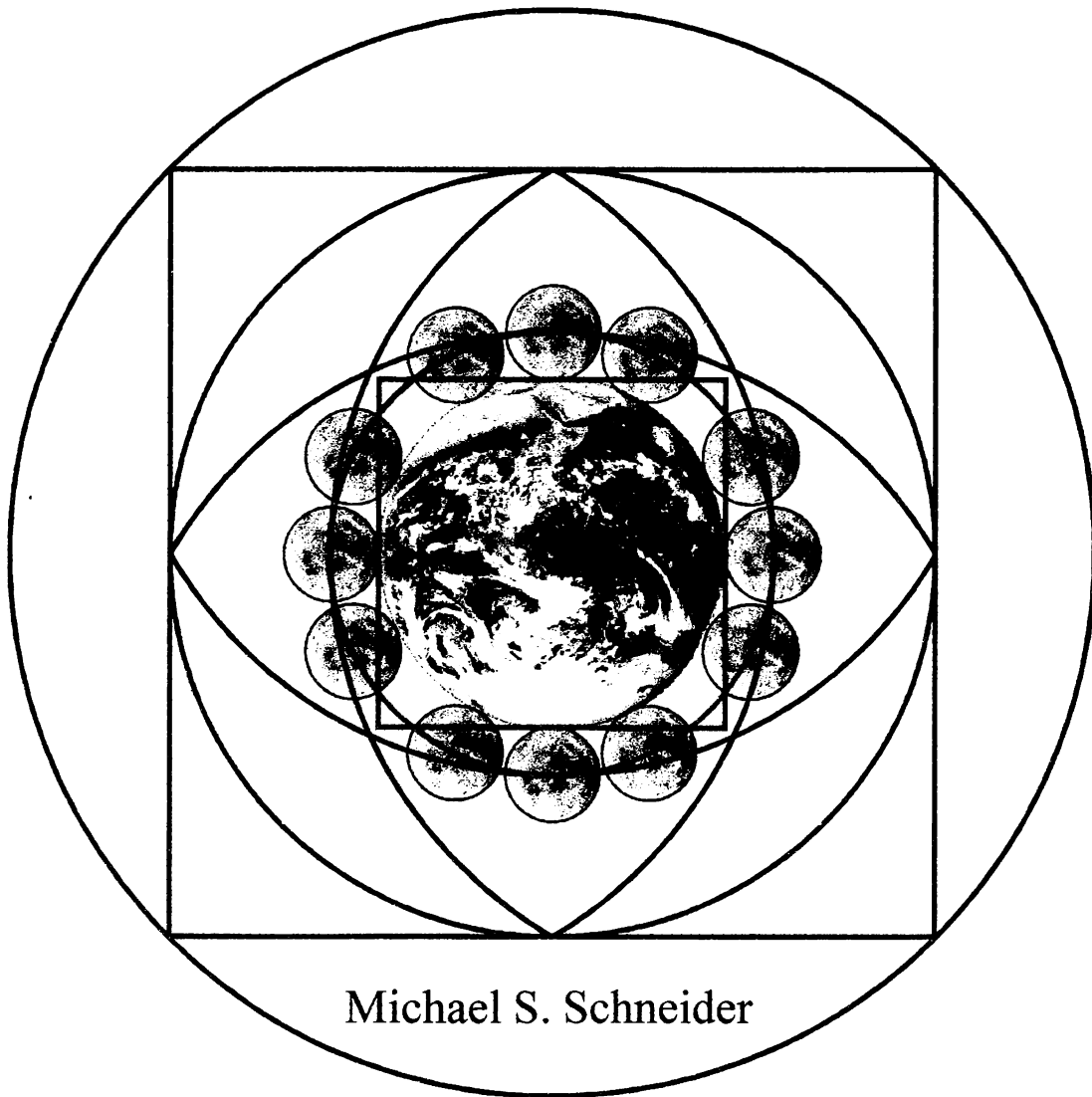


Constructing The Universe Activity Books

Volume 5

Constructing the Cosmological Circle

Symbol and Instrument for Universal Harmony



Michael S. Schneider

Author of

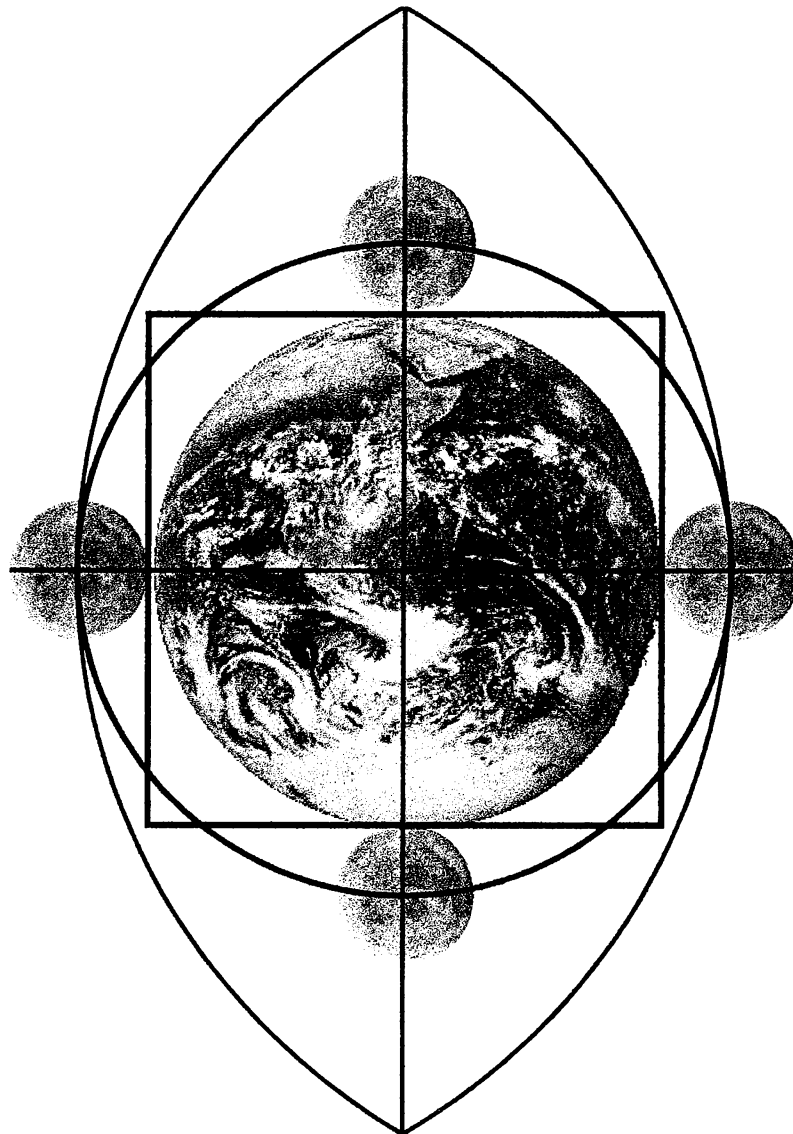
*A Beginner's Guide To Constructing The Universe:
The Mathematical Archetypes Of Nature, Art And Science*
(HarperPerennial)

Constructing The Universe Activity Books

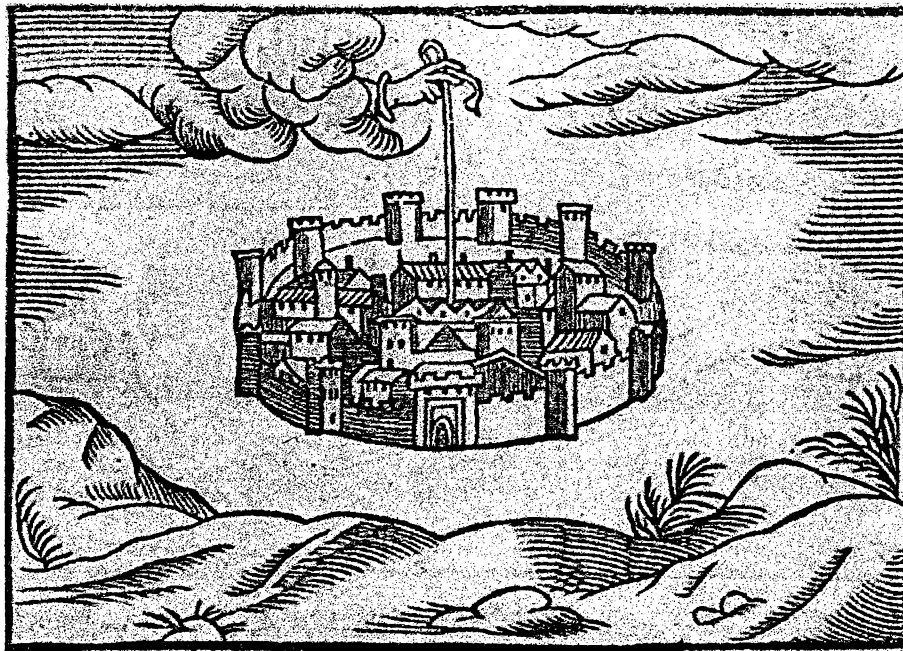
Volume 5

Constructing the Cosmological Circle

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Michael S. Schneider



Constructing The Universe Activity Books
Volume 5

Constructing the Cosmological Circle

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<http://www.constructingtheuniverse.com>

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at the California College of the Arts (San Francisco and Oakland)

Cover: The Cosmological Circle diagram showing the actual size relationship of the Earth and Moon.
The "squared circle" at its core is highlighted in red.

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Introduction

"What the mathematicians have been calling abstraction is reality."

-- R. Buckminster Fuller
(*Synergetics* 220.11)

"... it really seems to me that mathematics -- in which as such God cannot appear -- shows us the intelligent structure of the universe."

-- Pope Benedict XVI, 2006

"Equations are just the boring part of mathematics. I attempt to see things in terms of geometry."

-- Stephen Hawking (English cosmologist and physicist, 1942-)

"Contrary to popular belief, mathematics is the simplest language in existence."

— Alfred Korzybski (founder of General Semantics, 1879-1950)

In 1993 I wrote *A Beginner's Guide To Constructing The Universe* to explore the appearance of numbers and shapes around and within us. Numbers, shapes and their beautiful patterns are the basic ordering principles at work in the world intelligently structuring natural and human designs. The book was followed by four *Constructing The Universe Activity Books* providing further opportunities for hands-on geometric constructions and explorations through nature and art. This is the fifth book in the series and, in a sense, encompasses them all.

Simple observation of nature shows that we live in a numerically ordered universe. Modern scientists and ancient philosophers agree on that. Galileo pointed out that the proverbial *Book Of Nature* is written in a rational language we can actually learn to read, an alphabet of geometric shapes whose handful of letters include circles, triangles, squares, pentagons, hexagons and spirals. They combine in different materials, sizes and ways to express a vocabulary from dewdrops and insects to flowers and stars. Nature's geometric words and phrases are temporary models, passing approximations of preexisting eternally perfect archetypes, numerical ideals they strive towards but can never precisely equal. The evidence of this mathematical language is written everywhere around us and we can learn much from it.

Mathematics is indeed a true language. Like all languages, mathematics has two kinds of words, symbols (which are numerals), and propositions (which are relations like plus, times and equations): 1 stone + 2 stones = 3 stones. Relations are structural so mathematics gives us structural data about the world's shapes and patterns. The number line is an example of structure: 1,2,3,4, ... and $1+2=3$. Without relations, number names alone would be ridiculous (Second Avenue plus Third Avenue equals Fifth Avenue?!)

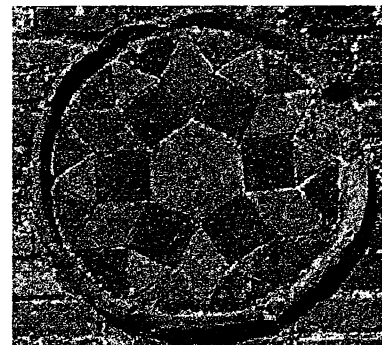
One difference between mathematics and all other languages is that mathematics is the only language without physical content. Also, mathematical descriptions are complete, while in other languages countless details are always left out of descriptions. For example, mathematics defines a circle as the locus of all points in a plane equally distant from a central point. This describes all circles and nothing about the circle is omitted. (OK, give it a radius.) But if I draw a 'circle' on the blackboard, it's not a true circle because its chalky curve has width, color, temperature, thickness, etc. Just try to describe anything physical, like a "pencil". You can describe its length, colors (and their shades?), weight, shapes, materials, densities, temperatures, dents, etc. But however you describe it, some aspects won't ever be mentioned. Physical abstractions always have characteristics left out. Only in the language of mathematics are all particulars included. This is the eternal nature of mathematics.

Shapes are numbers made visible. A triangle is a mask of the number three. Numbers, shapes and their relationships were not invented by any person or group or even by mankind, but their truth is freshly discovered by whoever explores them. Numerals, the symbols we use to represent the eternal principles of numbers, are a human invention. Numerals change from culture to culture as with the different Egyptian, Babylonian, Chinese, Hindu, Mayan and Roman Numeral systems. But the ideal, intangible number principles they represent, and their relationships, are unchanging eternal truths. Mathematics is Truth upon which all people agree, even those who disagree about other matters.

Modern mathematics as taught in education and used in commerce and science limit their use of numbers to manipulating them as quantities. But learning about mathematics can be approached by also recognizing numbers as *qualities* having different personalities. When we let them reveal themselves to us we first notice the patterns they create alone and together. As in human relations, some numbers get along with others easily, engaging in mutual affairs, as the number two pals around with four, six, eight, ten and twelve. The personality of three prefers the company of six, nine and twelve. Some numbers who wouldn't ordinarily associate with each other have friends in common: five and ten are cordial when two is around. Two and three need six to make sense of their relationship. We see their friendships expressed in the geometric patterns of flowers and snowflakes and also in tiles, quilts, wallpaper and paper towels.

One, known to its admirers as unity, is the eternally faithful friend to every number, multiplying and dividing each without detracting from its mate's identity. All numbers are actually aspects of unity, which is really all there is. The multitude of numbers just tell us another of unity's infinite characteristics in a neverending spectrum of interrelated personalities. Numbers take an infinitely long journey away from their source in unity. Yet, like Dorothy in Oz, each number always has within itself the precise inverse proportion which will return it to oneness.

Some numbers are moody and reticent to socialize with others except in rare circumstances. This is most notably seen in the aloofness of the virgin number seven, which has no suitors (other than faithful unity) and relates to no number in the first twelve. The same is true for its heptagonal shape, impossible to construct with the traditional tools of compass and straightedge, and so makes no public appearance as tile patterns or crystal shapes. Seven is more subtle, appearing not as a tangible object or shape but preferring a more abstract entrance as the number of possible crystal systems and the ungraspable colors of the rainbow.



A Pompeii wall pattern illustrates how different numbers and shapes can "cooperate" with each other to create a symmetric whole, as in this relationship of 1, 2, 3, 4, 6 and 12. Three and four, as triangle and square, are seen to "get along" only in the presence of their hexagonal "chaperone".

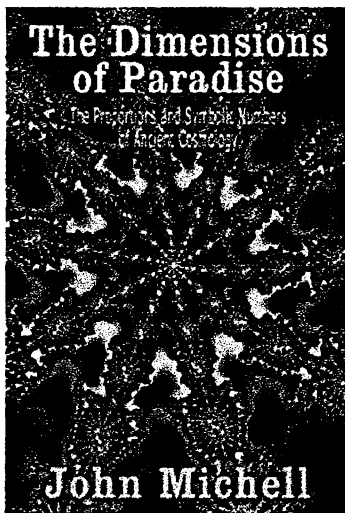
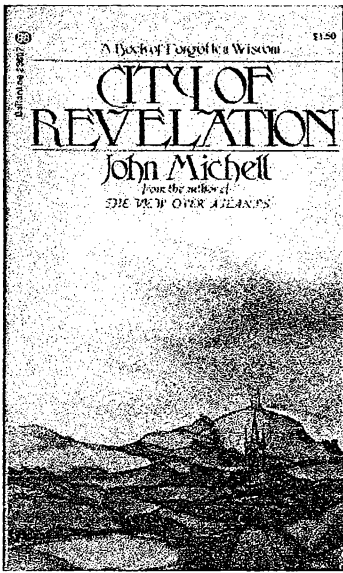
$$\frac{2}{1} \times \frac{1}{2} = 1$$

"... whence shall he have grief, how shall he be deluded who sees everywhere the Oneness?"

-- *Isha Upanishad* (India circa 2000 BCE)

"Mathematics knows no races or geographic boundaries; for mathematics, the cultural world is one country."

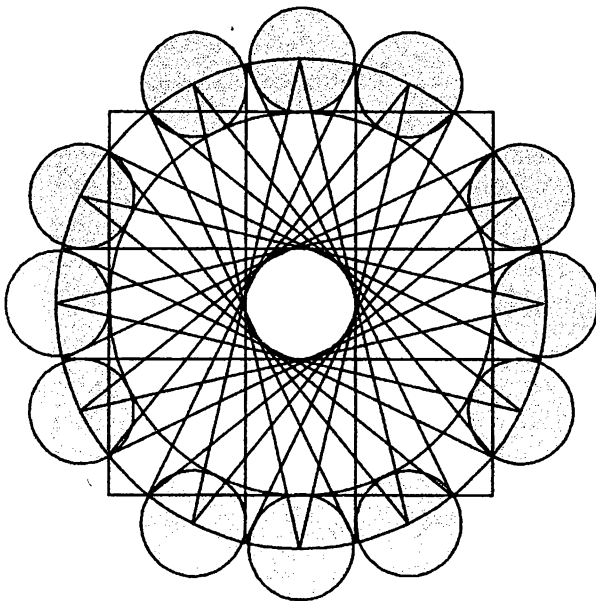
-- David Hilbert (American mathematician, 1862-1943)



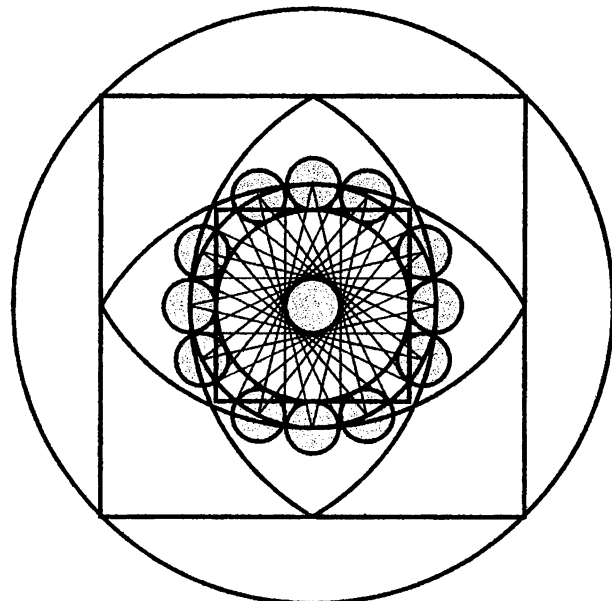
A question arises: Is there a situation where all these different personalities can get along with each other at the same time? Like cordial guests at a small dinner party, can all the numbers be seated amicably at one table and agreeably converse with each other? Is there a numerical or geometric pattern which expresses such balance of mutually harmonious relationships amidst this diversity, finding for each its proper place in the whole?

Indeed there is.

The solution emerged over decades in the work of John Michell, antiquarian, philosopher, author and teacher, whose writings on this and other subjects I first became aware of in 1972, soon after I had graduated college and hitchhiked across the United States. I discovered his *View Over Atlantis* while working in a bookstore literally underground in the New York City subway system. In his *City Of Revelation* I first pondered the New Jerusalem Diagram, so-named because its proportions are described in the New Testament as the proportions of the ideal and perfect Heavenly City whose significance includes representing the numerical order of the universe. With it's paradoxical "squared circle" Michell realized that its proportions are also expressed in the dimensions of Stonehenge, Glastonbury, other monuments and relics of worldwide cultures. I was stunned to see it beyond human creations in the relationship of the Earth and Moon. Thirty years after the basic composition of this diagram became apparent, his book *Dimensions of Paradise* (2001) expanded it more completely as the full Cosmological Circle diagram which has at its center the New Jerusalem Diagram, and is a key to long forgotten science and philosophy associated with Golden Ages. In 1986 I attended workshops in New York given by John on wide ranging related subjects.



The New Jerusalem Diagram



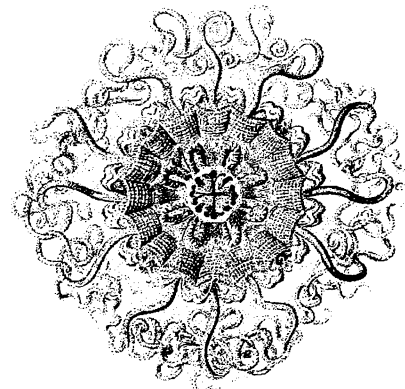
The Cosmological Circle

Since then, our friendship and visits in California and London, and teaching together in New York and Glastonbury, have taught me much over the years. I've been continually astonished at each revelation of the unfolding dimensions, relationships and implications of the Cosmological Circle. It is to John that I, along with countless others, owe a great deal of thanks for recovering this nearly-lost trail and sharing with us a vision of what was and can be. My gratitude and thanks are offered in no small measure for his inspiration and encouragement for this book (not to mention his gift of the title for *A Beginner's Guide To Constructing The Universe*). His inestimable contributions to philosophy and antiquarian studies are deeply appreciated by many around the world. It's my hope that this book makes more readers aware of the Cosmological Circle and have easy confidence to explore it more deeply in John Michell's wonderful, accessible works.

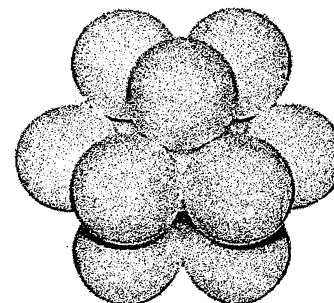
He's shown that the Cosmological Circle is the table at which all numbers sit with proper dignity and enthusiasm. No number is good or bad but all have found amicable relations with each other in the group. Even the shy, elusive number seven finds its comfortable place among this arrangement of salon guests. The Cosmological Circle is a geometric mask of the mathematical reconciliation of the disparate numbers one through twelve. It shows us a model of the structured harmony discovered among numbers and found abundantly in the order of nature.

Why are twelve guests at this table? Although we generally count by tens for its apparent convenience, numbers themselves look to twelve for their own place in the structure. All numbers build upon an expanding twelfold scaffolding, so that reconciling the first twelve numbers means the reconciliation of all numbers. (For more about this see pages 81+.) This wholeness underlies the many appearances of twelves in the symbolism of mythology, religion and other cultural affairs. Twelve, and twelve around a thirteenth a the center, is a mask revealing the structure of unity.

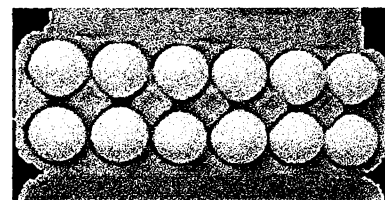
We'll see that the area of the whole Cosmological Circle is equal to the numbers one through twelve multiplied together. The individual elements within the Cosmological Circle, its lengths and areas, represent different aspects of the way the twelve numbers, and thus all numbers, integrate. Since the Cosmological Circle is a synthesis of the proportions and harmonies found in nature and number, even music, it has been considered a faithful image of the universe, encapsulating in miniature the whole orderly cosmos and revealing the innermost order of number and nature. Thus it was consulted long ago as a numerical standard, a canon of harmonious proportion for application to all matters from science to statecraft.



Jellyfish



The wholeness of twelve is a fact of existence. Here, twelve identical spheres can always perfectly surround one at their center. Each sphere touches five others.



Traditional measures worldwide were based on the excellence of twelve and its ability to divide equally in the most ways among small numbers.

Cranial Nerves

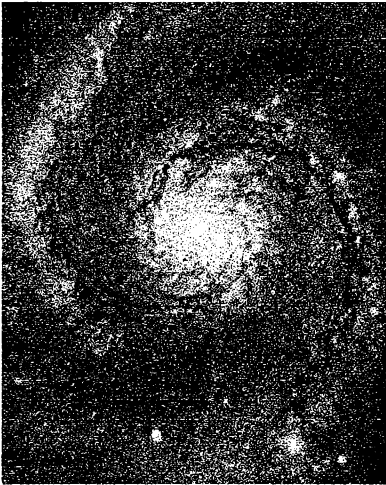
- I Olfactory
- II Optic
- III Oculomotor
- IV Trochlear
- V Trigeminal
- VI Abducens
- VII Facial
- VIII Vestibulocochlear
- IX Glossopharyngeal
- X Vagus
- XI Accessory
- XII Hypoglossal



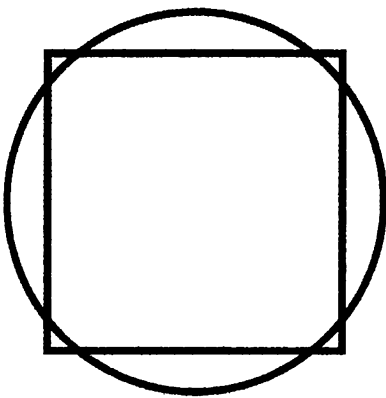
Our nervous system has a duodecimal structure.

There is great value in exploring and contemplating the Cosmological Circle diagram. By appreciating its unifying harmony and satisfying proportions we develop a taste for harmony around and within us, and invite this vision to Earth and our lives.

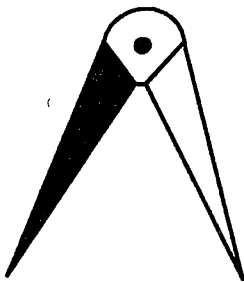
The book is organized in five sections. The first, *From Chaos To Cosmos* considers some ancient creation myths describing mathematical aspects to the birth of the universe, in contrast with modern cosmology. Did the universe begin with a scary "Big Bang" and randomly bring us here to conquer and tame nature? Or are there other ways to understand it? Studying nature's order, its "outbursts of truth" reveals first hand how the universe is organized and unfolds. Today, science, religion and mythology present differing views, although this wasn't always the case. All societies organize and comport themselves in accord with the cosmology they perceive. In the past intentionally planned "cosmologically ordered societies" were formed. They're sometimes recognized by their deep interest in particular numbers which recur in their religion, literature, statecraft and the proportions of their monuments and buildings. They did this to resemble as closely as possible the harmony they perceived in nature's numbers at the heart of the universe and in themselves.



The second section, called *Geometer's Heaven and Earth* looks at two shapes central to the sacred art, architecture and philosophy of cultures where universal order was a main interest. These shapes are the circle and square, worldwide symbols of eternally existing heavenly perfection and their transitory earthly approximations. Circle and square are predominant in the Cosmological Circle diagram so we benefit by understanding their geometry and symbolism.



Of all the ways that the circle and square interact, the most interesting is the "squared circle" where they have the same perimeter or area. The next section, *Squaring The Circle*, looks at the geometry and history of this seeming impossibility. Symbolically, a squared circle signifies the meeting of Heaven and Earth, the ideal and the actual, which by definition are different. Cosmologically ordered societies often used squared circle geometry in their sacred architecture. By looking at various examples we'll gain insight into the squared circle at the center of the Cosmological Circle construction.



The next section, *Construct the Cosmological Circle* is the heart of this book. It guides the reader along illustrated step-by-step directions for the construction of the Cosmological Circle with a compass and straightedge. It's steps are well worth pondering for the way they integrate different shapes and their proportions into one harmonious whole. Artists and architects may use the construction for creative projects. Some people will approach it as a meditative process and symbol.

The final section, called *The Number Canon* removes the geometric mask and looks into the numbers at the heart of the Cosmological Circle. The way the twelve numbers combine and organize into an all-encompassing whole was the model for most of the ancient world as a microcosmic representation of the harmonious universe. It was used as a standard for defining relationships among weights, measures, music and the proportions of sacred art and architecture. This section looks at some of the numbers in this structure and their recurring appearances in various cultures and nature.

A Bibliography lists some books useful for further exploration of the Cosmological Circle in mathematics, art and philosophy.

Different readers will be more interested in different sections. Some may wish to go directly to the geometric construction of the Cosmological Circle on page 55. It's hoped that every reader will do this construction for themselves with a compass, straightedge and colored pencils. There's no substitute for doing geometry by hand to learn more about it, better than using a mouse and even better than by just mentally looking at the pictures, albeit remarkable in themselves.

Because the characteristics of numbers are timeless and unchanging, the principles behind their harmonious organization are available for discovery by any one at any time, including now. A most important reason for this investigation, as Plato pointed out, is that such studies can rekindle the best elements of our mind. It was once well understood everywhere that the active investigation of number and geometry can lead the mind from the world's shifting appearances to contemplation of its unswerving standards and order. Plato noted that this approach to the study of mathematics turns the soul from the world of Becoming, from the natural forms which are merely approximations of eternal Reality, towards contemplation of the changeless ideas they represent in the ideal World of Being. He wrote in *Laws* (quotation, right) that this study sharpens our faculty for perceiving Truth and serves to purify, exalt, invigorate, elevate and enlighten the mind:

So please explore the Cosmological Circle in ideas and by hand. In it you might glimpse the architectural plan of an ideal city and by its contemplation, as Plato encourages us (next page), to become its citizen.

I hope you enjoy this book and that it and the Cosmological Circle inform and inspire you.

Michael S. Schneider
San Anselmo, California
28 October 2006

1 2 3 4 5 6 7 8 9 10 11 12

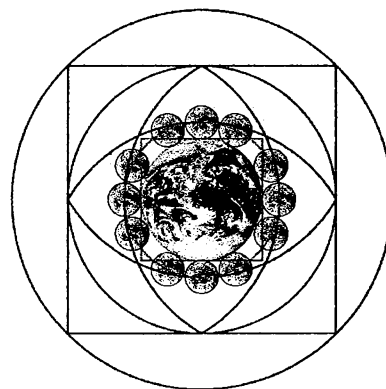
“Without familiarity with mathematics, sanity is only a matter of luck.”

— Alfred Korzybski

"But it is in fact no easy matter, but very difficult for people to believe that there is a faculty in the mind of each of us which these studies purify and rekindle after it has been ruined and blinded by other pursuits, though it is more worth preserving than any eye since it is the only organ by which we perceive the truth."

"... no single branch of educational science possesses so great an influence as the study of numbers: its chief advantage is that it wakes up the man who is by nature drowsy and slow of wit, and makes him quick to learn, mindful and sharp-witted, progressing beyond his natural capacity by art divine."

-- Plato (*Laws* 747b)



“I understand,” he said; “you mean the city whose establishment we have described, the city whose home is in the ideal; for I think that it can be found nowhere on earth.”

“Well,” said I, “perhaps there is a pattern of it laid up in heaven for him who wishes to contemplate it and so beholding to constitute himself its citizen. But it makes no difference whether it exists now or ever will come into being.”

— Plato (c427-c347 BCE, *Republic* 592b)



Plato

"Let a hall be raised
Peerless, thou great artificer high-praised,
... Wonderful the pile shall be,
No mortal man shall copy although he
Labour to grasp it, nor on transient earth
Another equal wonder shall have birth.
Vast let it be. Let human and divine
And the Titanic meet in one design."

-- Hindu *Mahabharata* (from "The Building of the Hall"
translation by Sri Aurobindo)



Vishvakarman
"The All-Worker", Hindu
Architect of the Universe

From Chaos To Cosmos

Cosmogony and Cosmology

Why is the universe here instead of nothing? Some prefer a religious answer; others, a scientific explanation. Is the universe intentionally created or the result of random accident? Is it divine-centered or self-centered? Or something else?

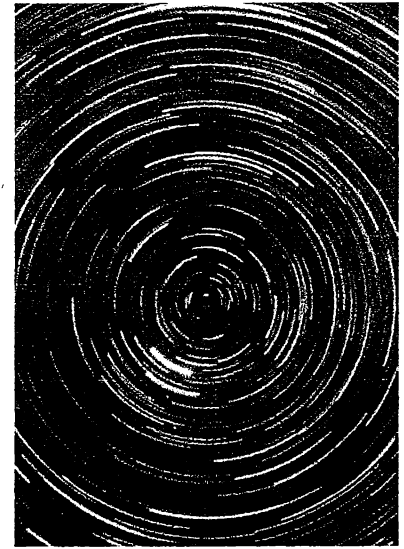
We have a word for the study of the birth (if any) of the universe: cosmogony (also spelled "cosmogony"). It derives from the Greek words *kosmos* signifying "order" and *gineo*, like "genesis", "to be born". Cosmogony today is the branch of astrophysics that studies the origin of the universe and has long been the concern of countless creation myths.

The more familiar word "cosmology" (from *kosmos* "order" and *logos* "study") was only first used in 1731 by the German philosopher Christian Wolff in his *Cosmologia Generalis*. Today cosmology refers to the scientific study of the large scale structure of the universe. It aims at a comprehensive theory of the history, structure, dynamics and evolution of the entire physical universe, the totality of all matter and energy in existence. Related words include cosmography (the science that maps the general features of the universe) and cosmolatry, the worship of the sun, planets and stars.

But let's consider this root word "cosmos". Most people take it to mean "the universe" or "outer space". Yet it has a much richer significance. Literally, it means "embroidery" implying an intrinsic order and harmony at the core of the entire universe. The modern sense of cosmology ignores this connection and limits its scope mostly to astronomy, physics and chemistry. Something similar has happened with the religious word "heaven" which has pluralized to become "the heavens" signifying outer space. Just as ancient stories of mythological gods have given way to modern tales of celebrity, words and interests change. But it's valuable to investigate word origins for clues about greater matters.

Greek words related to *kosmos* include *kosmeo* ("to establish order") and *kosmetikon* ("cosmetic") which didn't have today's cynical inference of a deceitful cover-up, but referred to the surface covering of archetypal patterns. Personal cosmetics were used for accentuating the harmonious order and wholeness of the elements of the face and body. From the related word *harmonia* (with its *-ar* root "fitting together") we find words like order, ornament, art, arithmetic, rhyme and rhythm, all situations where harmonious relations are important.

Modern, scientific cosmogony may be summed up with a colossal "BANG!" No one can say why it occurred, if it really did, or what



Time lapse photograph
northward of stars around
Polaris

"The supreme task of the physicist is to arrive at those universal elementary laws from which the cosmos can be built up by pure deduction. There is no logical path to these laws; only intuition, resting on sympathetic understanding of experience, can reach them."

-- Albert Einstein, 1918

"The Beginning cannot be known through equations."

-- Attributed to Buddha

"Reason cannot arrive at any final truth because it can neither get to the root of things nor embrace the totality of their secrets; it deals with the finite, the separate, the limited aggregate, and has no measure for the all and the infinite."

-- Sri Aurobindo, *The Future Evolution Of Man*

"He who sees the infinite in all things sees God. He who sees the ratio sees only himself."

-- William Blake, *There Is No Natural Religion*, 1795

"Whenever a myth has been taken literally its sense has been perverted. . . [and] whenever it has been dismissed as a mere priestly fraud or sign of inferior intelligence, truth has slipped out the other door."

— Joseph Campbell (1904-1987, renowned teacher and scholar of mythology)

inspired it. What aspect of nothingness could impel nothing to explode into something? Scientists, the modern priests of cosmology, confidently assure us that its shrapnel became a thermal soup of quarks, electrons, photons and a zoo of other elementary particles, unseeable strings folded and vibrating in impossible ways, strobing lighthouses pulsing in deep space-time illuminating bouts of matter annihilating anti-matter, with invisible holes sucking in everything around them. And it appears the same in all directions. It sounds worse than parts of some modern cities. Camps of experts don't even believe what other experts say, and everyone disagrees as to the cosmic finale, if any, our descendants can expect. Some equations seem to surely predict that the universe will inflate forever until a world-shattering "POP" sends everything to... where? Others see in the same equations proof that everything will smash together in a colossal "CRUNCH" reverting to... nothingness? Bang, pop and crunch. It sounds more like an advertisement for a breakfast cereal than an explanation for the mystery of existence. This is the mythology informing and guiding our age.

Looking back at ancient cultures we see how mythology guided their lives. But we hardly notice that our own cosmology shapes us in far-reaching ways too. Its enchantment over the modern world motivates commerce, the arts and entertainment, technology and politics. Sadly, it offers its enthusiasts a rather dismal outlook. While modern and ancient science are both based on number, modern cosmology's shortcomings include that it has no humanitarian basis or reflection of the Divine. In contrast, traditional cosmologies first assumed that a sacred, harmonious order already exists on all scales, including the human. Everything without exception was included in this harmony, and was not limited to the obvious physical structure and its astromechanics. A cosmology which describes the formation of stars but doesn't account for peoples' wonder at those same stars, other than to say that they're the result of sparking electrochemical circuits -- what does that really explain? A cosmogeny and cosmology worthy of their original names must show that the stars and our awe of them are of one fabric. Any apparent split between science and spirit is, by definition, artificial, in a *universe*.

Many people intuitively find today's scientific philosophy rather unsatisfying. It's a depressing non-coherent philosophy which tends sooner or later to nihilism. It provides neither inspiration for living nor a satisfying explanation for existence, due in part to its lack of an all-important cohesive unity which full cosmology must exhibit. Either there is unity in a universe and the cosmology which describes it, or it should be explicitly called a duoverse or something else. While the modern model has unlocked knowledge of the mechanical and energetic workings of nature, unleashing a torrent of technological marvels, it cannot fully place itself in the company of cosmological systems which began by taking as axiomatic an all-encompassing wholeness, harmony and goodness at its foundation.

Chaos and Order

Mystery is best described not through equations but poetry. Until the modern rational worldview became prominent, traditional philosophy worldwide often took the form of a mythological tale, artistic image, architectural structure and even jewelry. It did not theorize and measure an allegedly accidental universe filled with ominous objects. Instead, it began by considering a unified and harmonious whole created by wise and benevolent Divine intention.

The first feature of traditional cosmogeny is its featurelessness. It (though there was no "it" anywhere) was often described as a void, a mysterious state of non-being sometimes called chaos. It's a common misconception to think of this original chaos as mere confusion or mixed-up matter, for there was nothing distinguishable to confuse ("pour together"). Nor was it chaos in the modern mathematical sense of "fractal" ("fractional dimension") patterns seen in the wild edges of ocean waves, rugged mountains and soft clouds which are composed by repeating self-similar forms on different scales. Fractal parts resemble the whole as the small branches of broccoli resemble the whole bunch. While these fractals are said to be chaotic, they actually exhibit precise mathematical order and organization.

Traditional chaos has been described in various worldwide mythologies as a deep dark void, boundless abyss, misty gas and endless ocean. The word *kaos* in Greek literally signifies a "yawning gap". Thus "chaos" shares its root with "chasm". It's labeled in Qabala as *Ain Soph*, "without bounds". Plato used the word *apeiron*, literally "no perimeter". Actually indescribable, the main characteristic of primeval chaos is limitless featurelessness, without bounds, lines, perimeters, shapes, distinctions, relationships or measures, absolutely undifferentiated, an uncreated eternal zero having had no beginning or eventual end. But like an egg it is all potential, sometimes likened to the mighty womb of nature. Physicists might refer to it as an infinitely large, motionless *standing-wave*. By its non-movement and non-differentiation it seems not to exist at all, like the zero before the one. Its dark stillness keeps it unknown to our usual ways of perceiving, even with modern technology. The Buddhists of the *Mahayana* ("Great Vehicle") school describe it as *Sunyata* or "solid emptiness" undetectable except through profound meditation. Such emptiness is a paradox: while it is infinitely empty it is pure awareness, a great ocean ("Dalai" Lama) of perfectly silent consciousness, the power-to-be-conscious itself in silent abeyance.

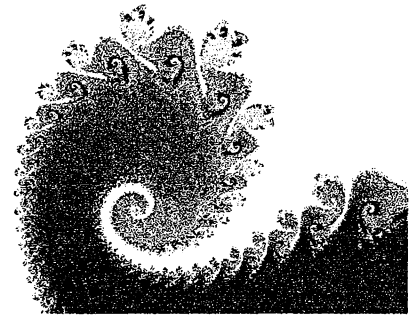
What could ignite and transform this silent empty chaos into an orderly universe, a true cosmos? The idea of a particular action inaugurating undifferentiated chaos into order occurs in worldwide creation

"At first was neither Being nor Nonbeing. There was not air nor yet sky beyond. What was wrapping? Where? In whose protection? Was Water there, unfathomable deep? There was no death then, nor yet deathlessness; of night or day there was not any sign. The One breathed without breath by its own impulse. Other than that was nothing at all."

-- *Rg Veda* (Hindu oral tradition, first written c2000 BCE)

"Truly, indeed, was Chaos first of all."

-- Hesiod, *Theogony*

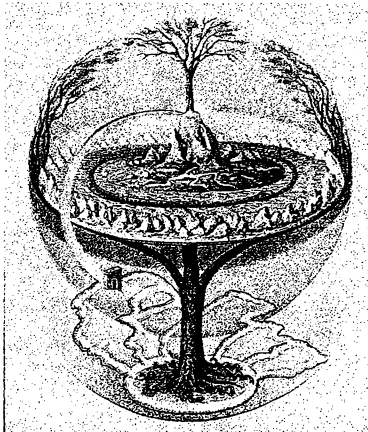


"Fractal chaos" is not confused but actually organized so that each of the parts models the whole.

"In the beginning God created the heaven and the earth. And the earth was without form, and void, and darkness breathed upon the face of the Deep. And God said, "Let There Be Light", and there was Light." -- *Genesis* 1:1



Vishnu naps on the ocean of silent chaos until the universe as a lotus periodically grows from his navel as he awakens. (See Volume 3 page 122 for a geometric analysis of this illustration.)



Yggdrasil, Norse World Tree

"Clouds and Thunder:
The image of difficulty at the beginning. Thus the superior man Brings Order out of Chaos."

-- *I Ching* (kua 3, *Chun*)

"Darkness was there, all wrapped around by darkness, and all was Water indiscriminate. Then that which was hidden by Void, that One, emerging, stirring, through power of Ardor, came to be.

-- Hindu *Rg Veda*

mythologies and religions. In Hindu mythology this quietness is described as the state of *pralaya* when the deity Vishnu sleeps. As he awakens the cosmos blossoms into existence as a lotus flower growing from his navel. Gradual awakening is more appealing than a startling bang (unless you're in a race). The western Biblical tradition of Genesis, itself based on older eastern sources, describes the transformation from this deep, dark primal chaos to the beginnings of order. In place of the action-film explosion postulated by modern science, ancient sensibilities heard the elegant speech of Divine Word commanding Light to exist and bring chaos to order. In the Greek myth of creation told by Aeschylus and Hesiod it is Light and Love together which transform the gloomy mist of *kaos* to bright orderly *kosmos*. In the Scandinavian account of the *Eddas* we read

"...there was once no heaven above nor earth beneath, but only *Ginnungagap*, the Gaping Gap, the bottomless deep, and a world of mist in which flowed a fountain. Twelve rivers issued from this fountain, and when they had flowed far from their source, they froze into ice, and one layer accumulating over another, the great deep was filled up."

Notice how in this transformation of the watery mist of chaos to harmonious existence the number twelve appears at the heart of cosmic order as a framework organizing the whole.

To a philosophical geometer, this state of quiet chaos and potential is represented by the undifferentiated surface of a blank page. For many of our ancestors the earth was the original surface for doing geometric constructions upon. The Greeks and Romans spread mistlike sand upon the floor or a table to do their constructions. The compass and straightedge, tools of the Creator, introduce polarity and trajectory into the creating process by which the geometric symbols of order emerge from blank chaos.

What is the geometer's first step for setting bounds on boundless chaos and bringing order to the blank surface? Some traditions anthropomorphize it and see the cosmic creating process coming about through the work of a Divine Geometer and Architect.

"When in the height heaven was not named,
And the earth beneath did not yet bear a name,
And the primeval Apsu, who begat them,
And chaos, Tiamut, the mother of them both
Their waters were mingled together,
And no field was formed, no marsh was to be seen;
When of the gods none had been called into being,
And none bore a name, and no destinies were ordained;
Then were created the gods in the midst of heaven,
Lahmu and Lahamu were called into being..."

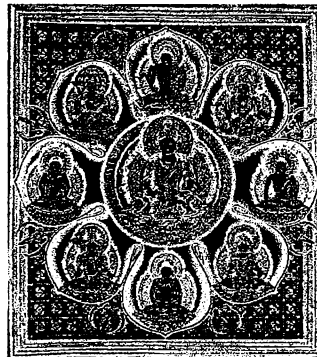
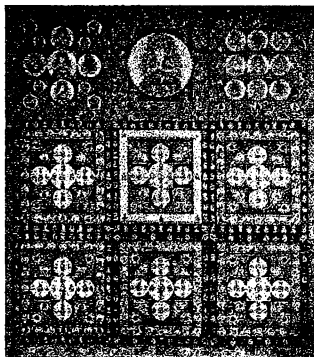
-- Enuma Elish, Sumerian creation epic

Divine Geometer

Different cultures explained the appearance of the world's order in various ways. The ancient Chinese didn't personify the creative process with any anthropomorphic creator deity but focused on the *principles* shaping the world which arose spontaneously in harmonious synchronization. But in some eastern and western metaphors the motivating principle has been likened to the work of a Divine architect, gardener, author, blacksmith, carpenter or other craftsman. The Greeks considered two aspects of divinity (analogous to zero and one): an unknowable, unmanifest, undifferentiated aspect, beyond form or further definition, labeled *Theos*, and a manifest aspect called *Demiourgos* ("artisan," "craftsman" from *de'mos* "people" + *e'rgos* "work") who intelligently designs and skillfully builds and benevolently maintains a just universe. Christian iconography includes images of God using a compass divider to create the cosmos. Whatever his guise, the Demiurge creates a unified whole according to a wise and well-conceived plan in which order, balance, harmony and goodness are built in. This is achieved by creating limits, setting proportional bounds and rhythms upon unbounded chaos by using the simplest numbers and shapes to tame, transform and sanctify this cosmos.

The plans of the Demiurge are conceived in eternity and so have always existed without any beginning in time. Plato called this the World of Being, the source of unchanging numbers and shapes which are actually indestructible Ideas, eternal archetypes. These ideal geometric possibilities serve as blueprints for the geometric patterns echoing throughout nature as their pale, transitory reflection. This is why Plato called time the "moving image of eternity" and nature's temporary constructions as the World of Becoming. Nature's forms emerge, transform, blossom and decay, striving for, but only approximating, the ideal blueprints from the World of Being on which they're based. We see this in the way that the many leaves of one tree all strive for the same ideal pentagonal plan, but each is altered by the changing environmental conditions.

In Buddhist symbology, Plato's worlds of Being and Becoming are called the Diamond World and the Matrix World, each with its associated geometric mandala:



"God the Architect of the Universe", *Bible moralisée* c1220 CE. Illuminated Manuscript. Codex 2554 Vienna, National Library.

"Wisdom put forth her voice:
When He established the
heavens I was there: when He
set a compass upon the face
of the deep."

-- Proverbs 8:27



Christ as Pancrator ("All-Creator") with the crystal sphere of the firmament (*kristallene Himmelskugel*) as royal orb. Oil painting by Johann Kemmer, 1537. Provincial Museum, Hanover. From Schramm, *Sphaira-Globus Reichsapfel*.

"Geometry existed before the creation of things, as eternal as the spirit of God; it is God himself and gave him the prototypes for the creation of the world."

-- Johannes Kepler
(*Harmonices Mundi*, 1619)

"And therefore there will be need of studies: the most important and first is of numbers in themselves; ... and the greatness of their influence on the nature of reality. ... and this will be clearly seen by him who is able to understand it to be a marvel not of human, but of divine origin."

-- Plato (*Epinomis* 990)

"However, let us return and inquire further concerning the Cosmos, -- after which of the Models did its Architect construct it? [...] Now if it so be that this Cosmos is beautiful and its Constructor good, it is plain that he fixed his gaze on the Eternal"
-- Plato (*Timaeus* 28b)

"The heavens declare the glory of God; and the firmament sheweth his handy work. Day unto day uttereth speech and night unto night sheweth knowledge. There is no speech nor language, where their voice is not heard."

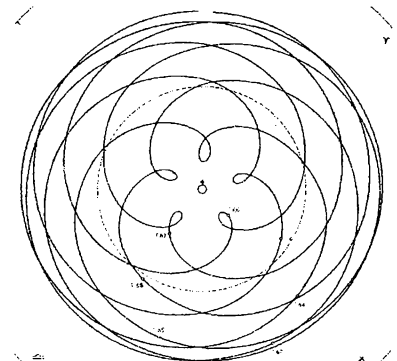
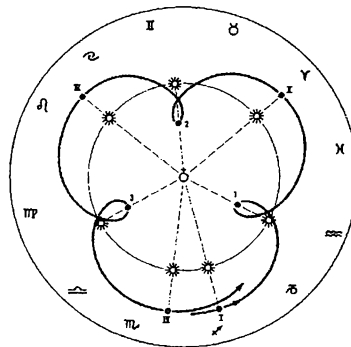
— Psalms, xix, 1-3.

