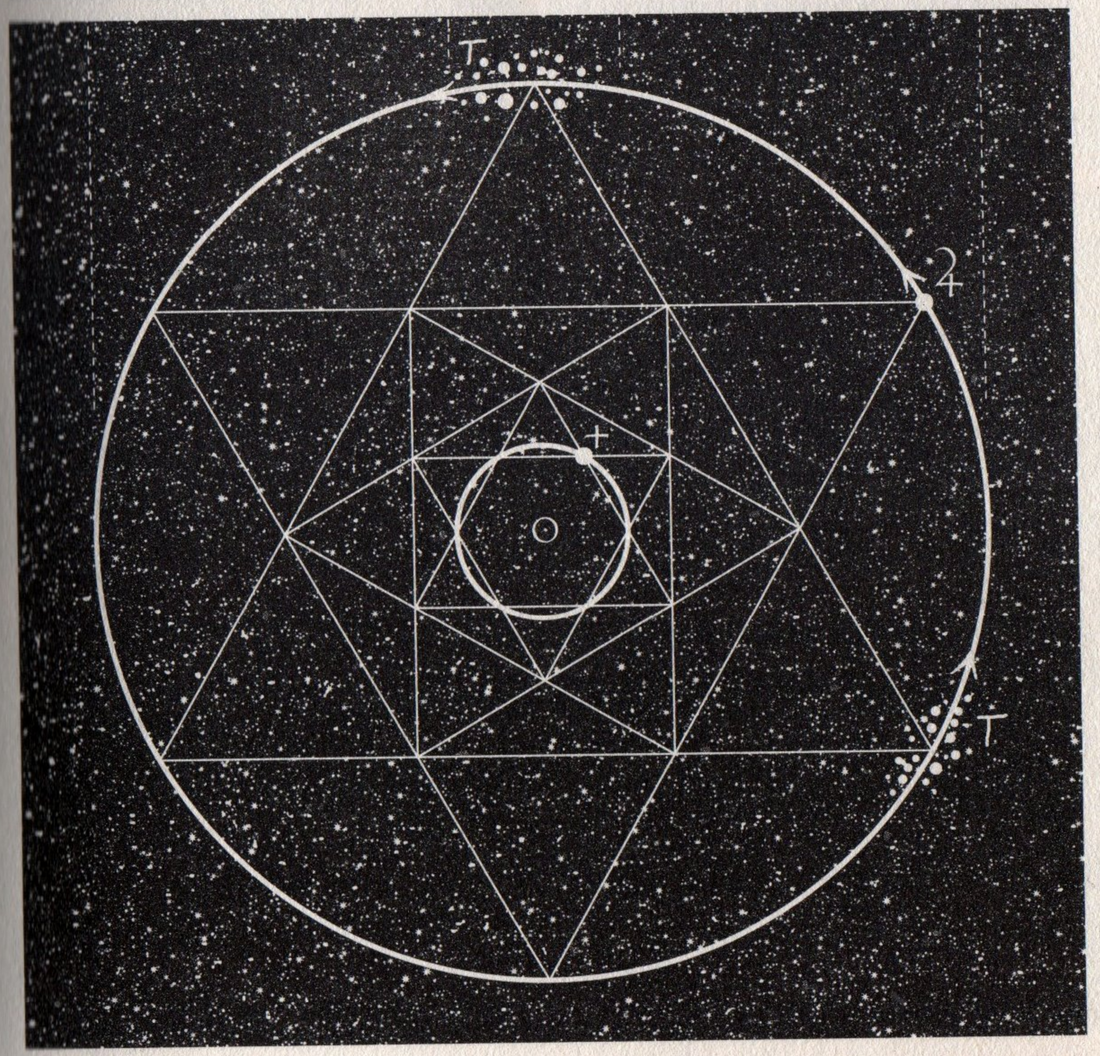
Just for the fun of it, if we now join the spokes as shown opposite then three hexagrams can be seen to produce Earth's mean orbit from Jupiter's (99.8%), - a very easy trick to remember. Earth and Jupiter's orbits are thus lurking in every crystal. Another name for a six-pointed star made of two triangles is a *Star of David* or *Seal of Solomon*, a kingly design indeed, by Jove!

Exactly the same Earth-Jupiter proportion may be created by spherically nesting three cubes, or three octahedra, or any threefold combination of them (*two are shown alternating below*).









The Golden Clock

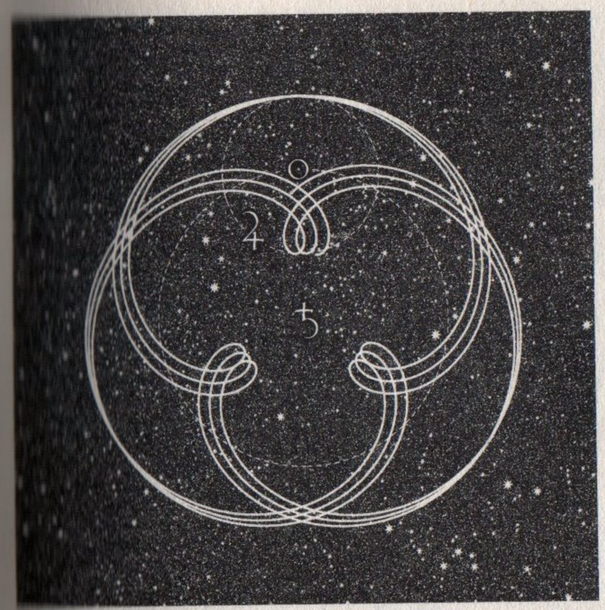
Jupiter and Saturn seen from Earth

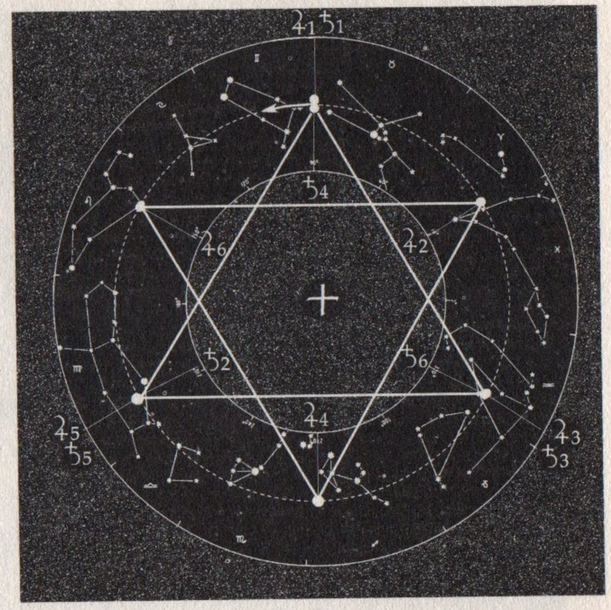
Jupiter and Saturn are the two largest planets of the solar system and ruled the outer two spheres of the ancient system. In ancient mythology, Saturn was Chronos, the Lord of Time.

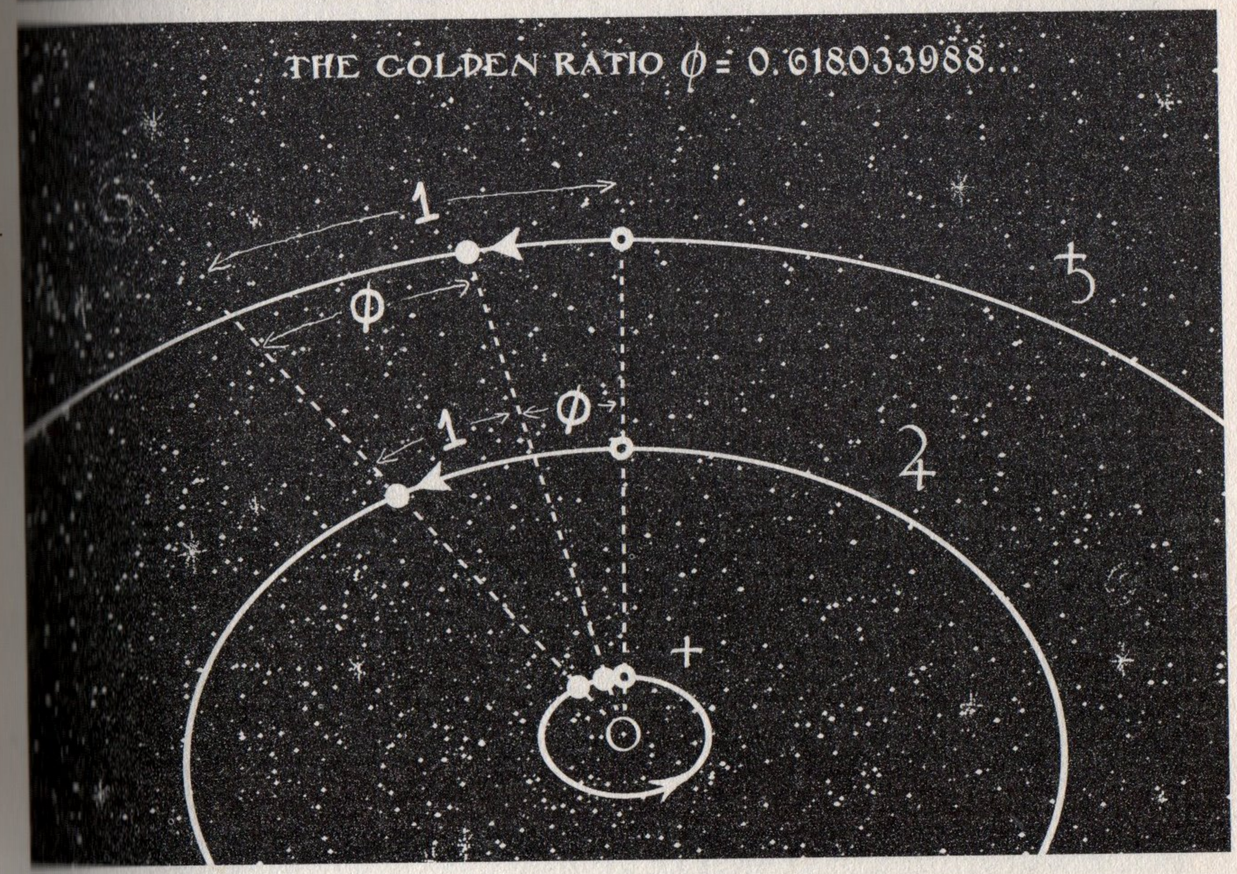
The top two diagrams opposite show the close 5:2 ratio of their periods. Top left we see their dance, here Jupiter is viewed from Saturn, although Saturn's experience of Jupiter is no different. The beautiful three-fold harmonic is immediately apparent, spinning slowly because of the slight miss in the harmony. From Earth, this pattern is seen as an important sequence of conjunctions and oppositions of Jupiter and Saturn, who kiss every 20 years. Top right we see the hexagram created by these positions - with conjunctions marked on the outside of the zodiac and oppositions marked inside. The planets move anticlockwise around the dashed circle of the ecliptic, starting at twelve o'clock, Jupiter moving faster than Saturn.

The lower diagram opposite shows the relative speeds of orbit of Earth, Jupiter and Saturn. We start with the three planets in a line at twelve o'clock. Earth orbits much faster than the outer planets and makes a complete circuit of the Sun (one year, 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).

Richard Heath recently revealed that the Golden Ratio is defined here in time and space to a *stunning* 99.99% accuracy! The two giants of our solar system thus reinforce life on Earth.