In Hindu philosophy, *Karanajagat* is the name of this world of ideal types and causes approximated in the visible world *Nihatah Purvameva*. No matter in what language they're labeled, the Divine Architect's planning and handiwork are evident in the geometric pattern language of the *Book Of Nature* and throughout every aspect of the orderly cosmos.

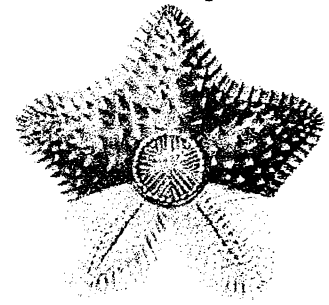
What evidence do we have of this ideal order towards which nature strives and approximates? Plato, like anyone who observes the night sky over time, saw beautiful, transitory patterns embroidered in the moving lights and recognized the unchanging ideals they strive for. He wrote in *Republic* (529d-e)

"Then," said I, "we must use the blazonry of the heavens as patterns to aid in the study of those realities, just as one would do who chanced upon diagrams drawn with special care and elaboration by Daedalus or some other craftsman or painter. For anyone acquainted with geometry who saw such designs would admit the beauty of the workmanship...."

He was referring to the patterns embroidered ("*kosmos*") in the night sky over time by the retrograde patterns of the planets, well known to the ancients. Consider the trefoil pattern made by the planet Mercury as seen from Earth over the course of one year, and the pentagonal flower made by Venus observed over eight years. The ideal trefoil and pentagram they approximate, but never equal, are also hinted at in the transitory forms of plants and animals.



Retrograde patterns of Mercury (about 3 retrograde loops each year) and Venus (5 retrogrades in 8 years) resemble mundane patterns.



As has been said, the Greek word *kosmos* originally meant more than "outer space" but literally "embroidery". It referred to the *beautiful order* of the universe which is known to us as the numerically codified creating process we see in nature. Unity, harmony, beauty, rightness and just proportion are not added *onto* nature but are inherent within it. This was expressed by Joseph Ratzinger, now Benedict XVI:

"The mathematics of the universe does not exist by itself, nor ... can it be explained by stellar deities. It has a deeper foundation: the mind of the Creator. It comes from the Logos, in whom, so to speak, the archetypes of the world's order are contained. The Logos, through the Spirit, fashions the material world according to these archetypes. In virtue of his work in creation, the Logos is, therefore, called 'the art of God'. The Logos himself is the great artist, in whom all works of art – the beauty of the universe – have their origin."

Numbers were seen as mediators between Divine Reason and human reason. Number's code of just order was traditionally translated into the world of human affairs, as best as possible, as the ideal model for art and law. This was one role of the Cosmological Circle diagram. By revealing the numbers one through twelve in balance and order, it served as a reference for understanding the world's harmonious structure. Since the Cosmological Circle is a synthesis of the proportions and harmony found in number and nature, it's a faithful image of the universe. Thus it served as a guide for all the traditional arts and sciences, the designs of sacred architecture and just government on earth.

Throughout the world, cosmic order was respected and recognized by many names. *Navoti* is the Hopi word for "harmony among all things between Heaven and Earth". In India, *Dharma* is this law, and *Rta* is the name for the world order in continual battle with chaos and ignorance. *Asha*, its counterpart in the Persian religion of Zoroastrianism, battles *Drug* representing this deceit and disorder. In Taoism, the *Tao* is literally translated as "the Road" or "Way" and represents cosmic order and perfect rightness, the primeval power correctly organizing the foundation of all that is. While the Roman word *mundus* is usually translated as "world", giving us words like "mundane" and "mountain", it's actually identical in meaning to the Greek *kosmos* and other labels for the harmonious order of creation. In Egypt, the cosmic order was personified as the goddess *Ma'at*.

"God is a master craftsman; yet none can draw the lines of his Person.
Fair features first came into being in the hushed dark where he mused alone;
He forged his own figure there, Hammered his likeness out of himself...
All powerful on (yet kindly, whose heart would lie open to men).
Planting his image there in the unknown depths of his mystery.
He cared, and the sacred form took shape and contour, splendid at birth!
God, skilled in the intricate ways of the craftsman, first fashioned Himself to perfection."

-- Egyptian religious poem

"Thou hast ordered all things
in measure and number and
weight."

-- Wisdom of Solomon 11:20

"Who hath measured the
waters in the hollow of his
hand, and meted out heaven
with the span, and
comprehended the dust of the
earth in a measure, and
weighed the mountains in
scales, and the hills in a
balance?"

-- Isaiah 40:12

"Look how the floor of
heaven/ Is thick inlaid with
patines of bright gold:/
There's not the smallest orb
which thou behold'st/
But in his motion like an
angel sings,/ Still quiring to
the young-eyed cherubins./
Such harmony is in immortal
souls;/ But whilst this muddy
vesture of decay/ Doth grossly
close it in, we cannot hear it."
-- Shakespeare, *The Merchant of Venice* Act v. Scene 1

"All things that have been
arranged by nature according
to a workmanlike plan
appear, both individually and
as a whole, as singled out and
set in order by
Foreknowledge and Reason,
which created all according
to number, conceivable to
mind only and therefore
wholly immaterial; yet real;
indeed, the really real, the
eternal."

-- Nichomachus

"All men agree the Egyptians are the healthiest and most long of life among men; for the soul they introduced philosophy's training, a pursuit which has the power, not only to establish laws, but also to investigate the nature of the universe."

-- Isocrates (*Busiris* 23)



"*Ma'at*, the everlasting and never-changing goddess...."

-- from "A Hymn of Praise to Ra when he riseth upon the horizon, and when he setteth in the land of life"



The Egyptian deity *Djehuti* (Greek *Thoth*), giver of language and number, was the divine scribe. *Ma'at*'s feather on his head indicates that he only writes truth.

Ma'at

In some Egyptian creation myths the beginnings of order came when a hill arose in the midst of the waters of chaos. Upon this hill blossomed a lotus from which emerged *Nefer Tem* ("the Beautiful All") as the sun *Ra*, the solar creator-god who brings about the world in harmonious order. This righteous order was personified as his daughter the goddess *Ma'at*. Her name derives from the Egyptian word *ma'a*, "truth". The words mother, matter, material, mathematics, measure, and meter are all related to it. Adding to *ma'a* a feminine "t" ending plus the determinative glyph of a goddess spells *Ma'at*. Her name implies more than truth but also justice, righteousness, integrity, uprightness, genuineness, harmonious balance, equilibrium, proportionality and the beautiful order of creation, as no one English word captures it. Her domain was all-inclusive, seen in the orderly unfoldings of nature as well as human social and ethical orders. While modern cosmology is mainly limited to describing the evolution of astronomical structures, Egyptian cosmology recognized the unity of everything from stars to social organization. Without *Ma'at* even the gods would be powerless to act. All this, and a positive philosophy to live by, was the purview of *Ma'at*.

Ancient Egyptian civilization was invested in maintaining *ma'a* through their approach to divine government on Earth, applying it to statecraft and law for over thirty centuries. They learned the basic principles of cosmic order by carefully observing nature and by studying the properties of numbers and shapes. The flawless organization of nature and number was their reference for organizing the civilization. The stability of each Pharaoh's rule, like the Chinese Emperor's and Mayan King's, depended upon working in accord with the principles of *Ma'at*. In this regard, one of the sacred names of Amenhotep III was "Lord of the Cosmic Order is Ra". Since law and justice were considered to be expressions of "proper proportion", *Ma'at* was the patroness of judges, magistrates and all court officials, who wore her ostrich feather symbol on a necklace. A righteous, just and truth-speaking person was called a *Ma'ati*. They were honored with the terms "true of voice" and "justified".

Related to *ma'a*, "truth", is the Sumerian word *gi* signifying a reed and a measuring ruler. The word also meant "to act justly" and "to stabilize", showing similar appreciation of the relation between proper measure and justice.

The hieroglyph of *ma'a* looks like the beveled side-view of



Priestesses of *Ma'at*

a ruler. It is upon this *ma'a* glyph which *Ptah*, the creator-god of Memphis, stands. He was the primordial shaping force of the universe and patron of craftsmen and architects. Standing on this pedestal symbolizes that his work is founded upon *ma'a*, the timeless truth of number and cosmic measure. His body, except for his hands, is bound as a mummy to indicate that his handiwork is constrained by timeless truth.

Ma'at was symbolized by the ostrich feather seen in her head band. Her image, or just her feather, is often seen atop weighing scales at the balancing point. On the *Papyrus of Ani* is the famous scene of the judgment of the deceased whose heart is weighed against *Ma'at's* feather to determine which is heavier. The result determines whether the soul will ascend to a heavenly realm or be consumed by *Ammit*, the composite beast waiting nearby. *Ma'at* observes from above the beam's balancing point. Her light feather of Truth against which the initiate's heart is measured indicates whether his life was lived with clear conscience according to eternal truths, justice and righteousness, or had become heavy with fear, greed, deceit, iniquity, injustice and disorder -- chaos.

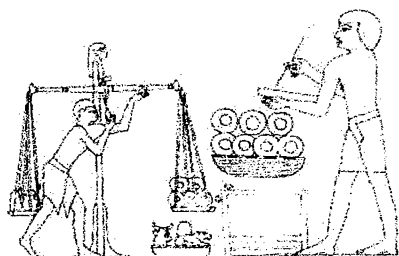
Before the initiate's heart was weighed against *Ma'at's* feather, he recited forty-two denials including "I have not made myself deaf to the words of truth and righteousness (*ma'a*)." It was considered honorable for a person to spend their life respecting and practicing the principles of *ma'a* (and worthwhile today too).



The glyph *ma'a*, signifying "truth and righteousness" is the root of the name *Ma'at*. It is written as the side view of a ruler representing cosmic measure and harmony.



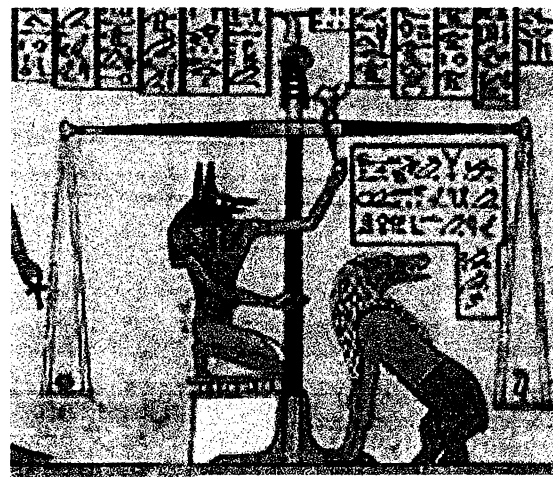
Ptah stands upon the glyph *ma'a*, affirming that his work is done in accordance with the cosmic order.



Ma'at sits atop scales to oversee the truth of their measure.

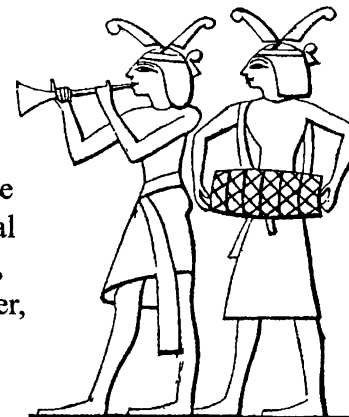


Governor Rekhmire's Musical Banquet.
Harpist and lute player, detail. Tomb of Rekhmire.
XVIII Dynasty, 1570-1293 BCE, New Kingdom.
Necropolis at Sheikh Abd el-Qurna, Western Thebes.



Weighing a heart against *Ma'at's* feather

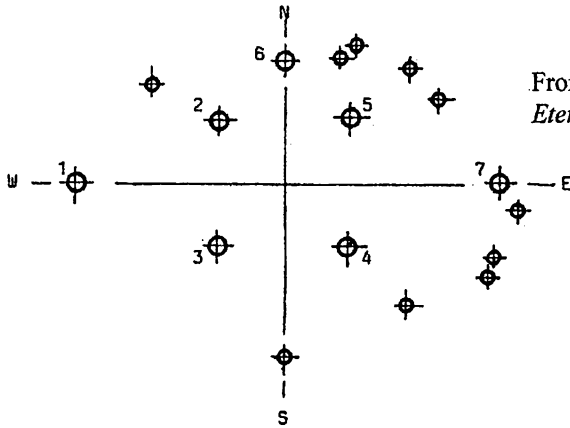
Since musical intervals are based on simple number fractions, music was considered to be an expression of Truth, and musical tunes were composed using mathematical patterns. Thus *Ma'at's* image, and sometimes just her feather, adorns the headbands of musicians.



Cosmologically Ordered Societies

Layout of the villages of the Skidi Pawnee (below).

- 1 - Star of the West
- 2-5 - Four Leading Stars
- 6 - North Star
- 7 - Morning Star



From *Architecture, Time and Eternity* by Adrian Snodgrass

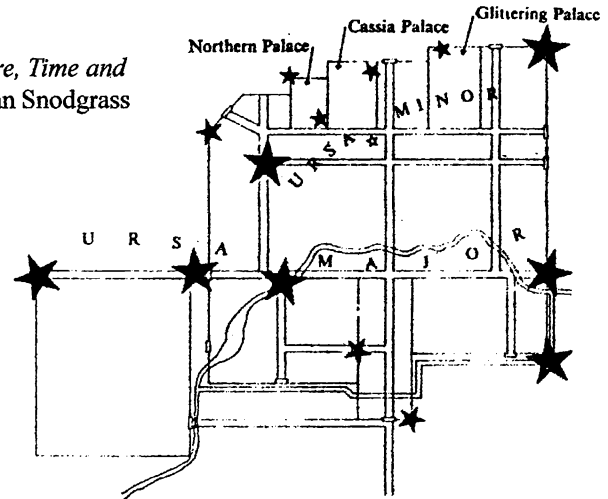
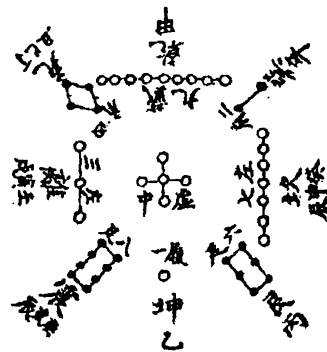
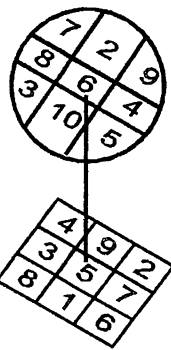
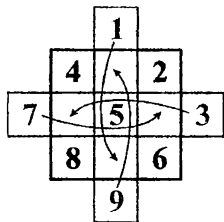


Fig. 57
The constellations Ursa Major and Ursa Minor superimposed on the plan of the Han dynasty Ch'ang-an. The white star is the Pole Star of Han times.



The dots on the cosmic tortoise represent the numbers 1 through 9 of the Magic Square of Earth.

How the 3x3 Magic Square is woven:



In Chinese tradition the North Star is connected directly to the Emperor by the World Pole, the axis at the center of the universe around which all revolves. Like one leg of a geometric compass, the North Star, Emperor and World Pole remain fixed amidst change. China, which considers itself the "Middle Kingdom" of Earth and Universe, has a long tradition as a cosmologically ordered society. Its own foundation myths indicate the importance of organizing society by transforming chaos to order through the power of number. It came from the markings of a mythological tortoise, the Magic Square of Earth *Lo Shu*, whose columns, rows and diagonals add to the same sum (15). The Magic Circle of Heaven above it maintains a different sum (18), while the sum of their corresponding vertical cells is always eleven. Harmony between Heaven and Earth mirrors the balance of power between the Emperor and people.

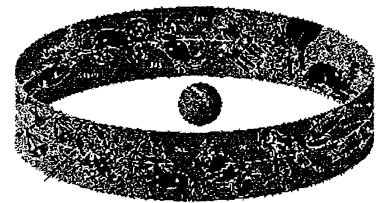
中 *Zhong*, Chinese glyph of the nation's name, China, the "Middle Kingdom". An earthly rectangle revolves around the central pole of the universe.

王 *Wang*, Chinese glyph for "Emperor". The top horizontal line represents Heaven, the bottom line Earth, with Humanity across the middle. The Emperor is the pivot of the vertical "cosmic axis" around which all turns, symbolically linking and encompassing them all.

Number was the template which translated into mythology, government, architecture, science, art and ritual. Cosmologically ordered societies were founded according to a mythological vision of the unchanging aspects of nature, numbers and shapes whose patterns served as their organizational model. Such societies always have a sacred center around which they're planned and oriented. In stellar layouts the center is the North Star around which all stars turn, or the constellations around the sun and Earth. Such organization is called an "amphictyony" (pronounced am-fik·ty·o·nee from the Greek *Amphiktuonia*, from *amphi-* = around, on the periphery, + *ktizein* = to settle). An amphictyony can be defined as "dwellers around a central shrine". Above all else, its members are responsible for the maintenance and protection of a central temple or sacred place. Amphictyonies existed all over the world in the ancient Middle East, China and throughout Asia, Africa, Hellenistic and European cultures and the pre-Colombian Americas.

Organization of a society around a common center hints that we have found an amphictyony. The most famous was the Great Amphictyonic League responsible for support of the Oracle at Delphi and the temples of Apollo and Demeter. It was founded c1100 BCE by Amphictyon, brother of Hellen, the common ancestor of all the Greeks, who was said to have been born of the sacred soil itself. Representatives of the amphictyony's twelve member districts surrounding the Delphic district of Hellas met at Thermopylae in the spring and at Delphi in the autumn, near the times of the two initiations of the Eleusinian Mysteries. Coins from each of the twelve areas surrounding Delphi depict a different zodiacal sign. Each amphictyony had its own numismatic zodiac.

The sacred center was always the starting point of a geometric plan of society. The plan was literally delineated on the ground, the world's largest drafting table. A famous instance involves the founding of Rome's seven hills in 753 BCE by the twins Romulus and Remus, who noticed twelve vultures pointing them out. They followed traditional ritual, identified the center, purified themselves, dug a pit (Latin: *mundus* "the ordered world" equivalent to the Greek *kosmos*) and built a fire altar above it. Then, with white and black bulls, they chanted as Romulus ploughed a circular furrow around the Palatine Hill where they were suckled by a she-wolf. The earth broken by the plough was directed inward so that no portion of the sacred earth fell outside the enclosure. Romulus lifted and carried the plough over what would be the gates or portals (*portare*, to carry, "portable") and that's why a door is called a portal, because in the sacred ceremony the plough was portable and carried over that gap. It was strictly forbidden to cross a sacred ploughed line, which Remus did. And it was because of this impious act by his brother that Romulus slayed Remus and founded Rome alone. Related Latin words which reveal this relationship between ploughing and society include *Urbs* (city), *Orbis* (round), *Urvum* (plough), *Urvo* ("I plough around"). Of course, the Big



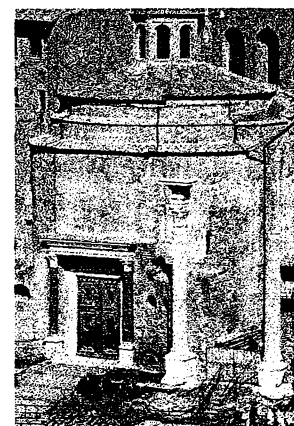
The stars and twelve constellations of the zodiac provided a model for amphictyonies.



Coin from the Delphic Amphictyony ("AMFIKTIO") 333 BCE. Apollo with lyre sits on Delphi's famous *omphalos* "navel".



Zodiacal constellation coin



Temple of Romulus

"... the lawgiver must first plant his city as nearly as possible in the center of the country, choosing a spot which has all the other conveniences also which a city requires After this, he must divide off twelve portions of land, -- when he has first set apart a sacred glebe for Hestia, Zeus and Athena, to which he shall give the name "acropolis" and circle it round with a ring-wall; starting from this he must divide up both the city itself and all the country into the twelve portions. The twelve portions must be equalized by making those consisting of good land small, and those of inferior land larger.

-- Plato (*Laws*)

"The Athenians were happy as long as they lived under the laws of Solon, and the Lacedaemonians under those of Lycurgus; and at Thebes, as soon as those who had the conduct of affairs became philosophers, the city flourished.

-- Aristotle (*Rhetoric*)

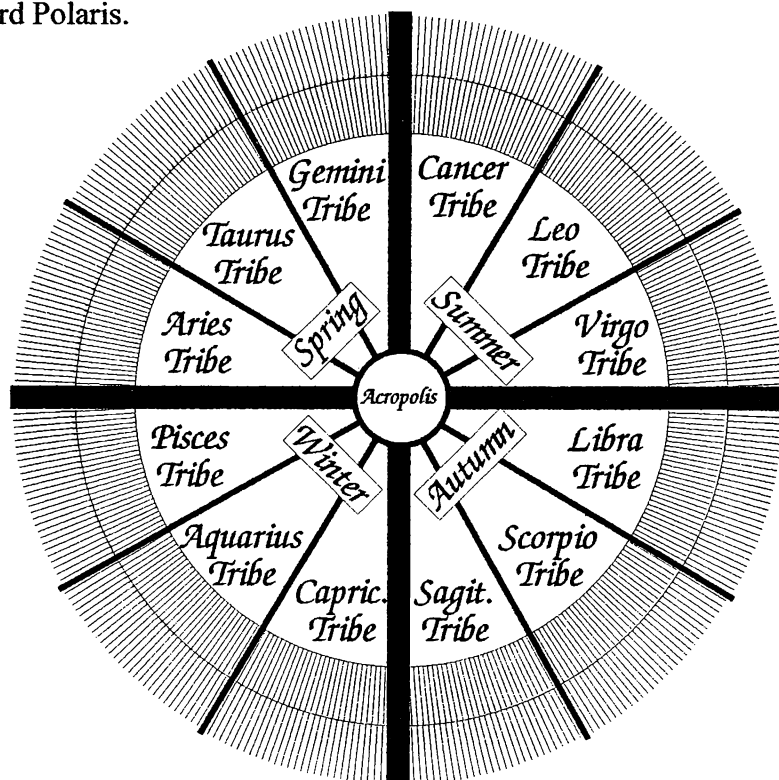
"But we will not give up our virtue in exchange for their wealth."

-- Solon (*How To Profit By Our Enemies*, in Plutarch)

Dipper is still known many places as "the plough" constellation circling the North Star in the great cosmic amphictyony.

Amphictyonies often share a telltale appearance of the number twelve. Such duodecimal organizations for society ranged from Israel with its twelve tribes around the temple in Jerusalem, to similar organizations in Ireland, Italy and throughout Europe, the Americas, Africa and Asia. Their "zodiacal wheel" organization provided equal access to the local oracle and set the dates and locations for religious festivals and market days. It helped to organize laws and justice, according to eternal principles learned from the way numbers naturally organize themselves. Such states have been remarkably enduring. The astounding twelve-century span of the Great Amphictyonic League, and thirty three centuries of Egyptian civilization, come to mind.

Another amphictyonic example is described in Aristotle's account of the Athenian Constitution set in place by Solon, Plato's ancestor. Solon liberated the populace from the previously draconian Laws of Draco and organized Greek society upon a calendrical or zodiacal pattern. At the center was the Acropolis temple complex. This was surrounded by the four *phylai* or tribes representing the four seasons. Each tribe contained three *phitrai* or clans, corresponding to the three months of each season. Each clan consisted of thirty *gene* or patrician families as the days of each month. Each tribe, clan and family held religious and civic responsibilities which were called forth at their day, month and season. This way, the twelvefold society around its sacred center was made to resemble the zodiacal wheel revolving around the sun and oriented toward Polaris.



Calendrical or zodiacally ordered societies took other forms. Some emphasized the fourfold "seasonal" division. By 2000 BCE a quaternary structure of Indian society appeared as the system of four castes, corresponding to the seasons and to the four regions of the body of *Purusha*, the cosmic being whose body *is* the universe and its cosmic order. As society, his head became teachers and priests, his chest and arms the royalty and military, his gut the merchants and farmers, his legs and feet the servants. Three millennia later in Medieval Europe towns were similarly organized into four classes of priests, knights, burghers and peasants.

It's characteristic of cosmologically ordered societies that the parts model each other and the whole, as seen in nature where the twig is a smaller version of the branch which models the limb and the whole tree. It was the same for the quaternary of individual, family, town and nation to be understood as models of each other. This fourfold structure of society also resembles our own four somatic divisions -- head, heart, gut and hips -- symbolizing the four major faculties of the soul and their the four "mystic seasons" or degrees of initiation whereby each individual and group is faced with lessons to learn and teach: teachers learn wisdom, the military learn courage, commercialists learn uprightness, and laborers learn self-discipline.

Cosmological or sacred architecture (from Greek *archae*, "foundation" or "first principles") in a cosmologically ordered society deals with more than just beautiful and stable buildings and the physical representation of worship. Sacred architecture traditionally models in miniature the structure of Cosmos. Such architecture is a crystallization of the founding principles and proportions by which Deity designed cosmos. The same care was given to the design of a whole temple complex and single floor tile so that each takes its proper place in the entire orderly cosmos. In Greek and other temples, the geometry of a column's capital is typically the geometry of the whole temple in miniature.

The steps of the geometric construction by which an architectural plan was conceived reenacted the culture's creation myth in which chaos was brought to order. Sacred architecture is an *imago mundi*, a codified world-image, a cosmic paradigm or likeness of the unchanging Real which exists outside and within ourselves. Temples, cathedrals, ziggurats, pyramids, stupas, town layouts and even homes were lessons in spiritual wisdom made visible. In part and whole they were both a map of the orderly whole around us and a diagram of our spiritual journey within. Cosmological art and architecture are maps for gathering and integrating the fragmented chaos of our lives individually and as groups into an ordered whole through conscious acknowledgment of the sacred unity of cosmos and ourselves.

"You understand, Athenians, the beauty of Solon's directions for legislating."

-- Demosthenes (*Speeches*)

"The design of a temple depends on symmetry, the principles of which must be most carefully observed by the architect. They are due to proportionProportion is a correspondence among the measures of the members of an entire work, and of the whole to a certain part selected as standard. From this result the principles of symmetry. Without symmetry and proportion there can be no principles in the design of any temple; that is, if there is no precise relation between its members, as in the case of those of a well shaped man."

-- Vitruvius "De Architectura"

Sacred architecture is "that wholeness embodying the highest knowledge available, to be carried within the form for future generations."

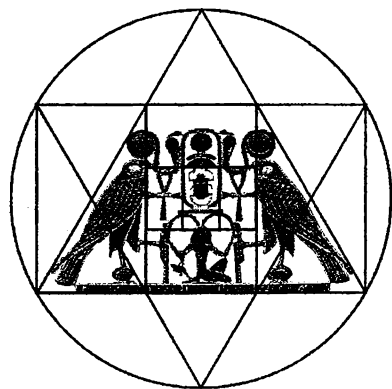
-- Keith Critchlow (architect, teacher, writer)

They used "... an esoteric code of number, harmony and proportion which was supposed to reflect the perfectly structured mind of the Creator.

-- John Michell

"In all their works [the ancients] proceeded on definite principles of fitness and in ways derived from the Truth of Nature. Thus they reached perfection, approving only those things which, if challenged, can be explained on the grounds of truth."

-- Vitruvius (First Century BCE, Roman architect, engineer, writer)



This pectoral of princess Sit-Hathor-You-net displays typical geometric design. Notice how each rectangle is the same "root three rectangle" in different sizes. It repeats an important lesson, that unity underlies diversity.

It should be no surprise that ancient societies worldwide revered the harmony inherent in the number twelve and its expression in the Cosmological Circle. To structure sacred art according to the way the twelve numbers themselves are organized is to create a microcosmic representation of the harmonious universe. Because sacred art is the clothing of revelation, they used this vision of mathematics to organize and proportion their sacred objects. Using the Cosmological Circle's symbolic language of twelvefold order, ancient designers scrupulously ordered and proportioned their temples, monuments, sculpture, coins, paintings, government, weights and measures, music, poetry, cuisine, medicine, mythology, calendars and festival days, literature and rhetoric using numbers, shapes, measures and ratios. Each work was a cosmological model, replica of the entire universe and ourselves in miniature, symbolically and aesthetically proportioned to attract blessings from Heaven and Earth. They knew that the more closely a society was organized in accord with harmonious principles which sanctify the landscape and society, the better life would be and the longer the society would endure. To deviate from just balance was like creating a crack which widens into a more rapid downfall. Plato wrote in *Laws* (656-657) how the Egyptian priests had a canon of lawful proportions for music, dance and all the arts and architecture preserved in the state temples, which were the centers of government, science and education. All youth were exposed to this canon so they would learn to recognize and value its benefits:

"You will wonder when I tell you: Long ago they appear to have recognized the very principle of which we are now speaking—that their young citizens must be habituated to forms and strains of virtue. These they fixed, and exhibited the patterns of them in their temples; and no painter or artist is allowed to innovate upon them, or to leave the traditional forms and invent new ones. To this day, no alteration is allowed either in these arts, or in music at all. And you will find that their works of art are painted or moulded in the same forms which they had ten thousand years ago;—this is literally true and no exaggeration,—their ancient paintings and sculptures are not a whit better or worse than the work of today, but are made with just the same skill."

The world's landscape and its museums are strewn with remnants of cosmologically ordered societies. They're characterized by architecture modeling the universe in miniature. These include Buddhist stupas, the Halls of Light in Beijing and Hue, Christian cathedrals, Native American camps, tipis, lodges, hogons and kivas, megalithic structures on every continent, and the countless temples, tombs and monuments of Egypt and Africa, Greece and Europe, India, Asia, the Middle East and Americas. Each was designed using timeless geometric symbolism to tell the

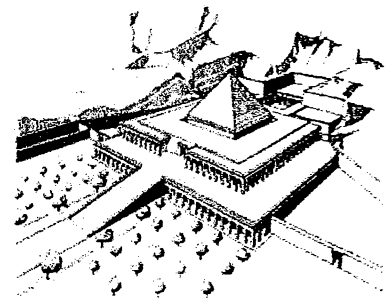
story of the culture's cosmogeny (creation story), cosmology (organization) and our sacred path through it.

But modern archaeological orthodoxy doesn't seem to believe that ancient cultures could think much deeper than a superficial sort of mathematics. It generally overlooks the depth and implications of the symbolic aspect of numbers and coherent dimensions found in the objects and sites studied. It's an intellectually fatal mistake to assume that the ancients were inexact in their mathematics and measures. It's clear that ancient cultures worldwide had deep understanding of numbers and their relations, but they didn't put into writing everything they knew, especially about sacred subjects. Instead, they consistently built their wisdom into the dimensions of their monuments which were repositories of their knowledge of number, harmony and wholeness.

By dismissing the intelligence, knowledge and insights of our ancestors we miss the opportunity to learn from them. World art and travel expose us to countless examples of the application of this canon of number and shape but we too often do not recognize what's before us, blinded by our belief that the ancients were generally primitive and incapable of such philosophical and mathematical accomplishments. But the proof of ancient achievement lies squarely in the numbers, measures and proportions of the works themselves.

A worldwide tradition of sacred monarchy (*monas* "one" and *arche* "foundation") occurs in many cosmologically ordered societies. The King, Emperor or Pharaoh was regarded as incarnation of the Sun deity, our enlightened self, surrounded by twelve powers represented by the constellations of the zodiac. The regent (from Latin *rex* "king", like *lex* "law") is a mythic figure traveling between Heaven and Earth whose role was to set boundaries and organize chaos into an orderly realm outside and within himself. Confucius saw the Emperor not as a tyrant but as the embodiment of a system of cosmic law represented by the symbolically organized court, regalia and ritual. Each coronation was also the New Year's Festival, considered a new beginning of cosmos, society and self, coinciding with a new beginning in nature, often the Vernal Equinox.

The initial actions of sacred kingship -- ascent to the throne and coronation with proper regalia -- have remained similar in ancient and modern cultures. All regalia is traditionally made with specially chosen materials, colors and proportions. They're actually cosmic symbols: the square-based throne represents the Earth below, and round crown or headress Heaven above. The garment or robes represent life and society, the mesocosm between Heaven and Earth, as seen in the star garment of the Persian king, feather mantle of the Hawaiian kings, and ornaments of Egyptian, Babylonian, African, Mayan and Chinese rulers. At the proper moment in the ceremony the king is handed the scepter, the staff or



Funerary temple of
MentuHotep

“Until philosophers rule as kings or those who are now called kings and leading men genuinely and adequately philosophise, that is, until political power and philosophy entirely coincide, while the many natures who at present pursue either one exclusively are forcibly prevented from doing so, cities will have no rest from evils,... nor, I think, will the human race.” Plato (*Republic* 473c-d)



The Egyptian deity Shu, wearing Ma'at's feather, separated Sky from Earth to make room for the world. He sits upon a square (Earth) throne, wears a round (Heavenly) head band, and holds an ankh ("life") symbol and a uas ("power") scepter, all designed with specific lengths and proportions.



England's Queen Elizabeth (ruled 1558-1603) holds the royal scepter and spherical globe, symbols of rule representing the Earth's mean diameter and cosmic axis on which the universe turns.



Darius, the Persian king, ruled 521-486 BCE

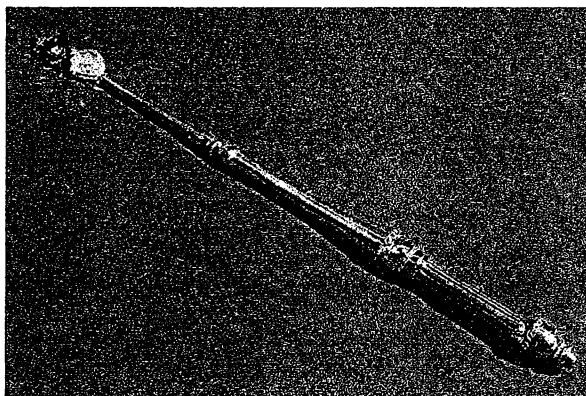
"Thy throne, O God, is for ever and ever: the scepter of thy kingdom is a right scepter."

-- Psalms 45:6

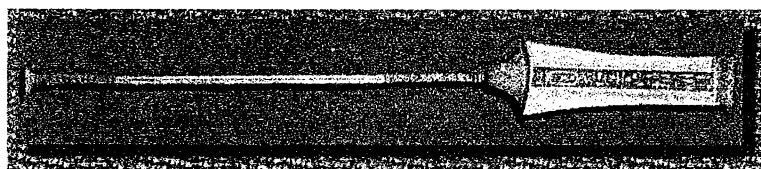
measuring stick through which the "rule" is carried out. That's why a king is called "ruler". He is holder of the standard of just cosmic measure by which authority he commands. This was true everywhere from the royal staff of the African *Akan* culture, called *Akyamepoma*, to the British royal scepter containing the world's largest diamond. Their sizes are not random or approximate but chosen to be very specific lengths, made with great precision. Staffs and scepters symbolized and functioned as the culture's measurement standard which was derived from a deep knowledge of the structural harmony of numbers and their latitude on Earth. The scepter represents the divine diameter of the universe around which all rotates, the cosmic pole, *axis mundi*, the Chinese "Great Ridgepole" which both separates and joins its zenith and nadir. It has also been symbolized as a divine lightning bolt and pillar of light around which all things turn in the cosmic amphictyony. The Divine Architect, like the good monarch of fairy tales, uses this standard to measure his realm and rule it with justice.

"When the royal scepter was coming down from heaven, the august crown and the royal throne being already down from heaven, he (the king) regularly performed to perfection the august divine services and offices, laid the bricks of those cities in pure spots."

-- The Eridu Creation Myth



"Then shall the Dean of Westminster bring the Sceptre with the Cross and the Rod with the Dove to the Archbishop. The Glove having been presented to the Queen, the Archbishop shall deliver the Sceptre with the Cross into the Queen's right hand, saying: 'Receive the Royal sceptre, the ensign of kingly power and justice'."



Scepter of Tut Ankh Amon

Theoretically, a wise and beneficent Monarch rules the realm and brings order to society in the balanced, just way that God rules Creation. Just as the Divine Architect's first act establishing the beautifully organized Cosmos is to establish bounds on the unlimited Chaos, the king too first measures, establishes and enforces the kingdom's boundaries. He announces the bounds of law and the proportions of justice, standardizes weights and measures, fixes the intervals of the musical scale, the sizes and subdivisions of money, medallions and emblems, the proportions of architecture and organs of government and societal structure into one organic whole. Until the Nineteenth century, Chinese examinations for potential government officials required a knowledge of astronomy, mathematics, calendrical studies, musical harmonies and awareness of their relation to proper governance. Any culture's cosmological vision, whether it's inspiring, unified and uplifting or depressing, divisive and dismal can be known by looking at whether the society is organized or fragmented. Ancient civilizations knew that their continuation depended on conforming as closely as possible with least friction to the beautiful order of creation. This way they attracted to themselves divine blessings proportional to their success in creating a heavenly paradise on earth. The lesson for us from the past is that real progress, creativity, prosperity, happiness and blessings come by aligning with eternal, changeless Truth.

Such demand for a standard and its just fulfillment can only be accomplished under certain conditions. It's not democratic -- everyone's ideas aren't equal here. There's strict discrimination between ideas which are constructive and those which are destructive to society and individuals, which are strictly forbidden. Today, people hunger for harmony but are so uneducated about real issues that if someone or a group claims to be able to lead based on an ideal standard, even the Cosmological Circle, it would invite tyranny and fascism. It would be too easy to fall into an ideological or theological tyranny or an atheistic communal state, each with their attendant unpleasant consequences. Such ideal rule is for a future era when the world is different and we experience revelation and a leap in consciousness -- a general "upwising". Only when the perennial wisdom blossoms again producing an enlightened populace and true "philosopher kings" ("those who love the sight of truth" [Plato, *Republic* 475c]) -- steeped in self-awareness, nature and mathematics -- will the Cosmological Circle's message again be understood and people live in accord with the principles of harmony and justice it demonstrates. Until then we can study and gain understanding in order to build into our psyche an image of the ideal that we can aspire to and live individually.

The Cosmological Circle diagram is a symbol of this ideal, comprehensive order. It's also a functional tool, a standard for organizing twelve parts into an harmoniously proportioned whole. Its proportions are found in its interplay of circles and squares, symbols of Heavenly perfection and Earthly approximation. Let's examine them.

"He fixed the borders, marked them off... My noble sister, the holy Nidaba, got the measuring rod, and tied about her arm the lapis measuring line, proclaims all the great measures, fixes the borders, marks off the boundaries, is now the scribe of the land."

--Sumerian Myth of Enki

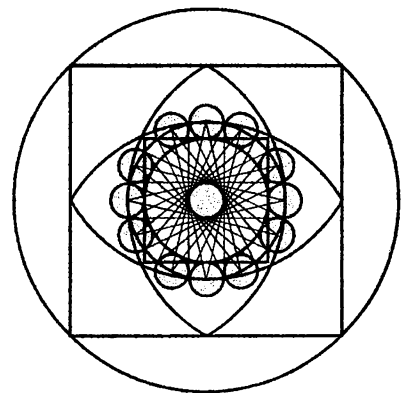


"The lawgiver must keep all these in view and charge all the citizens to hold fast, so far as they can, to this organized numerical system."

-- Plato (*Laws* 747a)

"... the superior man creates number and measure, and examines the nature of virtue and correct conduct ... the backbone of morality."

-- *I Ching*, 60, "Limitation"

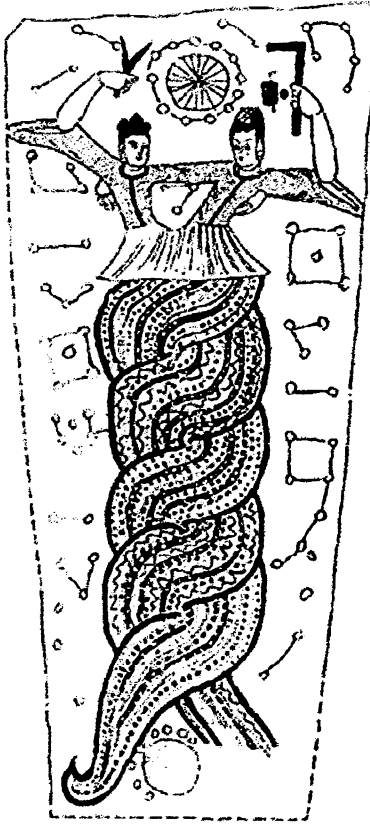


Geometer's Heaven and Earth

Circle and Square

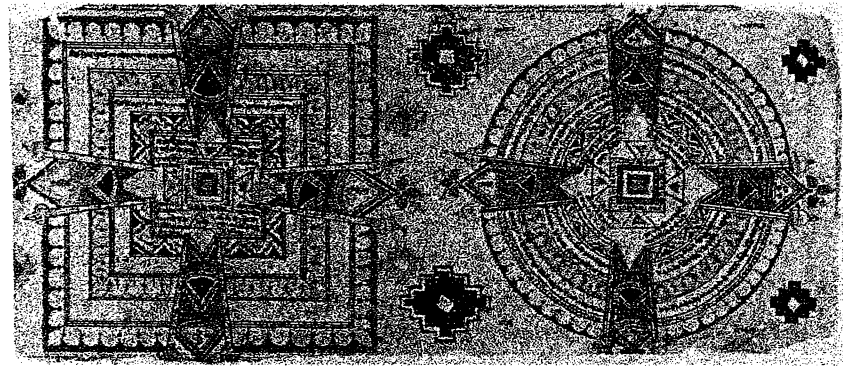
A quick glance at the Cosmological Circle diagram (page 6) shows that it's composed of simple shapes including circle, square and other polygons which appear in the natural world. Of interest for our philosophical consideration are circle and square. The square is not the circle's opposite since they don't combat or compete with each other. Rather, they're complements expressing different archetypal principles, the interdependent poles of Heaven and Earth, the eternal ideal and its transitory approximation, the Platonic Worlds of Being and Becoming.

The Chinese phrase *kuei chü* literally means "compass and square" but it's used colloquially to mean "the way things should be," the ideal standard against which everything between Heaven and Earth may be measured. These tools construct the circle and square and represent them.



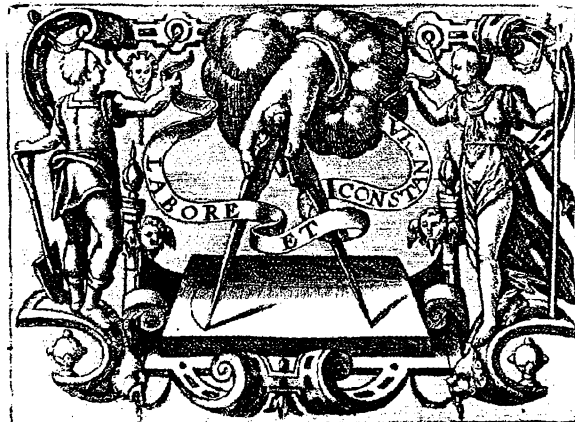
Chinese Astana Banner
(T'ang dynasty)

Fu Hsi and his wife *Nu Kua*, the Chinese "Adam and Eve", hold the compass and square aloft as their serpent bodies entwine. He holds the compass pointing up because he rules the roundness of Heaven. She holds the square and plumb-bob because she rules the square Earth below. It is from the marriage of polarity, of Heaven and Earth, round and square, male and female, *yang* and *yin* that all creation comes.



Mandalas of the Jain Cosmos: Square Earth and Circle of Heaven

From the interplay of circle and square, Heaven and Earth, ideal and actual, transcendental and rational, the Divine Architect constructs bounds, order and measure to transform the unlimited, undefined, measureless chaos into the consecrated space of cosmos. Sacred architecture is this consecrated space in miniature. Let's first consider the circle.



Engraving by DeCruce

The Heavenly Circle

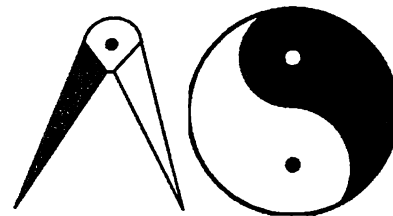
When closed, the geometer's compass represents the single cosmic axis around which the universe rotates. When open, even the slightest amount, polarity is called into the world and the rhythmic creating process begins. The compass is symbol and tool of the Great Unity which creates through the interplay of complementary poles.

With compass closed, fix a point on paper, the center of the universe. Then open it and plant the other leg on the paper. Turn a circle. Notice that while one leg remains unmoved, fixed at a single point, the other leg moves around marking out a circle of infinitely many points. This is the way of *Tao*, the interplay of polarities, of complements *Yang* and *Yin*, sunshine and shadow, stillness and motion, positive and negative, within and without, one and many, expansion and contraction, active and receptive, male and female: two principles working together to generate everything else.

With his compass, the Divine Scepter, the standard measuring rod of creation, the Divine Architect first fixes the single cosmic center. He traditionally opens the compass and turns the cosmological circle which will contain all else. Using analogs of the Divine Architect's tools — the compass divider and unmarked ruler — artists, craftspeople and architects worldwide designed sacred objects using number and geometry, to sanctify their environment, feeling that they were doing divine work upon earth. This was certainly true of the Gothic Cathedral and temple designers, and other communities of builders who were inspired by nature and mathematics to design this way everything from pottery to nations. When we do geometric constructions with these tools and a meditative mind we have the opportunity to observe the ordering process by which the Divine Architect bounded chaos to let cosmos flourish.

The mystery of the circle is that it is both a whole and a hole — at once full and empty — Zen symbol of the totality of cosmos as well as its source in voidness.

Upon quiet chaos the Divine Architect traditionally constructs one all-encompassing circle of the universe, inaugurating a period of cosmic activity. The circle is the womb of potentiality, the cosmic egg from which the beautiful, ordered universe is born, the space in which geometric shapes may be constructed to reveal its order. But after vast cycles within cycles of unimaginable time, the orderly whole will dissolve back to its central point and chaos, the quiet standing wave from which it began before Time, repeating the cycle of chaos and cosmos in endless rhythm.



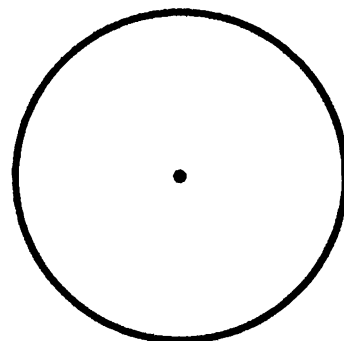
Geometric dividers and the famous *Tai Chi* symbol both represent the identical principle of "unity creating through polarity".

"Every 'point' is an event embryo."

-- R. Buckminster Fuller

"God makes himself known to the world. He fills up the whole circle of the universe, but makes his particular abode in the center, which is the soul of the just."

-- Lucian (c 240-312, Christian theologian)



Plato in *Timaeus* (34a) described the Divine Architect's first construction this way:

"For movement He assigned unto [Kosmos] that which is proper to its body, namely, that one of the seven motions [forward, back, right, left, up, down, center] which specially belongs to reason and intelligence; wherefore He spun it round uniformly in the same spot and within itself and made it move revolving in a circle; [...] And in the midst thereof He set Soul, which He stretched throughout the whole of it, and therewith He enveloped also the exterior of its body; and as a Circle revolving in a circle He established one sole and solitary Heaven, able of itself because of its excellence to company with itself and needing none other beside, sufficing unto itself as acquaintance and friend."

"All the works that the good God has created go around in a circle and are perfect, returning from whence they have come."

-- John Dastin (14th century alchemist)

Without any identifiable beginning or end, like the *ouroboros* snake with its tail in its mouth, a circle is everywhere associated with eternal affairs, symbol of Heaven and the spiritual realm. In architecture this was traditionally honored by circular hearths, round temples and domed structures. The Babylonian word for "circle", *shar*, was also their word for the entire universe.

In constructing this furthest horizon the Divine Architect created the most practical and efficient shape enclosing the greatest area by the shortest boundary. The circle is a sacred boundary which cannot be crossed, the ultimate "ring-pass-not" demarcating the cosmic precinct. Reminiscent of the circle as a magical boundary are traditions of protective jewelry in the form of circular necklaces, bracelets, rings and belts. In many traditions, passing through a circle like a traditional Chinese doorway is said to remove evil spirits. Likewise, walking through the rounded opening of a triumphal arch is an honor accorded heroes to celebrate outstanding achievement.

On a 'flat plane' (which is an Idea and can't actually exist in the World of Becoming) the circumference of an ideal circle is everywhere equidistant from its center. In three-dimensions, the surface of an ideal sphere is also everywhere equidistant from its center. Thus, circles and spheres are worldwide symbols honoring equality, as when people sit together around a circular campfire or conference table, as opposed to hierarchical rows. Traditions as diverse as the philosophy of Plato and religions of Native America consider the universe to be a sphere, symbol of perfection, equality and fairness to all in the cosmic amphictyony.

The Divine Architect turned his compass and set the circle of cosmos spinning. Its roundness has always seemed obvious to anyone



Dante and Beatrice in *Paradiso* gazing transfixed at the concentric circles of the heavenly host around the divine center of the cosmic amphictyony.

-- Engraving by Gustav Dore

observing the motions of the heavenly vault, the *apparent* path of the sun and nightly rotation of stars and planets. For untold millennia the sky's circle reminded people of the world's perfection, goodness and divine embrace. As wheels within wheels, celestial cycles drive the seasonal rhythms of the environment, plant, animal and human life. Even technology requires complete cycles, as obvious as the working of a water wheel or hidden as electrons making the rounds in the circuit (Latin *circus* "ring") of an electronic gadget.