Octaves out There

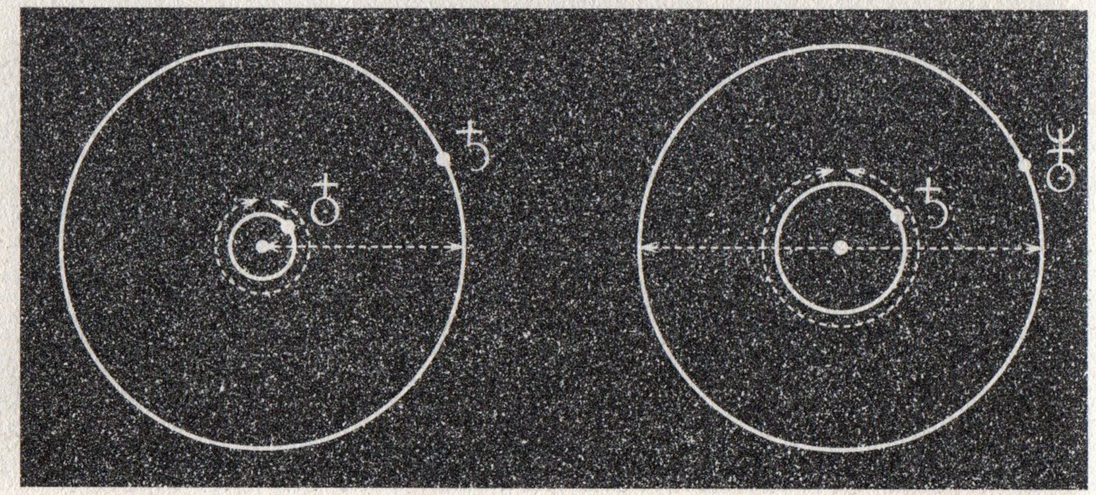
threes and eights again

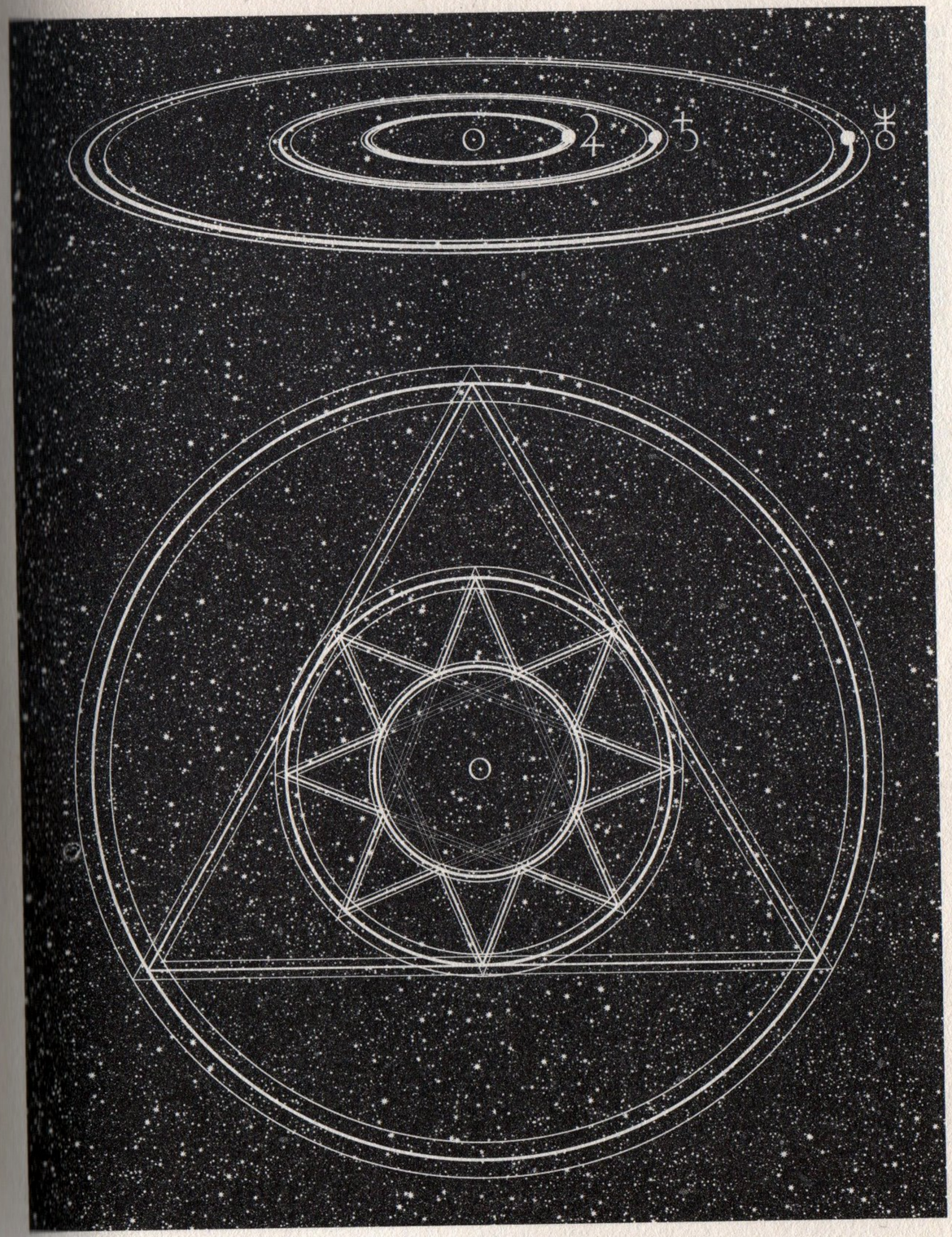
If you ever want to incorporate Jupiter, Saturn and Uranus' orbits into a window, floor or T-shirt design, the diagram opposite might help. An equilateral triangle and an octagram proportions the outer, mean and inner orbits of the three largest planets. Small inaccuracies can be seen in some parts of the diagram, but the fit is good overall, memorable, and adequate for many purposes.

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.

Another rule of thumb is to remember that if Jupiter's orbit is 6, then Saturn's is 11 (99.9%), twice the Moon:Earth size ratio (*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 is the diameter of Neptune's orbit (99.9%).