Most mysteriously, in the circle's diameter and circumference the Divine Architect fused in one shape the rational and transcendental. That is, when a circle's diameter is a rational number (a simple ratio of two numbers) its circumference *cannot* be rational. And when the circumference is a rational length, the diameter cannot be. Their relationship is not merely an irrational one, but a special case called "transcendental" by mathematicians. This means that the relationship of circumference and diameter isn't expressible by any finite equation having rational numbers as coefficients. Of course, this transcendental relationship between straight and curved is known as "pi", the longest known-about natural constant. (Another famous transcendental number is "e", the logarithmic path of natural growth and decay. The Golden Ratio, "phi" is *not* a transcendental number since it can be expressed as a simple algebraic equation.)

A true circle's circumference is always 3.14159265358979323... times its diameter. Its neverending digits revealing no regular pattern. But there are no "true" circles except as an idea. No circle we draw, no matter how exact, can ever equal the eternal ideal of a circle which has no thickness and perfect curvature everywhere equally distant from its center. Pi's infinite fullness belongs to the eternal world of Being, not the earthly realm of approximations. No one has really ever drawn or even seen true circles but only their approximations in this world of Becoming. In such cases, approximations of pi can be appropriate. For example, the Earth isn't a true sphere but bulges at its equator, so in for some measurements pi can be approximated as 22/7 (= 3.142857...).

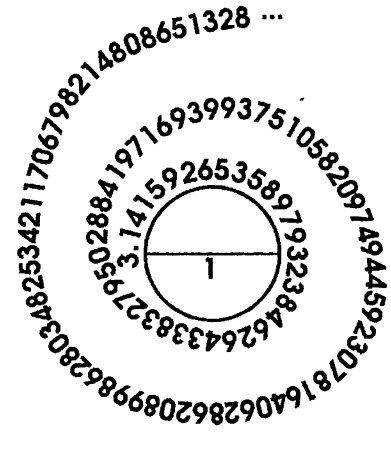
In their primordial appearance and perfection the circle and sphere have been worldwide symbols of that which is transcendent, ideal, perfect and spiritually enlightening.

The construction of the Cosmological Circle diagram begins as this circle whose area equals the numbers one through twelve multiplied together. The next step is to recognize the four cardinal directions and inscribe a square in the circle.

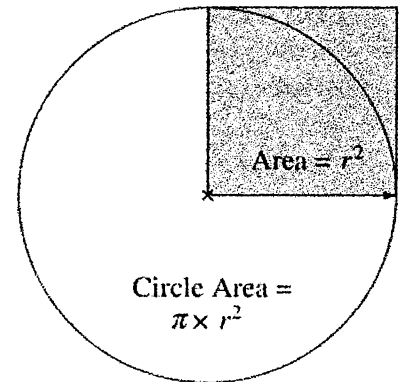
"The Heavens are round in shape like an open umbrella, while the earth is square like a chess board."

"Everything an Indian does is in a circle, and that is because the power of the world always works in circles, and everything tries to be round."

-- Black Elk (1863-1950)



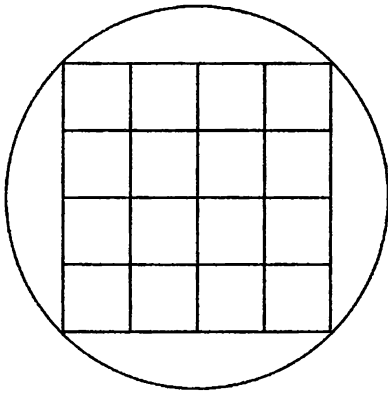
A circle's diameter, circumference and area represent the limited and unlimited, the rational and transcendent in one body.



The area of any circle equals pi times the area of the shaded square:
Area = pi x radius squared

-- Chinese book *Chin Shu*, 644

The Earthly Square

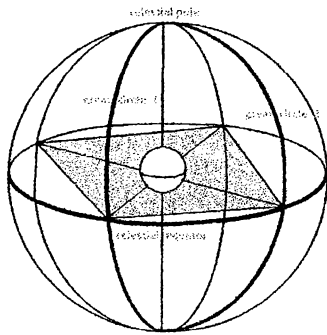


Earthly Square

A 4x4 square is the only one to have the same number for its perimeter and its area.

"And after these things I saw four angels standing on the four corners of the earth, holding the four winds of the earth ..."

-- Revelation 7:1 (King James Version)

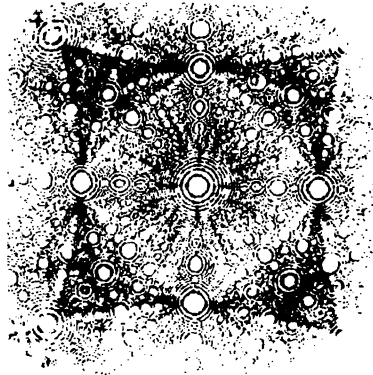


"Although God himself delights in the odd number of the Trinity, nonetheless he unfolds himself profoundly through the quadrinity in all things: thus he finally enters the physical for the sake of its comprehensibility."

-- Giordano Bruno, *On The Monas*

The square is the first shape to have distinct, crossing diagonals. (A triangle's sides *are* its diagonals.) With its four equal sides and right-angle corners the square has come to represent what is "earthly", transitory, rational, sensible, material, and three-dimensional, succinctly symbolized by "earth". Even though we know that planets are round we still hear reference to "the four corners of the world". This refers to the four natural cardinal directions: the east-west path of the sun crossed by the north-south of Earth's axis. In familiar terms it's the orientation of our body to the front, back, right and left. When we stand with our two feet slightly apart they become two sides of our square on the earth. It was not unusual for kings, like the Sumerian *Naram-Sin*, to assume the title "king of the four quarters of the Earth". Many mythologies describe the sky as held up by four pillars, giants or trees situated at the world's four "corners". Modern sports playing fields and square board games (whose ancient origins were divinatory) represent the symbolic playing field of "earthly" battles. We find reference to the square as symbol of all that is mundane throughout worldwide mythology, religion, fairy tales and folklore. The sciences of molecular chemistry and crystallography know the square and cube as major molecular forms. The four states of matter (solid, liquid, gas, plasma) were called by ancients the "four elements" (earth, water, air, fire). See Chapter Four of *A Beginner's Guide To Constructing The Universe* for much more about this.

Now that we've established the circle and square as symbols in our geometric metaphor, we can observe how they interact. In what ways can the circle and square, as the cycles of time and directions of space, the transcendental and rational, the creative and receptive, the strong and mild, work together?



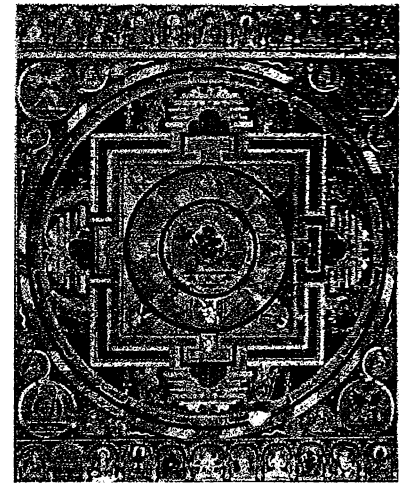
Tungsten crystal.
Each circle is an atom.



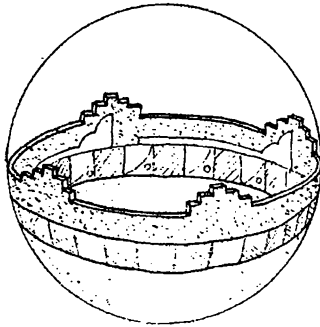
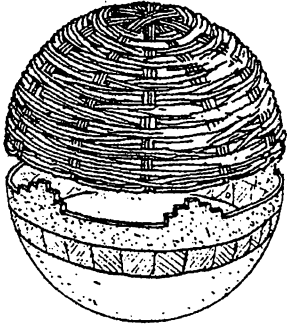
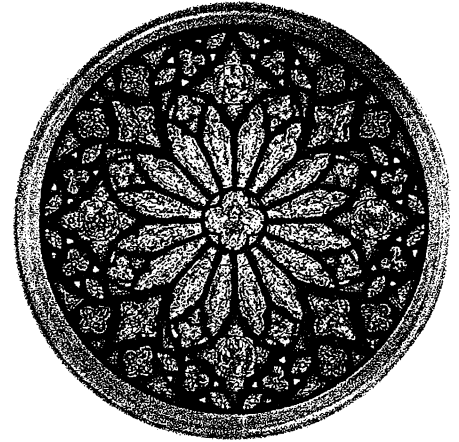
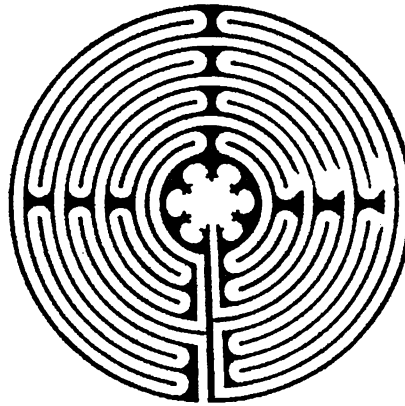
Cave paintings of Lascaux, France from twenty thousand years ago clearly show square blazons, each of its cells a different color, beneath the animal's feet.

Heaven And Earth Together

All that occurs in the rhythms of cosmos is due to the interplay of Heaven and Earth. It resembles the tension created between two ends of a taut string which vibrates to produce sound waves and even music. Nothing happens anywhere until complements interact and then all else flows out. In the geometric symbolism of sacred traditions, the various ways circle and square combine have been depicted around the world in a variety of *ad quadratum* designs, the fourfold circular designs of mandalas, labyrinths, rose windows and much more. Notice the ways that circles and squares interplay in these well known examples.

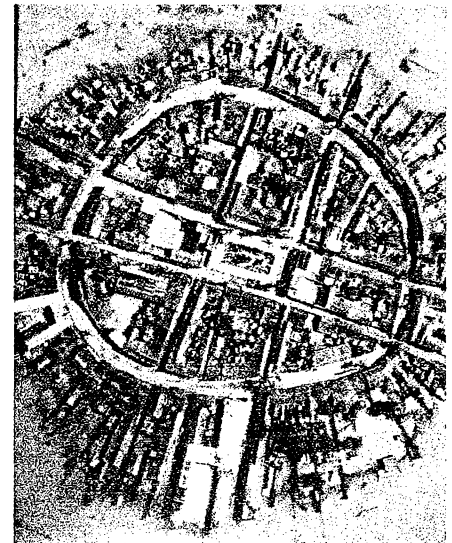
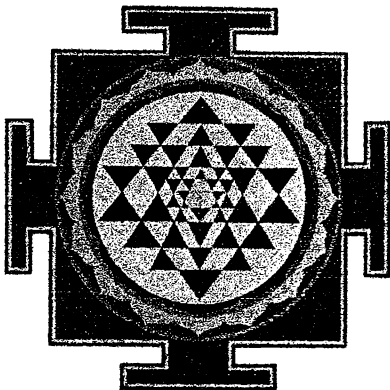


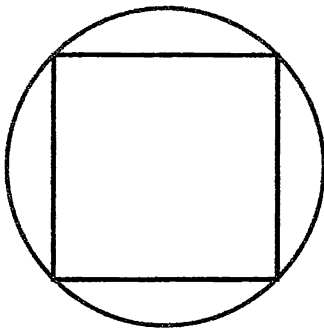
THE LABYRINTH OF CHARTRES



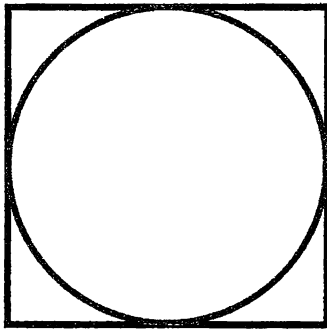
Sky-basket (top) and earth-bowl (bottom). (Drawing: Jeremiah Iova.)

Earth-bowl. (Drawing: Jeremiah Iova.)





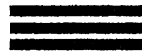
The circle is around or "above" the square within or "below" it. But "above" or "higher up" really means "deeper within".



The square is around or "above" the circle within or "below" it.

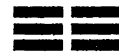
The simplest relationship between circle and square occurs when one is inscribed within the other. A square inside a circle may be considered below the circle. The heavenly circle naturally belongs above the earthly square since this is how the world seems to us: sky above, earth below. But in art and philosophy we sometimes find the reverse, the heavenly circle below or within the earthly square. We can understand this reversal in terms of symbolism.

A fine clue comes in the Chinese text *I Ching* (*Book of Changes*) with the meaning of *kua* 11, called *T'ai*, "Peaceful Prosperity And Harmony". It's comprised of the three broken lines of the trigram of Earth, *K'un*, placed atop the three solid lines of the trigram *Ch'ien*, Heaven, in reversed positions from what seems natural. But since the tendency of Earth is to sink downward like a stone, and Heaven to rise upward like a bubble, these two complements move toward each other, infusing and bringing about conditions called "Peaceful Prosperity and Harmony".



Ch'ien
Heaven
"The Creative"

First trigram of the *I Ching*, the strong, active, primal creative power of Heaven, motion and time.



K'un
Earth
"The Receptive"

The second *kua* of the *I Ching* symbolizes Earth, devotion, mildness and primal receptive powers.

T'ai

"The small departs, the great approaches.
Good fortune. Success."

"In this way heaven and earth unite, and all beings come into union. Upper and lower unite, and they are of one will. The light principle is within, the shadowy without; strength is within and devotion without; the superior man is within, the inferior without. The way of the superior man is waxing; the way of the inferior man is waning."

-- *I Ching* (commentary)



T'ai
"Peaceful Prosperity and Harmony"

Earth is above, sinking;
Heaven is below, rising.
They intermix resulting in "Peaceful Prosperity and Harmony"

"The general who is skilled in defense hides in the most secret recesses of the earth: he who is skilled in attack flashes forth from the topmost heights of heaven."

-- Sun Zi Sun Tzu, *The Art of War* (c 500 BCE)

This reversed order, square above circle, earth above heaven, is also the symbolism behind the graduation cap or "mortarboard", the official academic headdress of universities. A square (or double-square) "nimbus" or halo is above a round hemisphere or cylinder. As the mortarboard's square symbolically sinks and the circle rises, they blend to indicate that its distinguished wearer has mastered the knowledge of Heaven and Earth and has attained their wisdom. The cap appeared as an honor in western Medieval educational traditions around the fifth century. But it appeared much earlier as the double-square headdress of China's wise legendary Yellow Emperor.



Like everything else, when "Peaceful Prosperity and Harmony" ripens and reaches its natural limit it transforms into its opposite, the next *kua* 12 called *P'i* or "Standstill". It's symbolized by the three solid lines of Heaven *above* the three broken lines of Earth. Rising and sinking from their natural positions, Heaven and Earth don't interact but move further apart. Named "Standstill", nothing constructive occurs.

"Evil people of the time of Standstill do not further the perseverance of the superior man. The great departs; the small approaches. Thus heaven and earth do not unite, and all beings fail to achieve union. Upper and lower do not unite, and in the world, states go down to ruin. The shadowy is within, the light without; weakness is within, firmness without; the inferior is within, the superior without. The way of the inferior is waxing, the way of the superior is waning." -- *I Ching* (commentary)

This is the symbolic significance of the Chinese wine vessel having a square base below and circular rim above: heaven is in its proper place above and earth rests below. When the vessel stands upright, circle and square are in their natural relationship so nothing occurs: standstill. It's only when the order is reversed, when the vessel is tipped and square earth is brought above the rim of heaven that they interact and wine flows out.

"The Tao ("Way") is great.
The universe is great.
Earth is great.
Man is great.
These are the four great powers.

Man follows the earth.
Earth follows the universe.
The universe follows the Tao.
The Tao follows only itself."
-- *I Ching*



P'i
"Standstill"

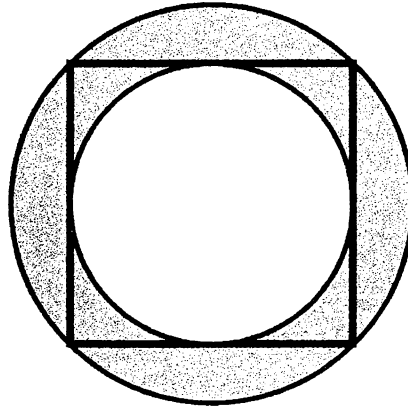
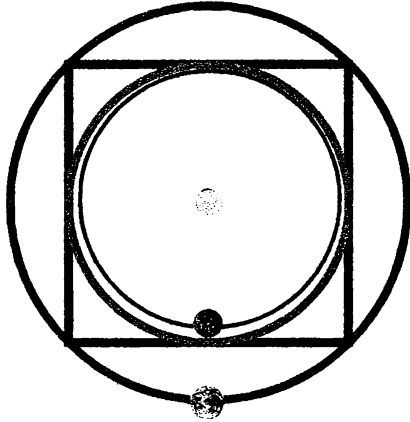
Heaven already above, rises further; Earth already below, sinks further. With no interplay between them, events are stagnant.



Square Mediates Between Circles

The mean orbits of Venus and Earth around the Sun conform with 99% accuracy to the ideal proportion defined by the square mediating between two circles.

(After John Martineau)



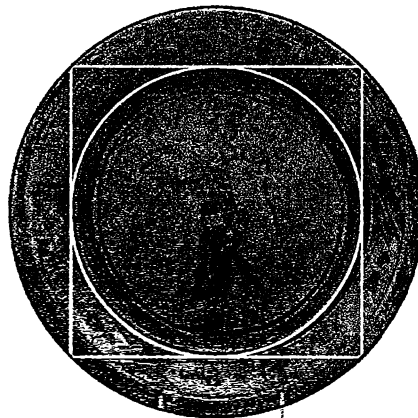
When a square mediates between circles, the area of the inner circle is precisely half the area of the whole circle. Thus the area of the inner circle and the dark ring around it are equal. The square separates a circle into equal areas.



This particular geometric relationship defined by a square between two circles was widely used to proportion sacred art. Consider the following designs from different cultures. In each of the ancient plates below (and modern seal, left) the area of the central scene or *tondo* is exactly equal to that of the band surrounding it, or half the entire circle's area. This creates an aesthetic balance without calling attention to it. Such polygonal proportioning with triangles, squares, pentagons, hexagons and even heptagons was commonly used by artisans around the world to compose their works, very well aware that such mathematical relationships result in visual pleasure whether the viewer is familiar with geometry or not.



Greek plate

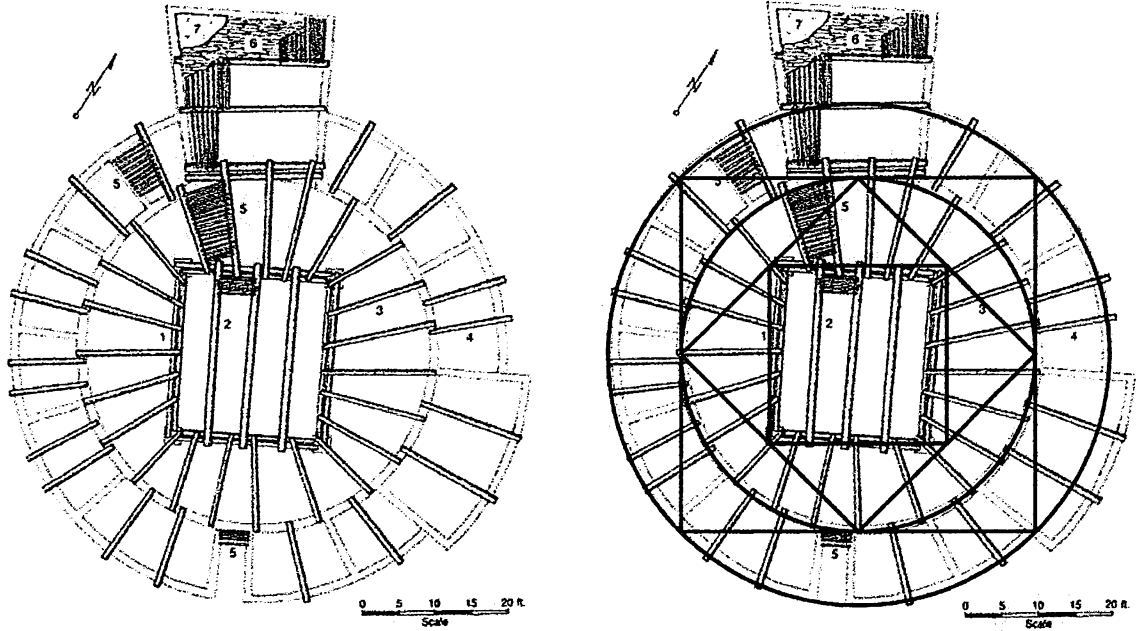


Mayan plate

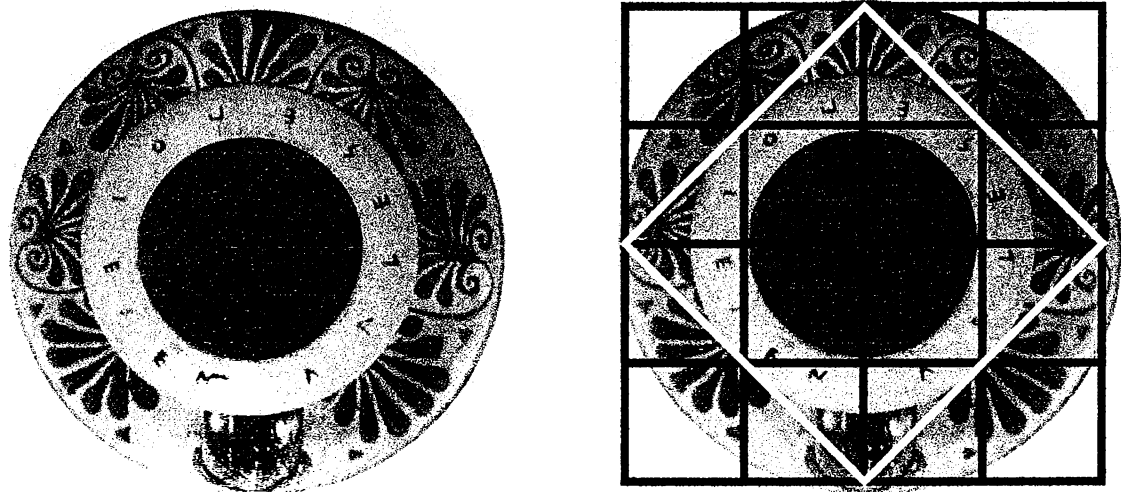


Michelangelo plate
"The Holy Family"

Such geometric relationships have appeared for aesthetic and symbolic reasons in every culture since the cave painters of twenty thousand years ago. It appears often in sacred architecture, found here in the design of a large, rebuilt circular wooden roof of the Native American "Great Kiva" or underground ceremonial chamber from Aztec, New Mexico, but common throughout the southwest. The concentric hoops framing the roof are separated by an invisible square symbolically balancing earth between heaven above and below it. Another square within defines the corners of the central square door.



In this Greek vase (seen from above) we see the three concentric circles of its shoulder, lip and mouth. Unseen squares between them determine their sizes. The areas of the hole and the white band are equal, and together equal the area of the shoulder band around them.



When we observe the square mediating between circles in the Cosmological Circle diagram we'll know that it's creating a balance between them.

Squaring The Circle

Pursuing the Impossible

Now we come to the most interesting relationship between the circle and square called the "squared circle", where a circle and square have the same perimeter or same area. This is important to the construction and proportions of the Cosmological Circle since a squared circle sits at its core.

"It is easier to square the circle than to get round a mathematician."

-- Augustus de Morgan
(Mathematician, 1806-1871)

Meton: "With the straight ruler I set to work to make the circle four-cornered."

-- Aristophanes (Greek playwright, c444-380 BCE)

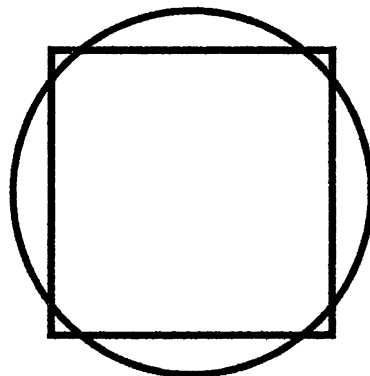
Considering the diverse natures of the circle and square, one with corners and the other none, can they ever be equal to each other in either perimeter or area? Is precise equality between circle and square, Heaven and Earth, the eternal and transitory, the transcendental and the rational ever possible? The circle glides around in a curve while the square marches along straight edges. Can these ultimate complements ever be reconciled and found equal? Heaven and Earth may approach each other, retreat, enclose and expose each other, but can they ever be precisely equivalent?

The attempt to reconcile Heaven and Earth is not new to theologians or to mathematicians. Called the "quadrature" or "squaring" of the circle, the challenge is to construct a circle and square which have equal areas or equal perimeters. Squaring a circle is like holding two opposing ideas at the same time. It's associated with two other classical problems from ancient Greece: doubling the volume of the cubical altar at Delos while maintaining its shape; and trisecting an angle, dividing it into three equal angles. These tasks may seem deceptively simple but the restriction is that they must be done using only analogs of the tools which the Divine Architect used, the unmarked ruler and compass dividers.

Squared Circles

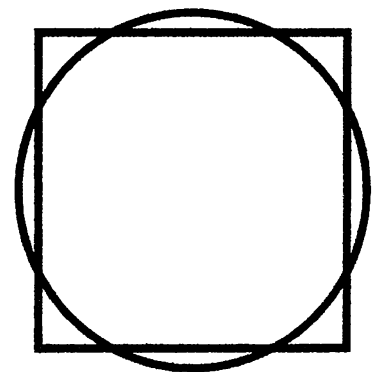
"Mine hand also hath laid the foundation of the earth, and my right hand hath spanned the heavens: when I call unto them, they stand up together."

-- Isaiah 48:13



Equal Perimeters

The perimeter around the square *virtually* equals the circumference around the circle.



Equal Areas

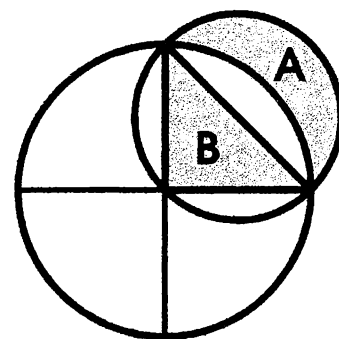
The area within the square *virtually* equals the area within the circle.

The earliest recorded attempt to "square the circle" as a mathematical problem comes from one of Egypt's oldest surviving mathematical writings, the Rhind papyrus, written around 1650 BCE by the scribe Ahmes who copied a document 200 years older. Some experts believe that it's based on a work going back to 3400 BCE. It's a scroll about 18 feet long and 13 inches wide and its 84 problems are written on both sides. It begins "*Correct method of reckoning, for grasping the meaning of things and knowing everything that is, obscurities and all secrets.*" It gives a rule for constructing a square whose area is nearly equal to that of a circle. The rule is to cut $\frac{1}{9}$ off the circle's diameter and to construct a square on the remainder. It yields a quite good approximation of pi, 3.1605, rather than 3.14159....

The quest for the squared circle was taken up by Anaxagoras of Klazomenae (c500- c428 BCE) the Greek philosopher remembered for his astronomy, including his discovery of the true cause of eclipses as the shadows of Earth and moon. He wrote on squaring the circle to pass time while in prison where he had been deposited for asserting that the sun was not a deity but a huge red-hot stone as large as Peloponnesus, and that the moon borrowed its light from the sun. He never found a definitive solution for "squaring the circle" but got the ball rolling for a number of mathematicians who worked on this problem over the centuries.

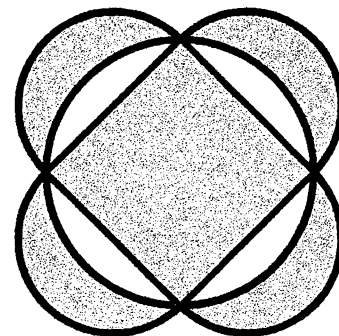
It seems to have been a rite of passage for mathematicians to attempt the challenge. Hippocrates (460-c377 BCE) raised great hope when he discovered that curved sections of circles called "lunes", named for their crescent moon shape, are equal in area to the triangle half of a square. But this doesn't complete the task (see right).

Mathematicians have subsequently found ways to "square" other shapes including the regular pentagon, but squaring the circle remained elusive. Renowned mathematicians sought solutions and failed. Leonardo da Vinci, who often thought about mathematics in a very mechanical way devised mechanical methods to square the circle in 1505, the same year he studied the flight of birds and designed flying machines. But no one could actually find a geometric method using only compass and unmarked straightedge to rigorously reconcile the circle and square either by area or perimeter. Even to this day a remarkable succession of amateurs claim success, but no one's proof has stood up. Among those caught in an incorrect proof were Hippocrates himself and the philosopher Thomas Hobbes. By 1775 the Academie Française refused to consider any more attempts from "circle squarers", a term still derisively applied to anyone who obsessively attempts the impossible. The mania to square a circle has so affected some of its seekers that it was suggested by the mathematician De Morgan that an illness motivated them called *Morbus Cyclometricus* ("deadly circle measuring"). He also suggested that St. Vitus be made the patron saint of circle-squarers, a reference to "St. Vitus'



Hippocrates discovered that the area in the curved "lune" (A) equals the area of the triangle (B).

The total area of the four lunes outside the circle (below) equals the area of the square inscribed within it. But this does not yet "square the circle" because while the lunes are rounded they don't make a full circle. This pattern appears often in floor tiles and church windows.



"We have compared the probability that an unknown savant has solved the problem with the probability that there is one madman the more on the earth. The latter appears to us the greater."

— The French Academy, in explaining why it would accept no more memoirs on circle-squaring.

"Mad Mathesis alone was
unconfined,
Too mad for mere material
chains to bind,
Now to pure space lifts her
ecstatic stare,
Now running round the circle
finds it square."

-- Alexander Pope (1688-
1744, *The Dunciad*: Book IV,
31-34)

"Like a geometer wholly
dedicated to squaring the
circle, but who cannot find,
think as he may, the principle
indicated -- so did I study the
supernal face. I yearned to
know just how our image
merges into that circle"

-- Dante (*Paradiso* Canto
XX. See illustration page 25)

dance", a wild leaping dance in which people screamed and shouted in a kind of mass hysteria.

While no attempt achieved the goal, its appeal still remains strong because the solution always seems tantalizingly close, with eternal fame and glory assured for its victor. Intense interest motivated the energetic search for solutions to the three classical problems of antiquity, profoundly influencing mathematicians over the centuries, leading to many geometric discoveries about the conic sections, cubic, quartic curves and transcendental curves, portions of the theory of equations concerning rationality, algebraic numbers and group theory, all topics which delight mathematicians but leave the uninitiated gazing blankly.

Quite remarkable were the ruler and compass constructions of the mathematical prodigy Srinivasa Ramanujan (1887-1920). In the *Journal of the Indian Mathematical Society* in 1913 in a paper named "Squaring the Circle" Ramanujan gave a construction which was equivalent to giving an approximate value of 355/113 for pi (used by the ancient Chinese) which differs from the ideal value only in the seventh decimal place. He ended his paper with the following: "If the area of the circle be 140,000 square miles, then [the side of the square] is greater than the true length by about an inch." Very close, but never exact.

The answer to the question about whether it's even possible to square a circle, or circle a square, requires knowing about π (the Greek letter *pi*). As was noted earlier, pi doesn't actually represent a number but describes a *relationship*, the eternally fixed relationship between what is curved and what is straight, the circle's circumference and its diameter. Some very thorough books have been written about the history of our growing awareness of π .

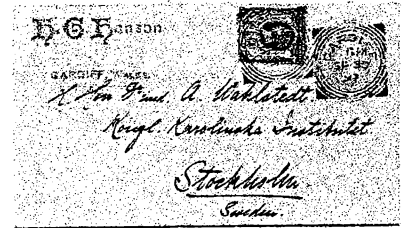
The final, definitive solution to the problem of whether a circle and square can be made precisely equal using only straightedge and compass came in 1882 when the mathematician Ferdinand Lindemann proved that π was not merely an "irrational" number (one which cannot be expressed by a whole number ratio) but it was "transcendental" (it's never the root of any ratio or polynomial equation having rational coefficients; that is, it can't be expressed as a simple algebraic equation). True pi reaches for the infinite and never fully engages with things mundane and rational. The transcendental and rational, Heaven and Earth, can approach each other but cannot, by definition, fully meet, as they shouldn't. No ruler and compass construction can truly square a circle. When the Divine Architect separated Heaven and Earth it was permanent.

The use of the word "transcendental" in both mathematics and religion is an interesting overlap. In both cases it implies a passing or traveling beyond normal constraints to a state undefinable in the usual

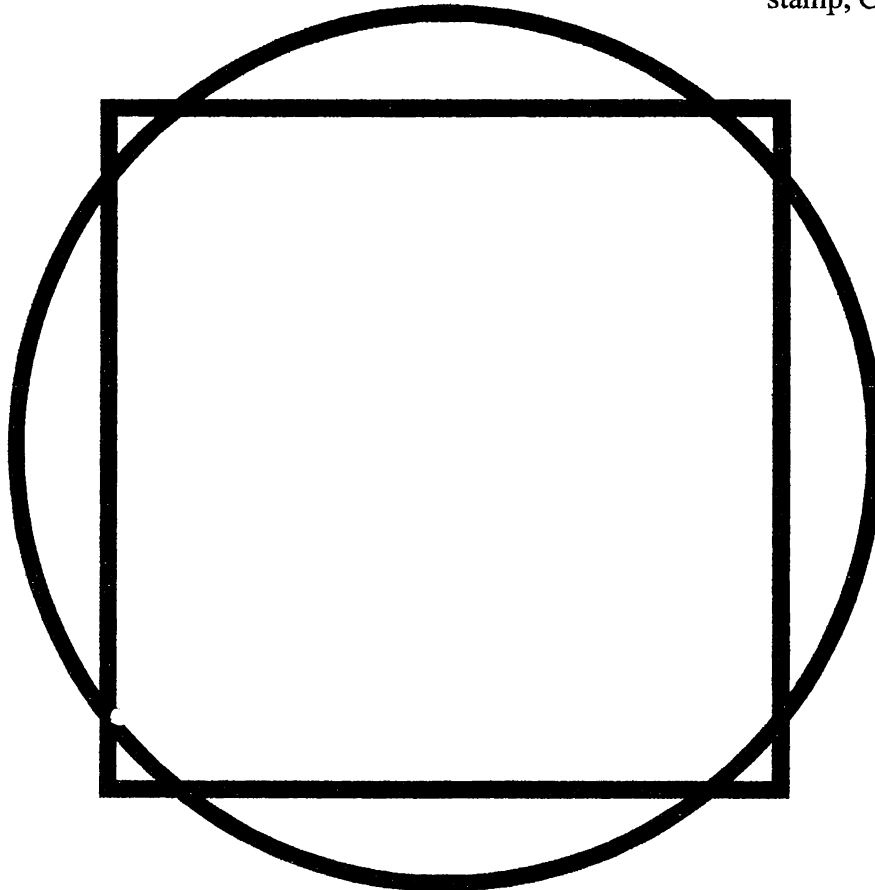
terms. The transcendent exists beyond the bounds of the rational and within the sacred (from the Greek *sacer*, "separated, reserved, taken out of normal usage, beyond the usual bounds").

While a reconciliation of the transcendental circle and rational square cannot be accomplished with perfect mathematical exactitude, nothing stops anyone from constructing a *very nearly equal* semblance, as Ramanujan did. Various constructions exhibit different degrees of precision. Approximations of the squared circle have long been intentionally applied to the designs of sacred arts, crafts and architecture throughout the world for practical and symbolic reasons.

In the timeless language of geometric symbolism the squared circle represents the marriage of complementary principles, the *yang* and *yin* interplay, cycles of time woven with the spread of space by which cosmos is known. A "squared circle" says "Heaven and Earth, the ideal and actual, *meet here*". It's a passageway between them, and so is appropriate for sacred designs from mandalas to monuments.

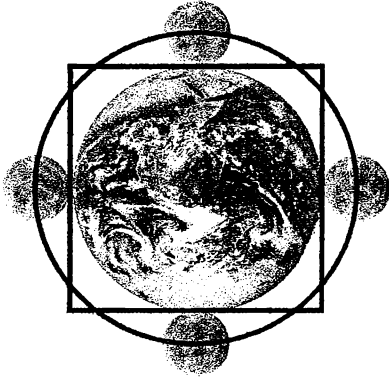


"Squared Circle" postage stamp, Cardiff 1881-1904



Squared Circle (by perimeter)
Look, and get a feel for it.

Earth And Moon Square the Circle



**Mandala of
the Earth and Moon**

Turn a circle to show the path taken by the center of the moon as it would roll around the Earth. Use simple geometry to add moons in all four directions around the Earth to create this squared-circle mandala.

An interesting example of the squared circle (by perimeter) relationship occurs with the ratio of the sizes of the Earth and moon. Although the moon is roughly thirty Earth-diameters away from Earth, imagine it brought down and placed directly *upon* the Earth to roll around the planet. It's this arrangement which leads to a squared circle of equal perimeters.

Look at this picture (below) of a square circumscribed around the Earth. Place your compass point at the center of the Earth and bring the pencil point to the center of the moon. Turn the compass to show the circular path taken by the center of the moon as it would roll around the Earth. Notice how this circle cuts the corners of the square. This construction virtually squares the circle, but how closely?



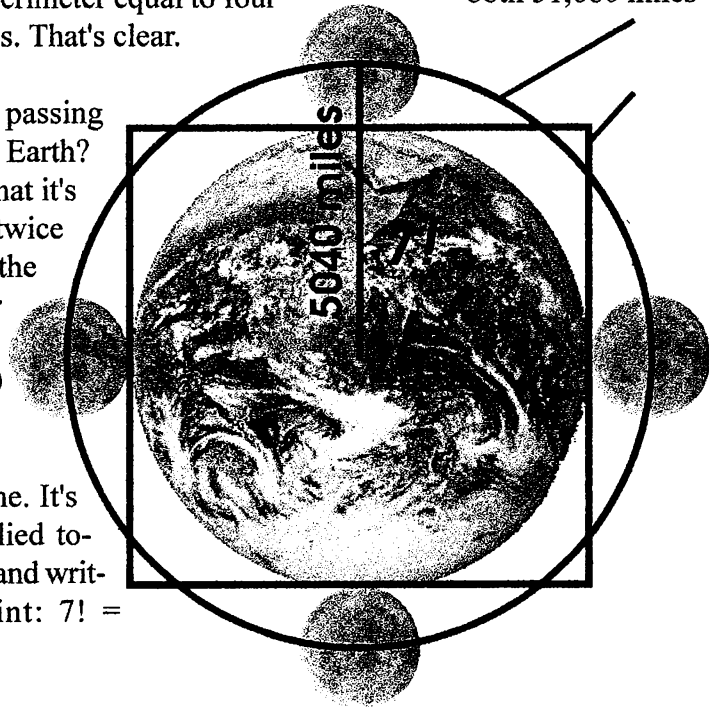
We know that the polar diameter of the Earth is 7920 miles, and the diameter of the moon is 2160 miles. They're in relation as eleven is to three. (There will be more about these numbers in the book's final section.) A square drawn around the Earth has a perimeter equal to four times Earth's diameter, or $4 \times 7920 = 31,680$ miles. That's clear.

When pi is rationalized as $22/7$, square and circle are both 31,680 miles

What is the circumference of the circle passing through the center of the moon rolling around the Earth? The formula for a circle's circumference tells us that it's equal to pi times the circle's diameter, or pi times twice its radius. This Moonpath circle's radius is simply the radius of the Earth plus the radius of the moon, or

$$\text{Radius} = 3960 \text{ miles} + 1080 \text{ miles} = 5040 \text{ miles}$$

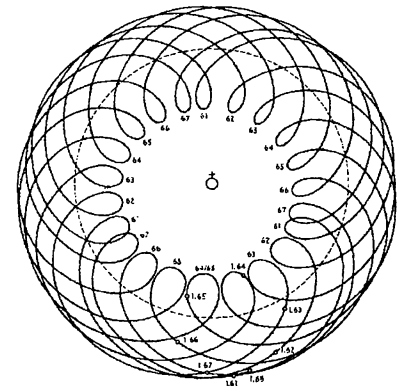
This number 5040 is a very interesting one. It's equal to the numbers one through seven multiplied together, called by mathematicians "seven factorial" and written as a 7 followed by an exclamation point: $7! = 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 5040$



5040 also equals the numbers seven through ten multiplied:

$$5040 = 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 7 \times 8 \times 9 \times 10$$

Since Earth and moon are part of the changing World of Becoming, their circumferences aren't ideal circles but approximations. So using the ideal value of pi wouldn't give an accurate measure for them. Thus it's appropriate to use an approximation of pi to find their circumferences. In this case, we'll approximate pi with the long-known ratio of $22/7 (= 3.142857\dots)$ inscribed in the night sky over time as the flower of Mercury's retrograde pattern (seen right).



Ancient observers of the night sky noticed that the planet Mercury appears to make about three retrograde loops annually (see page 16) or twenty two loops in seven years, just as pi is approximated by $22/7$.

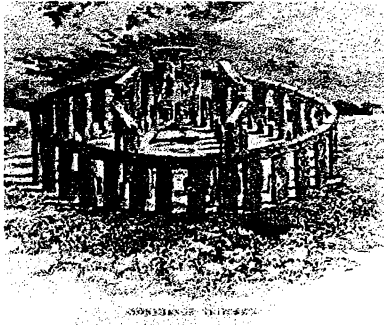
Since the circumference is pi times twice the radius, we have

$$\text{Circumference} = (22/7) \times 2 \times 5040 = 31,680$$

This is the same length as the Earth-square's perimeter. In this way, the sizes of the Earth and moon can be seen as having a squared circle relationship.

Using this approximation for pi, which rationally relates straight and curved lines by simple whole numbers, reveals our approach to the world's numerical scheme. Note that these relationships appear only when using a traditional measures (such as feet and miles) and never with the modern metric system which obscures the patterns. It always astounds me when I come across archaeological measurements of a site or architecture or even a cup done in centimeters, when applying the native units of measure clearly reveals the scheme. These significant numbers will be further discussed in *The Number Canon* chapter.

Stonehenge

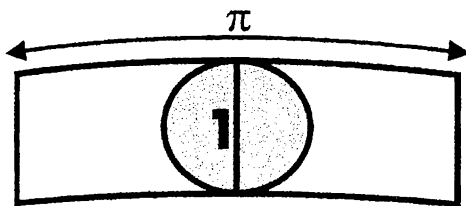
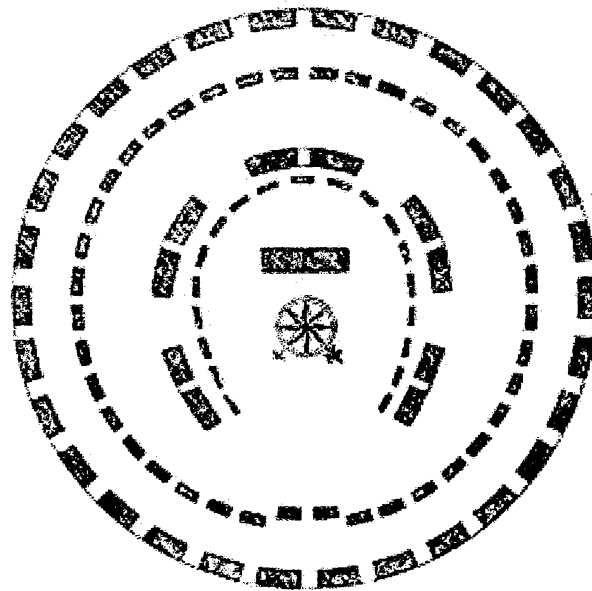
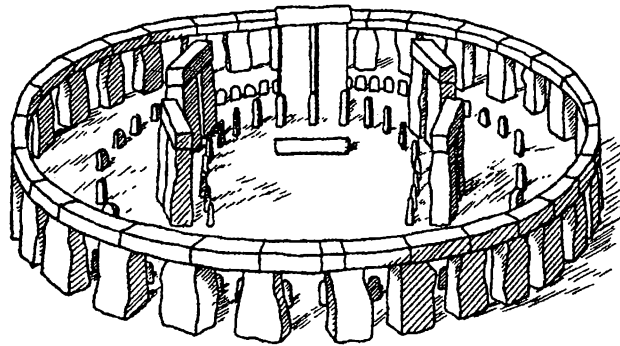


The construction of Stonehenge (located at $51^{\circ}10'43.9\text{N}$, $1^{\circ}49'31.6\text{W}$), the most famous of European Bronze Age and Neolithic megalithic ("large stone") sites was begun about 3000 BCE, even before the famous Egyptian pyramid building dynasties. It developed in stages over the next fifteen centuries according to what appears to have been one single unfolding numerical plan. At the heart of the completed structure is a squared circle design: Heaven and Earth meet here.

First, consider the reconstructed plan of Stonehenge. Notice an outer circle of thirty raised lintel stones fitting precisely together by mortar-and-tenon technique. Within them is a smaller circle of Aubrey stones surrounding a horseshoe of upright trilithons around an innermost horseshoe of bluestones.

“Our Countrymen reckon this for one of our wonders and miracles, and much they marvel from whence such huge stones were brought. I am not curious to argue and dispute, but rather to lament with much grief, that the authors of so notable a monument are buried in oblivion.”

—William Camden (16th century historian and antiquarian)



Lintel stone

The width of each of the thirty curved lintel stones encircling Stonehenge measures one-thirtieth of the circle's diameter. That is, if the lintel stones of its circumference were instead placed across Stonehenge they'd equal its diameter. And the length of each lintel is also curiously proportioned as pi times this width. It's as if a circle inscribed in the lintel was unwrapped and its circumference became the lintel's length.

The measures and proportions of Stonehenge are marvelously coherent. The single plan which Stonehenge's dedicated builders slowly and painstakingly made manifest through fifteen centuries must have expressed the highest geometric, astronomical and philosophical knowledge of their culture. It's apparent that Stonehenge was the site of an advanced school for teaching the timeless knowledge of the natural harmonies of arithmetic, geometry, music and astronomy.

It's well known that Stonehenge orients to the horizon and meshes with known celestial cycles, revealing rhythmic movements of the sun, moon and stars through the seasons. A square circumscribed around the Aubrey circle (below) has a perimeter equal to the distance around the outer circle of lintels, squaring the circle. Its squared circle geometry symbolically says "Heaven and Earth meet here". To have designed such a marvelous scientific instrument required long observation and a clear understanding of mathematics, astronomy and geodesy. Stonehenge may be considered a repository of geodetic measures, establishing in stone the standards of measure which the society valued and used.

Being a cosmological model, Stonehenge resembles the dimensions of the planet. Consider, for example, that the outer radius of its largest circle is on a scale of exactly 1:400,000 with the Earth's polar radius, the natural standard of measure.

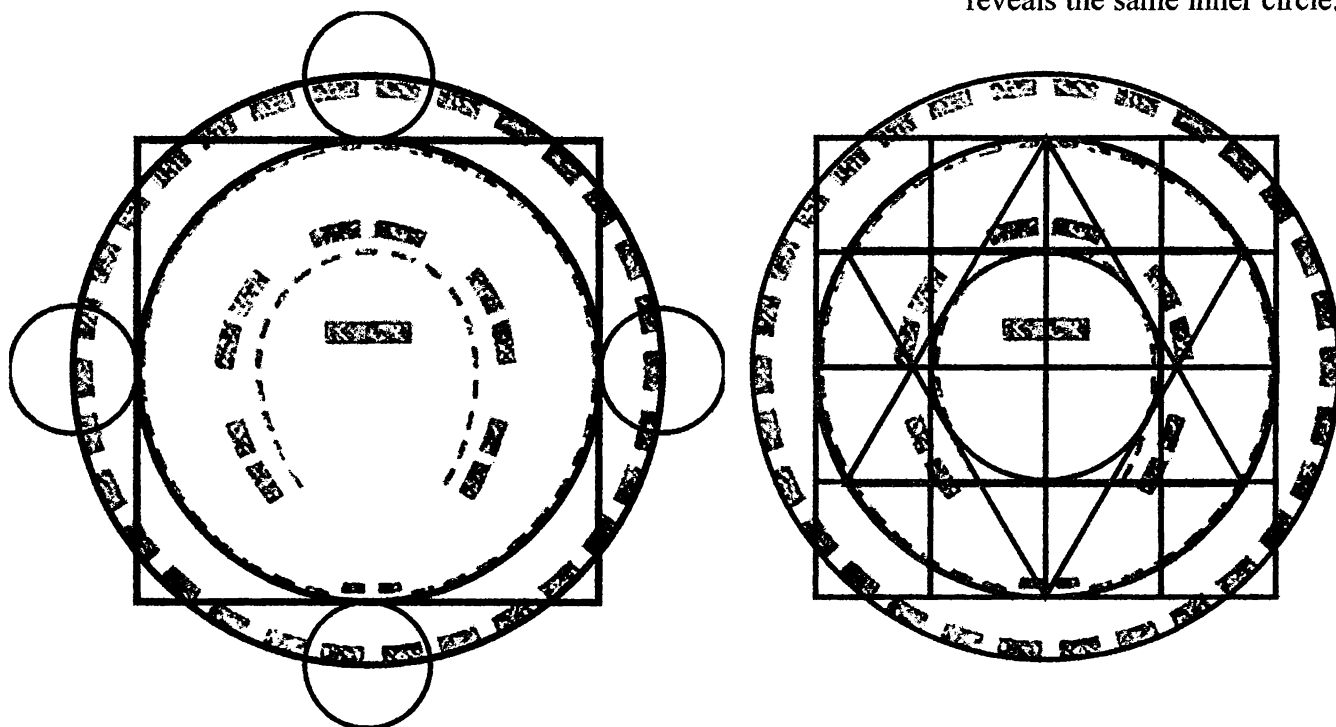
It may seem shocking to modern orthodoxy that the builders of Stonehenge could have mastered such knowledge, but their precision in measure and construction clearly documents what they did not record in writing.