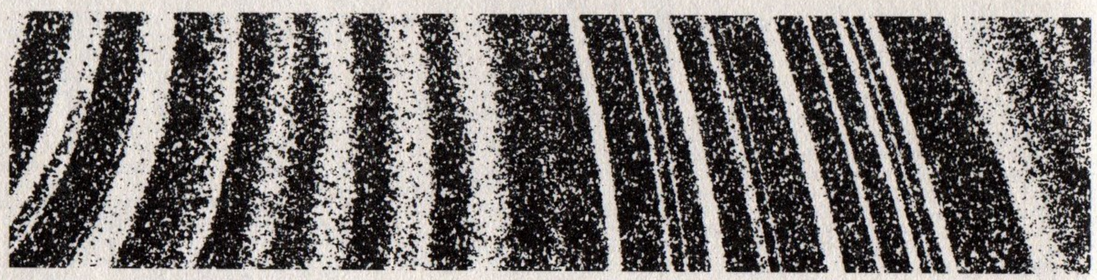
Harmonic Secrets

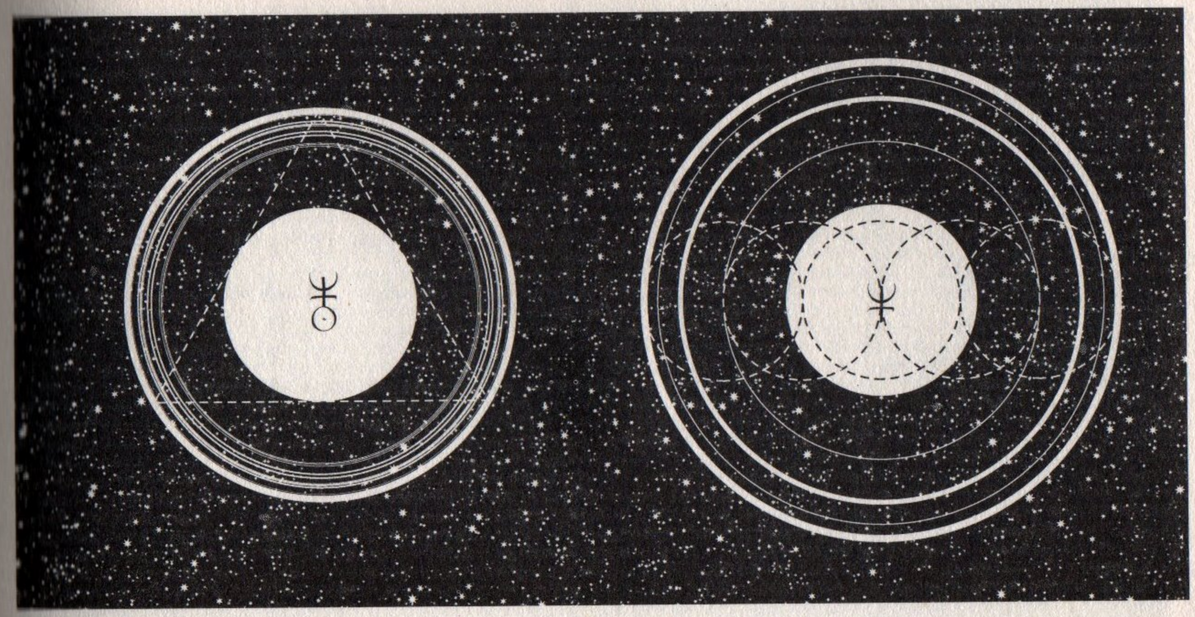
rings and shepherd moons

Uranus and Neptune both have faint ring systems - thin etched circles hanging in space. Like Saturn's rings (*below*), their origin is a mystery, the fine dust and tiny rocks may be the remains of moons, or they could be older. Some gaps in Saturn's rings are cleared by small moons, called 'shepherds', other spaces appear at 'Kirkwood' distances where particles orbit at periods which are harmonic with one or more moons.

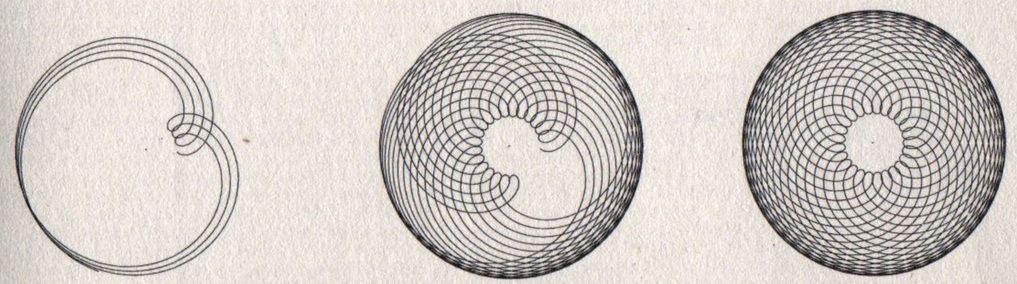
Strangely, Uranus' bright outer ring has a diameter twice that of Uranus itself (99.9%), and Neptune's innermost ring is two-thirds the size of its outermost (99.9%). These proportions mirror the local timing as Neptune's orbital period is twice that of Uranus, and Uranus' is two-thirds that of Pluto.

The two planets kiss every 172 years, creating a beautiful heart shape (*opposite*). This then spins so that every 4300 years they both experience a *perfect* division of the zodiac into twenty-five kisses. Coincidentally, the tiny comet-planet Chiron, which orbits wildly between Saturn and Uranus, also measures out a perfect twenty-five in the Uranian sky. Chiron is seriously well tuned (*see page 57*).

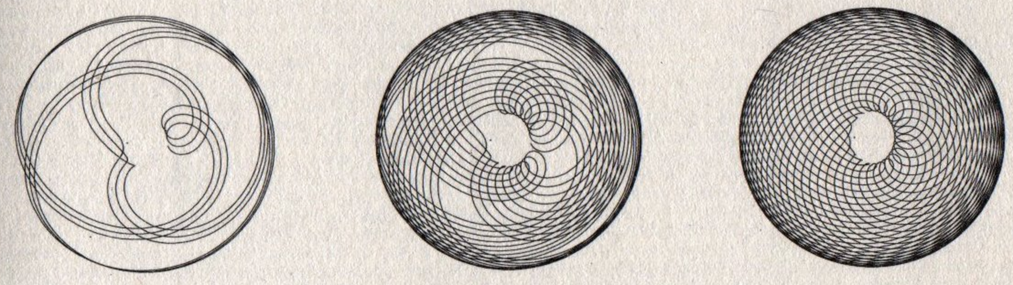




URANUS' AND NEPTUNE'S RINGS



URANUS' AND NEPTUNE'S DANCE



URANUS' AND CHIRON'S DANCE

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 ancients, however, pondered consciousness deeply, and held that life, or 'the soul', was particularly akin to the applied 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. More recently, the equations of Newton, Einstein and others have been continually refined towards simplicity and beauty.