“A tradition which has been credited by many learned men over the centuries is that the ancients encoded their knowledge of the world in the dimensions of their sacred monuments.”

-- John Michell (*Ancient Metrology*)

(Below) Stonehenge as a squared circle plan, reminiscent of the Earth-moon squared circle (page 42).

When the square is further divided into a four-by-four grid, we see how the curve of the innermost horseshoe of stones was determined. A hexagram reveals the same inner circle.



The Great Pyramid

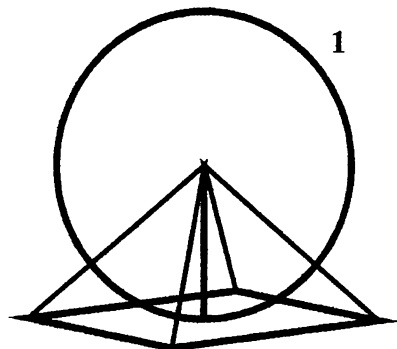


With all that has been investigated in the past few centuries about the Great Pyramid on the Giza plateau, you may not be surprised to hear that the squared circle relationship appears prominently in its design.

Said to be built about 2500 BCE by the Pharaoh Khufu during Egypt's Old Kingdom pyramid-building dynasties, it is perhaps much older. But its age is of little interest here. Whatever its age or purpose, it was certainly not a tomb, which had different characteristics.

It has been traditionally claimed that this pyramid's height is 280 cubits and has a base side length of 440 cubits. There's no need to know the exact length of this Egyptian cubit to appreciate their relationship, so we'll first consider only its proportion.

Figure 1: The pyramid offers a unique expression of the squared circle scheme. Its square base has a perimeter of 4×440 cubits = 1760 cubits.



The circumference of the circle whose radius is the pyramid's height can be calculated using the usual formula "circumference = $\pi \times 2 \times$ radius". But to solve this we must again use the traditional approximation of $\pi = 22/7 = 3.142857\dots$, slightly higher than ideal transcendental π . But this approximation isn't due to the Egyptians' supposed ignorance of the true value of π . It was used worldwide because it eliminates irrational values and maintains whole number ratios, a useful feature in monumental design and construction.

So the circumference of the circle whose radius is the pyramid's height is $(\pi \times 2 \times \text{radius}) = (22/7 \times 2 \times 280) = 1760$ cubits. This is equal to the perimeter we found around the pyramid's base, verifying this structure as a rationalized "squared circle" design.

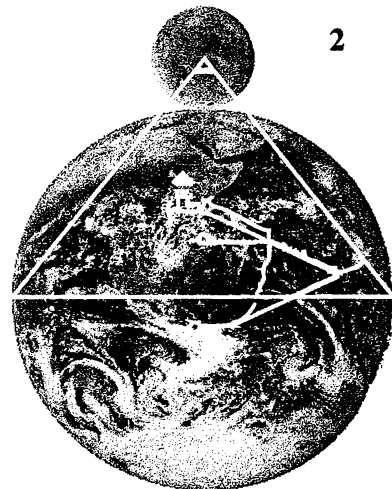


Figure 2: The dimensions of the Great Pyramid are those of the "squared circle" seen in the Earth-moon diagram. Consider a vertical slice through the center of the Great Pyramid. When its apex is placed at the center of the moon, the enlarged pyramid's base spans Earth's equatorial diameter.

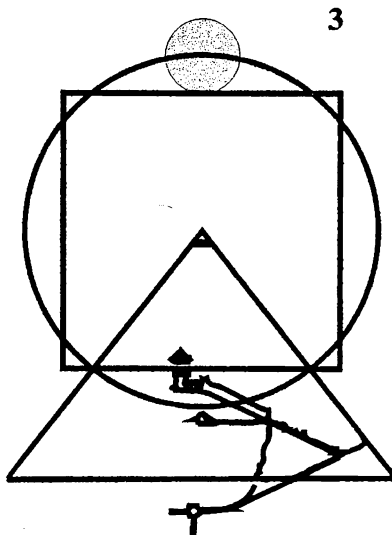


Figure 3: Seen yet another way, if the apex is placed at Earth's center the sides of the pyramid pass precisely through the points where circle and square cross.

For readers interested in ancient metrology, the science of measures, I offer the following insight into the dimensions of the Great Pyramid. For those readers wishing to learn more I strongly recommend the essential work on metrology by John Neal "All Done With Mirrors".

It has been speculated that the Great Pyramid is a model of the Earth's northern hemisphere. True, but it represents an *idealized* hemisphere, one not based on the Earth's polar radius or even its equatorial radius, but their *mean* value. Thus the pyramid represents a hemisphere of Earth of *mean* radius and *mean* circumference in miniature.

It has been noted that the height of the pyramid is 280 cubits, and its base side is 440 cubits. (Actually, the four sides are not precisely identical for reasons we needn't go into here). What are these heights in terms of feet, a remnant from wise traditional measures rooted in the dimensions of the Earth?

The Egyptians used different cubits in different situations: the common, royal and sacred cubits. (A royal cubit is 1/7 longer than a common cubit, and a sacred cubit is 1/5 longer than the royal.) The length of the standard royal cubit was 12/7 times the length of a foot, or 1.1714285... feet, about 20.57 inches. This is the unit of measure used in the step pyramid of Zoser and the pyramid of Amenhotep III at Dashur.

But the cubit used in the Great Pyramid was slightly different, adjusted to the *mean* latitude of Earth. The ratio of the mean radius to the polar radius is very slight, just 441/440. So for the cubit of the Great Pyramid we expand the length of the standard royal cubit by this small ratio and we get

$$12/7 \text{ feet} \times (441/440) = 1.7181818... \text{ feet} = 20.618... \text{ inches.}$$

Now it will be easy to solve for the Great Pyramid's side (440 cubits) and height (280 cubits).

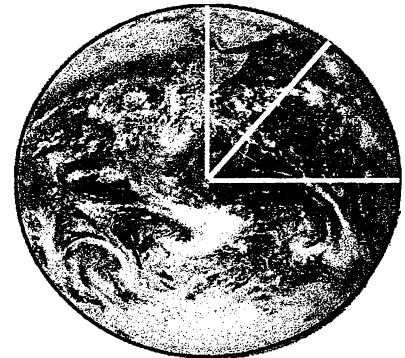
$$\text{Side} = 440 \times [12/7 \times (441/440)] = 756 \text{ feet}$$

Because the Earth spins on its polar axis, it's not a sphere but an "oblate spheroid" bulging at the equator and flattened at its poles. As its curvature changes *the actual length of a degree of arc is different at different latitudes*. So is it a coincidence that 756 feet, the base side of the pyramid, is the number of feet in one degree of latitude at 30-31 degrees North where the pyramid sits at Giza?

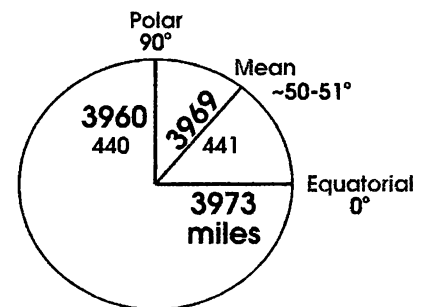
Finally, the pyramid's calculated height = $280 \times [12/7 \times (441/440)] = 481.0909... \text{ feet}$ (= 481 and one-eleventh feet).



Although we're taught that ancient measures like the cubit come from transitory body measures, they were actually based on the unchanging relationships found among numbers.

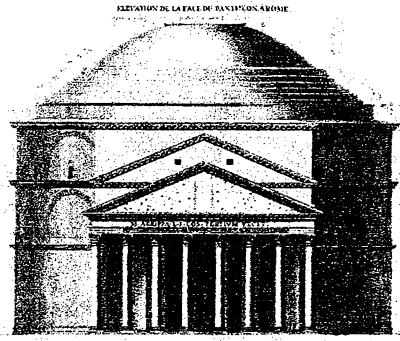


3 Radii of Earth

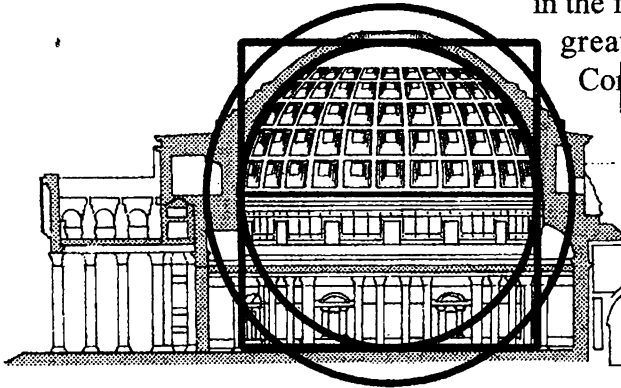


Because the Earth bulges, it has three radii: polar, equatorial and their mean. Ancient measures were adjusted to the latitude where they were used.

The Pantheon

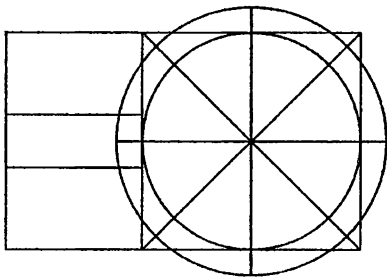


The Pantheon ("All the Gods") temple in Rome is the best preserved of all great classical Roman monuments. It's said to have been constructed, as was the tradition, on a more ancient temple site in 27 BCE by M. Vispanius Agrippa, the admiral who defeated Anthony and Cleopatra at Actium. In 609 Pope Boniface IV received the building as a gift from the emperor of Byzantium, transforming it into a Christian church dedicated to the Madonna and the martyrs.



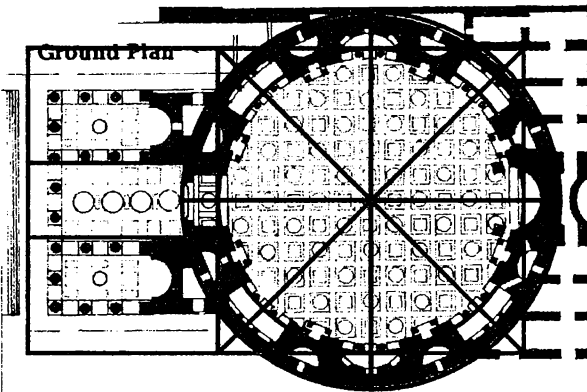
The Pantheon is a cosmological model, essentially a cosmic egg in the form of a spherical building of concrete faced with brick. Its great concrete dome rises behind a front porch of sixteen Corinthian columns supporting a gabled roof with triangular pediment. The dome has an immense spherical interior measuring about 142 feet in diameter, the largest dome built until modern times. Lit solely by the light flooding through its twenty seven-foot *oculus* or "eye" at its top, it works as a sundial. The word "dome" derives from the Greek *domos* and Latin *domus*, giving us words like domicile, domain, dominion and even "Madonna" ("Lady of the House") which produced madame and madam.

A circle (sphere) in a square (cube) shapes the dome and interior space. The square around it, with the larger circle, define important elements of the architecture.



The exact method of its construction has never been determined, but its success is due, in great part, to the excellent quality of the mortar used in the concrete and careful selection and grading of the stone which ranges from heavy basalt in its foundations and lower part of the walls, up through lighter brick and tufa (stone formed from volcanic dust) to the lightest pumice toward the top center of the vault. Although its interior stands stripped of most ancient adornments, it is still structurally intact. Its seven interior niches were apparently designed for the seven planetary deities (Apollo, Diana, Mars, Mercury, Jupiter, Venus, Saturn) who ruled over the days of the week. In short, the Pantheon was built to incorporate the most expansive philosophical beliefs of the late Roman pagan faith.

These illustrations show how the Pantheon is yet another example of squared circle microcosmic design. In three-dimensions it forms a "cubed-sphere".



The view from above reveals that the floor plan's octagonal geometry is part of the squared circle design. A Golden Rectangle extension to the left of the square, further subdivided by rabatment with overlapping squares, reveals the design of the front porch.

"Now the sacred buildings which they constructed bear witness to the grand manner of the men of that day."
-- Diodorus *Historical Library* [13.82.1]

Native American Kivas

Chetro Ketl Kiva

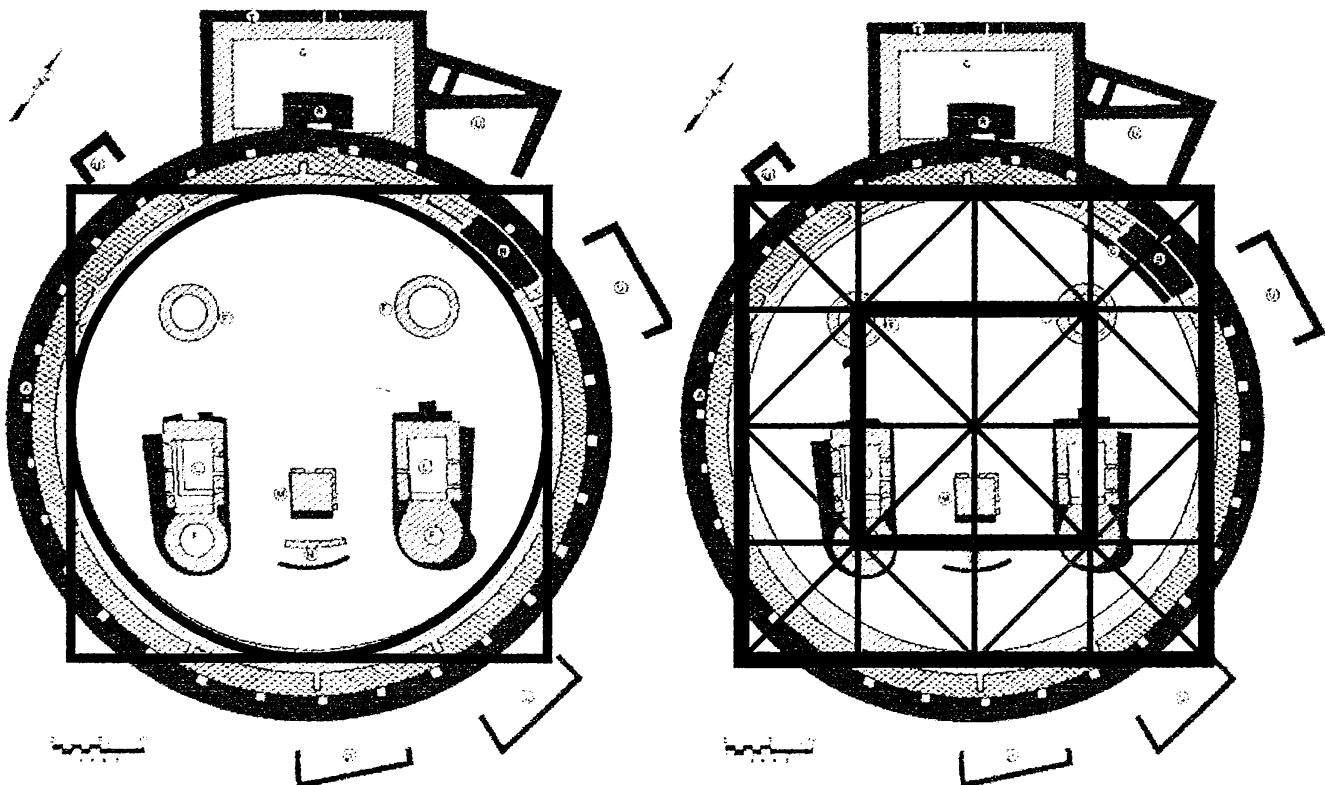
A *kiva* is a subterranean ceremonial and social chamber, a womb in Mother Earth, still honored by use in Pueblo American Indian villages and admired in the ruins of the southwestern canyons. Colorful murals painted with local mineral pigments wrap around the inner walls depicting sacred figures or scenes from daily life. A *kiva* is entered from above, through a square hole at the roof's center over the fire below. In the tradition of consecrated spaces worldwide, the *kiva* is a mesocosm, a space between Heaven and Earth, a cosmically ordered model of the universe designed as a crystallization of cosmic principles.

In New Mexico's remote Chaco Canyon are many ancient kiva ruins including a "Great Kiva" called *Chetro Ketl* having about a 60 foot diameter. Around the circular room against the wall is a bench for sitting. Four main columns support the roof, reminiscent of mythologies from Egypt to Polynesia which describe four pillars, trees or other quaternaries upholding the sky. Off center is square fire box, protected by a small stone wall which prevents rushing air from striking it directly. On either side of the fire box, connected to columns, are two large rectangular drums for striking and dancing upon to create rhythm. And somewhere in the floor is the *sipapu*, the symbolic hole through which the tribe first emerged into the world.

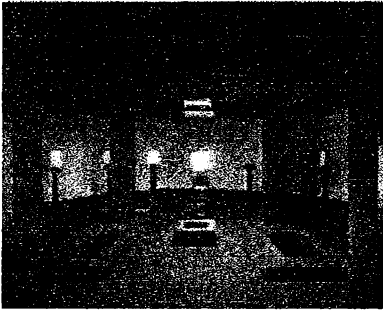


View up through the door in the center of the roof of a *kiva*.

Chetro Ketl kiva as a squared circle design



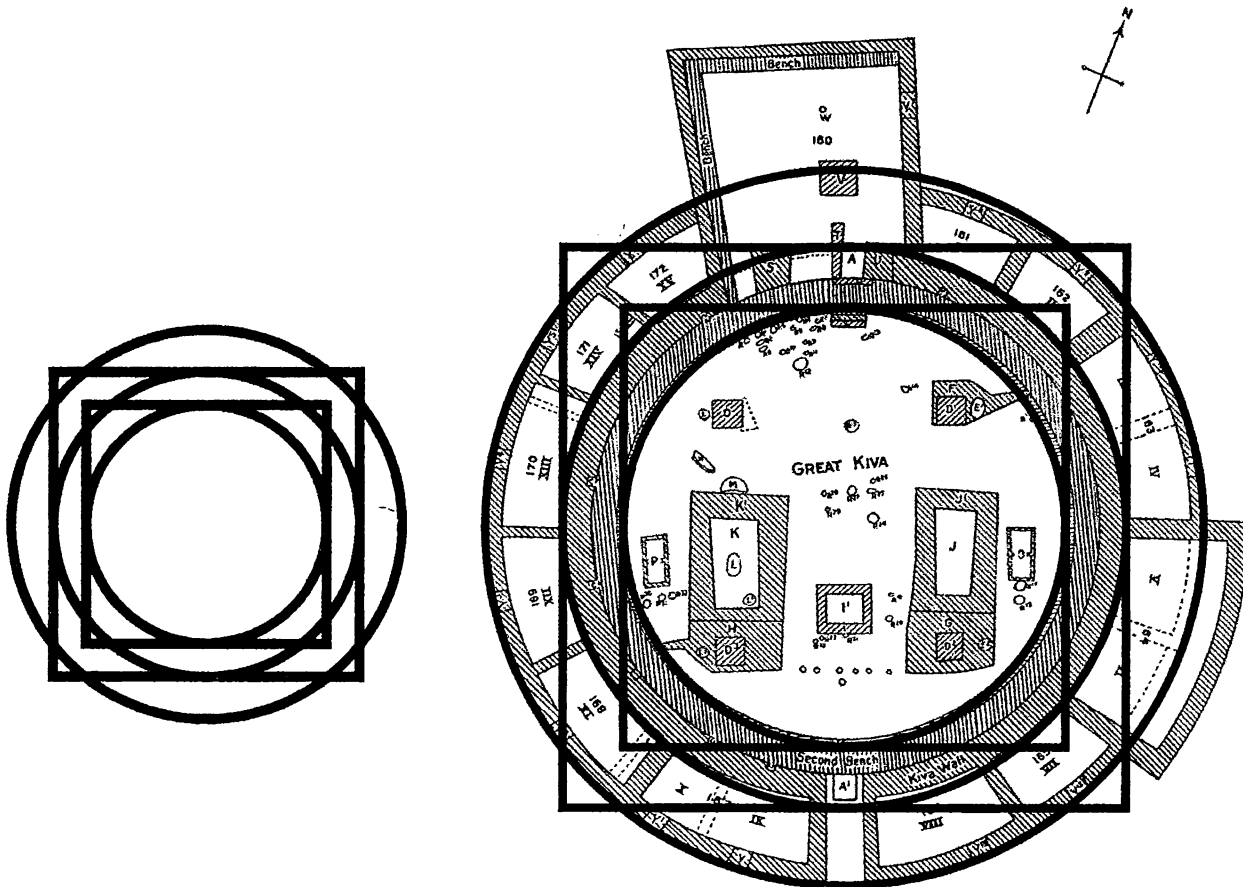
The accompanying diagrams show its geometric plan. If the kiva's *inner* circle, the chamber dug into the earth, is taken as our central "Earth" circle and a square is drawn around it, the circle of the kiva's *outer* wall has a circumference equal to the square's perimeter. Again, in the time honored, worldwide language of the geometric symbolism of sacred spaces, this squared circle design indicates that "Heaven and Earth meet here". Further dividing the square into a four-by-four loom reveals why the four pillars are placed where they are, and how all elements are organized in cosmological order around the sacred center.



View inside the reconstructed Aztec Great Kiva

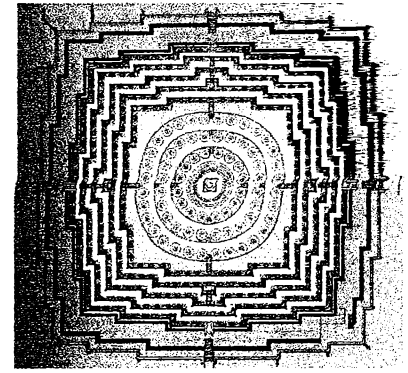
"Aztec" Kiva

A similar archetypal squared circle design recurs in many kiva plans, including the reconstructed eighty-foot Great Kiva at Aztec, New Mexico (misnamed because settlers there incorrectly thought it was an Aztec site). At ground level above and around the underground ceremonial chamber is a circle of rooms. Like the plan of *Chetro Kettle*, the square around the round inner pit "squares the circle" of the kiva's round outer wall. But now there's a surprising extension. Taking the kiva's outer wall as a new, inner "earth" circle within a square, the outermost wall of the upper rooms becomes the circle whose circumference equals the square's perimeter. What is below is perfectly integrated with what is above.



Borobudur Temple

The Borobudur Temple on the island of Java, Indonesia, is another example of the squared circle and full Cosmological Circle design expressed as sacred architecture. It is a Buddhist revelation, a marvel of *stone standing in a garden* and one of the greatest monuments in the world. Oriented to the four cardinal directions, it was built from 792 to 824 by the wise Saliendra kings. For about a century and a half it was the spiritual center of Buddhism in Java, but abandoned until its rediscovery in the eighteenth century.



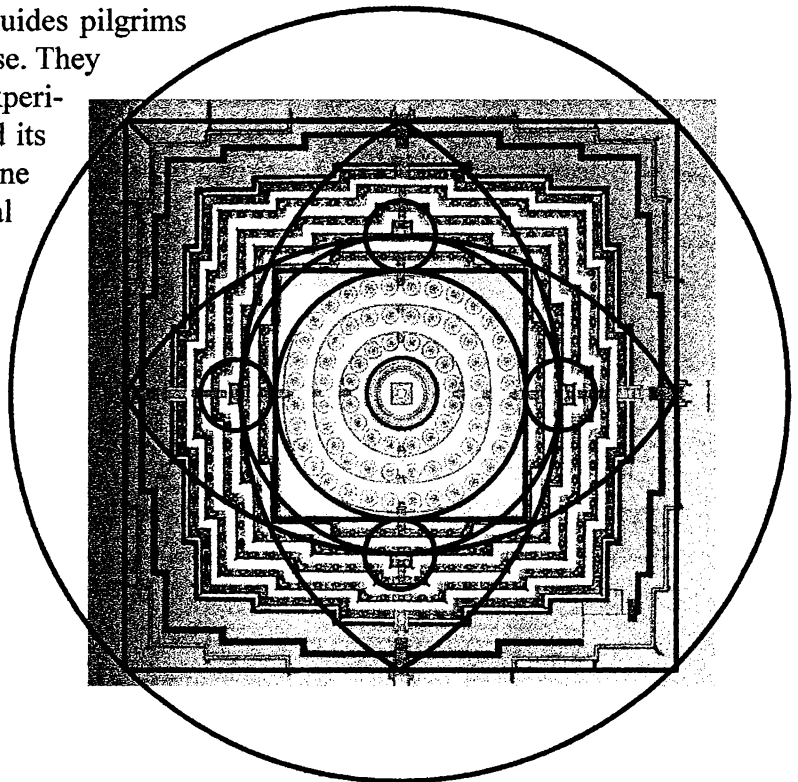
Seen from above, the "God's eye view", Borobudur is a three-dimensional mandala. It is an example of the temple as cosmos, a mesocosm between Heaven and Earth, a model of universe and the complete self. It's the visible Buddhist expression of the stages of spiritual enlightenment. As pilgrims make their way around its square, earthly base and up its first six square storeys they travel through images of the world as we ordinarily know it, filled with desire, attraction and repulsion, cause and effect, where we're easily influenced by negative impulses. Eventually pilgrims reach three circular levels containing seventy two perforated stupas, domed structures where the pilgrim moves through light and dark spaces depicting various scenes from the Buddha's life, a higher stage of spiritual wandering, learning to control negative impulses and use positive ones. Eventually they reach the uppermost terrace with its solid central stupa, symbol of the state of *nirvana* (literally "no winds") and enlightenment of the Buddha ("Awakened").



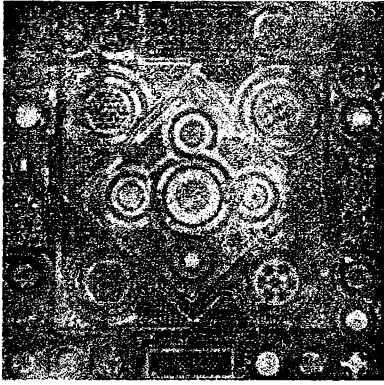
Borobudur Temple overlaid by the mandala of the Cosmological Circle.

The path indicated at Borobudur guides pilgrims along, around and up the axis of the universe. They travel from Earth to Heaven through the experiences of the world mountain, going around its symbolic architecture starting at our mundane circumference and journeying to our spiritual center.

The journey's stages around and up Borobudur are clearly defined by the lines of the squared circle Cosmological Circle construction, which shouldn't surprise us.



Cosmati Pavement of Westminster Abbey

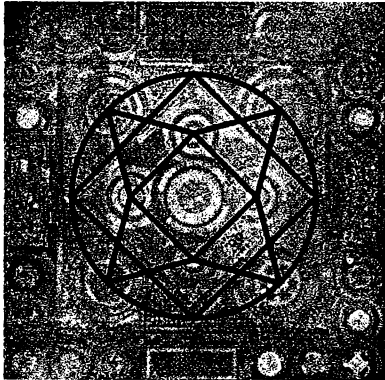


"If the reader wittingly reflects upon all that is laid down, he will discover here the measure of the primum mobile.... Here is the perfectly rounded sphere which reveals the eternal pattern of the universe."

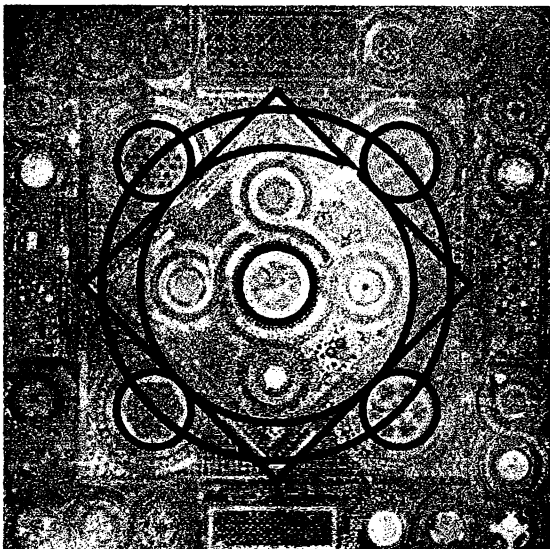
-- fron. the Pavement's inscription

Another curious geometric puzzle concerns a remarkable floor tiling, now in a very poor state of repair, kept under a carpet before the altar of Westminster abbey in London.

Its style of tiling, called "Cosmati" work, also appears on other architectural surfaces and church furniture. It derives from the ancient Roman tiling tradition which, after Rome fell, survived the Dark Ages in monasteries to emerge in the early Middle Ages. The Ninth century Byzantines developed the simple Roman designs into intricate geometrical mosaics made up of pieces of marble of various sizes and shapes. Cosmati tiling appeared in the West in southern Italy in 1071 at Montecassino, the great center of learning which preserved knowledge from ancient sacred and scientific traditions. The style soon spread to other parts of Italy and France, Germany and England. It was further developed by decorators and architects in the Twelfth and Thirteenth centuries, but after the Fourteenth century the production of Cosmati work appears only in a debased form.



The Great Pavement of Westminster Abbey was laid down by Italian craftsmen in 1268 for Henry III. It consists of tiny triangles and squares of colored stone and glass paste arranged in busy, intricate geometric patterns balanced with large, smooth strips and disks of plain and semiprecious stones. Researchers have noticed a structure of circles whose centers form a net of equilateral triangles and squares. But another way to see it is as a "squared circle" where the large square's perimeter is virtually equal to the circle passing through the small circles' centers, resembling the path of the moon rolling around Earth.

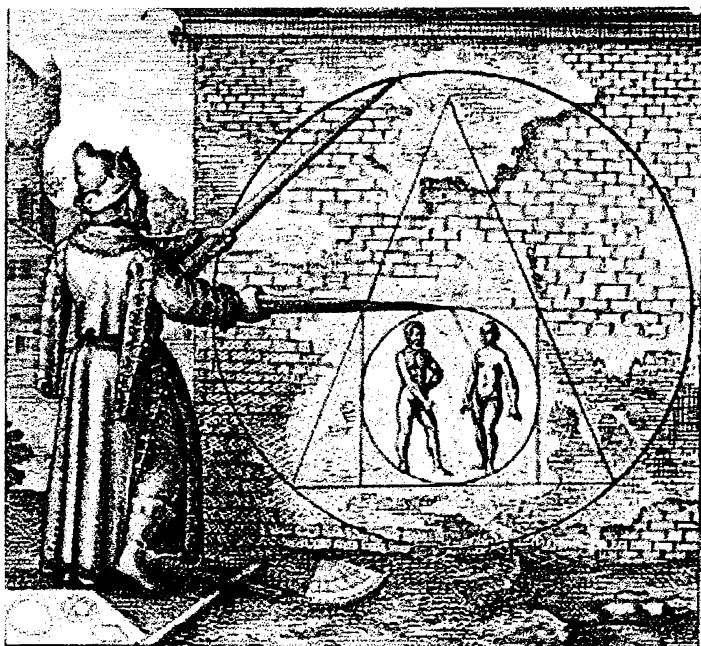


While the word "Cosmati" is said to refer to the name "Cosma" shared by members of several families involved in the art, it's possible that the name refers to an appreciation of "cosmos" and the world's order represented by the geometric construction itself. It was the traditional responsibility of royal and sacred guardians of civilization to maintain the knowledge of this design and to transmit it in public sight. It reveals in geometric language their knowledge of the harmony by which the universe is organized, and by which the court, religion, the structure of society and its laws were modeled to resemble.

Alchemical Fusion

"Make of the man and woman a Circle,
of that a Quadrangle, of this a Triangle, of the same a Circle
and you will have the Stone of the Philosophers."

-- Michael Maier, 1617, *Atalanta fugiens*, Emblem XXI



This alchemical engraving or "emblem" with its enigmatic caption was created by Michael Maier (1568-1622), German alchemist, Rosicrucian and court physician to Emperor Rudolf II at Prague. He's also respected for his work as a dedicated chemical laboratory worker. His alchemical work represents the Hermetic tradition as it stood in the early seventeenth century. This scene is the twenty-first of fifty illustrations engraved on copper which compose his work "*Atalanta fugiens*" (*Flying Atalanta*). Each emblem is associated with a musical canon or "fugue" (a pun in the title) and is accompanied by legends, epigrams and notes which, as he writes on the title page, is "partly for the ears and the soul's recreation."



Michael Maier

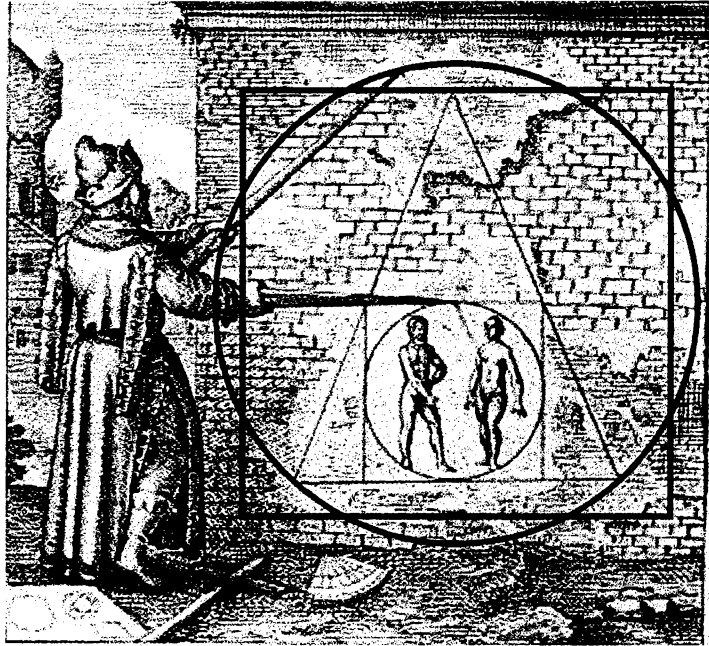
Depicted is a geometer-philosopher standing before a wall on which he has constructed a geometric diagram with his large divider. Within a central circle are a naked man and woman. Around their circle is a square which is inscribed within a larger isosceles triangle. We notice that this triangle touches the circle at two points below, but its apex falls short of the circle. Strewn upon the ground are astronomical and surveyor's tools and a page of geometric drawings. The shapes symbolize alchemical principles (circle, the cyclical process; triangle, the three principles salt, mercury and sulphur; and the square, the four elements) representing the preparation of the Philosophers' Stone.

What could this visual puzzle signify? Maier mysteriously writes that the "philosopher's stone" is here, which turns lead to gold, a metaphor for transforming base passions to wisdom, and whose discovery is the goal of esoteric alchemy. But why does the top of the triangle not reach the circle? We are meant to see that the image -- like the pair at the center and ourselves -- is somehow incomplete.

Its key was discovered 350 years later by John Michell through a geometric analysis. He saw that a square passing precisely across the top of the triangle has virtually the same *area* as the large circle.

"To the Cabalists our vessel is perfectly well known, because it must be made according to a truly geometrical proportion and measure, and from a definite quadrature of the circle, so that the spirit and the soul of our matter, separated from their body, may be able to raise this vessel with themselves in proportion to the altitude of heaven."

-- Theophrastus Paracelsus, ("The Aurora of the Philosophers", Chapter XVIII: Concerning Instruments and the Philosophic Vessel)



This "missing" square completes a "squared circle" and suggests the reconciliation of all complements, including the masculine and feminine principles, Jung's *anima* and *animus*, at work in society and within each of us and whose "mystical conjunction", as Maier wrote, results in "the granting of Wisdom's splendour". The squared circle represents alchemy's central paradox, the harmonious reconciliation of our own inner Heaven and Earth.

Other alchemical references describe the elusive philosopher's stone and *aurum philosophicum*, philosopher's gold, as well as the entire *opus alchymicum*, the completed alchemical work, as a squared circle having the power to perfect all imperfections.

"When thou hast made the quadrangle round,
then is all the secret found."

-- Inscribed in the innermost circle of the
"alchemical wheel" engraving by
Sir George Ripley (c1415-1490, English alchemist)

Construct the Cosmological Circle

With the previous pages' background in the mathematics and our cultural heritage of the Cosmological Circle we're better prepared to appreciate its geometric construction. Do the construction on a separate sheet of blank paper. The larger you can make it the better you'll see its details.

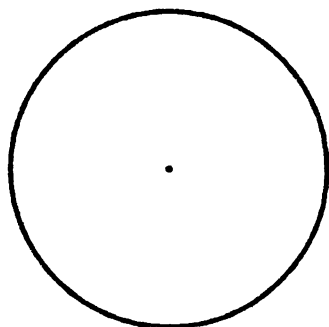
Before doing anything else, first consider your blank sheet of paper. It represents the state of primeval chaos upon which the construction will establish the order of a cosmic kingdom. It's hoped that all readers will do this construction at least once, and creative people will explore and lawfully develop it further with a compass and straightedge. Developing it lawfully means without approximations or innovations but exploring it by only using the points, lines and areas which the construction reveals at each stage, with no arbitrarily "made up" ones which ruin its harmonious cohesion.

It should be remembered that every geometric construction (and picture) is actually an image in our consciousness which *appears* substantive. It has no effect upon us unless *we first agree* to it on some level. Otherwise they don't do anything at all to us. Some geometry, like that found in mandala design, can have a beneficial effect, but be aware that *we must have first agreed* to resonating with it. Alone, it didn't do anything. Please don't easily give your power away to any image, but recognize that *its source of power is in your own consciousness* and not in the picture. This is where people get in trouble with idol worship.

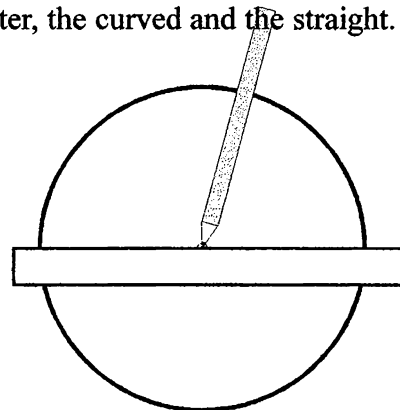
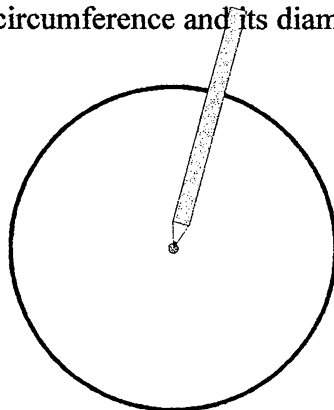
The Cosmological Circle diagram can be constructed from the center outward or from the whole Cosmological Circle inward. Since traditionally the first act of the Demiurge was to turn the full cosmic circle, we'll do the same. You may not want to reveal all the lines drawn along the way in your final design so may wish to draw some lightly or erase them.

1) Find and mark the center point of the page and universe.

Open your compass and turn a circle in one sweep.

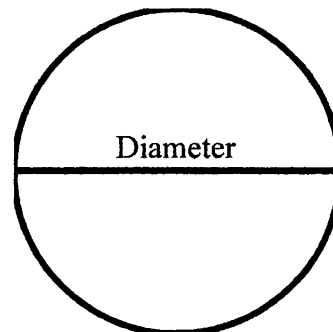


2) Draw a diameter: Place your pencil point vertically at the center and bring the straightedge up to it. Draw a diameter across the circle's center. This introduces the transcendental π relationship between a circle's circumference and its diameter, the curved and the straight.



"A crosswise line cut Being from Nonbeing.
What was described above it, what below?
Bearers of seed there were and mighty forces,
thrust from below and forward move above."

-- Rg Veda





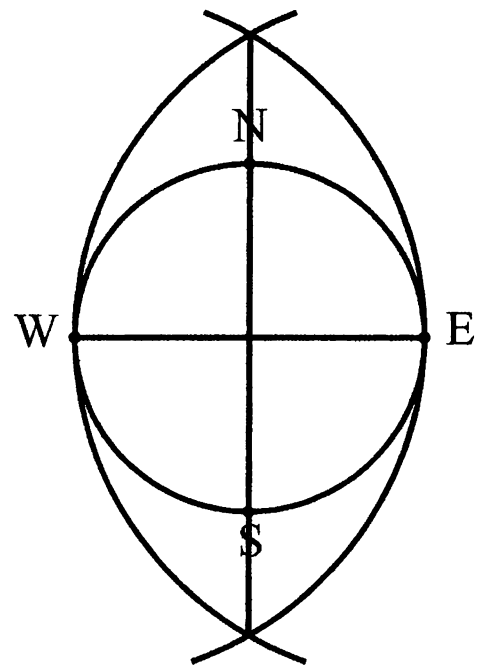
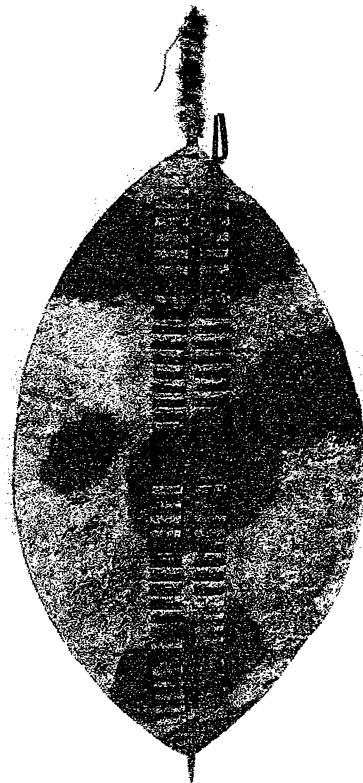
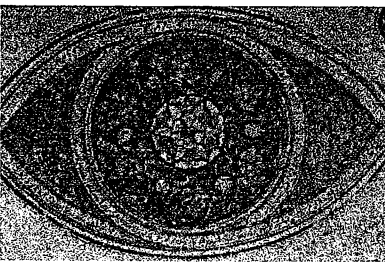
3) Open the compass to the ends of the diameter and turn two arcs. This will embrace the Cosmological Circle with a *Vesica Piscis* or almond shape (see Volume 1 Chapter 2).

Carefully draw a straight line to connect the Vesica's crossings with a vertical line segment.

The *Vesica* infuses the Cosmological Circle with the square root of three ratio (see Volume 4), the stamp of Divinity, announcing it as a sacred passageway. (The length of the vertical line is root-three (1.732...) times the East-West diameter.)

Notice the four points around the circle where the lines cross at the North, South, East and West. This quartering of the circle acknowledges the four directions of space, four seasons of time, four states of matter and four points which enclose the simplest three-dimensional volume (the Tetrahedron).

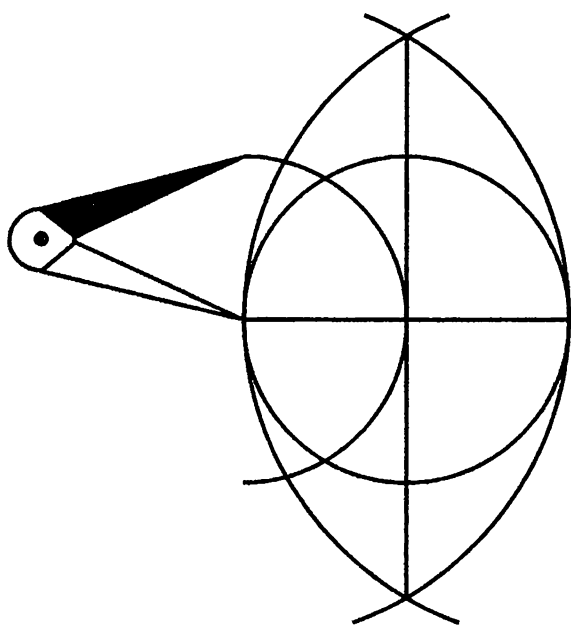
Ponder what you've done at each step in the construction.



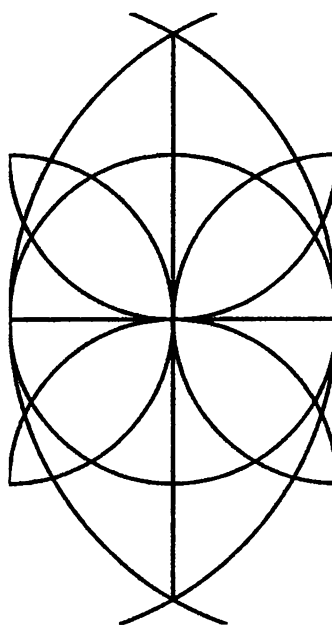
The Vesica Piscis
 construction in the art of
 Christianity
 Buddhism
 Islam
 Zulu shield

4) Now we'll construct a square *around* the Cosmological Circle.

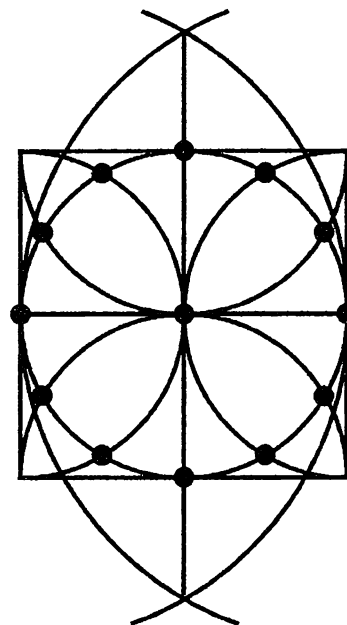
(See Volume 1 Chapter 4 for more about this construction.)



Place the compass point at the West point, open to the cosmic center, and turn a half-circle.



Do the same from the North, South and East points to create four "petals".



Carefully connect the four petal corners to draw the square.

(You may wish to emphasize this pattern in your final construction, but they'll be in the way of some upcoming elements of the construction, so you may wish to draw them lightly and later erase them.)

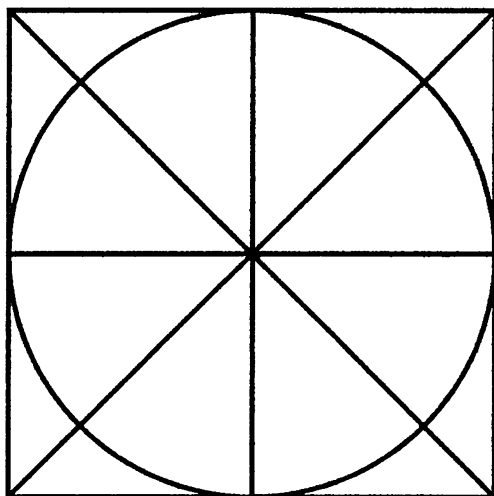
If you did it accurately, the middle of each side of the square will touch the circle at the NSEW points.

The square introduces the square root of two expansion ratio (1.414...) into the Cosmological Circle and our cosmos.

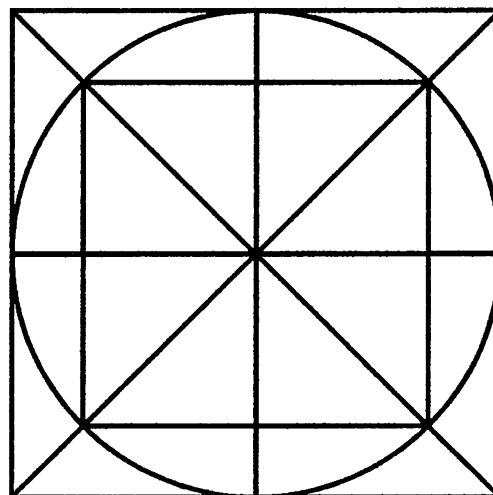
And notice that the petals plus the NSEW points indicate twelve points around the circle, dividing it into twelve equal divisions. This is symbolic of the mythologies of twelve gods, disciples, knights, advisors, companions, journeys, tasks, etc., infusing the basic structure of the Cosmological Circle.

5) Consider this square surrounding the Cosmological Circle.

We'll inscribe a square *within* this circle.

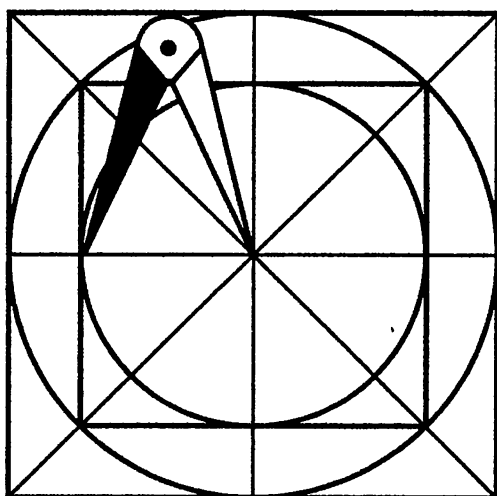


This is easy to do: First draw the square's diagonals.



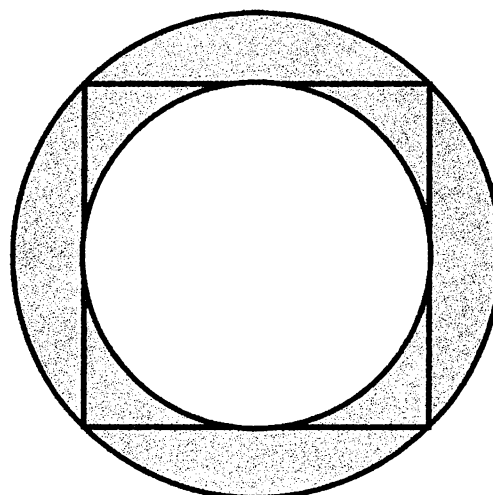
Then connect the four points where the diagonals cross the circle.

6) Next we'll inscribe a circle within the inner square.



Place the compass point at the cosmic center. Open the pencil to the midpoint of one side of the inner square (where the circle's horizontal or vertical diameter crosses it).

Turn the circle.



As we saw on page 36 the square mediates between these two circles in a unique relationship. The area of the whole circle is **twice** the area of the inner circle.

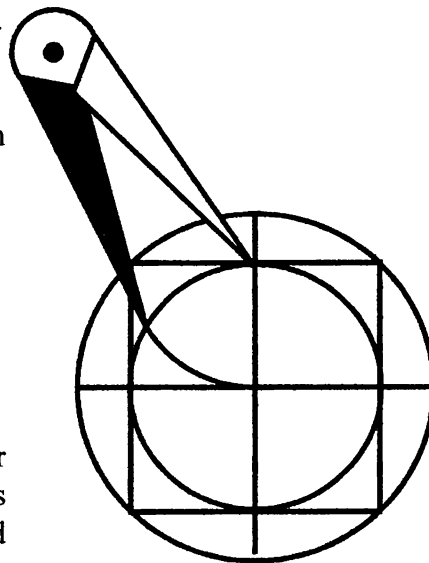
Put another way: The *area of the inner circle* is precisely **equal** to the *area of the ring* around it.

In this symbol we're reminded of the description of Creation in *Genesis* of the equal separation of light and dark, day from night, and the equinoxes.

7) Next, we'll locate six equally-spaced points around this inner circle. (See Volume 2 Chapter 6.)

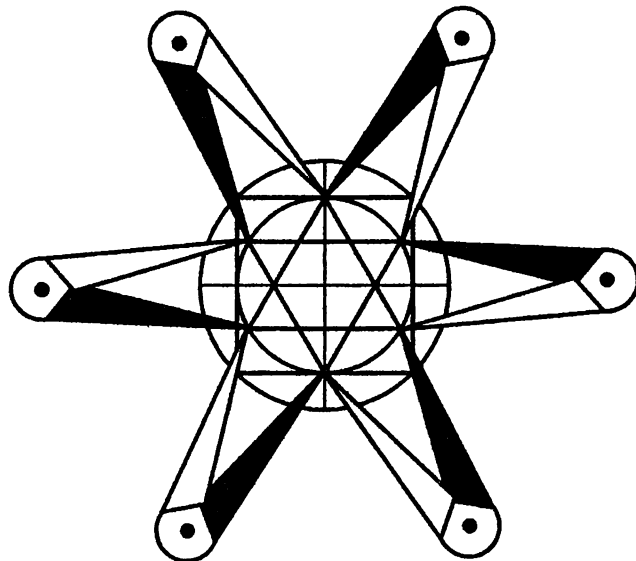
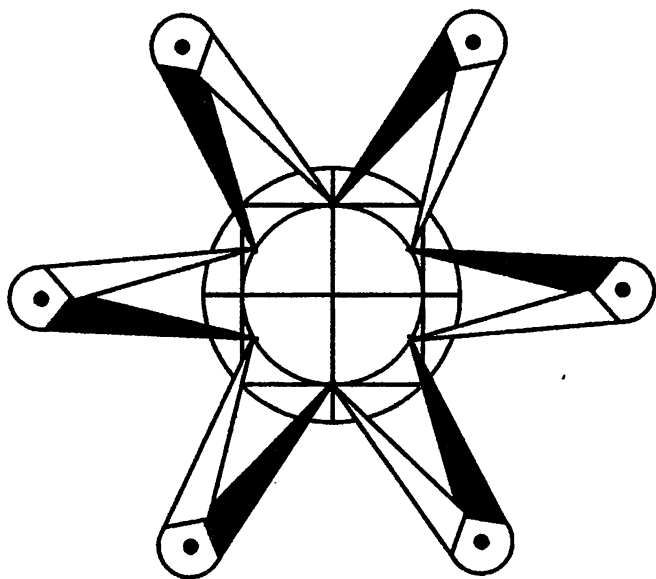
Place the compass point at the North point of the inner circle, and open the pencil to the cosmic center.

Swing an arc upward and notice where it crosses the inner circle.

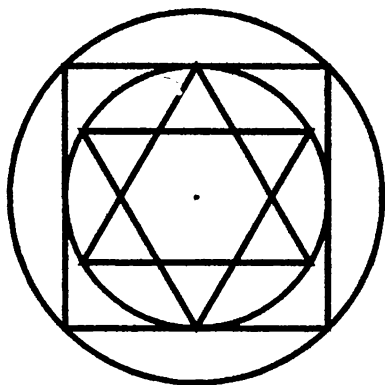


8) Now place the compass point on that crossing point. Make another mark further along the circle and continue the process. The compass should "walk" around the circle precisely six times. The final point should connect with its beginning at the North point (below).

If you walk the compass around and its final point doesn't land on the first point, then start again at North but walk the compass around in the *opposite* direction. The most accurate points are found *halfway between* each pair of marks.



9) Connect these six points around the circle to make a Hexagram star.



10) So far, you've inscribed a Hexagram within a circle inside a square within the whole cosmic circle.

This Hexagram symbol is found around the world in every culture and religion.

10) We'll now turn a circle which connects the intersections of the Hexagram.

Simply place your compass point at the center and open the pencil to one of the crossings of the Hexagram star.

Turn the circle and join the six intersections. Observe how accurately the circle crosses each point.

For easy reference this inner circle will be called the "Moonpath Circle" (see pages 42-43).

It will ultimately be the "squared circle" at the center of our Cosmological Circle diagram.

Something remarkable has appeared: Arithmetic calculation shows that the three circles demonstrate the most simple ratio of 1:2:3.

That is,

If the area of the inner circle 1 is unity, the area of ring 2 is two and the area of ring 3 is three.

The full area of circle 2 is three, equal to the area of ring 3.

If the area of circle 1 is one, then the total area of the largest circle 3, the Cosmological Circle, is six.

Remarkable simplicity underlies the harmonious relationships among the numbers and shapes of the Cosmological Circle.

(For more about the numbers which these shapes mask, see the final section *The Number Canon*.)

The numbers 1-3 here label the circles.

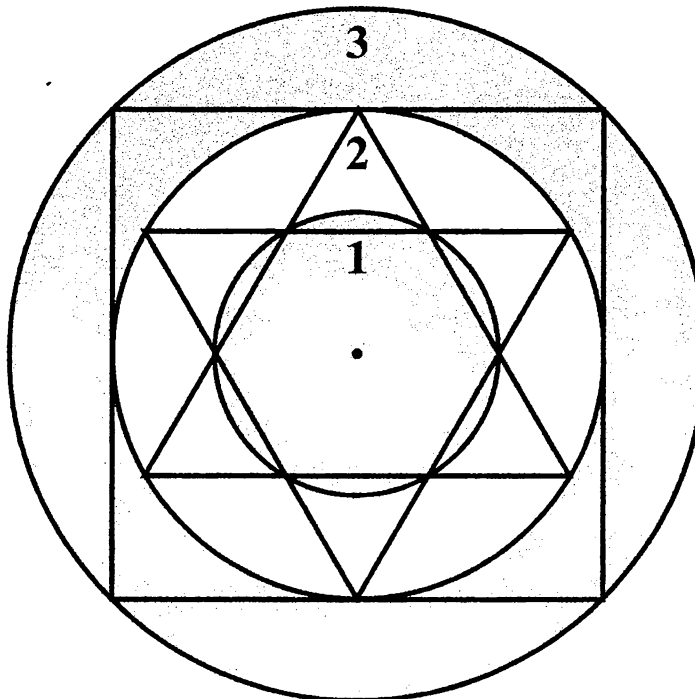
Area Circle 1 = 1

Area Ring 2 = 2

Area Circle 2 = 3

Area Ring 3 = 3

Area Circle 3 = 6

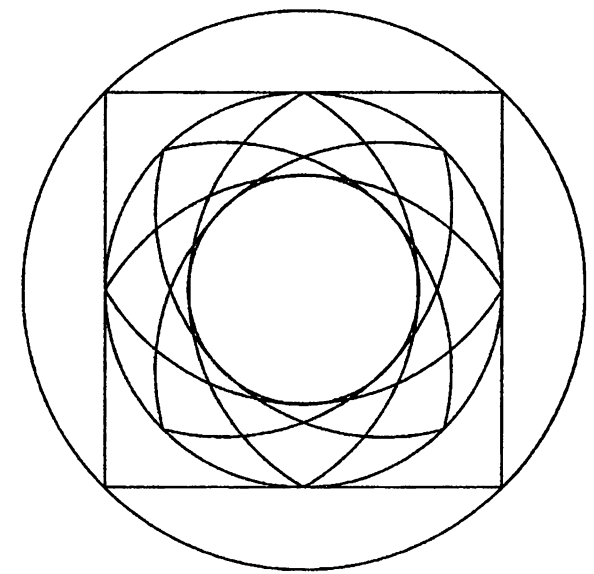
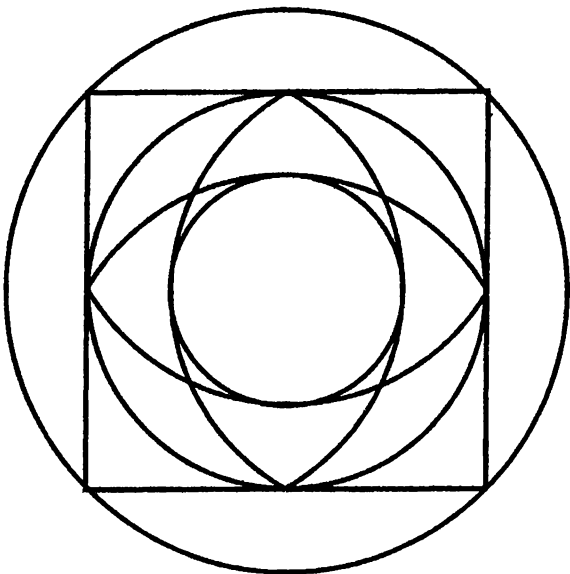
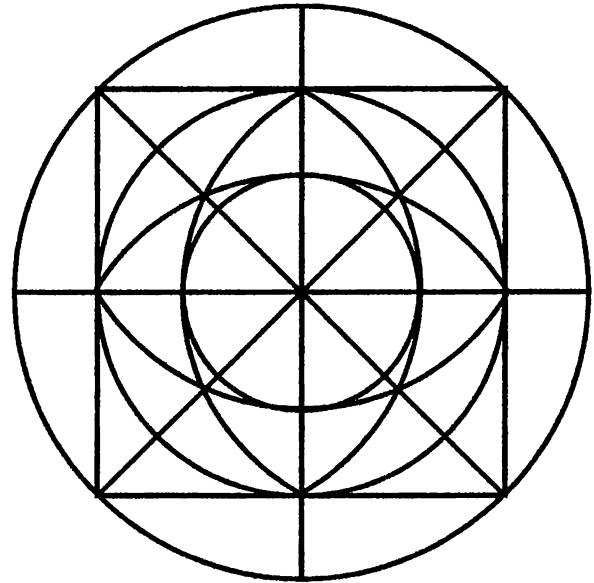
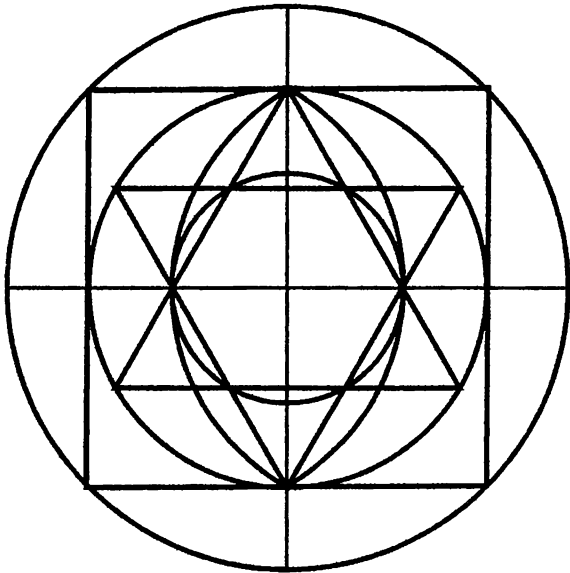


11) At this stage you have a choice. You can keep the Hexagram or transform it into *Vesicas Pisces* almonds, like an unfolding lotus.

To see how this is done, open the compass between the North and South crossings of the innermost circle, the Moonpath circle, and turn arcs.

Then repeat this with the compass open between the East and West points on the Moonpath circle.

The Vesicas should cross at the midpoints of the sides of the square.



To eliminate confusion in our construction we'll erase the Hexagram and keep the two *Vesicas Pisces*. But you may want to keep the Hexagram and include it in your final construction.

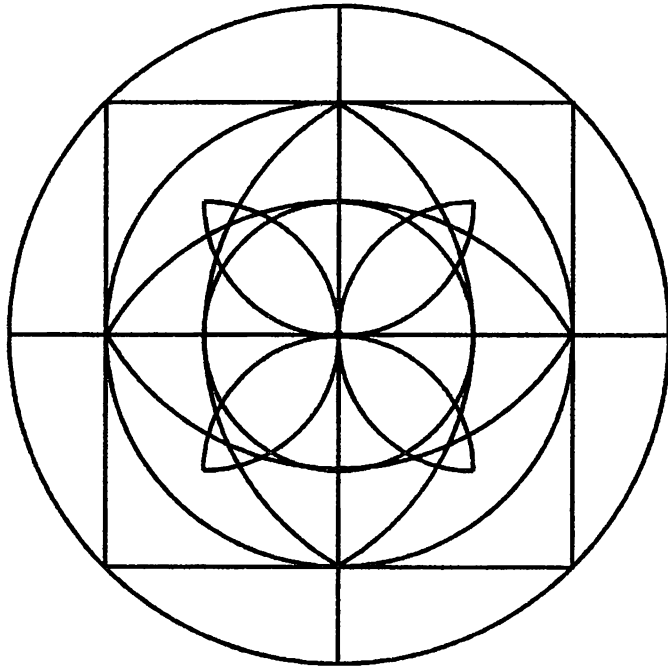
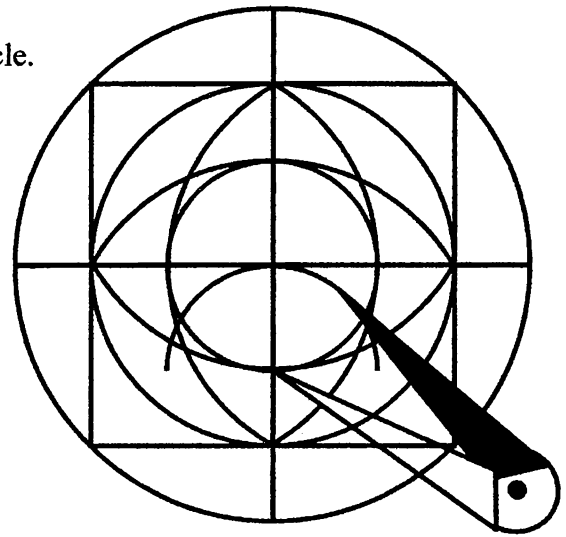
Two more *Vesicas* (with compass open to where the inner circle crosses the square's diagonals) will produce an eight petaled lotus.

12) Next, we'll construct a square *around* the Moonpath Circle.

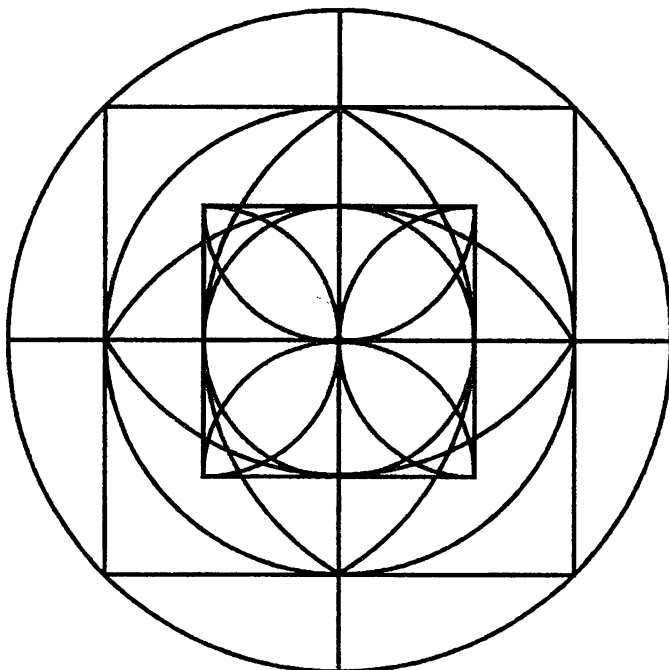
To do this, first place the compass point on the Moonpath Circle's South point.

Place the pencil on the circle's center.

Turn a half-circle.



13) Repeat this (as we did in step 4) now with the compass point at the Moonpath circle's North, East and West points until you create four "petals".



14) Connect the petals' four corners and draw a square.

This square should just touch along the North, East, South and West points of the Moonpath Circle it encloses.

If you wish to develop and explore more here, notice that the petals and NSEW points divide the inner circle into twelve equal divisions.

15) Let's look at this inner square only.

Our task now is to construct four equilateral triangles on the inner sides of the square.

Then we'll use them to find 28 points around the Moon-path Circle, and eventually to square that circle.

Place the compass point on one of the square's bottom corners and open the pencil to the other bottom corner. Turn an arc to reach the top opposite corner. (How accurately does it arrive?) Turn these arcs lightly and erase them later because there's more to draw in this space.

Switch the compass point and pencil along the bottom and turn another arc (or just show the point where it crosses the first arc).

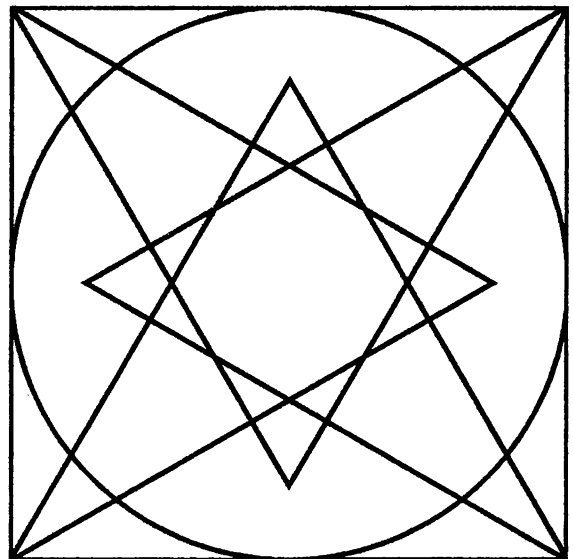
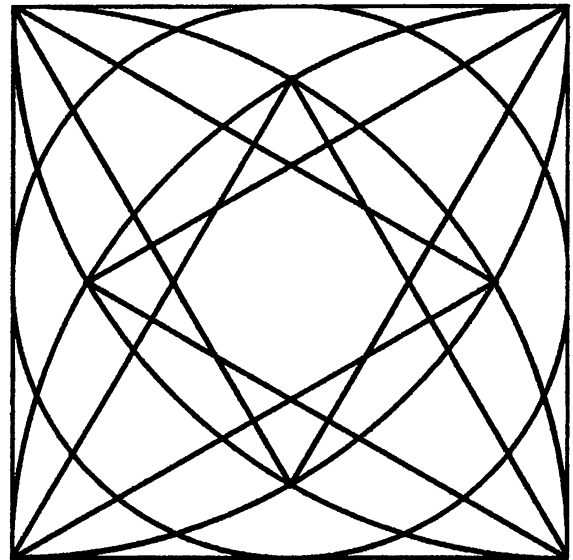
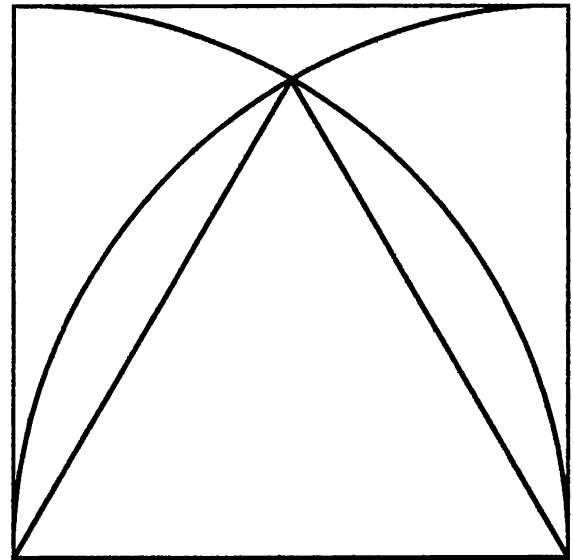
Draw lines to join the point where the arcs cross to both bottom corners of the square, revealing an equilateral triangle (which has been there invisibly all along).

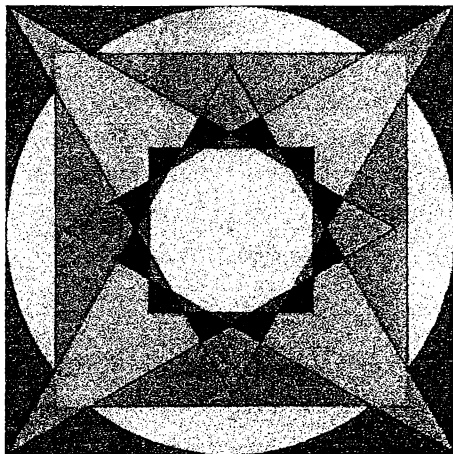
Repeat this process inside all four sides of the square...

... to reveal four overlapping equilateral triangles.

It's a great design to ponder and build upon. Use it as a pattern for artistic exploration.

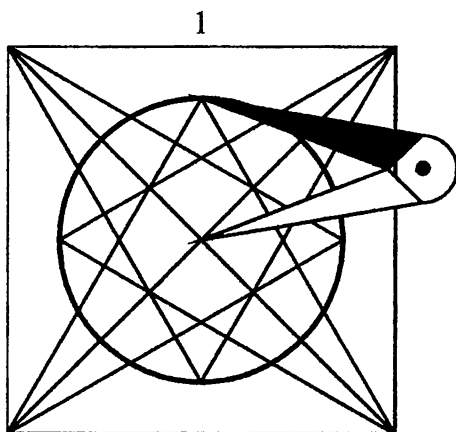
(Erase the arcs now if you don't intend to use them for any development.)





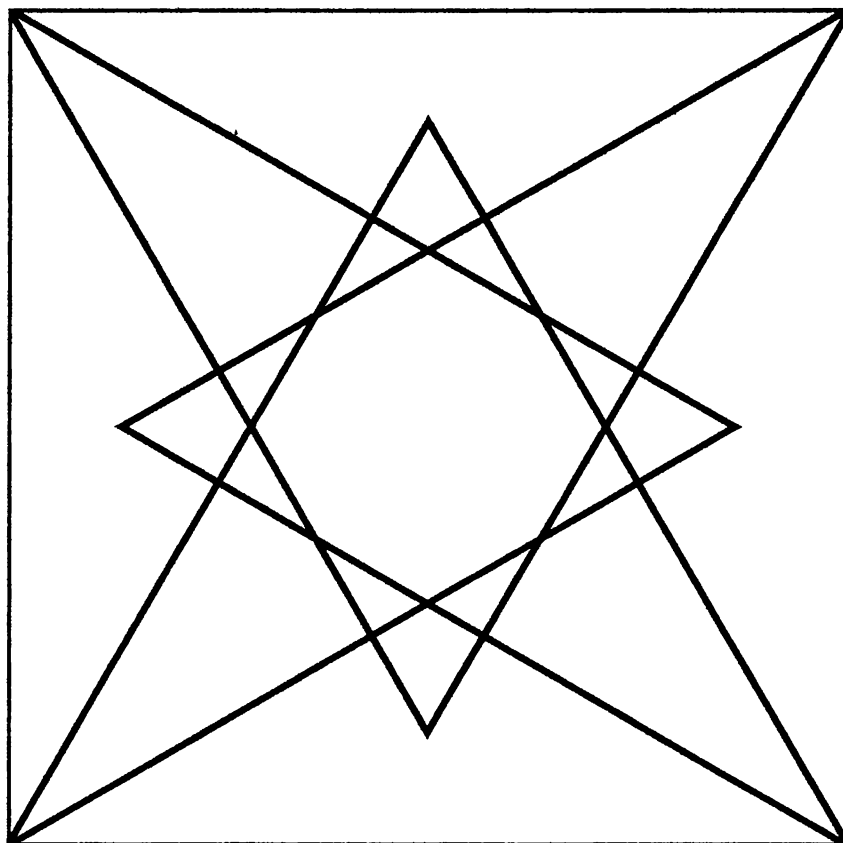
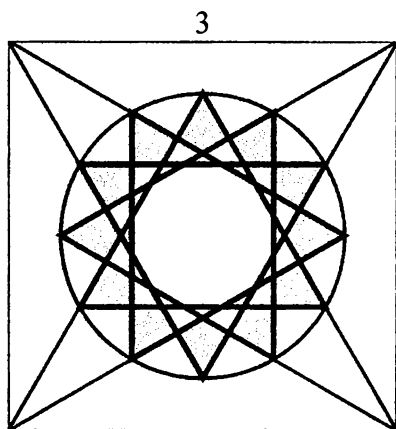
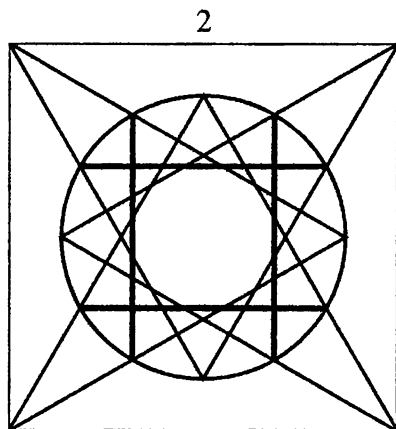
As an aside, let's look at this construction of four triangles within the square. Notice their four "arrowhead tips" in the cardinal directions. It's possible to develop them into twelve identical equally-spaced arrowheads further containing twelve smaller quadrilaterals (the corners of three rotating squares) within it. Notice how this watercolor by John Michell makes the inner quadrilaterals appear. Here's how to produce them both (also seen in Volume 2 page 210). Try it in the large square below.

(1) Lightly draw diagonals to find the square's center. Then place the compass point at this center and open the pencil to the tip of one triangle. Turn a circle. It should touch the tips of all four triangles.



(2) Carefully draw straight lines between the crossing points made by the triangles and this circle as shown.

(3) Look what you've done: you've identified concentric rings of twelve points around this circle. Identify the twelve arrowheads and smaller rings of twelve quadrilaterals around the center, and notice even smaller triangles. While this construction isn't absolutely essential for the construction of the Cosmological Circle, it's one well worth investigating and developing further on your own.



16) Our task now is to find 28 equally-spaced points around the Moonpath Circle.

Twenty eight is an interesting number. Not only is $28 = 4 \times 7$ the number of days in four weeks, approximately a lunar cycle, it is also the sum of the numbers one through seven, the number of days in one week: $28 = 1 + 2 + 3 + 4 + 5 + 6 + 7$.

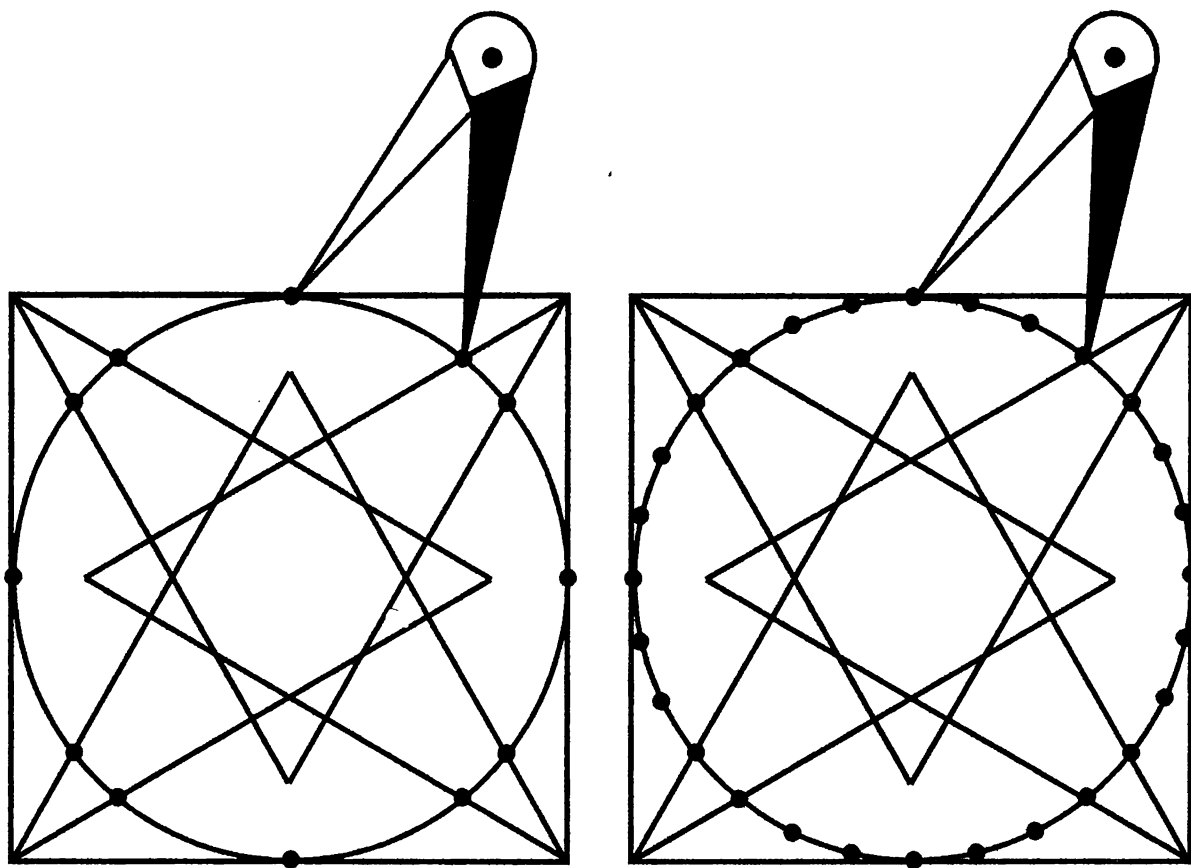
Twenty eight is called a "perfect" number since it is equal to the sum of its own divisors: $28 = 1 + 2 + 4 + 7 + 14$. (Six is the previous perfect number: $6 = 1 + 2 + 3$. The next is 496. Can you prove it?)

There are a variety of ways to find the 28 points around the Moonpath Circle.

One way requires knowing how a circle, square and triangle will reveal the seven points of a Heptagon around the circle. (See Volume 2 Chapter 7 for Heptagon constructions.) Doing the Heptagon construction four times (once with each triangle) will reveal the 28 points.

Another way (below) is to realize that we're already shown twelve points (of the twenty eight) where the triangles cross the circles plus NSEW points. We need sixteen more.

If we place the point of the compass on the North point of the Moonpath Circle, and open the pencil to the nearest point where a triangle crosses that circle as shown, we'll have a measure which lets us "walk" the compass around the circle until we've found 16 new points for a total of 28.



17) Our next step is to connect the 28 points with straight lines to make the star pattern shown below.

Since $28 = 4 \times 7$, we can see this as four overlapping Heptagram stars, one of which is shaded.

One way to connect points is done is by counting.

Start with the top point as "1" and then count around to 13.

Connect these points with a straight line.

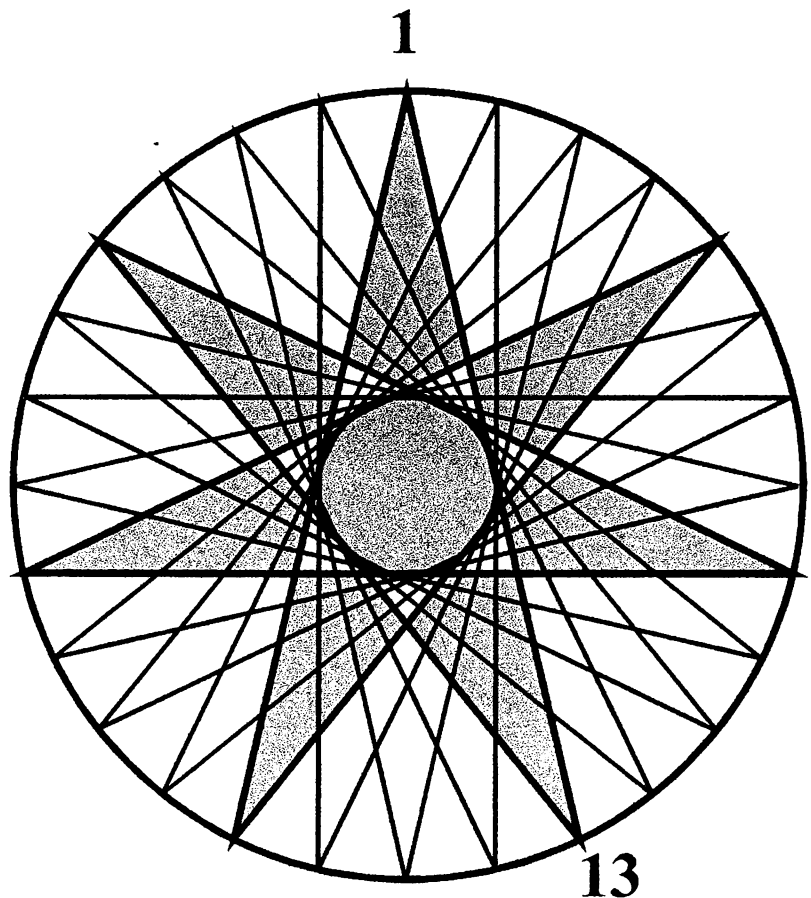
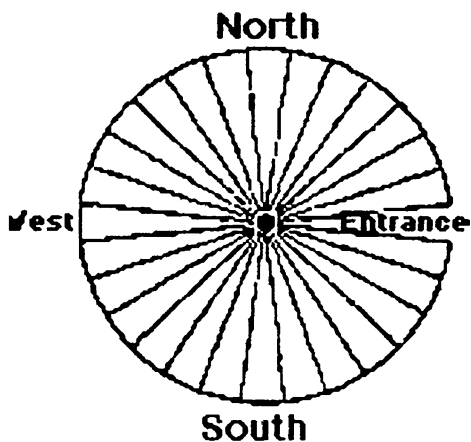
Repeat the process, now starting with that 13th point as the new first point "1", and count around to 13 again. Connect those points and repeat until all lines are drawn.

Another way is done by imagining a diameter from the top point extending straight down through the center of the circle to the point on the other side. Then count two points away and connect that point to the first point. Then imagine a diameter across the center from *that* point, count two more around in the same direction and draw that line. Repeat this until all lines are drawn.

Whatever method you choose, notice that the lines can reveal four Heptagons and Heptagrams, and a roughly circular space at the center.



Twenty eight poles and beams structure a Native American Lodge House (above) and Medicine Wheel (below).

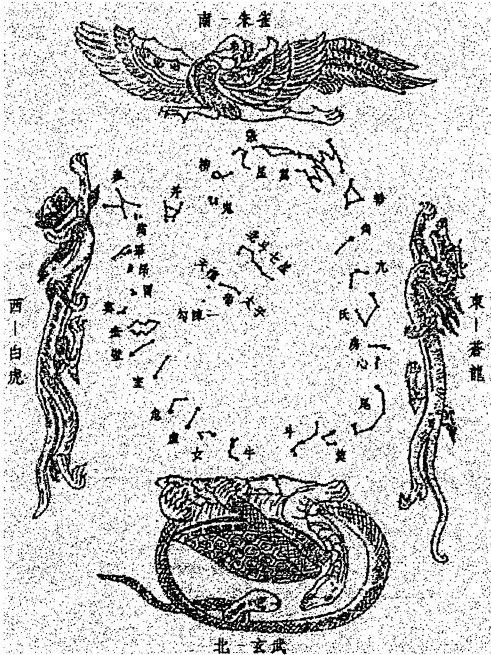
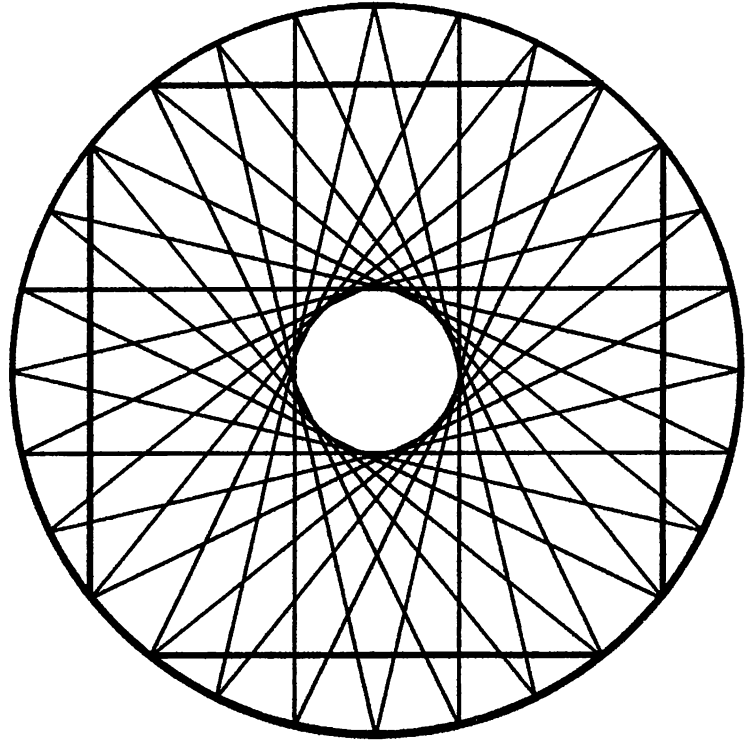


18) Now, carefully draw four lines connecting every seventh point *as shown here*.

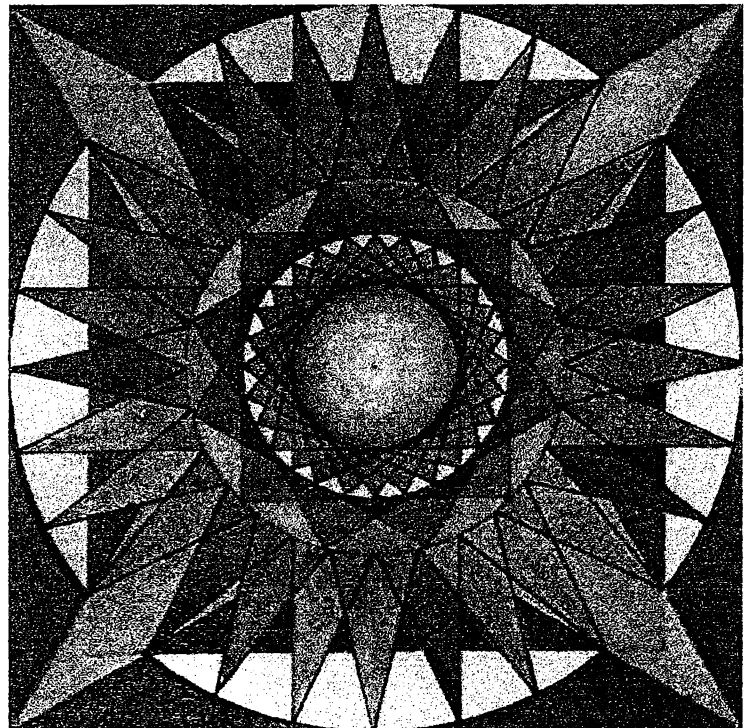
Notice that the four line segments *nearly* create a square.

Only its four corners are missing. This square will "square the circle".

But we'll put that aside for a moment.



Chinese astronomy divided the sky at the equator into twenty eight areas (*seishuku*) within twelve "palaces". Four celestial dragons (mirroring China's four major rivers) guard the cardinal directions.



Watercolor by John Michell

19) We'll now put four "moons" or "pearls" in the cardinal directions of the Moonpath Circle.

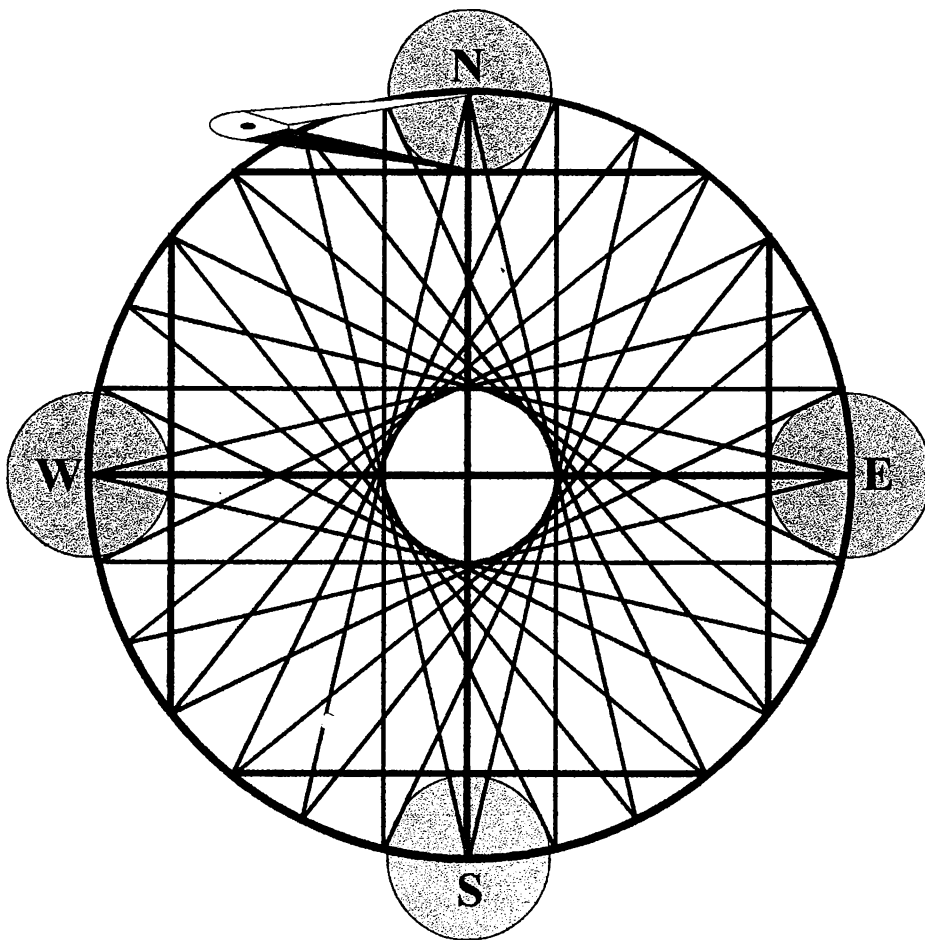
First draw two diameters (if they're not already there) across the Moonpath Circle by connecting the North-South and East-West points.

Now place the compass point at the North point of the Moonpath Circle. Open the pencil to where the circle's North-South diameter crosses the horizontal line. Carefully turn that North moon circle.

Draw three more identical moons at the South, East and West points of the Moonpath Circle.

Notice that these moons *do not touch the points* at either side of them but fall slightly short. (You can see this better in larger constructions.) See that each moon is nestled into the space and *rests on the lines!*

Note also that the central circle formed by the lines of the 28 star rays is identical in size with the outer moons, implying a moon at the construction's center.



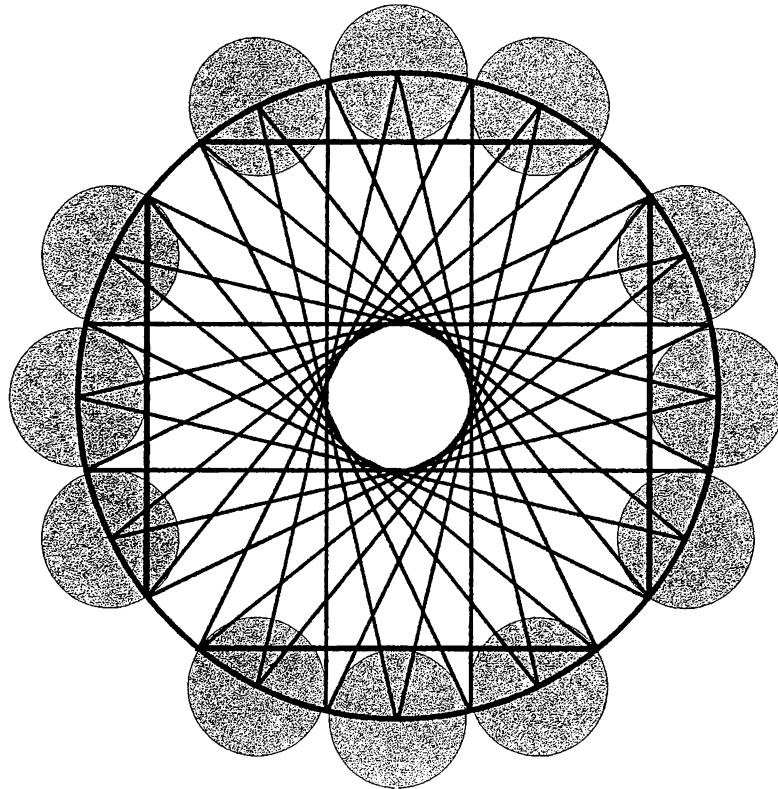
20) Now we'll draw two moons alongside each of these four, eight more, to reveal all twelve moons or "pearly gates" to our Cosmological City.

The center of each moon, of course, lies on the Moonpath Circle.

To draw these eight moons, keep the exact same compass opening (equal to the moon's radius) and place the compass point on each of the eight points as shown below and turn small moon circles.

Notice that the twelve moons are not equally spaced around the Moonpath Circle, but appear as four groups of three in the cardinal directions.

Note also that the twelve moons do not touch each other but there is a slight gap between them. They nestle in the rays of the 28-star which keeps them slightly apart. Notice also that the eight additional moons *do* touch the points at the ends of the four lines.



The New Testament alludes to it this way:

"And [The Heavenly City] had a wall great and high, and had twelve gates....
On the east three gates; on the north three gates; on the south three gates; and
on the west three gates....

And the twelve gates were twelve pearls: every several gate was of one pearl:
and the street of the city was pure gold, as it were transparent glass."

-- Revelation 21:12-13,21

21) Now we'll complete the corners of the unfinished square to finally "square the circle" in the New Jerusalem diagram at the heart of the Cosmological Circle.

First, find (or draw) two diagonals across the square around the Moonpath Circle.

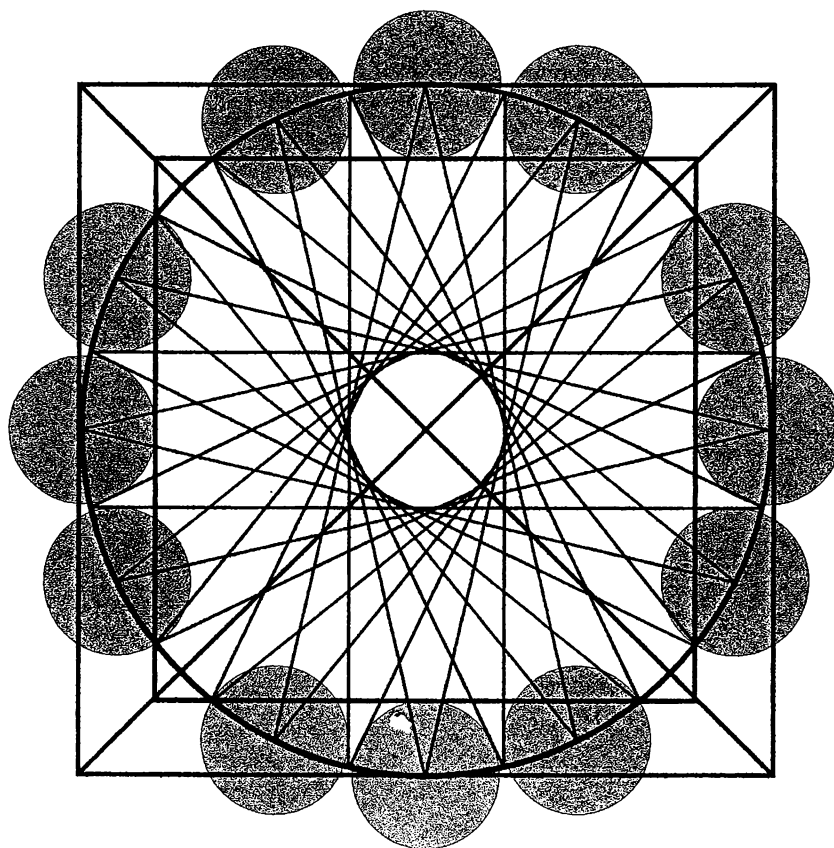
Using your straightedge, carefully extend the four sides of the unfinished square until they reach the diagonals. Test the points against your straightedge before you draw.