This book has shown simple and beautiful examples of harmony and geometry in the solar system. The Golden Ratio, long associated with life, and conspicuously absent from modern equations, plays lovingly around Earth. Does this in some way have something to do with 'why we are here', 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 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 labour 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)
The Sun	☉	-	-	-	-	-	-	-	-
Mercury	☿	46.00	57.91	69.82	0.205631	7.0049	77.456	87.969	87.968
Venus	♀	107.48	108.21	108.94	0.006773	3.3947	131.53	224.701	224.695
The Earth	+	147.09	149.60	152.10	0.016710	0	102.95	365.256	365.242
Mars	♂	206.62	227.92	249.23	0.093412	1.8506	336.04	686.980	686.973
Ceres	⚳	446.60	413.94	381.28	0.0789	10.58	???	1680.1	1679.5
Jupiter	♃	740.52	778.57	816.62	0.048393	1.3053	14.753	4,332.6	4,330.6
Saturn	♄	1,352.2	1,433.5	1,514.5	0.054151	2.4845	92.432	10,759.2	10,746.9
Chiron	⚷	1,266.2	2,050.1	2,833.9	0.38316	– 6.9352	339.58	18,518	18,512
Uranus	♅	2,741.3	2,872.46	3,003.6	0.047168	0.76986	170.96	30,685	30.589
Neptune	♆	4,444.4	4,495.1	4,545.7	0.0085859	1.7692	44.971	60,190	59,800
Pluto	♇	4,435.0	5,869.7	7,304.3	0.24881	17.142	224.07	90,465	90,588

MOONS (a selection)

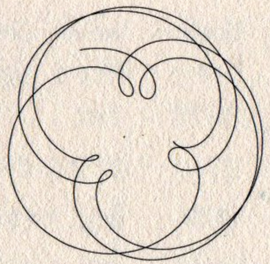
		Name of Satellite	Mean Orbital Radius (10^3 km)	Orbital Period (days)	Eccentricity of Orbit	Inclination of Orbit (°)	Diameter (mean) (km)	Mass (10^{18} kg)
Earth's	+	*The Moon*	384.8	27.3217	0.0549	5.145	3,475	73,490
Mars'	♂	*Phobos*	9,378	0.31891	0.0151	1.08	22.4	0.0106
		Deimos	23,459	1.26244	0.0005	1.79	12.2	0.0024
Jupiter's	♃	*Io*	421.6	1.7691	0.004	0.04	3,643	89,330
		Europa	670.9	3.5512	0.009	0.47	3,130	47,970
		Ganymede	1,070	7.1546	0.002	0.21	5,268	148,200
		Callisto	1,883	16.689	0.007	0.51	4,806	107,600
Saturn's	♄	*Tethys*	294.66	1.8878	<0.001	1.86	1,060	622
		Dione	377.40	2.7369	0.0022	0.02	1,120	1,100
		Rhea	527.04	4.5175	0.0010	0.35	1,528	2,310
		Titan	1,221.8	15.945	0.33	0.33	5,150	134,550
		Iapetus	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)
The Sun	☉	600 - 816	-	1,392,000	1,392,000	7.25	1,989,100	1,412,000	274.0	0.000868	5505
Mercury	☿	1407.6	4222.6	4,879.4	4,879.4	0.01	0.3302	0.06083	3.70	negl.	167
Venus	♀	-5832.5	280.20	12,103.6	12,103.6	177.36	4.8685	0.92843	8.87	92	464
The Earth	+	23.934	24.000	12,756.2	12,713.6	23.45	5.9736	1.08321	9.78	1.014	15
Mars	♂	24.623	24.660	6794	6750	25.19	0.64185	0.16318	3.69	0.007	-65
Ceres	⚳	9.0744	9.0864	960	932	var.	0.00087	0.000443	negl.	negl.	-90
Jupiter	♃	9.9250	9.9259	142,984	133,708	3.13	1,898.6	1,431.28	23.12	100+	-110
Saturn	♄	10.656	10.656	120,536	108,728	26.73	568.46	827.13	8.96	100+	-140
Chiron	⚷	5.8992	5.8992	208	148	???	0.000006	0.000024	negl.	negl.	???
Uranus	♅	-17.239	17.239	51,118	49,946	97.77	86.832	68.33	8.69	100+	-195
Neptune	♆	16.11	16.11	49,528	48,682	28.32	102.43	62.54	11.00	100+	-215
Pluto	♇	-153.29	153.28	2390	2390	122.53	0.0125	0.00715	0.58	negl.	-223

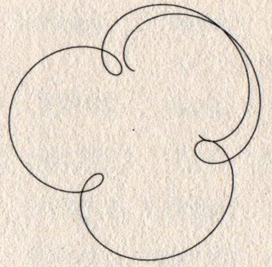
MOONS (continued)

		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)
Uranus'	♅	*Miranda*	129.39	1.4135	0.0027	4.22	235.7	66
		Ariel	191.02	2.5204	0.0034	0.31	578.9	1,340
		Umbriel	266.30	4.1442	0.0050	0.36	584.7	1,170
		Titania	435.91	8.7059	0.0022	0.14	788.9	3,520
		Oberon	583.52	13.463	0.0008	0.10	761.4	3,010
Neptune's	♆	*Proteus*	117.65	1.1223	0.0004	0.55	193	3
		Triton	354.76	-5.8769	0.000016	157.35	2,705	21,470
		Nereid	5,5413	360.14	0.7512	7.23	340	20
Pluto's	♇	*Charon*	19.6	6.3873	<0.001	<0.01	1,186	1,900

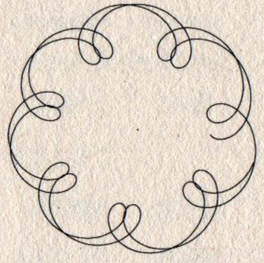
Only the major moons of the gas giants are given. In 2001 there were 28 known moons around Jupiter, 30 around Saturn, 21 around Uranus and 8 around Neptune. There are probably many more. There are 29.5306 days between full moons on Earth. Cosmology can seriously improve your health.