The square's sides should meet exactly at the same four corner points on the diagonals.

This "squares the circle". That is, the perimeter of the inner square is equal to the circumference of the Moonpath Circle (when pi is approximated to $22/7$. See the next section *The Number Canon*).

This "squaring of the circle" symbolizes a sacred meeting place of Heaven and Earth, the ideal and the actual, fused in one scheme.

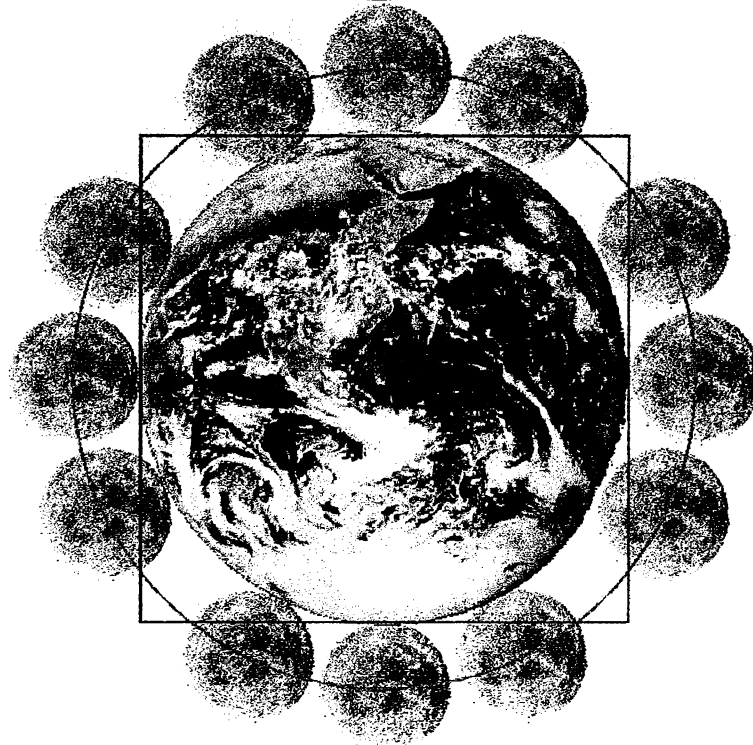
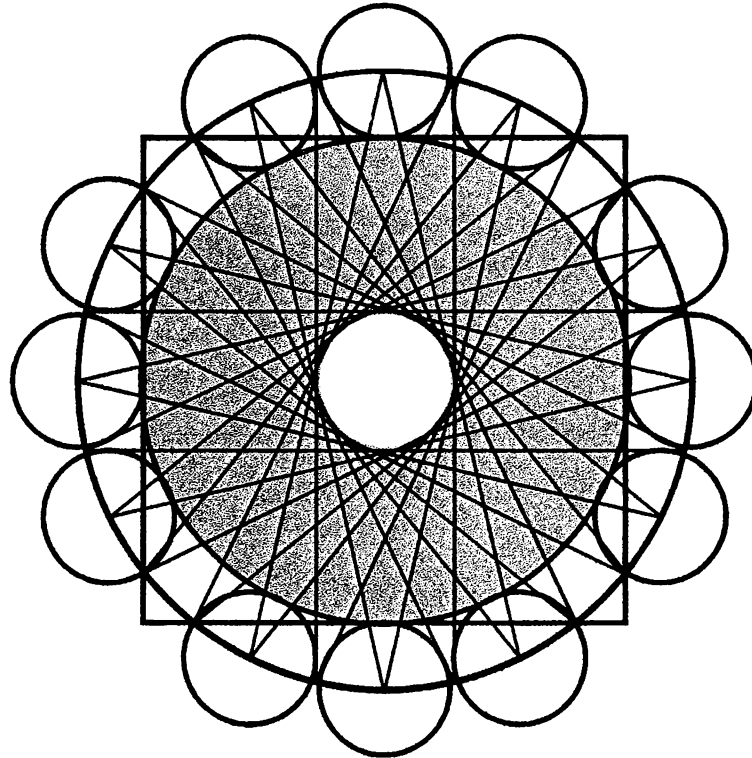
But where is Earth itself in the diagram?

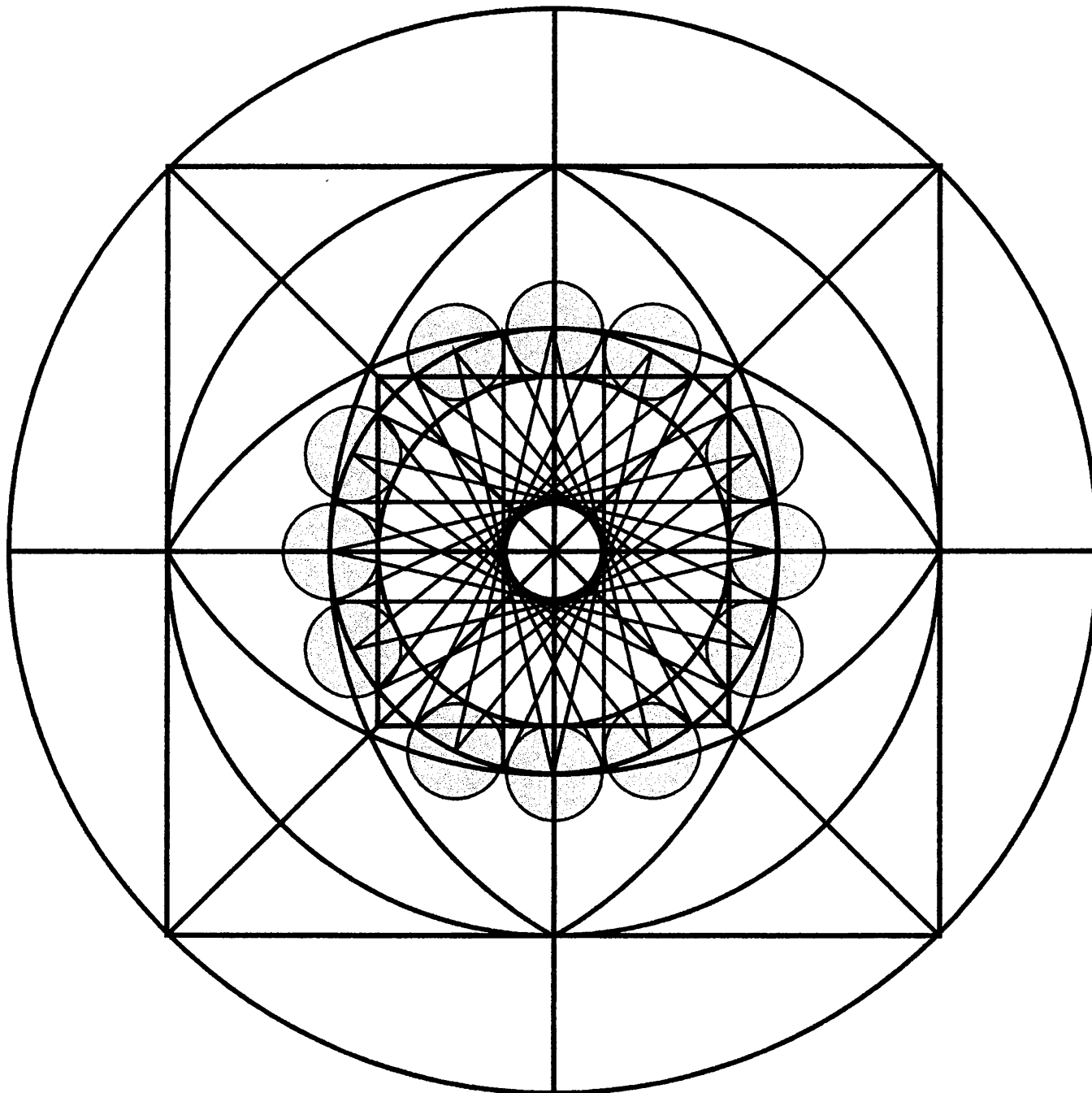


22) The Earth's dimensions are found in a circle inscribed within the innermost square just constructed.

Place the compass point at the center of the construction and open its pencil to the middle of one side of the square (where it crosses the North-South and East-West diameters). Turn the circle (shaded below). It should just touch the midpoints of the sides of the square.

This shows the correct size of planet Earth relative to the size of the moon, and much more, as we shall soon see. Notice the thirteenth "moon" implied at the center.



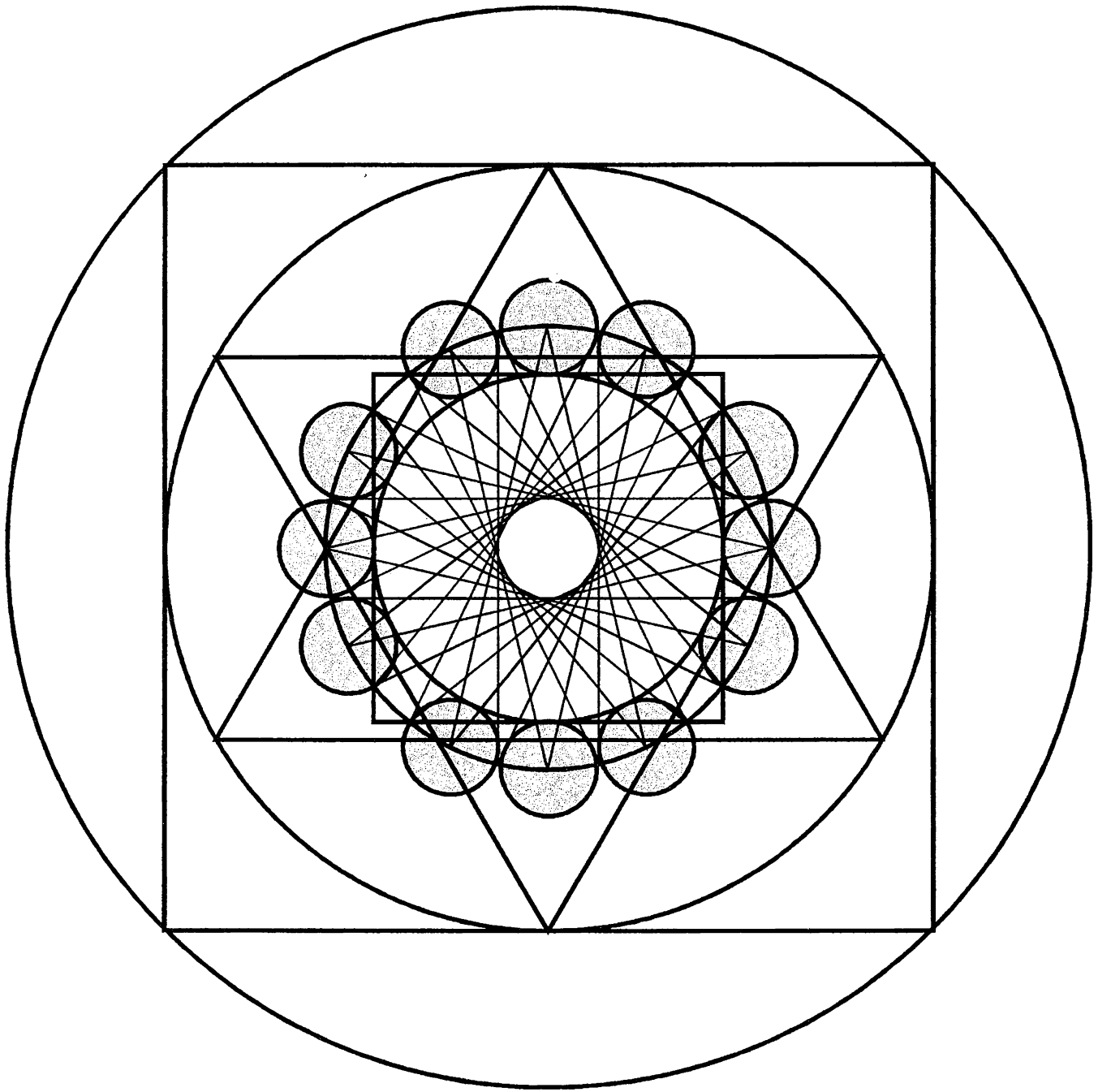


This completes the Cosmological Circle diagram construction.

Congratulations if you've successfully completed it!

It's hoped that readers will do this construction more than once until its steps become familiar. It's here for you to explore as others have done over many centuries. Creative people may develop it by emphasizing its various stages and possibilities. Discover, don't innovate. That is, don't make up imaginary points but use existing proportions to guide you and discover the Cosmological Circle's hidden wonder and wit.

Many more interesting number and shape relationships await to be revealed and discovered in this mathematical image of our harmonious Cosmos.



Here is the completed Cosmological Circle diagram with a Hexagon (page 59) instead of *Vesicas Pisces*.

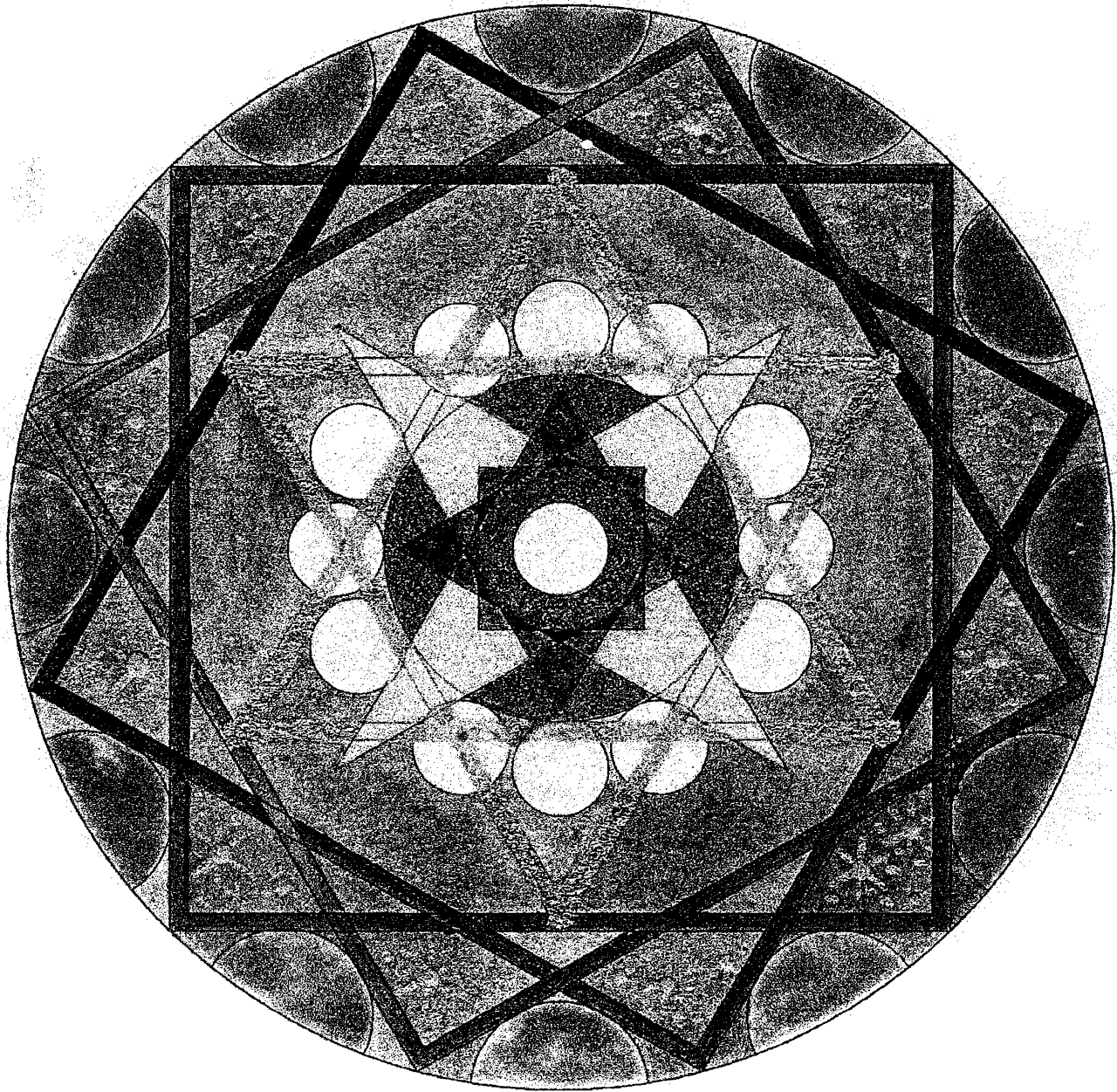
Soon we'll look deeper, beyond its geometric mask, to see how this diagram emerges from the void of a blank page to harmonize all the numbers one through twelve.

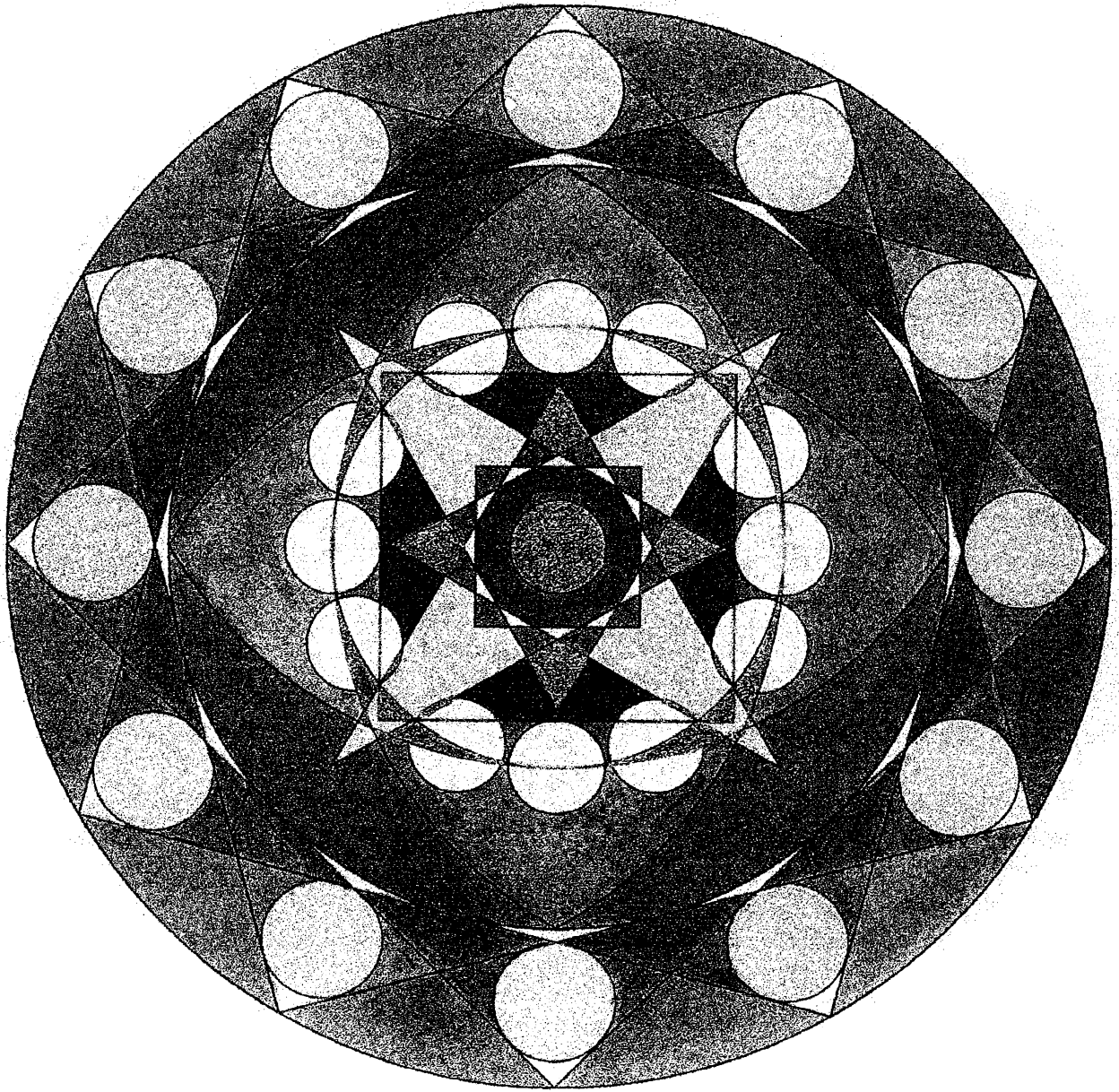
But first, let's see how it's possible to play with variations on the diagram.

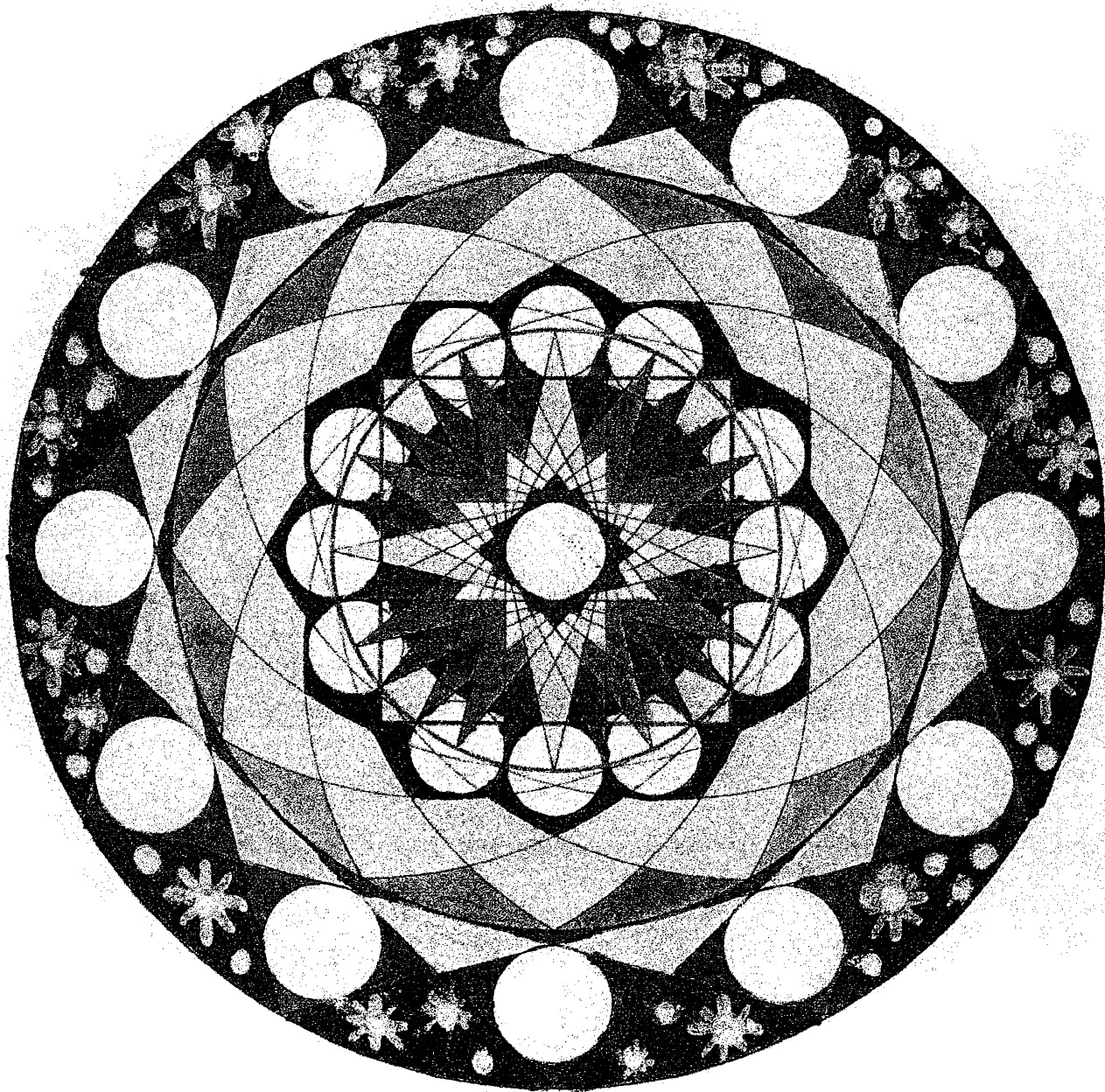
Watercolor Variations

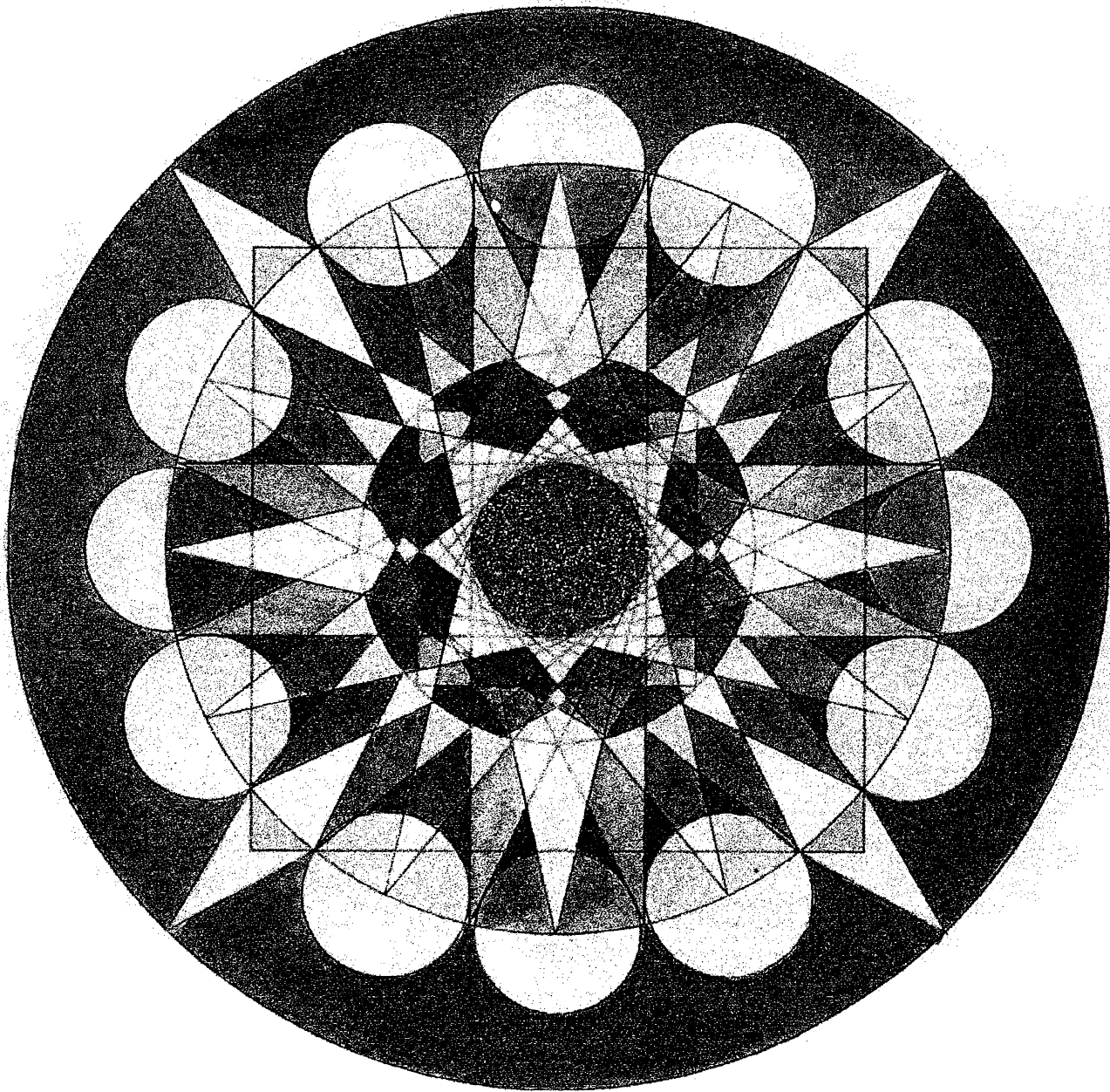
Here are some paintings I've done emphasizing and developing different aspects of the construction.

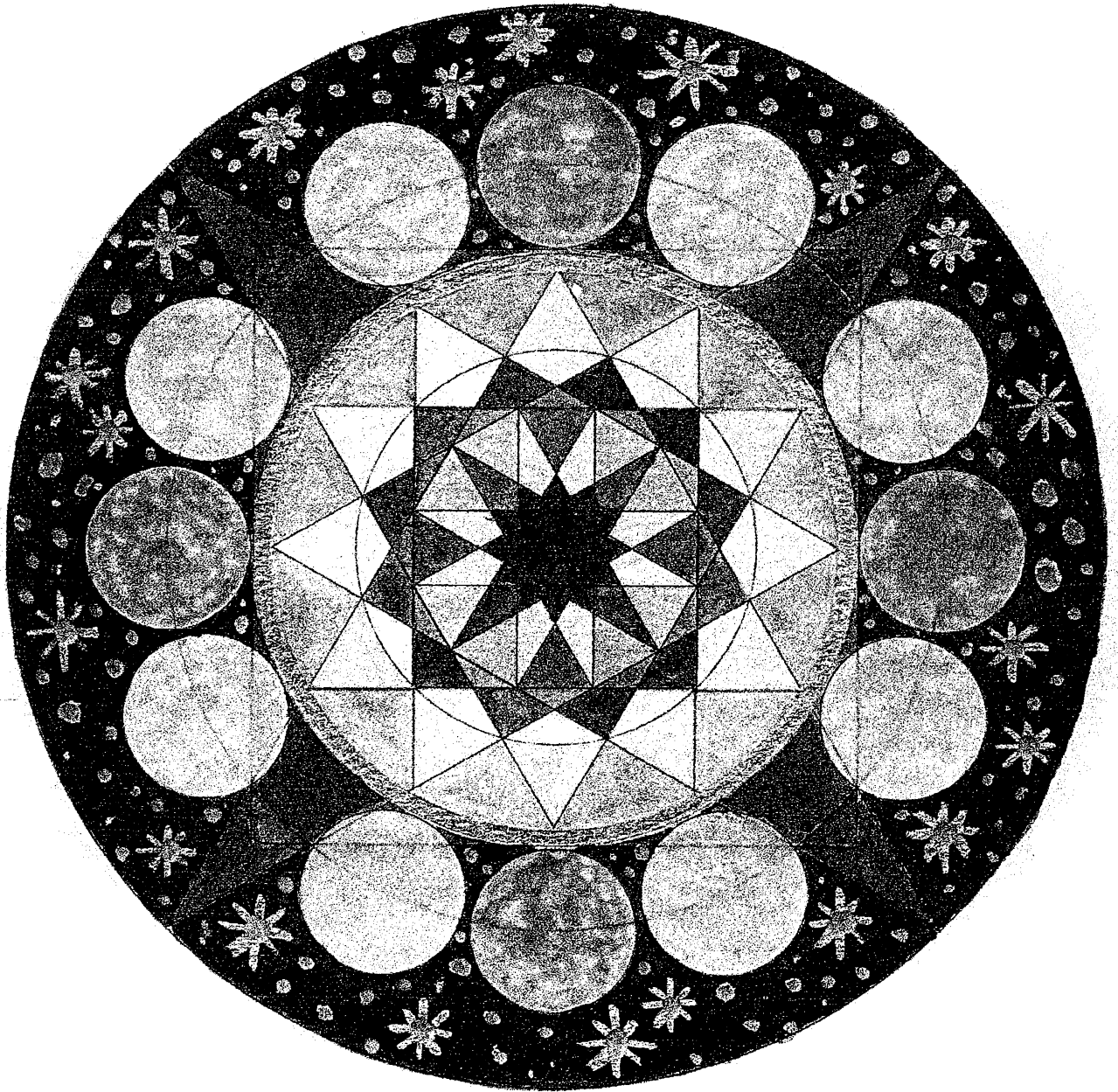
See them in color at <http://www.constructingtheuniverse.com/paintings.html>

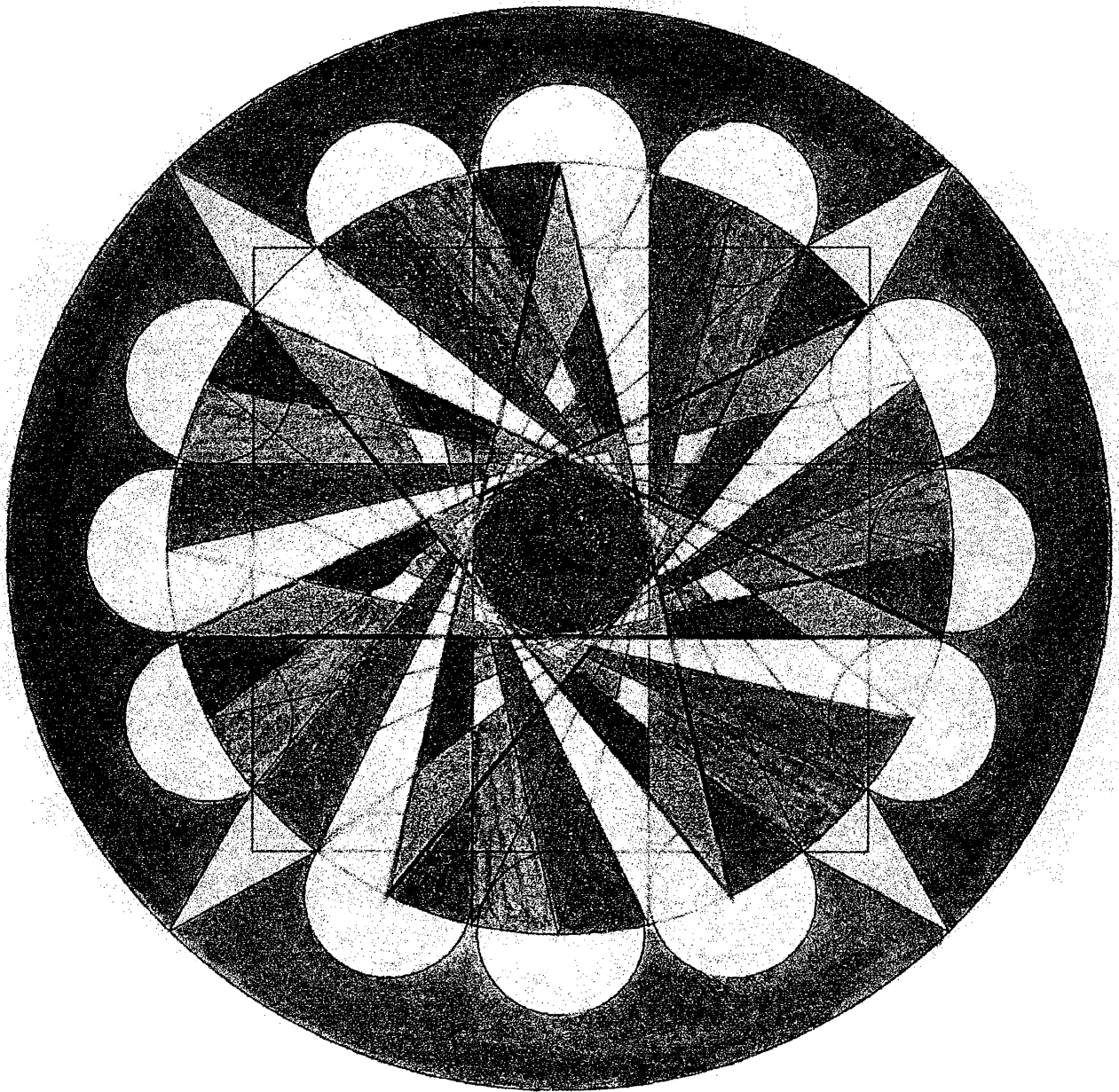


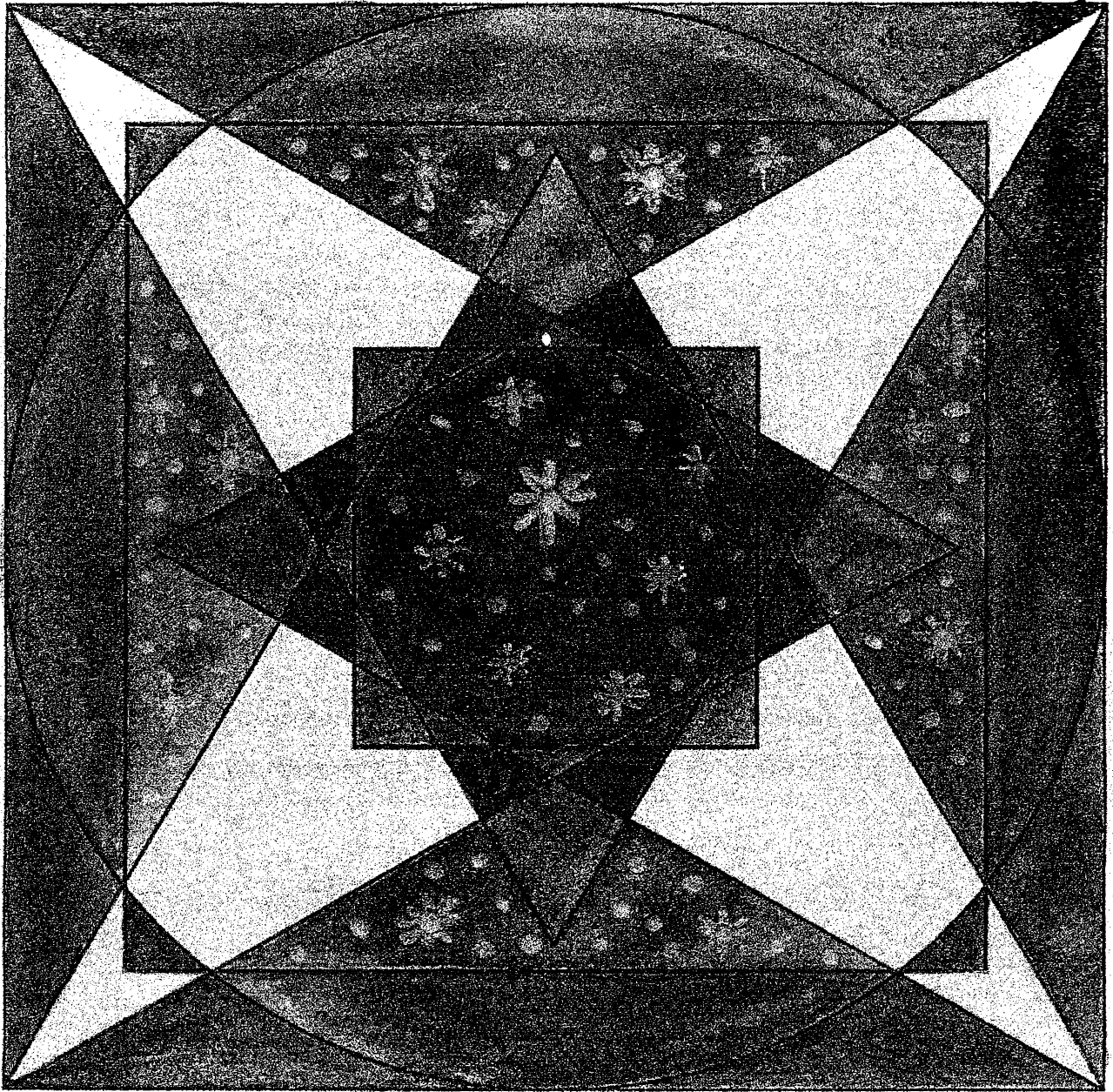










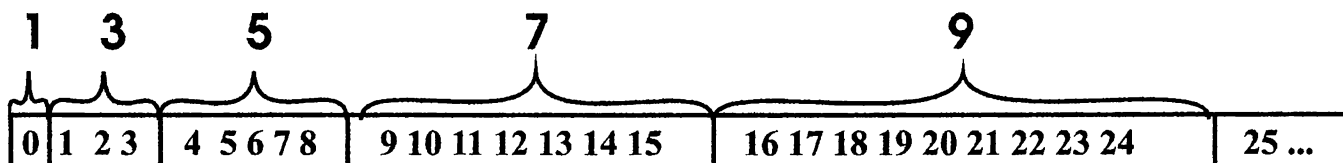


The Number Canon

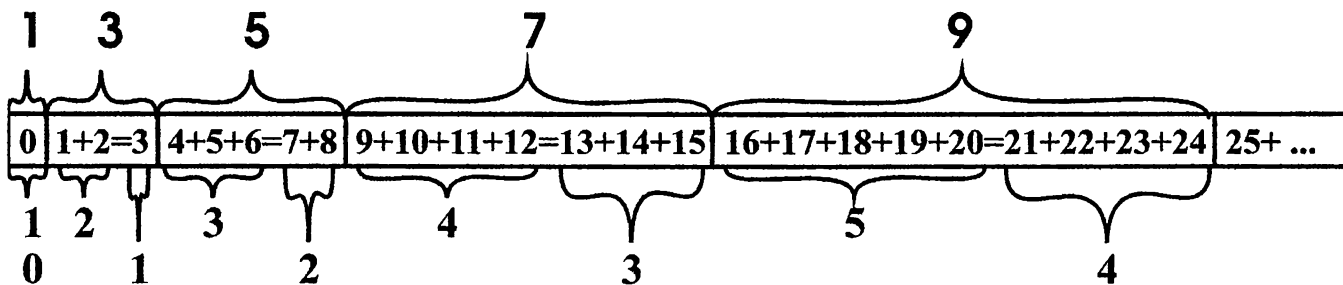
There's nothing more fundamental than number. Pythagoras said so, and even modern scientific orthodoxy recognizes mathematics as the foundation or "queen of the sciences". This is why number has always been considered fundamental to creation, the ongoing creating process of nature.

Numbers are usually only incidental to most of our lives. We use them for measuring, calculating, commerce and paying bills. But they can teach us more, simply by their existence. Consider the ordinary sequence of numbers, the "number line". If we even think of it at all, we usually see it as an endless chain of growing amounts. But children should be shown that there is an inner order in this number line. No one invented it or made it happen. It has always been true and can be discovered by anyone who looks.

So look at the beginning of the "whole number" line, starting with zero. Then separate the numbers into groups: one number (zero), then a group of three numbers (1, 2, 3), then five numbers (4, 5, 6, 7, 8), seven numbers, and so on. Notice that these groups of 1, 3, 5, 7, 9, ... is just the series of odd numbers.



We can further divide each group into two different-size parts separated by an equal sign. Then by putting plus signs between the remaining numbers they achieve equality and balance within each group.



For example, in the second group, the sum of the first two numbers equals the third ($1+2=3$). In the third group, its first three numbers add together to equal the next two ($4+5+6=7+8$). In the fourth group, the first four numbers add together to equal the sum of the next three ($9+10+11+12=13+14+15$). And so on, this pattern continues forever. The order-number of each group tells us how many numbers to add together on the left of the equal sign, and one fewer on the right, so each group will always balance within itself. On your own, continue the pattern further along the number line. What would this look like made of colored beads?

Notice also that the subgroups form sequences of the counting numbers: 1,2,3,4,5,... This means that whole groups can be grouped together to expand this ongoing balance forever on multiple levels.

This is only one small view into the harmonious order that numbers weave and reveal, entrancing mathematicians for centuries. (See also page 310 in *A Beginner's Guide*, and next page here, to see patterns within the multiplication table.) Numbers are a map of the beautiful order of the universe, the plan by which the Divine Architect transformed undifferentiated Chaos into orderly Cosmos. Cultures didn't nec-

“For the nature of number is to be informative, guiding and instructive for anybody in everything that is subject to doubt and that is unknown.

For nothing about things would be comprehensible to anybody, neither of things in themselves, nor of one in relation to the other, if number and its essence were nonexistent

One cannot only observe in the actions of demigods and gods the essence of the number and the power operative in it, but also everywhere, in all actions and words of men and in all branches of handicraft and in music.

The essence of number, like harmony, does not allow misunderstanding, for this is strange to it. Deception and envy are inherent to the unbounded, unknowable, and unreasonable... .

Truth, however, is inherent in the nature of number and inbred in it.”

— Philolaus (5th Century BC, Greek Pythagorean philosopher)

“Mathematics is the natural language of man.”

— Alfred Korzybski

X	1	2	3	4	5	6	7	8	9
1	①	2	3	4	5	6	7	⑧	9
2	2	4	6	⑧	①	3	5	7	9
3	3	6	9	3	6	9	3	6	9
4	4	⑧	3	7	2	6	①	5	9
5	5	①	6	2	7	3	⑧	4	9
6	6	3	9	6	3	9	6	3	9
7	7	5	3	①	⑧	6	4	2	9
8	⑧	7	6	5	4	3	2	①	9
9	9	9	9	9	9	9	9	9	9

X	1	2	3	4	5	6	7	8	9
1	1	2	3	④	⑤	6	7	8	9
2	2	④	6	8	①	3	⑤	7	9
3	3	6	9	3	6	9	3	6	9
4	④	8	3	7	2	6	①	⑤	9
5	⑤	①	6	2	7	3	8	④	9
6	6	3	9	6	3	9	6	3	9
7	7	⑤	3	①	8	6	④	2	9
8	8	7	6	⑤	④	3	2	①	9
9	9	9	9	9	9	9	9	9	9

Some patterns within the multiplication table.

essarily learn this from each other but only had to *look at numbers and their relationships* to see how they reveal harmonious models which are the same everywhere and at all times.

Harmonious interconnections among numbers and shapes occur various ways. The Cosmological Circle represents a matrix of numbers providing a deeper glimpse into the ways that seemingly disparate elements are actually united in harmony.

The Cosmological Circle expresses a number canon based on the first twelve numbers and their interplay. This word "canon" usually refers to a rule (or set of rules) guiding a field of art or philosophy. It actually derives from the Babylonian word *kanu* meaning "cane", not just the walking stick but a measuring rod, ruler, radius, a true standard of measure. The Cosmological Circle diagram reveals these canonical framework numbers, the scaffolding of creation with their interlocking relationships.

Whenever a culture or an individual gazes deeply into the natural organization of numbers they find this canon, an organization of harmonies in the unchanging structure of number. It has served as a set of standards which was applied to everything from the structure of society and government to the proportions of temples and brooms. Sacred arts, sciences, philosophy and sacralized landscapes of every great tradition were designed to model this eternal Truth. The natural organization of number was the traditional standard which ordered and served to sanctify the ancient world order. As we look at the canonical numbers of the twelvefold matrix of the Cosmological Circle notice how these same numbers were applied in diverse ways by different cultures.

Numbers are the rational mediator between the Divine wisdom and human understanding, allowing us to marvel at the beautiful order of creation. Let's look through the geometric mask of the Cosmological Circle to its source in pure number, beyond which the rational mind cannot penetrate. What are the numbers this great mask is presenting to us?

Traditional Twelve

To appreciate the numerical wonders of the Cosmological Circle and its role as a universal standard representing the number canon, it's essential to appreciate the number twelve.

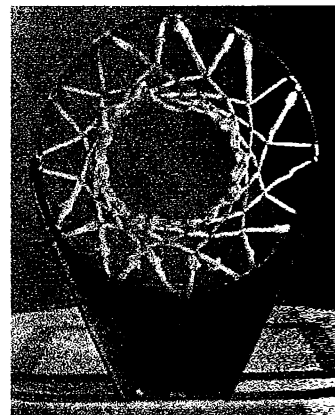
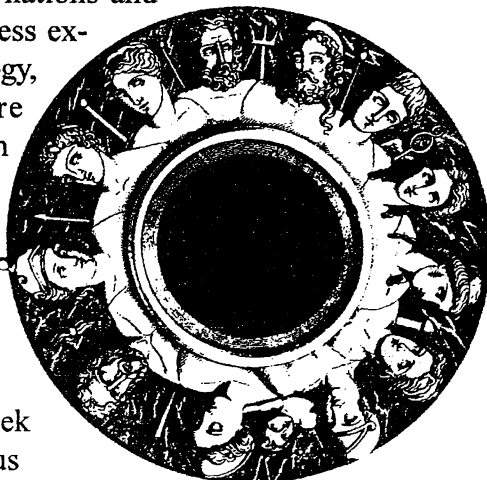
For a relatively small number, twelve has many (six or 50%) divisors (1, 2, 3, 4, 6, 12) while ten only has four (1, 2, 5, 10). Thus there are more ways to equally distribute a dozen items than ten. Twelve and ten together are especially powerful. Consider the number of divisors of ten dozen.