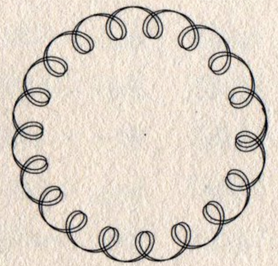
MERCURY - VENUS



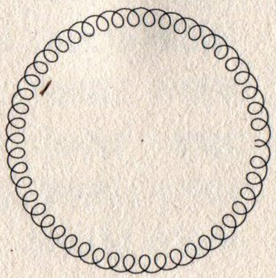
MERCURY - EARTH



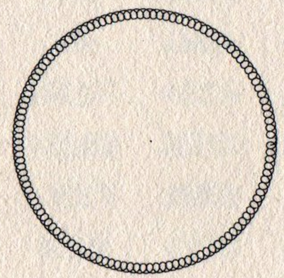
MERCURY - MARS



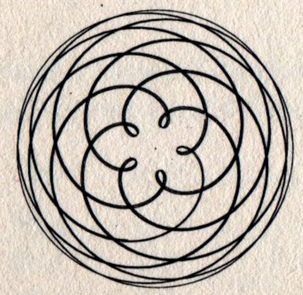
MERCURY - CERES



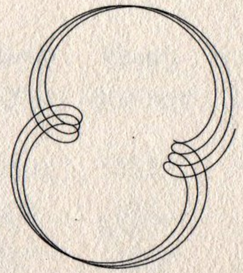
MERCURY - JUPITER



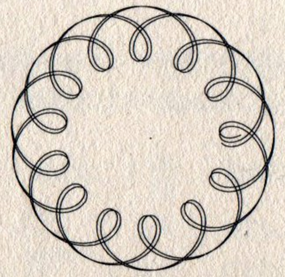
MERCURY - SATURN



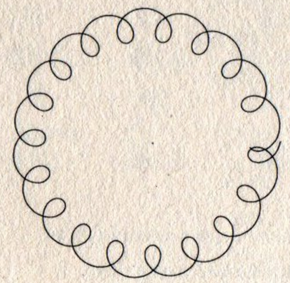
VENUS - EARTH



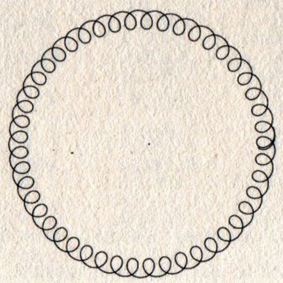
VENUS - MARS



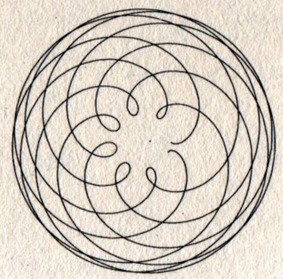
VENUS - CERES



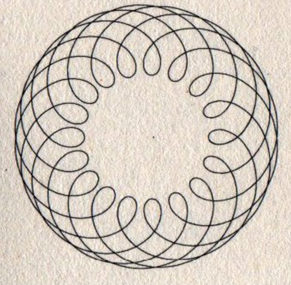
VENUS - JUPITER



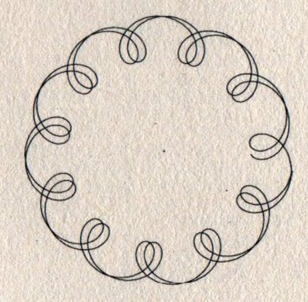
VENUS - SATURN



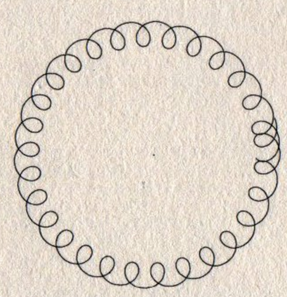
EARTH - MARS



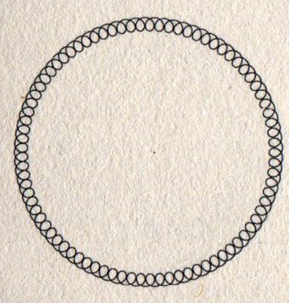
EARTH - CERES



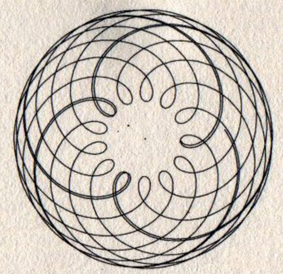
EARTH - JUPITER



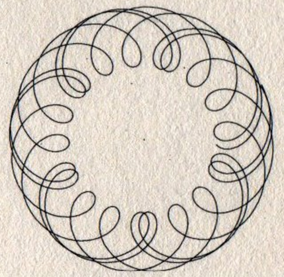
EARTH - SATURN



EARTH - URANUS



MARS - CERES



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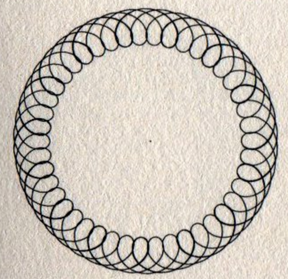

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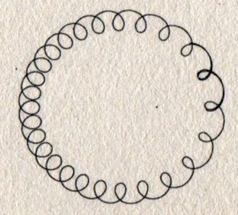
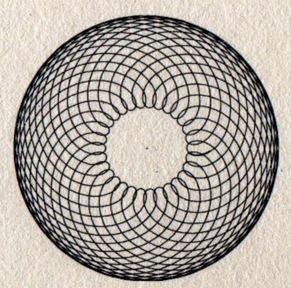
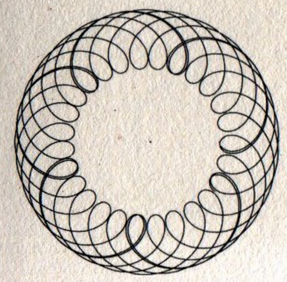


MARS - CHIRON



CERES - JUPITER



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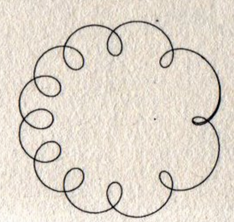

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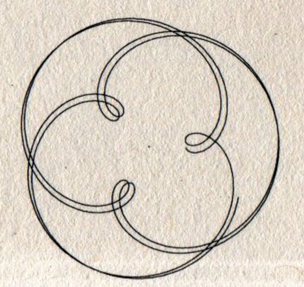
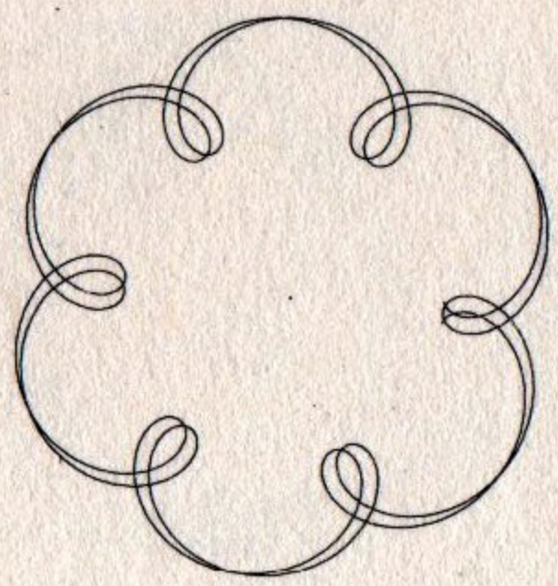


JUPITER - SATURN



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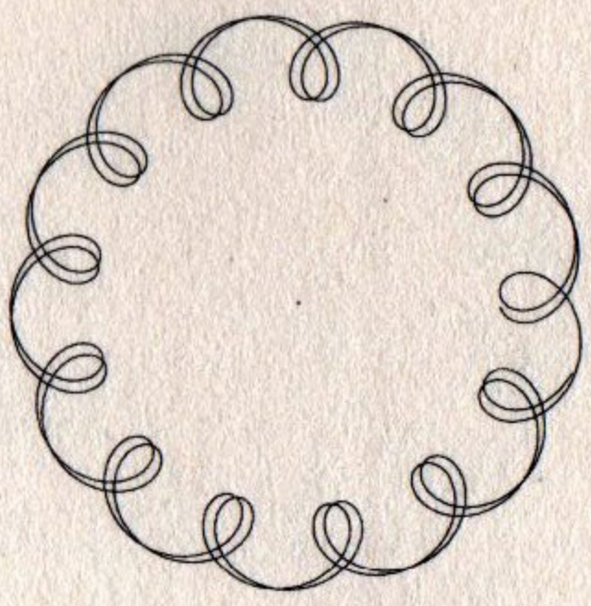
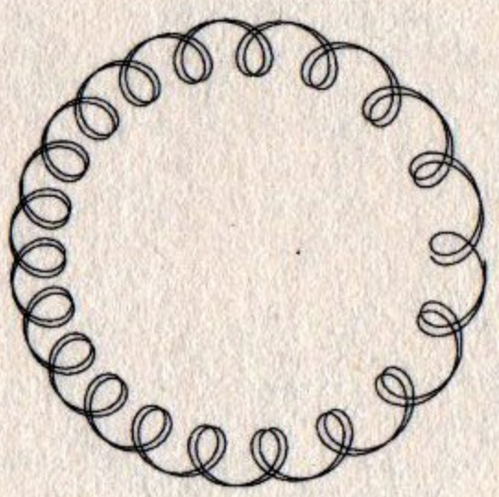
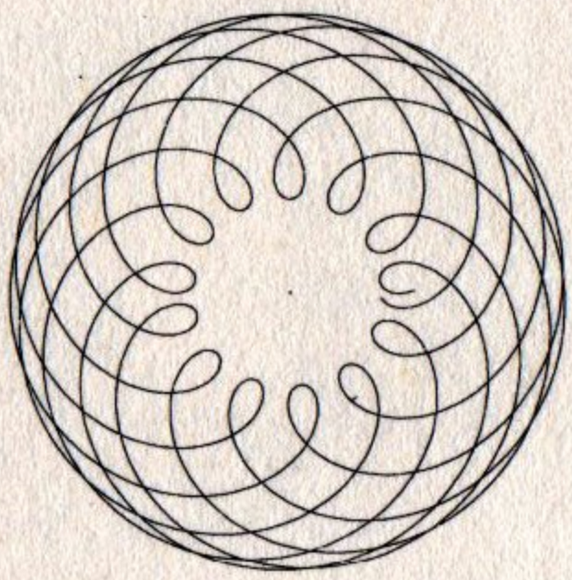


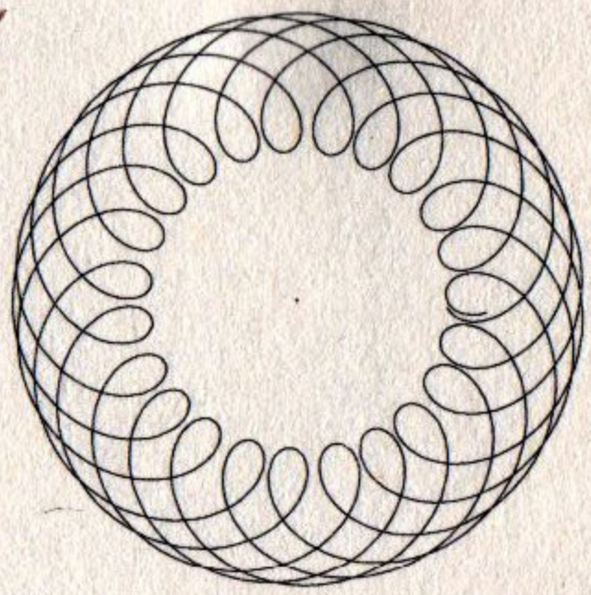
JUPITER - NEPTUNE



JUPITER - PLUTO



SATURN - URANUS



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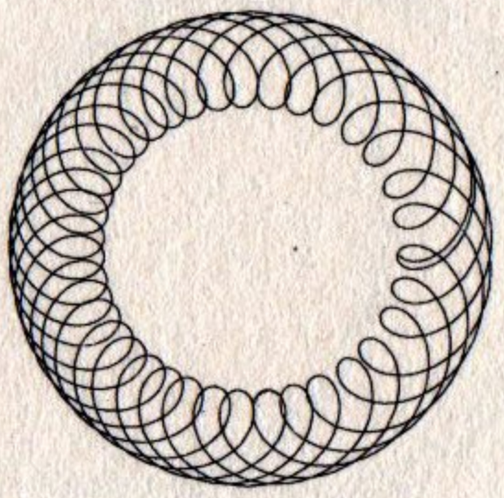