Even though we count by tens on ten fingers, some cultures counted by using our retractable thumb as pointer to the twelve bones of our four fingers. While most of the world has "gone metric" (although no one has ever voted upon it), in the United States we continue the ancient numerical tradition by counting our eggs, roses, jurors, months and inches by dozens.

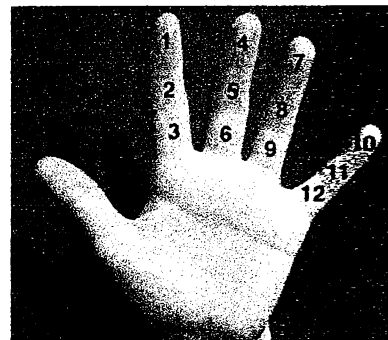
There are clues about counting by twelve hidden in plain sight in our language. Consider that in the English names of the first twelve numbers each number has an individual name, but it is only *after* twelve that a "-teen" or "ten" is added.

Consider the history and mythologies of twelve part cosmogenies, cosmologies, pantheons of deities, cults, ordeals, royal courts and other duodecimal divisions of the world, society and self (see *A Beginner's Guide* pages 197+). Twelve, or more fully twelve-around-one, is everywhere the supreme symbol of a complete cycle and whole universe. Recall the twelve Greek gods of Olympus, the twelve labors of Heracles, disciples around Christ, twelve knights of the Round Table sworn to King Arthur, twelve zodiacal constellations around the sun, twelve Jewish tribes around Jerusalem, twelve voiced letters of the Hawaiian alphabet around one silent aspirant, duodecimal rose window patterns, and the ancient twelve part divisions of nations and tribes and laws in countless examples of history, mythology, religion and literature worldwide. They each present us with a microcosm, a harmonious whole having twelve attributes around a motivating center.

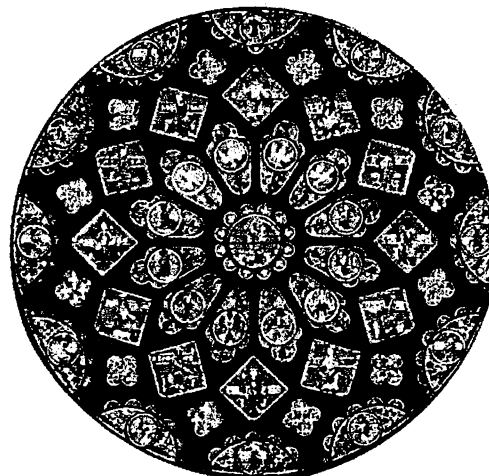
The twelve Greek gods of Olympus



Basketball Hoop



Rose window
Chartres cathedral



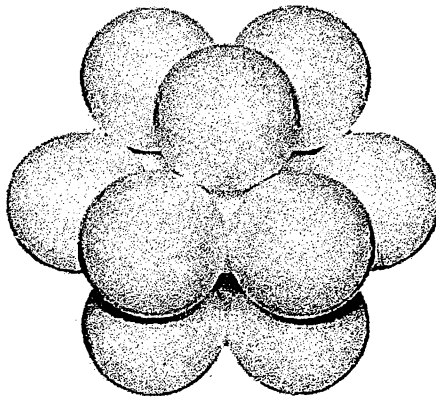
Twelve structures unity.

12 inches = 1 Foot.

Most of the world has scrapped the flexible ancient system of "twelve-ten" measure for the limited metric system. Worldwide measures traditionally were aspects of the canonical structure of numbers, and rulers' lengths were related by simple fractions.

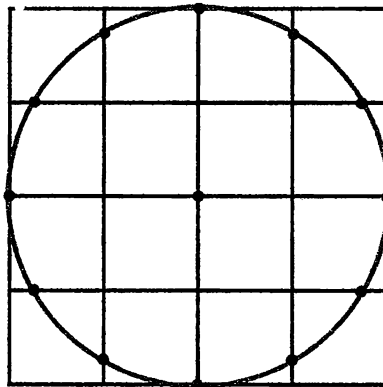
Twelve is considered the "framework number". Although we count by tens, the numbers themselves organize around twelve and its multiples. While counting by tens is "easy", twelve reveals the underlying structure, the beams and girders holding all numbers together.

One way to see this is with geometry. Each of these "twelves" (or "twelve around one") schemes creates a whole unit around a center. They're geometric models for the traditional societal amphictyony, twelve groups of dwellers around a central shrine.

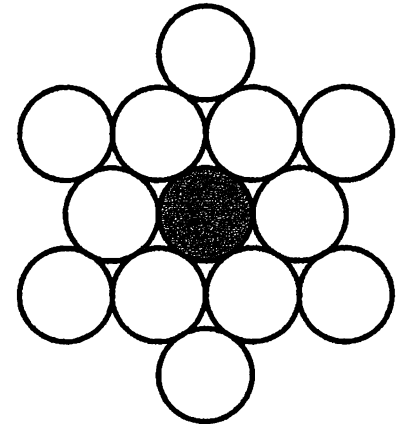


Twelve spheres close-pack around a center. Each touches four others and the center, perfectly fitting around it.

Connecting the spheres' centers with straight lines makes a "cubeoctahedron", the "dymaxion" ("dynamic maximum") ideal of Buckminster Fuller.



A circle inscribed in a 4x4 square crosses the lines naturally at twelve equally spaced points.

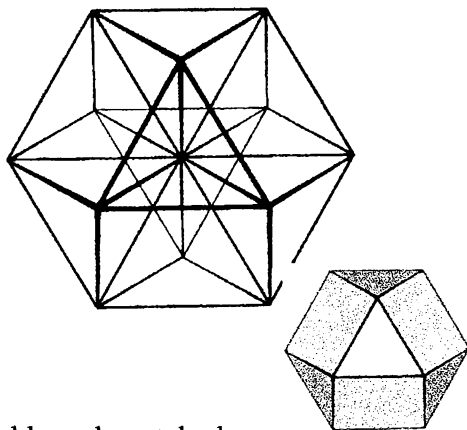


Twelve identical circles, like coins, will fit perfectly around one at the center.

Twelve around a center is a way of expressing unity.

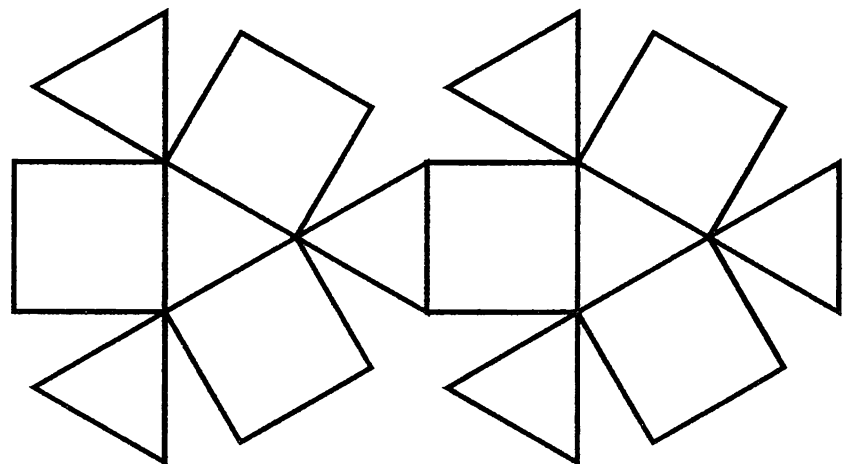
Through twelve, unity becomes structured and recognizable.

Chaos is transformed to Cosmos.



Fold a cubeoctahedron.

Cut out identical triangles and squares and join them in this pattern.



Highly Composite Numbers

Twelve and its multiples provide a scaffolding on which other numbers hang. How can we see this?

Consider the list in the box below showing numbers with their divisors, the smaller numbers which divide neatly into them. As numbers get larger they naturally have more divisors.

Notice the numbers (in bold) which show *the first time there are more divisors than before.*

One has one divisor.

Two has two divisors.

But three also has two divisors, nothing new.

Four has three divisors, a new level.

Five only has two divisors, but six has four divisors, another new level.

The next number to have more than four divisors is twelve, with six divisors.

What's the next number to have more than six divisors? Twenty four, with eight divisors, another new level.

The next number after two dozen with more divisors is thirty six, three dozen, having nine divisors.

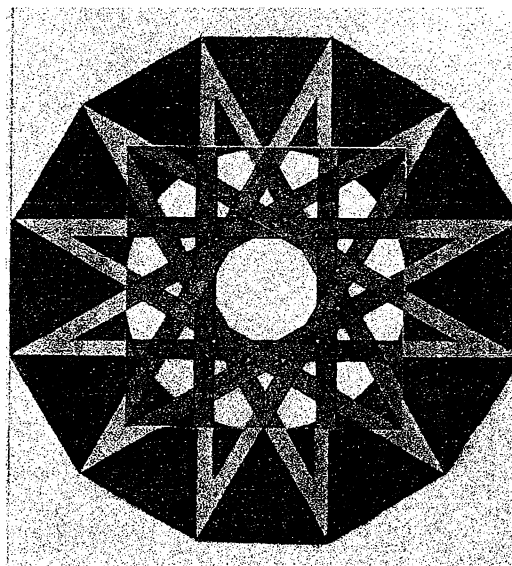
The sequence of numbers which represent each next higher number of divisors are called "Supercomposite Numbers", "Highly Composite Numbers" and also "Versatile Numbers". They begin

1, 2, 4, 6, 12, 24, 36, 48, 60, 120, 180, 240, 360, 720, 840, 1260, 1680, 2520, 5040, 7560, 10080,

Each number in this series has *more factors (divisors) than any smaller number.*

Thus, each can be split evenly *in more ways* than any number less than it (and some greater). They're the most just.

You may have already noticed that these Highly Composite numbers are all divisors and multiples of twelve.



Watercolor by John Michell

#	<u>Divisors</u>
1	1
2	1, 2
3	1, 3
4	1, 2, 4
5	1, 5
6	1, 2, 3, 6
7	1, 7
8	1, 2, 4, 8
9	1, 3, 9
10	1, 2, 5, 10
11	1, 11
12	1, 2, 3, 4, 6, 12
13	1, 13
14	1, 2, 7, 14
15	1, 3, 5, 15
16	1, 2, 4, 8, 16
17	1, 17
18	1, 2, 3, 6, 9, 18
19	1, 19
20	1, 2, 4, 5, 10, 20
21	1, 3, 7, 21
22	1, 2, 11, 22
23	1, 23
24	1, 2, 3, 4, 6, 8, 12, 24
25	1, 5, 25



List of Highly Composite Numbers

Each Highly Composite Number represents the first time that a higher quantity of divisors has appeared.

Twelve provides the main scaffolding of a natural structure upon which all other numbers hang.

<u>Order</u>	<u>Highly Composite Numbers</u>	<u>How Many Divisors?</u>
0	1	1
1	2	2
2	4	3
3	6	4
4	12	6
5	24	8
6	36	9
7	48	10
8	60	12
9	120	16
10	180	18
11	240	20
12	360	24
13	720	30
14	840	32
15	1260	36
16	1680	40
17	2520	48
18	5040	60
19	7560	64
20	10080	72

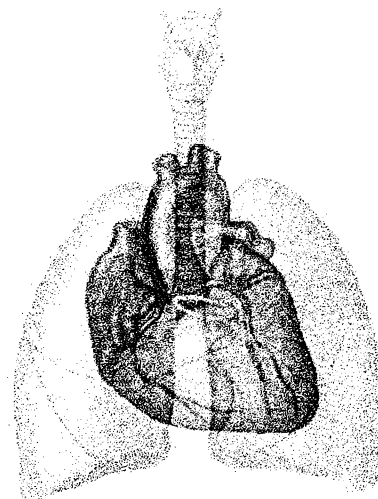
Rhythms of Human and Celestial Bodies

Number patterns represent ideals. Nature attempts to align with the ideal, but can only approximate it. Some of the Highly Composite Numbers show up as naturally as breathing and as close as our heartbeat. Look at this chart. On average, ideally, people have seventy two full heart beats and take eighteen breaths each minute. That's twelve heartbeats and three breaths every ten seconds.

Check your own heartbeat and breath using a timepiece with a secondhand counter.

We're integrated in the cosmic harmony without even trying, just by living and breathing.

HEART BEATS	BREATHS	TIME
12	3	10 seconds
72	18	1 minute
360	90	5 minutes
720	180	10 minutes
4,320	1,080	1 hour
8,640	2,160	2 hours
25,920	6,480	6 hours
103,680	25,920	1 day (= 24 hours)

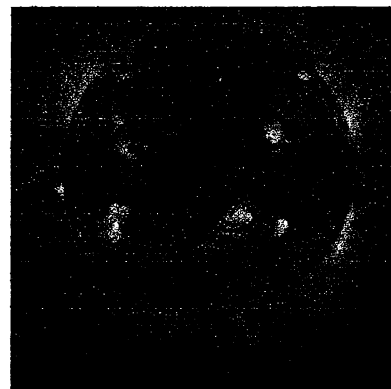


Some of these very same numbers and their multiples show up in the dimensions of the sun, earth and moon. Find them below. The number of miles in their radii and diameters resonate with the numbers of our breaths and heartbeats. The sizes of measures such as inches, miles and minutes were chosen to reveal these canonical numbers.

(Miles)	<u>Sun</u>	<u>Earth</u>	<u>Moon</u>
Diameter	864,000	7,920	2,160
Radius	432,000	3,960	1,080

The diameters of earth and moon added together equal $7920 + 2160 = 10080$ (another Highly Composite Number).

This brief introduction to some of the canonical numbers will help us to recognize them organized for all eternity in the Cosmological Circle diagram.



The New Jerusalem Grid

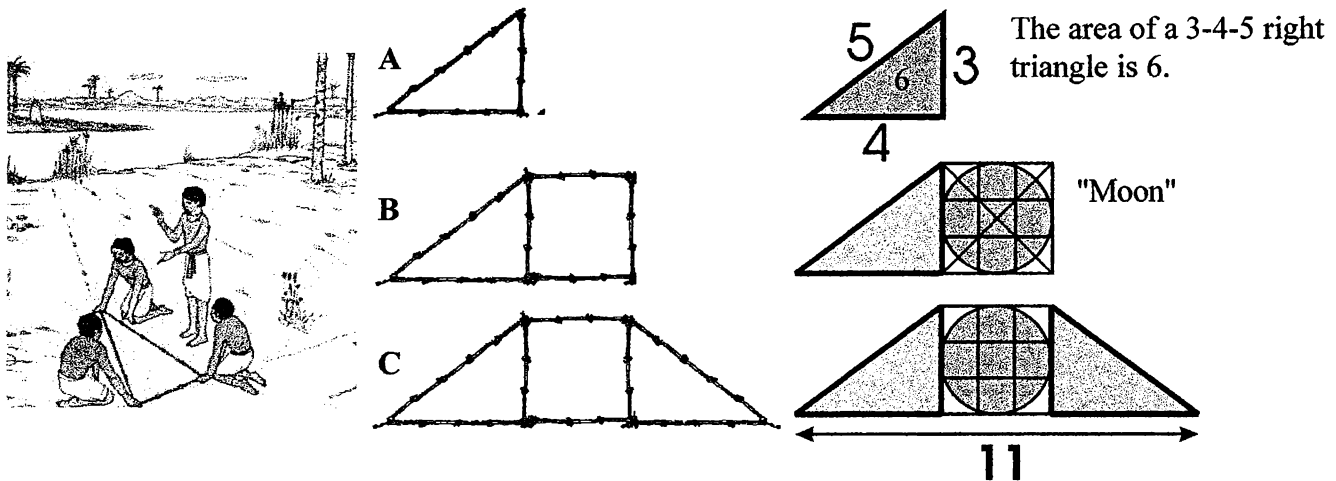
There are many ways to begin looking at the numbers of the Cosmological Circle. One way is to take a most primitive approach, using a loop of rope having twelve equally spaced knots or markers in it, as was done in Egypt, Babylon, India, Greece and elsewhere.

(A) A twelve-knotted rope makes a right triangle having sides of three, four and five.

(B) A twelve-knotted rope also makes a square with sides of three, in which a "moon" fits.

C) Another three-four-five right triangle flanks the square on its opposite side.

The length of the base of this construction is $4+3+4= 11$ units.



(D) If the 3x3 square holds a circle representing the moon, then an 11x11 square made on the long side of our construction contains a circle the size of the Earth!

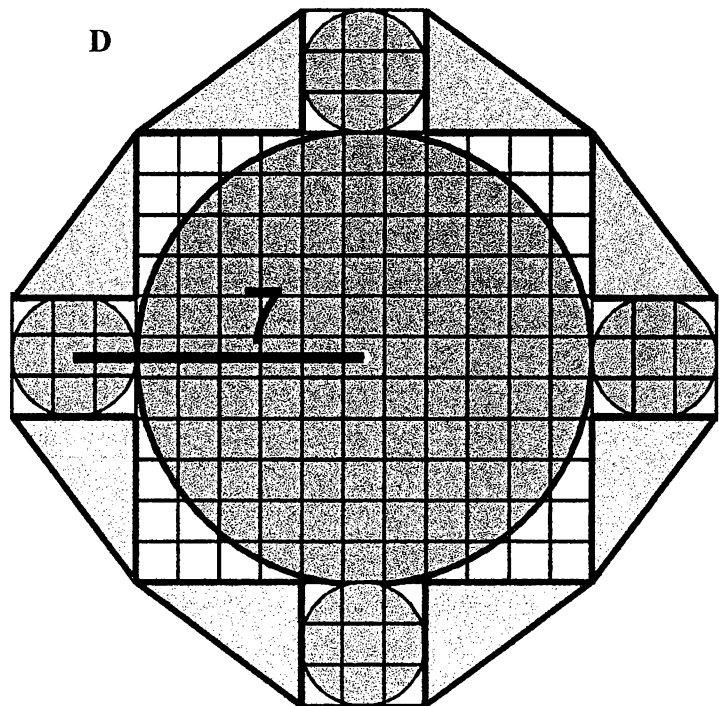
The diameters of the earth and moon form a ratio of eleven to three. Use a calculator to divide and confirm that

$$7920 / 2160 = 11 / 3$$

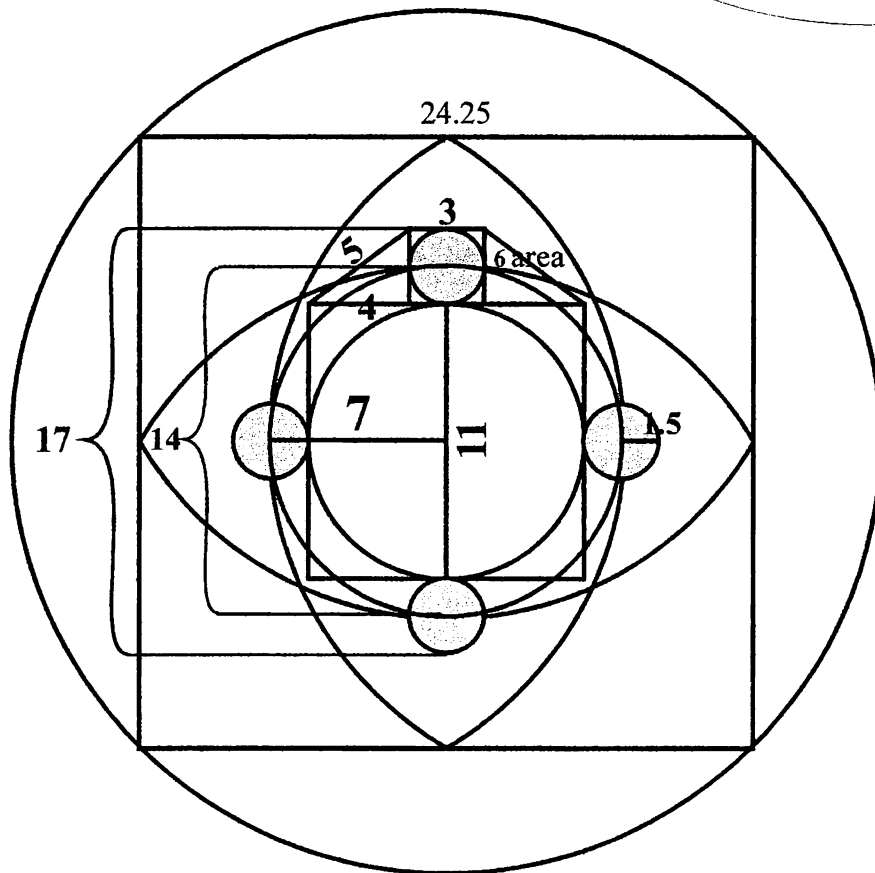
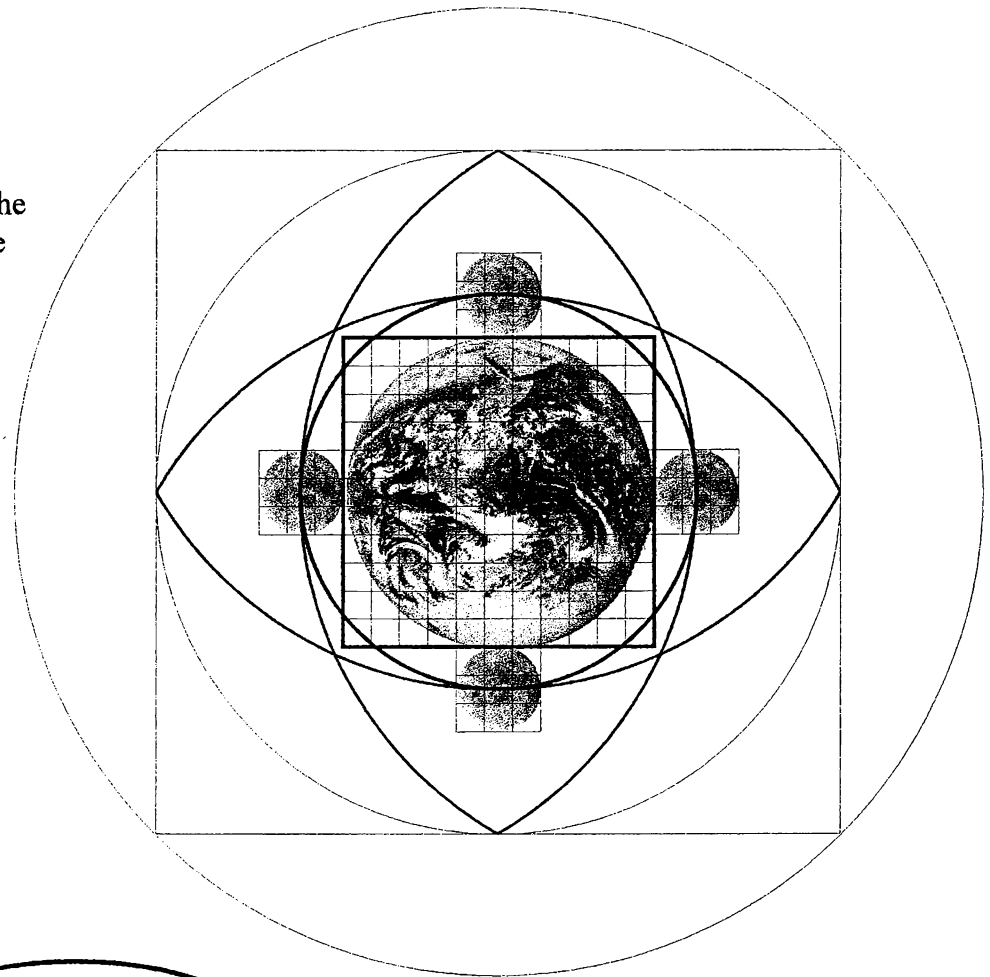
The square around the earth has a perimeter of forty four.

On this grid, the radius of the earth plus the radius of the moon equals seven.

These are the simple numbers at the heart of the Cosmological Circle, the central area sometimes known as the New Jerusalem diagram.



The Earth-Moon "New Jerusalem" grid within the full Cosmological Circle



Diameter of Moon = 3
Diameter of Earth = 11

Radius of Moon = 1.5
Radius of Earth = 5.5

Radius of Earth +
Radius of Moon = 7

Next, apparently, the Divine Architect multiplied all the lengths of this grid by each of the numbers one through six, or simply by 720, sixty dozen, to reveal the actual dimensions of the Earth and moon in miles. Notice how elements of the number canon, those of our heartbeats and breaths, have appeared.

$$720 = 1 \times 2 \times 3 \times 4 \times 5 \times 6$$

$$\text{Diameter of Moon} = 2160 = 720 \times 3$$

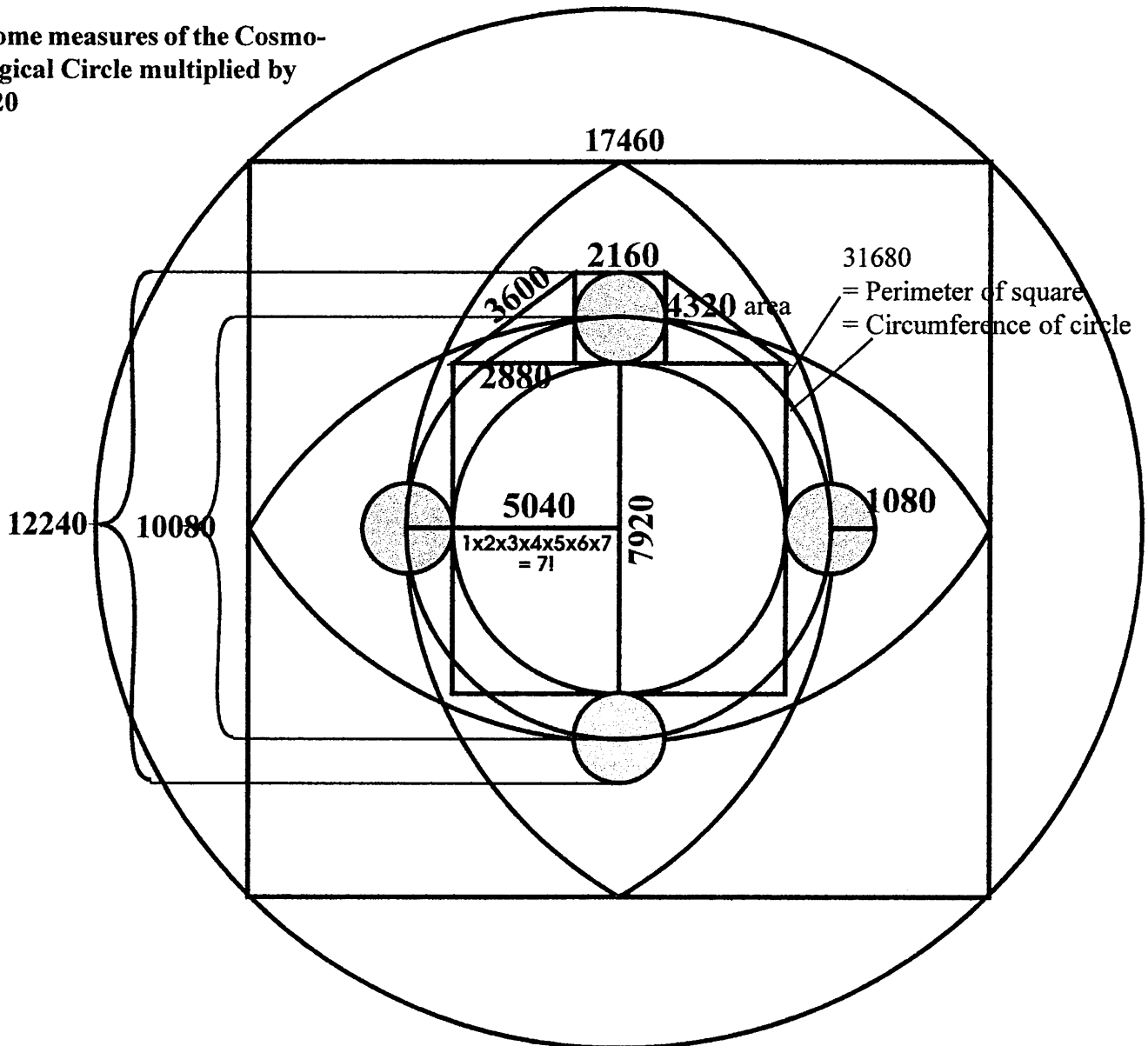
$$\text{Diameter of Earth} = 7920 = 720 \times 11$$

$$\text{Radius of Moon} = 1080 = 720 \times 1.5$$

$$\text{Radius of Earth} = 3960 = 720 \times 5.5$$

$$\text{Radius Earth} + \text{Radius Moon} = 1080 + 3960 = 5040 = 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 7 \times 8 \times 9 \times 10$$

Some measures of the Cosmo-logical Circle multiplied by 720



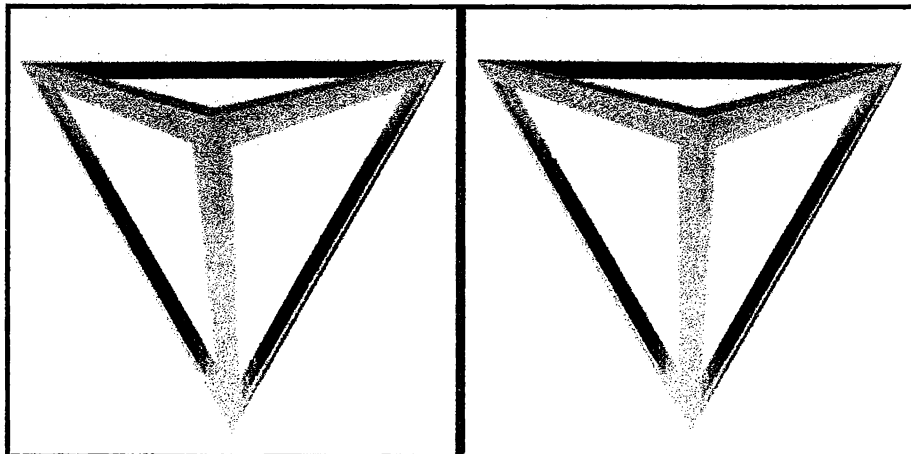
Seven Hundred Twenty

Why multiply each length by 720? What's so interesting about sixty dozen, the number of hours in 30 days and the number of minutes in twelve hours, and seconds in twelve minutes? To understand any number first consider its divisors, the numbers that neatly divide into it, and then observe its expressions in nature and human affairs.

Consider the sequence of numbers one through ten. Remove the number seven and leave a gap there; or, better yet, replace it with an equal sign because the numbers to its left, one through six, multiplied together equal the numbers to its right, eight, nine and ten multiplied together. Thus, 720 is divisible by all the numbers within the Decad one through ten *except* seven, its reclusive balancing point and pivot.

$$720 = 1 \times 2 \times 3 \times 4 \times 5 \times 6 = 8 \times 9 \times 10$$

The Divine Architect apparently produced the three familiar dimensions by unfolding a single zero-dimensional point to the two points of a one-dimensional line, three points of two-dimensional area and four points defining the minimum three-dimensional volume. This first volume produced was the self-stabilizing Tetrahedron, a tripod made of four triangular faces, the simplest enclosure of three-dimensional space. The Tetrahedron's six edges, like trajectories, meet at four corners to form three angles of each face. The four faces have a dozen sixty-degree angles giving the Tetrahedron a total surface of 12×60 degrees = 720 degrees. There can never be a three-dimensional structure whose surface angles total less than 720 degrees. Thus, multiplying the basic lengths of the Cosmological Circle by 720 tells us there has been a three-dimensionalization of cosmos.

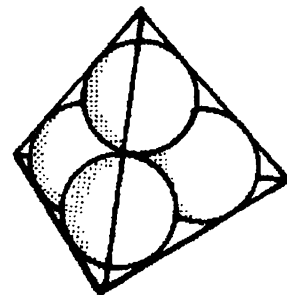


Stereoscopic Tetrahedron

Look at this pair of tetrahedra from a comfortable distance.
Stare at them until a third tetrahedron appears between them.

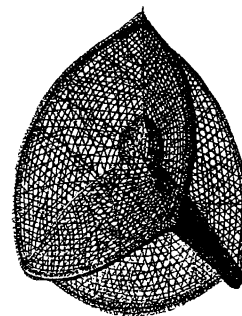
Move the book closer or further away.

The central tetrahedron should appear to be three-dimensional.



"The tetrahedron is the lowest common rational denominator of Universe."

-- R. Buckminster Fuller



Microscopic Radiolarian tetrahedron

"All local structural systems in Universe are always accomplished by nature through the elimination of 720 degrees of angle."

-- R. Buckminster Fuller



"The worlds originate so that truth may come and dwell therein."

-- Buddha

To develop the three dimensions (see the Platonic Volume chart next page) the Divine Architect added another 720 degrees to this first Tetrahedron, creating the eight triangular faces of an Octahedron's six corners. Adding a further 720 degrees creates eight corners which spread out to the six square faces of a cube. To that was next added twice 720 or 1440 degrees, spreading apart the twelve corners of the twenty triangle-faces of the Icosahedron. Finally, to that surface another four times 720 or 2880 degrees was added to spread twenty corners among the twelve pentagonal faces of the Dodecahedron, having nine times the sum of the surface angles of the primary Tetrahedron.

These "regular polyhedra" are the five famous Platonic Volumes, named after Plato who discussed them, although they were known long before the Greeks. Stone sets of them have been found around the megalithic and wood ring sites around Europe which were calendrical instruments, repositories of measure, and schools. These five volumes are equal expansions of space in all directions from a central point to the fundamental Tetrahedron, growing in multiples of 720 degrees. Notice that many numbers defining the five Platonic Volumes are those proportioning the Cosmological Circle and number canon.

These five volumes are geometric expressions of numerical and geometric harmony, equality and perfection. They're heirs of the principles taught by their all-encompassing sphere. A sphere is purely defined as a surface in three dimensions equally distant in all directions from a point. The five Platonic Volumes are perfectly proportioned to fit and interlace within one sphere so that their corners will partition its surface equally in all directions, with an identical edge, angle and face. They are five jewels, straight-line expressions of the sphere's own unity, wholeness and equality in all directions.






The Swiss mathematician Leonhard Euler (1707-1783) noticed a numerical relationship in each volume: the number of its vertices plus the number of its faces is always two more than its number of edges ($V+F=E+2$). See *A Beginner's Guide* page 81.

These five volumes are also based on the equation $12=2+4+6$. That is, for each Platonic Volume the number of vertices is always evenly divisible by two, the number of faces is always evenly divisible by four, and the number of edges is always evenly divisible by six. However we examine its structure, cosmos reveals duodecimal mathematical beauty.

So the Divine Architect seems to have multiplied the numbers of the Cosmological Circle by 720, creating blueprints for the five Platonic Volumes imposing definite three-dimensional bounds on undifferentiated chaos to create a cosmos of Platonic Volume atoms, molecules, crystals, viruses, dandelions, star systems, soccer balls, geodesic domes and a guide for sacred art, technology and civilization.

Surface Angle Totals of the Platonic Volumes

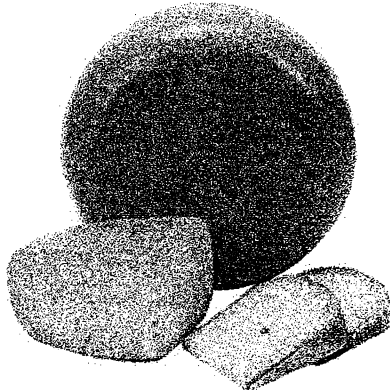
The sum of all the angles on the face of each Platonic Volume is a multiple of 720. Actually, for any Platonic Volume, the sum of all its surface angles equals the number of vertices times 360 minus 720. The multiples of 720 in this chart in-between those of the Platonic volumes are those of the Archimedean Volumes which may be considered transitional forms between them.

Volume	Face-Shape	Angles per Face	X	# Faces	X Face-Angle°	=	Sum of Surface Angles°
	Triangle	3		4	60		720 = 1 x 720
	Triangle	3		8	60		1440 = 2 x 720
	Square	4		6	90		2160 = 3 x 720
	Triangle	3		20	60		2880 = 4 x 720
	Pentagon	5		12	108		3600 = 5 x 720
							4320 = 6 x 720
							5040 = 7 x 720
							5760 = 8 x 720
							6480 = 9 x 720

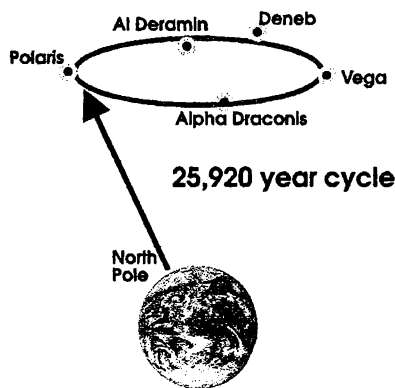
As long as we're looking at 720, let's consider its tenth part, the number 72, six dozen.

"Very well then," the Patriarch said, "which would you prefer to learn: the thirty-six heavenly transformations or the seventy-two earthly ones?"

-- *The Journey To The West*



Fine cheeses are traditionally made in wheels of seventy two pounds, easily divisible into 2, 3, 4, 6, 8, 9, 12, 18 and 36 equal parts.



Precession of the Equinoxes

The Earth wobbles so its north pole points to a different location in the sky, its "North Star" presumably through a 25,920 year cycle.

As a number, $72 = 6 \times 12 = 8 \times 9 = 2 \times 2 \times 2 \times 3 \times 3$ or $2^3 \times 3^2$, showing that it's still devoid of 7, as well as 5 now. But curiously, these numbers 6-8-9-12 are the source of traditional musical harmony producing the ancient twelve-note chromatic musical scale which is made of the seven-note diatonic and five-note pentatonic musical scales (see Volume 1 page 14). If converted to inch-distances between holes in a flute, or string lengths of equal tension, they produce the notes of the intervals known as the octave, fifth, fourth and fundamental tones. From these four relationships the remainder of the musical scale has been evoked from time immemorial. Neolithic bone flutes played for the first time in tens of thousands of years yield these same notes, as do flutes, bells and trumpets from Egypt, Greece, China, Africa, India, Europe, the Americas and elsewhere. This worldwide original musical scale, sometimes called Pythagorean tuning, was based on the way objects naturally vibrate, like leaves shimmering on an aspen tree or twang of a string. As with the relationships between numbers, this scale is a discovery and not an invention of fashion. In contrast, the notes of modern music have been flattened from their natural ideals and have lost their legendary therapeutic effect. That's innovation.

We've already seen the poignant and poetic expression of seventy two within us as the rhythm of our heart. An average, healthy human heart beats seventy two times per minute, or twelve heartbeats each ten seconds, showing how the interplay of ten and twelve together measure the rhythms of life.

Looking upward, as seen from Earth, the planet Venus disappears behind the Sun for seventy two days at a time. This was the seventy two-day season during which it moves from its maximum eastern elongation, once known as "Lucifer" or "Phosphorus" the "morning star", to its maximum western elongation formerly known as "Hesperus," the "evening star" observed by ancient astronomers and shepherds around the world. To the Aztecs and Mayans the disappearance of Venus, the Greek goddess of love, signaled the start of war. Since seventy two degrees equals one-fifth around a 360 degree circle, it's natural that Venus' retrograde pattern is a five-petaled flower drawn in the sky (see page 16).

On a larger time scale, seventy two years is the time it takes for the sun to appear to move along just one degree of the full circle of the "Precession of Equinoxes" along which the Earth is said to complete one wobbly revolution ideally every 25,920 (= 72 x 360) years.

The ancient Hebrew alphabet, like that of Sanskrit, Greek, Syriac and others, was organized as a cosmological model of the orderly whole.

Being carefully composed, it requires seventy two strokes of the pen to write its twenty two letters. Since the letters of the alphabet are also numerals, the values of letters in a word can be added together to produce another number and word or phrase. In Hebrew, the number seventy two is the value of the words "secret" and "fruitful". What is the secret of seventy two to which it refers?

The Masonic founders of the United States were so interested in this language-number connection called *gematria* (or Greek *isosephia*) that Thomas Jefferson proposed Hebrew as America's second language so that citizens could read the Old Testament in its original language and discover its secrets themselves. Instead, they passed along their deeper understanding through symbols, including the design of both sides of the Great Seal (seen on the dollar bill), whose Pyramid has a base made of seventy two stones. Their myths derived from Egypt where this number was also prominent.

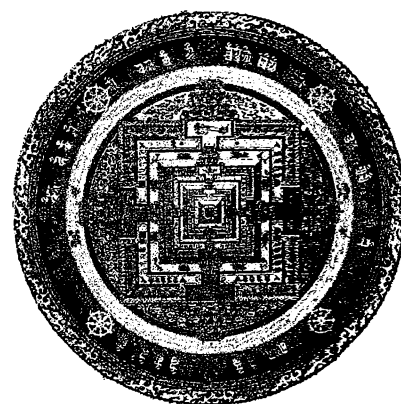
You may have noticed (pages 46-47) that the sum of the Great Pyramid's main dimensions, its height (280 cubits) and base (440 cubits) equals 720 cubits. Is this a coincidence? No less than the recorded fact that the meticulous process of mummification in ancient Egypt required seventy two days. This is certainly related to the group of seventy two henchmen who helped the Egyptian villain deity Set to trap his brother Asar (Greek: Osiris) by enclosing him in a custom-made sarcophagus, leading to his death, re-mem-bering and eventual resurrection.

A famous Buddhist mandala is the Dalai Lama's own *Kalachakra* or "Wheel of Time" mandala. It depicts a divine community of seven hundred twenty deities, emanations of the central archetype Buddha pair, the enlightened spiritual energies at the core of our being.

Such expressions mask a deeper understanding of ourself as a microcosmic expression of the universal canon of order. These seven hundred twenty deities, and seventy two angels moving up and down the ladder between Heaven and Earth in Jacob's dream symbolize something deeper within us. The traditional understanding is that the ladder represents our spine. In India, it's said that our nervous system is composed of seventy two thousand *nadis* or subtle nerve "arteries" emanating from our spine (see illustration next page). In the yoga of learning control of our nervous system the centers or plexuses where they mingle and can be purified, symbolized as "unsealed" and "resurrected", on the path of our spiritual awakening. In Christian theology, these awakened nerves are symbolized by the 144,000 (= 2 x 72,000) true-believers whose fore-heads were "sealed" (in Hindu the *ajna* "command" or "third eye" *chakra* associated with the pituitary gland) until the advent of the Messiah, our enlightened Self.

●	Y	= 10
● ●	Y H	= 15
● ● ●	Y H W	= 21
● ● ● ●	Y H W H	= 26
		72

The "Tetragrammaton", the "four letters" (YHVH - "Jehovah") of a Hebrew name of God, written as the *Tetraktys* has letters equal to numbers which sum to 72.



Kalachakra Mandala

"Hurt not the earth, neither the sea nor the trees, till we have sealed their servants of God in their foreheads. I heard the number of them that were sealed an hundred and forty thousand of all the tribes of the children of Israel."

-- Revelation 7:3-4

"There are 72,000 Nadi passages in this cage [the body]."

-- Maitri Upanishad [18]

"Then I saw the Lamb standing on Mount Zion, and with him were 144,000 who had his name and his Father's name written on their foreheads. And I heard a sound from heaven ... And no one could learn this song except those 144,000 who had been redeemed from the earth."

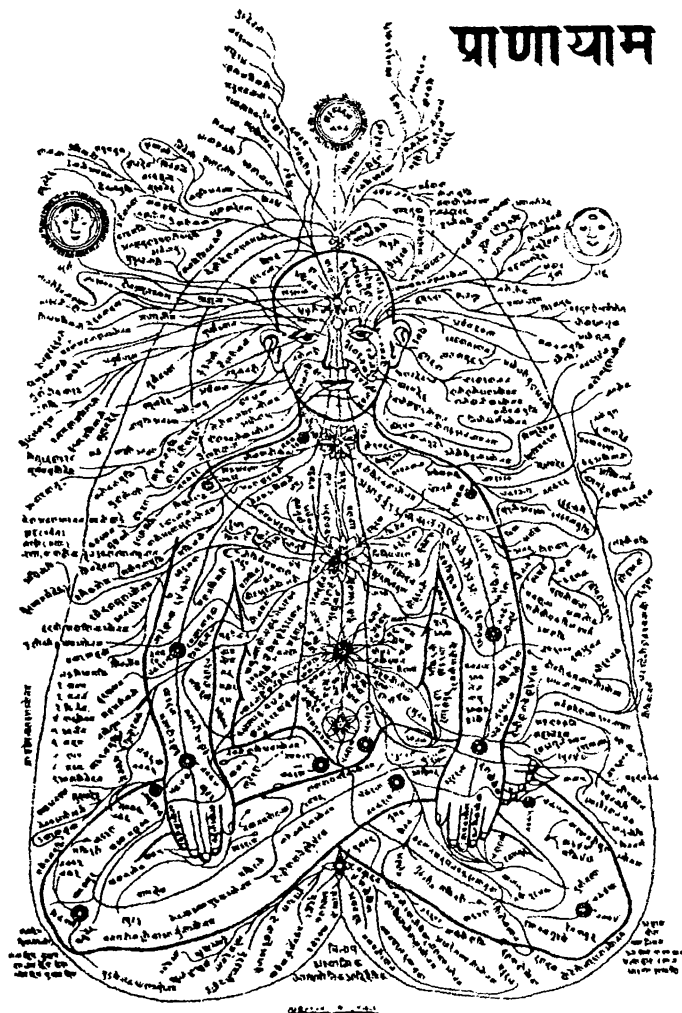
-- Revelation 14:1-2

"The light of the body is the eye: if therefore thine eye be single, thy whole body shall be full of light."

--Matthew 6:22

"Now when the law was transcribed, and the labor of interpretation was over, which came to its conclusion in seventy-two days, Demetrius gathered all the Jews together to the place where the laws were translated, and where the interpreters were, and read them over."

-- Flavius Josephus, *Jewish Antiquities* 12.101 (Whiston) (commenting on the translation of the Pentateuch, the first five books of the Bible, in seventy-two days by seventy-two Jerusalem rabbis)



Knowledge of our nervous system is the inner secret of seventy two kept symbolically in all spiritual traditions. Other references include:

According to Horapollo the Egyptians said that there were seventy two ancient "countries" of the world.

In Jewish tradition exists the seventy-two syllable name of God, made up of 216 (= 6x6x6) letters. This Name of Seventy-Two is derived from three verses in Exodus (14:19-21) each containing exactly seventy-two letters. If one writes these three verses one above the other, the first from right to left, the second from left to right, and the third from right to left, the result is seventy-two columns of three-letter triplets. These seventy-two names are divided into four columns of eighteen names each. Each of the four columns falls under the aegis of one of the letters of the Tetragrammaton, YHVH ("Jehovah" and "Yahweh"), actually written right to left HVHY.

According to writers such as Philo, Josephus and Aristobulus, Ptolemy II Philadelphus, the Greek ruler of Egypt (c288-247 BCE) had a magnificent library in Alexandria consisting of 995 books from many cultures around the world. "Let us add another five books, to make a

thousand," the king said in 285 BCE to his minister Aristaeus. The minister advised the king to complete his library by having the five holy books of the Jews, the Torah, or five books of Moses, the first five books of the Old Testament, translated into Greek. Immediately the king sent messengers to the high priest Eleazar in Jerusalem, asking to have translators sent to Alexandria to undertake the task. Eleazar sent seventy-two elders to King Ptolemy who placed the men in seventy-two separate rooms and told each to translate the Torah into Greek. At the end of seventy-two days the elders completed their independent translations. And behold! All were identical.

In China, Confucius (551-479 BC) toured various states during the Spring and Autumn Periods advocating his ideas on right conduct. Later he devoted his energy to teaching by opening schools and enrolling some 3,000 students. Among them, seventy-two were noted scholars who helped compile the ancient books, codifying his teachings into the book titled *The Analects*, *Li* or *The Way of Life*. He lived to age seventy two.

Every Zoroastrian wears next to his skin the *Sudarah*, a shirt of white material, symbol of purity, with a prescribed cut and symbolic mark. He also ties a sacred thread called *Kusti*, made up of seventy-two interwoven filaments, around his waist over that shirt. Each of the seventy-two filaments represents one of the seventy-two parts of the *Izashne* — the Yagna-Sacrifice ritual. The thread circumvents the waist three times, symbolizing the fundamental ideas of *Humata*, *Hukhata*, *Huaresta* or Good Thought, Good Word And Good Deed.

By far the largest and most magnificent building of the ancient Persians is the great audience hall of Persepolis, the *Apadana* ("palace") begun in the Fifth Century BCE by Darius and finished by Xerxes. It was used mainly for great receptions by the kings. Thirteen of its seventy-two sixty+-foot columns still stand on its enormous platform. It was destroyed in 331 BCE by Alexander the Great.

The Persian musical instrument the Santur has 72 strings. And the Hindu system of Karnataka music has seventy two *Melakarthis* or parent scales.

In Islam, the countenance of God is believed to be concealed in 72,000 veils of light and shadow. They mute the divine radiance making it bearable for humans. Seventy-two virgins (purified nadis) await in Paradise. Muhammad predicted that seventy-two corrupt creeds would appear in Islam.