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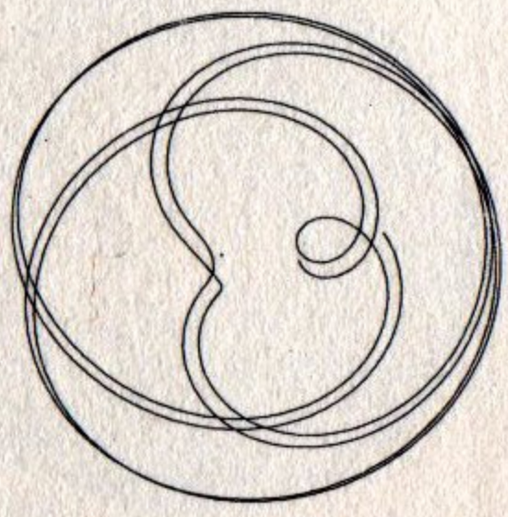
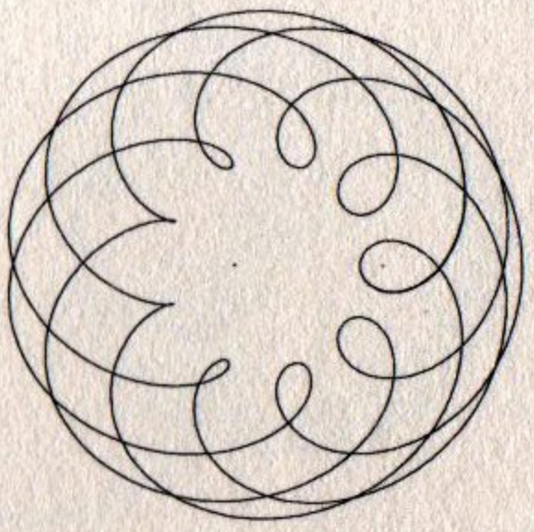
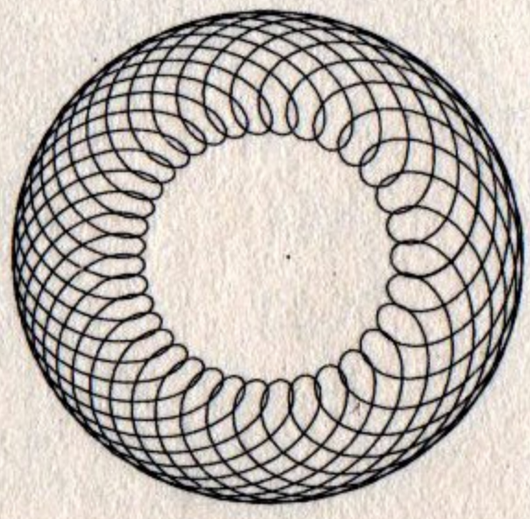


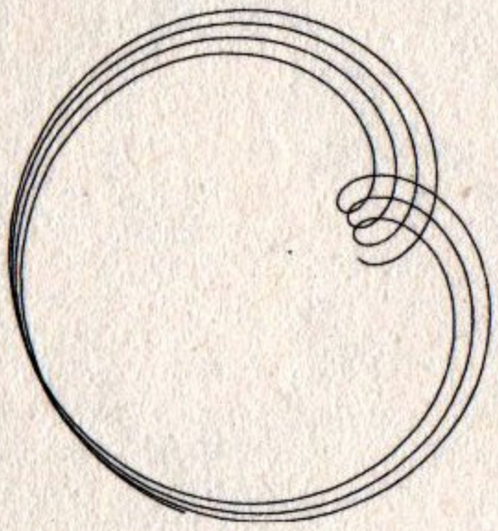
CHIRON - URANUS



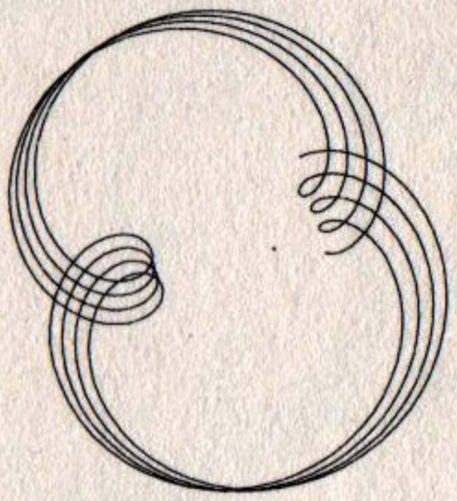
CHIRON - NEPTUNE



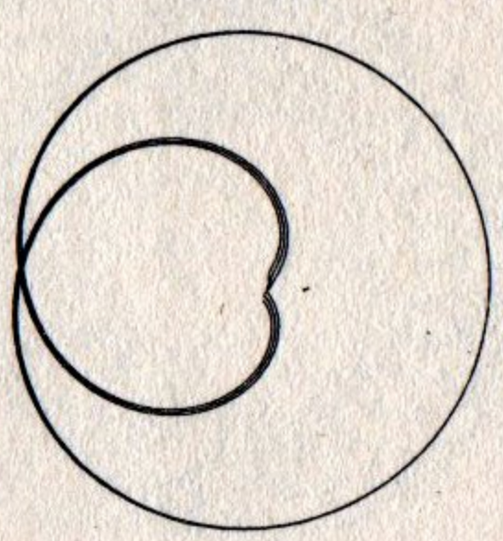
CHIRON - PLUTO



URANUS - NEPTUNE



URANUS - PLUTO



NEPTUNE - PLUTO