Let's now consider other numbers which appear in the Cosmological Circle for further clues to the cosmic order and its representations in sacred art, wisdom literature and monumental proportions.

"36,000 cattle, of which 72 were the Lord's share."

-- Numbers 31:38

"The Lord now chose seventy-two other disciples and sent them on ahead in pairs to all the towns and villages he planned to visit."

--- Luke 10:1

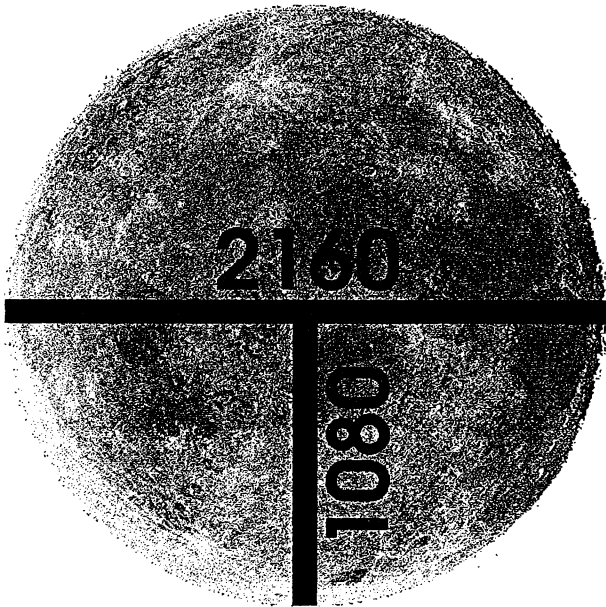
"To the port of Aegeira, which has the same name as the city, it is seventy-two stades from the Heracles that stands on the road to Bura. The coast town of Aegeira presents nothing worth recording; from the port to the upper city is twelve stades."

-- Pausanias *Description of Greece* 7.26.1 (Loeb). Greek sacred geography relied on multiples of twelve to organize the landscape.

Celestial Dimensions

The continuing appearance of multiples of twelve are a sign of the universal canon of order. Since, symbolically speaking, a complete universe incorporates the principles of all the numbers one through twelve, as we begin to look at the development of the Cosmological Circle we are beginning to see a striving to include all the numbers one through twelve.

We have seen some numbers from the Cosmological Circle in the dimensions of the Moon, Earth and Sun. All nature's shapes and dimensions, as they unfold in time, Plato's world of Becoming, approximate and try to conform to ideal numbers and proportions of the blueprints designed by the Divine Architect in the eternal world of Being. Let's begin to find this striving for the dozen number principles by gazing at the moon.



Moon's Radius

$$= 1080 \text{ miles}$$

$$= 9 \times 10 \times 12$$

Moon's Diameter

$$= 2160 \text{ miles}$$

$$= 6 \times 6 \times 6 \times 10$$

Moon's Circumference

$$= \pi \times \text{diameter} = (864/275) \times 2160$$

$$= 6786.327 \text{ miles}$$

$$= 35,831,808 \text{ feet}$$

$$= 12^7 \text{ feet}$$

$$= 12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12 \text{ feet}$$

Notice how the moon's radius, diameter and even its circumference are produced by different combinations of some of the numbers one through twelve. The moon's mean radius of 1080 miles happens to be the product of three numbers towards the end of the series of twelve numbers: $1080 = 9 \times 10 \times 12$. The number 1080, and its tenth part, 108, recur in the Moon's other measures: in terms of space, the minimum distance between Earth and Moon is never less than 108 times the Moon's diameter, or 233,280 miles. In terms of time, when the Moon's Synodic (Lunation) Period (the time between two full moons as seen from Earth) is divided by its Rotation Period (the time it takes to actually turn once upon its axis), we calculate

$$\frac{29.53059028 \text{ days}}{27.3215835 \text{ days}} = 1.080\dots$$

And as discovered by J.C. Neal, when the *product* of these periods of Lunation and Rotation is divided by their *difference*, we are shown precisely the number of solar days in one Earth year:

$$\frac{\text{Lunation} \times \text{Rotation}}{\text{Lunation} - \text{Rotation}} = 365.2421964 \text{ days}$$

These observations reveal the synchronization of the motions of the Moon, Earth and Sun in proportional resonance known to occur in dozens of relationships among the planets, moons, asteroids and comets of our solar system. Even in the approximations of this World of Becoming the work of the Divine Architect is carried out in great detail.

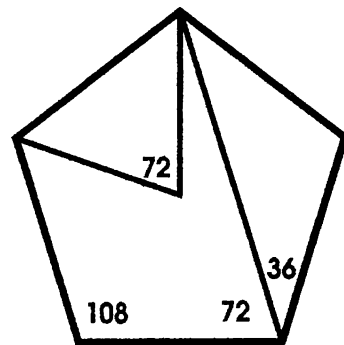
Silver is the metal traditionally associated with the light of the silvery Moon. It's atomic weight is 107.868, or *approximately* 108 times the weight of one carbon atom's six electrons and six protons. While this may seem wildly coincidental (how could the ancients have known?) it reflects the cohesion and consistency of the universal canon expressed as nature.

In keeping with the numbers of this canonical tradition, in 150 BCE the Greek astronomer Hipparchus categorized stars by their brightness. Stars which could still be seen one degree above the horizon at sunrise he called first magnitude. Those which could still be seen two degrees above the horizon he termed second magnitude, and so on, to create the system of classifying stars' brightness we still use today. He observed and cataloged the magnitude of exactly 1080 stars, ninety dozen. This number recurs through the ancient world in numbers relating to the night sky and realm of the moon, the "queen of the sky".

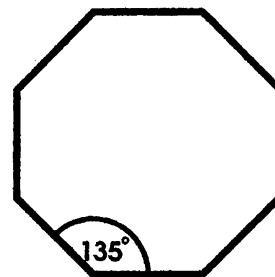
This number 108 (nine dozen) and its expansion by powers of ten appears in religious cosmologies worldwide from the most ancient times. The Hindu religion is replete with references to it in significant roles: the 108 beads of a rosary, the 108 Columns in the temple of Durga, and 10,800 bricks comprising Vedic fire altars. Readers familiar with sacred literature, art, ritual and symbology of various religions may know more examples for each of the numbers appearing in the Cosmological Circle and number canon.

As with the Hindu religion from which it sprang, Buddhists are familiar with the 108 beads their own rosary representing the 108 names of Buddha and 108 Volumes of Buddha's Teaching. With this significance, pilgrims at Phnom Bakhag Temple at Angkor, Cambodia, must make 108 turns to complete their sacred perambulation.

There are other references to 108 in Buddhism:



The numbers 36, 72 and 108 reveal themselves to be related angles within a Pentagon, and in other regular polygons, because they express fundamental truths about the harmony of numbers and the world's organization.



$$8 \times 135 = 1080$$

The sum of the eight internal angles of an octagon equals 1080.

"To tell you the truth," said Pilgrim laughing, "I know how to cloud-somersault, and a single somersault will carry me a hundred and eight thousand miles."

-- *The Journey To The West* by Wu Cheng-en. A delightful 16th century Chinese book considered the first novel ever written, about a 6th century monk traveling from China to India to retrieve Buddhist scriptures. It's filled with references to the classic number canon.

Beginning just before midnight on New Year's Eve, bells in Buddhist temples are rung 108 times to announce the passing of the old year and the coming of the new. It is said that humans are beset by 108 ill or earthly passions and that each stroke of the gong dispels one.

The Kanjur is a major section of the Tibetan Buddhist Canon, consisting of the words of the Buddha, attributed directly to Shakyamuni. It's collected in 108 volumes.

108 Brahmins were invited to the naming ceremony at the birth of the Buddha.

The roots of Christianity likewise partook of this sacred numerical reference but in more subtle ways, often in sacred literature. The ancient tradition of using the letters of the alphabet as numerals (*isosephia*) was practiced by the Greek writers of the Gospel to create the names of people, places and significant phrases. The sum of the letters of both the terms "The Holy Spirit" and "The Earth Spirit" is 1080, as is the sum of the letters of the names Jesus + Mary. The fact that the sovereign Vatican comprises 108 acres should be no surprise. In fact, one can find the numbers of the entire numerical canon in the names of people, places and phrases of Greek mythology and also in the Christian religion, and with them reconstruct the entire Cosmological Circle diagram.

This information is literally breathtaking, in the sense that we take one breath every four heartbeats, eighteen breaths per minute, or 1080 breaths per hour. Studies show that most people unconsciously synchronize their walking step to their heartbeat and breath. In this simple but fundamental way we're synchronized with unseen natural rhythms rooted ultimately in number patterns.

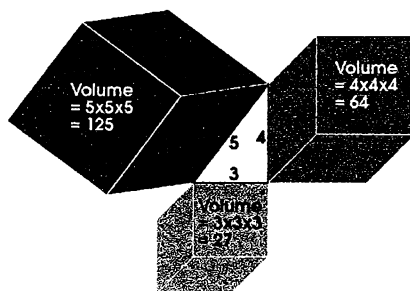
Twice the Moon's radius, its diameter of 2160 miles, is an especially interesting number. It teaches us about cubes. It's tenth part, 216, or twice 108, is the volume of a cube having sides 6 x 6 x 6. It's also the product of two small cubes ($2^3 \times 3^3$) and is actually the smallest cube which can be made of three other cubes: $216 = (3^3 + 4^3 + 5^3)$.

Consider a cube's eight corners, twelve edges and six faces. Since each face has four 90-degree corners for a total of 360 degrees, then the sum of the corner angles of all six faces totals $6 \times 360 = 2160$ degrees or six times the number of degrees in one circle.

Convenient manipulation of volume was certainly the intent behind the ancient measure of the "bushel" containing exactly 2160 cubic inches, or ten cubes having six inch sides. The bushel was a measure based on the human scale, the amount of seed required to sow one acre of land. The acre, another ancient measure, is the amount of land which

"Once I searched sincerely for the Way, climbing the Spirit Terrace Mountain to pick medicinal herbs. On that mountain lives an ancient Immortal one hundred and eight thousand years old. I took him as my master, hoping that he would show me a road to immortality. He said that the elixir is in one's own body -- it is a waste of effort to seek it outside."

-- *The Journey To The West*



When the sides of the 3-4-5 right-triangle are considered as the edges of three dimensional cubes, the sum of their volumes is 216.

a team of oxen could plough in one day. Ancient canons of weight and measure around the world all relied upon the interplay of ten and twelve for their intelligently designed systems incorporating the human scale. The modern metric system, limited to powers of ten, eliminates the richness and universal organization of numbers provided by powers of twelve.

Many other geodetic measures are structured by the first dozen numbers, including the measure of the Great Circle of Earth's polar circumference, 21,600 nautical miles. While Earth orbits the Sun at 66,000 miles per hour, the Sun too orbits through the galaxy at a speed of 21,600 miles per hour. The 2,160 year period called an "Age" (like the Age of Pisces) or "Platonic Month" is equal to one-twelfth of the 25,920 years it's presently thought to take for the full Precession of the Equinoxes. It's also the ideal number of breaths in one day. This number is found in the Cosmological Circle as the sum of the twelve moon-diameters.

Further doubling reveals other numbers of the Cosmological Circle. Twice 216 equals 432 ($= 3 \times 12 \times 12$). We find this number showing up early in the Cosmological Circle's construction as the area of the original 3-4-5 triangle, multiplied by ten. Multiplied by one thousand, it is the Sun's radius of 432,000 miles. Perhaps it's a coincidence that $432 \times 432 = 186,624$ a measure of the speed of light in miles per hour.

These numbers stand out prominently in Hindu sacred texts and rituals, as the 432,000 syllables it takes to recite the complete *Rg Veda*, and the 4,320,000 years duration of the great cycle of time called a *Mahayuga* ("Great Age").

About 260 BCE Berossus, a priest of Bel in Babylon, translated into Greek the standard Babylonian reference work on astronomy and astrology. He compiled a king list based on archives in the Temple of Marduk, which were themselves copies of ancient inscriptions. The total span of the reigns of the ten mythological antediluvian kings of Babylon was calculated to be 432,000 years.

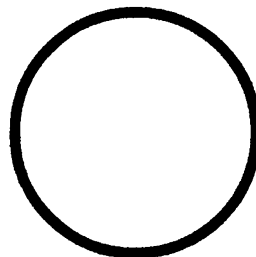
As always, these numbers also show up in traditional systems of weights and measures, as 432 grains comprise one ounce. Today, the musical note A is defined with a frequency of 440 beats per second. But this is because the notes of the musical scale have been flattened so that different instruments in an orchestra can resonate across different octaves. Before that, all over the world, the note A was defined as 432 beats per second, a basis of tuning preferred by Beethoven, Mozart, Verdi, Bach and others.

Doubling 432 brings us to 864, the number of square inches on the surface of a cubic foot ($6 \times 12 \times 12$). Our system of time, based on the ancient Babylonian twelvefold multiple divisions of the day, hour and

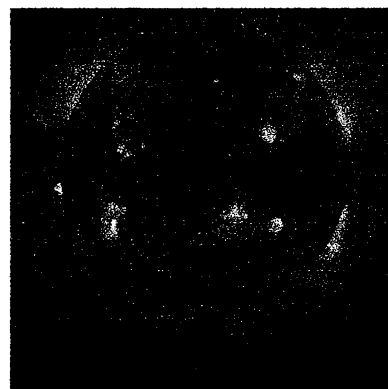
2160 cubic inches = 1 Bushel

21,600 = nautical miles on Polar circumference

The measure of every circle is 360 degrees, $\times 60 = 21,600$ minutes of arc.



432 = word "Foundation" (Greek *isosephia*)



Sun's Radius = 432,000 miles;
Sun's Diameter = 864,000 miles
 $= 5 \times 5 \times 12 \times 12 \times 12$

minute determine that there are 86,400 seconds each day. As a distance this is one-tenth of 864,000 miles, the Sun's diameter. Consider the ancient measure of the furlong ("furrow length"), an eighth of a mile, 660 feet, the length of the furrow along one side of an acre (whose width is one "chain" of 66 feet). Thus 8,640 such furlongs equals the Moon's radius. These numbers recur because the traditional units of measure in every culture were synchronized with the way numbers organize themselves around multiples of twelve, and to which nature also strives to proportion itself on every scale.

The traditional altar in Greek temples was a cube of 864 cubic inches, half of which was buried in the ground. In the letter-number system of Greek *isosephia*, 864 is also the value of the sum of the letters of the word "altar", as well as that of the contrasted cities Jerusalem and Babylon, the name "Pythagoras" and the word Θεον, "Theon" or "God". From these examples relating the sun, altar and divinity, it appears that the number 864 is traditionally associated with radiant centers.

All of these numbers emerging from the Cosmological Circle occur in the great time cycles of Hindu cosmology. According to one mythos, after a period of quiescent chaos the deity Brahman is born to bring about the cosmic order. He develops the universe in four cycles of different durations and characteristics, beginning with a long, virtuous golden age followed by three ages diminishing in duration and virtue. Each age has a dawn and twilight equal to one-tenth the main part of the era, like the momentary pauses on each side of a breath. Calculating these cycles we see a clear numerical structure based on the interplay of the powers of twelve and ten.

(Multiply each number x 1000 = solar years.)

<u>Hindu Yuga</u>	<u>Metal</u>	<u>Dawn</u>	<u>Daytime</u>	<u>Twilight</u>	<u>Duration</u>	<u>Pattern</u>
Krita	Gold	144	1440	144	1,728	= 12x12x12
Treta	Silver	108	1080	108	1,296	= 12x12x12 x 3/4
Dwapara	Bronze	72	720	72	864	= 12x12x12 x 2/4
Kali	Iron	36	360	36	432	= 12x12x12 x 1/4

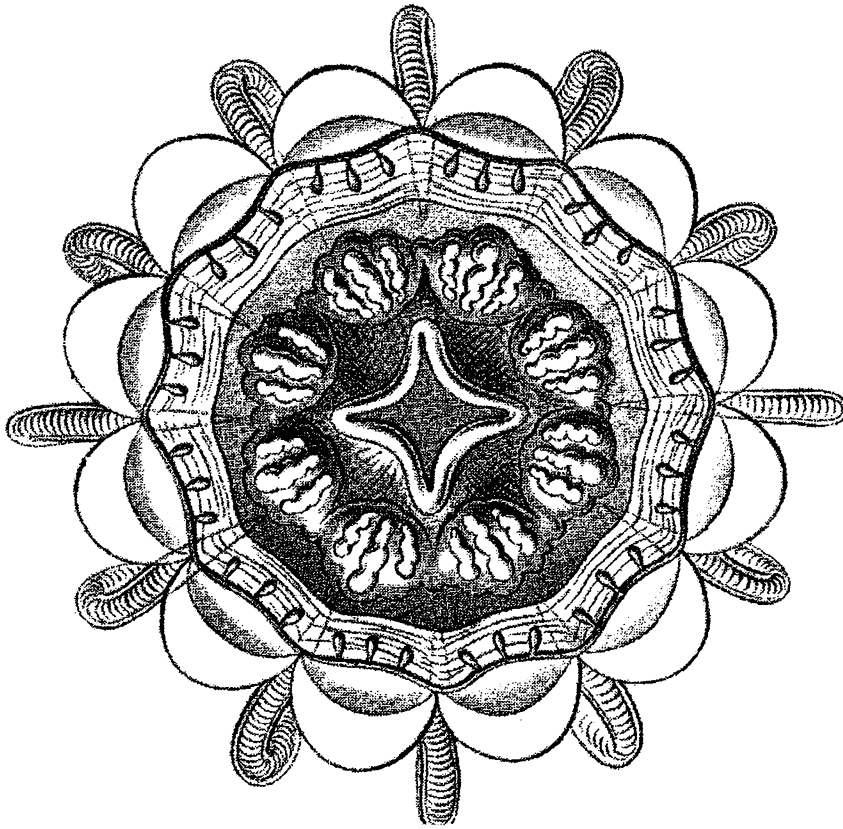
Duration
Divided by 360
 4800 years
 3600
 2400
 1200

Dividing these large numbers by 360 (a Divine Year) gives numbers within historical cycles, placing us now, according to some Hindu teachers, 300 years into the beginning of an upswinging 2400 year Bronze Yuga.

The total of all four ages or *yugas* is called a *Mahayuga*. One thousand of these *Mahayugas* is called a "Day of Brahma". Another thousand *Mahayugas* comprise the "Night of Brahma". Three hundred sixty such days and nights comprise one year of Brahma. One hundred such years constitute the lifetime of Brahman. This is followed by an equal

duration of his sleep with the complete dissolution of the cosmic order into undifferentiated, quiet chaos for a period equal to that of Brahman's whole life. When that duration is fulfilled, a new golden age dawns to repeat the fourfold unfolding order of cosmos. No initial bang or final crunch, only galaxies, stars, planets, moons and sentient biology precipitating and dissolving like crystals in liquid as the temperature and pressure change, although over incomprehensible aeons of time.

It's no coincidence that we find the same numbers recurring at the spiritual cores of diverse cultures. Researchers can easily find many more examples. The same numerical canon peeks through everywhere from different times and places, yet derives from only one, unchanging self-organization of number. Let's continue to uncover more of the numerical harmony of the Cosmological Circle.



"How dare you be so presumptuous as to want to seize the honored throne of the Exalted Jade Emperor? He began practicing religion when he was very young, and he has gone through the bitter experience of one thousand, seven hundred and fifty *kalpas*, with each *kalpa* lasting a hundred and twenty-nine thousand, six hundred years. Figure out yourself how many years it took him to rise to the enjoyment of his great and limitless position."

-- *The Journey To The West*

Heavenly Cities

From vast cycles of time, let's return to Earth and consider how its own dimensions contribute to the striving towards multiplication of the numbers one through twelve.

Earth's Polar Diameter

$$\begin{aligned} &= 7920 \text{ miles} \\ &= 8 \times 9 \times 10 \times 11 \end{aligned}$$

Earth's Polar Radius

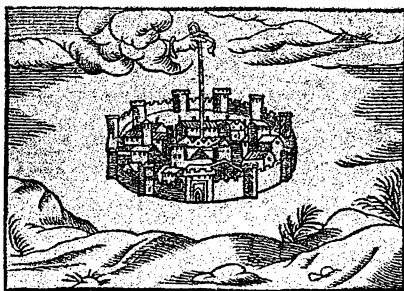
$$\begin{aligned} &= 3960 \text{ miles} \\ &= 3 \times 10 \times 11 \times 12 \end{aligned}$$

Earth's Polar Circumference

$$\begin{aligned} &= \pi \times \text{diameter} \\ &= 864/275 \times 7920 \\ &= 24,883.2 \text{ miles} \\ &= 12^5 / 10 \text{ miles} \\ &= 1.2 \times 12 \times 12 \times 12 \times 12 \end{aligned}$$



Notice how Earth's dimensions are multiples of different combinations of some of the numbers one through twelve. The innermost circle of the Cosmological Circle represents Earth with its polar diameter of 7920 miles. A multiple of this number recurs in sacred literature, as in the Bible's final, mysterious Book of Revelation of St. John. He describes the Heavenly City, the perfect New Jerusalem descending to a newly awakened Earth. As to the dimensions of this holy city, we read:



Chapter 21:16 "And the city lieth foursquare, and the length is as large as the breadth: and he measured the city with the reed, **twelve thousand furlongs**. The length and the breadth and the height of it are equal."

A geometric diagram is being described here. The Heavenly Jerusalem is a cube whose edge lengths are twelve thousand furlongs, a measure of space, reminiscent of the Hindu *Mahayuga* cycle of twelve thousand Divine Years, a span of time.

As was noted, this measure translated as "furlong" is the 660-foot side of an acre. But "furlong" here is translated from the original Greek word "stadion", the length of the race course at Olympia, from which we

get the word "stadium". (Its length was mythologically determined as the distance Heracles could run while holding his breath.) This universal Greek standard of measure was 600 Greek feet, each slightly (1.1 times) longer than the English foot. Thus the furlong's 660 English feet (7920 inches) is the exact equivalent of 600 Greek feet, one "stadium", both the eighth part of their miles. We can now calculate the heavenly city's dimensions to find that

$$\begin{aligned} & \mathbf{12,000 \text{ furlongs} \times 660 \text{ feet/furlong} \\ & \quad = \mathbf{7,920,000 \text{ feet}} \\ & \quad = \mathbf{1,500 \text{ miles}} \end{aligned}$$

The New Jerusalem is a large city, on a scale with the planet Earth as exactly one thousand feet is to one mile. What's going on here? Did the writer know the size of the planet? Perhaps ancient navigators measured the globe. But it wasn't necessary, since these measures come from the way numbers organize themselves without requiring knowledge of its expression in nature. The author of Revelation is representing a worldwide sacred tradition which used the numbers and proportions of the cosmological canon to both disguise and convey timeless wisdom.

Further, we read about the city's wall:

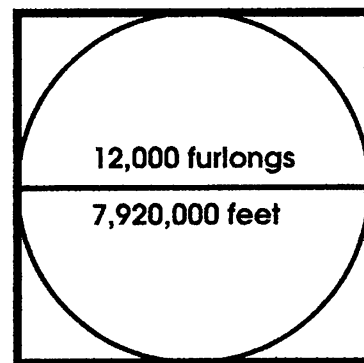
Chapter 21:17 "And he measured the wall thereof, **an hundred and forty and four cubits**, according to the measure of a man, that is, of the angel."

Does 144 (=12x12) refer the wall's height? More likely it refers to it's circumference. And what is this cubit's exact length? Again, it derives from pure number, equal to $(12 \times 12 \times 12) / (10 \times 10 \times 10)$ or 1.728 feet (approximately 20.736 inches). There are 1728 cubic inches within a cubic foot, so the number appears in mercantile affairs. Twelve dozen items are known as a "gross" and twelve dozen gross are a "great gross" or 1728 items. Using this value of 1.728 feet for the Holy City's cubit we find

$$\mathbf{144 \text{ Cubits} \times 1.728 \text{ feet/cubit} = \mathbf{248.832 \text{ feet}}$$

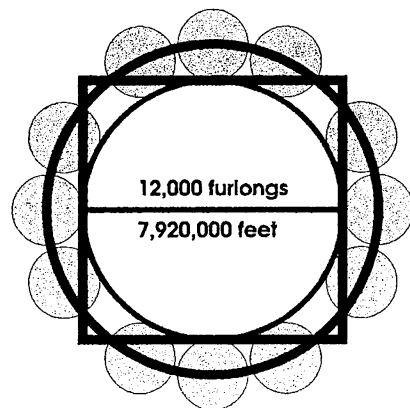
Now this is rather astonishing since this number is 1/100th part of the 24,883.2 miles of the Earth's actual mean circumference.

We are seeing in the dimensions of the Heavenly Jerusalem the numbers at the center of the Cosmological Circle diagram.



The Heavenly City

$$1.728 = \frac{12 \times 12 \times 12}{10 \times 10 \times 10}$$



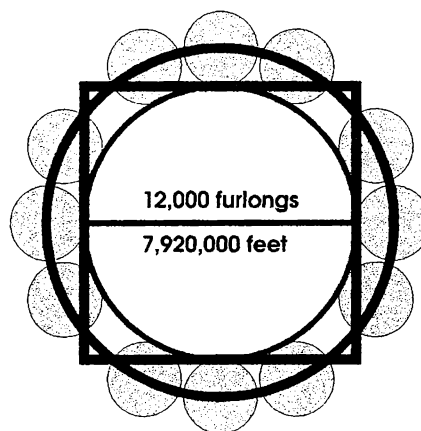
The "New Jerusalem" diagram resembles the description of the Heavenly City as having twelve "Pearly Gates" in each direction.

These same numbers recur in worldwide sacred architecture and mythology. Like the Heavenly City modeling the dimensions of the Earth, so do Stonehenge and the founding of Glastonbury's twelve "Hides" of land (1 Hide = 120 acres) reformed as a square.

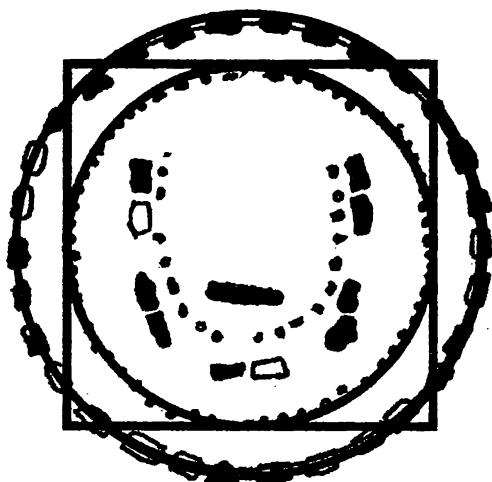
These numbers occur in worldwide traditions too often to ascribe to coincidence. They have in common that they all looked to a standards based on the way numbers naturally organize themselves.



Stonehenge



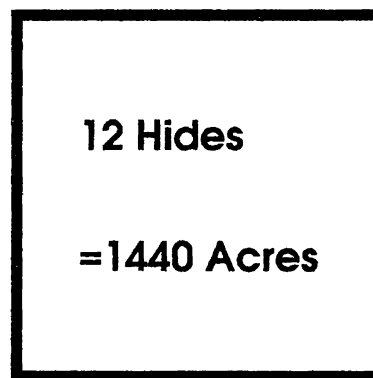
Glastonbury



**79.2 feet
Diameter of
the inner circle**

**316.8 feet
Circumference of
the largest circle
and perimeter of the square.**

12 Furlongs



12 Hides

=1440 Acres

**12 Furlongs
= 7920 feet
Side of Glastonbury's
12 Hides as a square.**

**31,680 Feet
Perimeter around
Glastonbury's
12 Hides "square"**

Five Thousand Forty

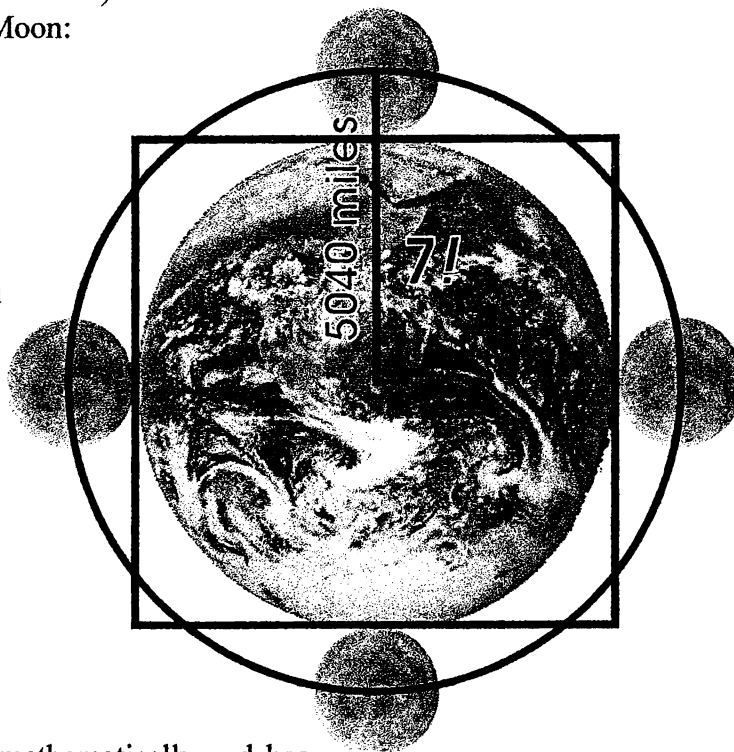
We saw that if the moon could roll around the Earth's surface, its center would leave a circular trail equal in circumference to the perimeter of the square around the Earth (both 31,680 miles). Consider now the distance between the centers of Earth and Moon:

Radius of Earth + Radius of Moon

= 3960 miles + 1080 miles

= 5040 miles

= $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 7 \times 8 \times 9 \times 10$



This number 5040 is very interesting mathematically and has many cultural connections. Among the first ten numbers it is both the product of the first seven numbers or the last four. Plato pointed out that for a number of moderate size, 5040 has the greatest possible number of divisors, 59 of them, including all the numbers one through ten, and twelve. Merely subtracting two, Plato points out, makes it divisible by 11. It is a rather unusual number, since 5000 would seem to be a smoother choice. So when reference is made to 5040, we consider it intentional and take notice.

When describing the science of statecraft Plato knew more than he wrote about, but he referred to the number twelve and to 5040 as the ideal number of families in his ideal city called "Magnesia", an amphictyony. Guardians of the state must learn mathematics. In "Laws" he writes:

[737d] Regarding numbers, every man who is making laws must understand at least thus much,— what number and what kind of number will be most useful for all States. Let us choose that which contains the most numerous and most consecutive subdivisions. Number as a whole comprises every division for all purposes; whereas the number 5,040, for purposes of war, and in peace for all purposes connected with contributions and distributions, will admit of division into no more than 59 sections, these

"After dismissing the pilgrims, Buddha broke up the assembly. Presently the Bodhisattva Kuan-yin appeared before the throne, saying "Long ago I was instructed by you to find someone in China who would come here to fetch scriptures. He has now achieved this task, which has taken him five thousand and forty days."

-- *The Journey To the West*

being consecutive from one up to ten. These facts about numbers must be grasped firmly and with deliberate attention by those who are appointed by law to grasp them...

[771a] For a beginning of the laws which are to follow, we must commence with things sacred. First, we must consider anew the number 5040, and the number of convenient subdivisions which we found it to contain both as a whole and when divided up into tribes: the tribal number is, as we said, a twelfth part of the whole number, being in its nature precisely 20×21 [$\times 12 = 5040$]. Our whole number has twelve subdivisions, and the tribal number also has twelve; and each such portion must be regarded as a sacred gift of God, conformed to the months and to the revolution of the universe. Wherefore also every State is guided by native instinct to hold them sacred, although some men possibly have made their divisions more correctly than others, or have consecrated them more happily. We, in any case, affirm now that we are perfectly correct in first selecting the number 5040, which admits of division by all the numbers from 1 to 12, excepting only 11—and this omission is very easily remedied, since the mere subtraction of two hearths from the total restores an integral number as quotient: that this is really true we could show, at our leisure, by a fairly short explanation.

$$5040 = 12 \times 20 \times 21$$

$$5040 = 3 \times 4 \times 5 \times 7 \times 12$$

1	15	24	14
12	28	3	5
21	6	10	4
20	2	7	18

In this "magic square", a small example of mathematical order, *multiplying* the numbers of each row, column or diagonals will always produce 5040. It's also true for multiplying the numbers in the four center squares and four corners.

There are other such symmetric groups of four. Can you find any?

Do you see why this magic square "works"? (Hint: reduce each number to its most basic divisors.)

Organizing a proper state requires the transformation of chaos to orderly cosmos; that is, to define limits based on canonical standards and then survey, fix and defend these boundaries, define and maintain standards of weight and measure, and establish the proportions of just law. Having an intelligent and cohesive system of measure and management is crucial for the long term health of a stable, thriving civilization.

Today, when we find references to these canonical numbers we're seeing vestiges of a disappearing wisdom, a once-admired knowledge of eternal principles relating humans to the Earth and Heaven. It created societies which sought the least friction with the ideal, an idea which clashes with today's values and motivations. Will the United States continue to maintain its links with the timeless wisdom through its earth-linked weights and measures, or will this human (and cosmic) scale of proportion be decimated and swallowed by the sterile decimalization devoid of twelve?

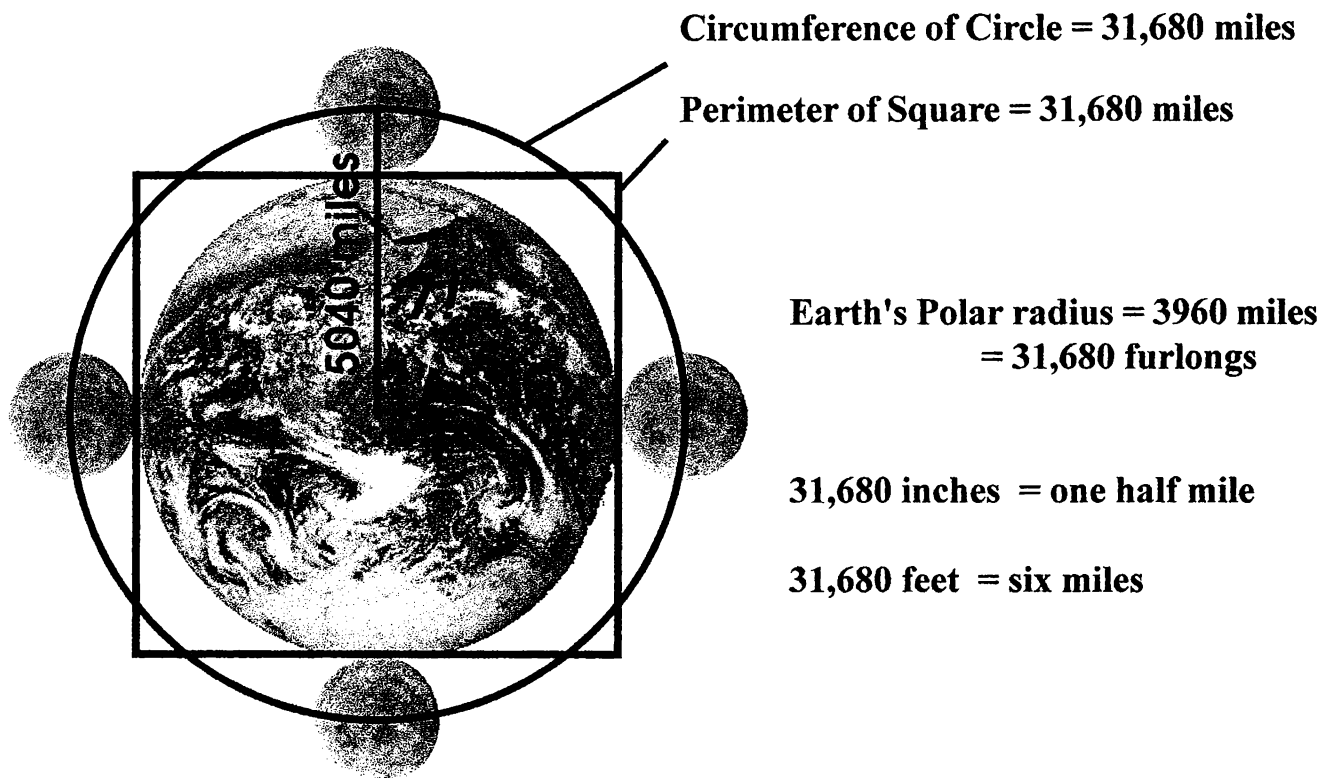
Let's continue to follow the trail of numbers of the Cosmological Circle.

Perimeters and Areas

Now we'll look deeper into the squared circle. Consider a square (or cube) circumscribed around the polar diameter of the Earth. Since the square's side is equal to the Earth's diameter its perimeter is four times it, or $4 \times 7920 = 31,680$ miles, a number encountered before.

What about the Moonpath Circle which "squares" it? Since the circumference of a circle equals ($\pi \times$ twice its radius), we only have to multiply ($\pi \times 2 \times 5040$). But, remember: we'll use an approximate value of $\pi = 22/7$, one of a traditional group of *rationalizing* values of π which allow the curved circumference and straight diameter to relate as whole numbers, appropriate for the Earth which is an approximate circle. So the circumference of this Moonpath Circle is

Circumference = $(22/7) \times 2 \times 5040 = 31,680$ miles.



The circumference of the Moonpath Circle is exactly the same as the perimeter of the square around the Earth.

The number 31,680 and its tenth part 3,168 are very interesting. Like other measures of the Cosmological Circle it has many connections with worldwide religious symbolism. In Christian *gematria*, for example, the values of the Greek letters of important phrases equal 3168, including "The Shrines of the Apostles" and "Faith of Jesus Christ". The most

fundamental phrase "Lord Jesus Christ" (*Κυριος Ιησους Χριστος*) = 800 + 888 + 1480 also totals exactly 3168. So symbolically, the phrase "Lord Jesus Christ" squares the circle; that is, Heaven takes on the characteristics of Earth and vice versa. This number, and its expansion and division by powers of ten, appears in various traditions as an architectural boundary symbol. In the Earth-moon squared circle it circumscribes the traditional sublunary world where we live.

Let's now consider the Moon Circle's area.

[A note about calculations: Modern mathematics education has unwittingly insured that the sight of a page of numbers, no matter how simple, and especially if there are equations involved, will produce anxiety and avoidance in many otherwise gifted people. They've been short-changed. So just take a breath. To follow this finale you only need to know how to simplify small numbers into even smaller ones, then rearrange and recombine them. If you take this slowly and stay with it you'll see something remarkable which was appreciated in golden ages long past.]

Since the area of a circle = $\pi \times r^2$, and the radius = 5040, we have

$$\text{Area} = (22/7) \times (1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7) \times (1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7)$$

"Cancelling" the final 7 above with pi's 7 below, and splitting 22 as 2x11, we can expand it to

$$\text{Area} = 2 \times 11 \times [1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7] \times [1 \times 2 \times 3 \times 4 \times 5 \times 6]$$

The numbers 4 and 6 can be factored into prime numbers (2x2 and 2x3) and replaced with

$$= 2 \times 11 \times [1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3) \times 7] \times [1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3)]$$

and rearranged to become

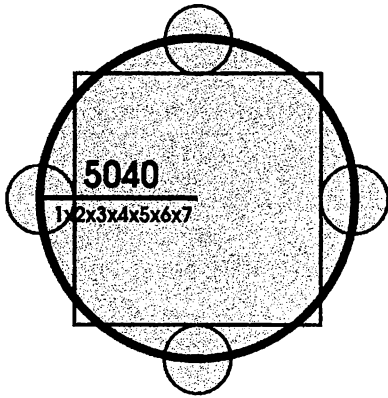
$$= 2 \times 1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3) \times 7 \times (2 \times 2 \times 2) \times (3 \times 3) \times (2 \times 5) \times 11$$

and finally recombined, so that the Moonpath Circle's area

$$\text{Area} = 2 \times 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 = 2 \times 11!$$

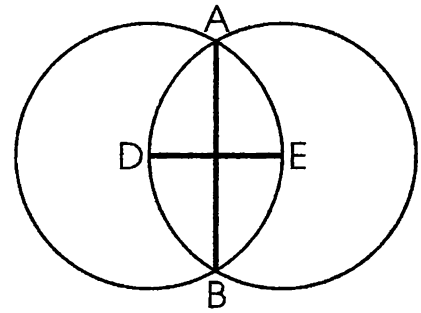
That is, **the circle's area is twice the numbers 1 through 11 multiplied together.**

We continue to see a yearning towards inclusion of all the numbers one through twelve. This is the closest we've come. The area of this circle is one-sixth of that goal.



The circle whose radius is the numbers one through seven multiplied, has an area which is twice the numbers one through eleven multiplied together.

Expanding further outward, let's consider the Cosmological Circle's largest square. What is the length of its side, and what is *its* area? To find them, we must recognize that the square's side is equal to the height of the entire *Vesica Piscis*, AB, and it's height is equal to its width DE times "the square root of 3" (1.732...). But we won't need to use that endless decimal.

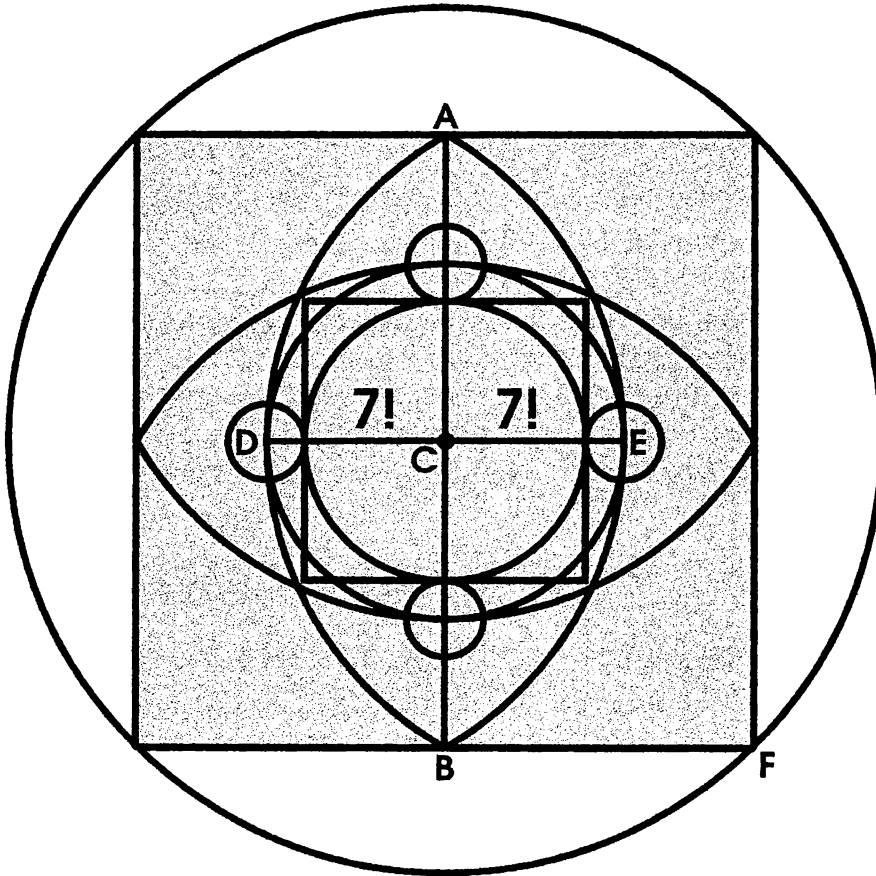


Since the Moonpath circle's diameter DE is twice its radius (7!), then

$$\text{Moonpath Diameter} = DE = 2 \times 7! = 2 \times [1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7]$$

The relationship of height to width of a Vesica Piscis is the "Square root of 3" relationship; or,

$$AB = DE \times (\text{Square root of } 3)$$



Due to the Root 3 ratio in the *Vesica Piscis*, the height AB equals DE times the square root of three, or

$$AB = \text{Side of Square} = (2 \times 7!) \times (\text{square root of } 3).$$

Any square's area equals its side multiplied by itself, or side "squared":

$$\text{Square's Area} = [2 \times 7! \times (\text{square root of } 3)] \times [2 \times 7! \times (\text{square root of } 3)]$$

Since "the square root of three" times itself equals three, this can be rearranged to

$$\text{Area} = 2 \times 2 \times 3 \times [1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7] \times [1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7]$$

Factoring each 4 and 6 into (2x2) and (3x3) gives

$$\text{Area} = 2 \times 2 \times 3 \times [1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3) \times 7] \times [1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3) \times 7]$$

Simply rearranging we have

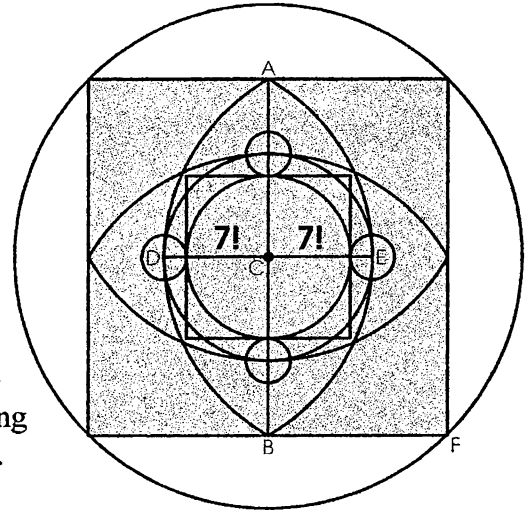
$$= [2 \times 2 \times 3] \times 7 \times [1 \times 2 \times 3 \times (2 \times 2) \times 5 \times (2 \times 3) \times 7] \times [1 \times (2 \times 2 \times 2) \times (3 \times 3) \times (2 \times 5)]$$

Multiplying the small groups we find

$$\text{Area} = 12 \times 7 \times [1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10], \text{ or}$$

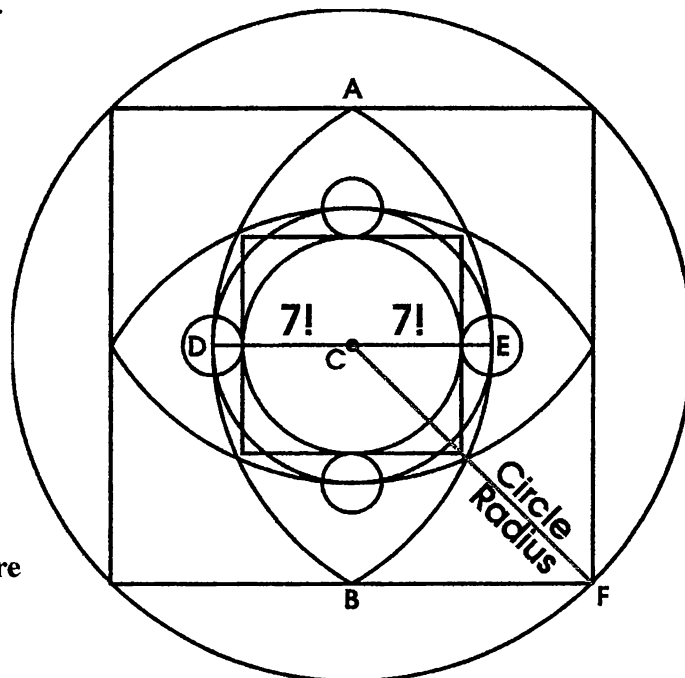
$$\text{Area of the Square} = 7 \times 12 \times 10!$$

That is, the area of the large square is "seven times twelve times all the numbers one through ten". These numbers show that we're getting tantalizingly close to the full complement one through twelve multiplied in one measure. If the seven became an eleven the goal would have been achieved. But seven, the number of spirit, is not eleven, the symbolic "passageway" number. How can our final passage to twelve, the number of all-encompassing structure, be found and traversed? The only remaining place to look is in the area of the full Cosmological Circle itself.



What is the Cosmological Circle's area?

Since the area of any circle is equal to (pi x its radius-squared), we only need to know the radius of the Cosmological Circle. It extends from its center to any of the square's corners.



The radius of the Cosmological Circle is half the diagonal of the square

Look at it this way: the Cosmological Circle's radius equals the side of its inscribed square times *half* the "square root of two", since it is half the square's diagonal, or

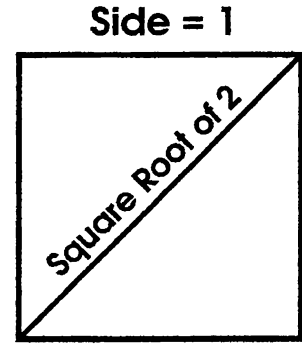
$$\text{Radius} = [2 \times 7! \times (\text{square root of } 3)] \times [1/2 \times (\text{square root of } 2)]$$

which can be simplified to

$$\text{Radius} = (\text{square root of } 2) \times (\text{square root of } 3) \times 7!$$

or

$$\text{Radius} = (\text{square root of } 6) \times 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7$$



Finally, knowing this radius of the Cosmological Circle we can complete the puzzle and find its area. Since any circle's area = (pi x radius²), and using the rationalized approximation of pi we have

$$\text{Area} = (22/7) \times [(\text{square root of } 6) \times 7!] \times [(\text{square root of } 6) \times 7!]$$

Since the square root of six times itself equals six, this resolves into

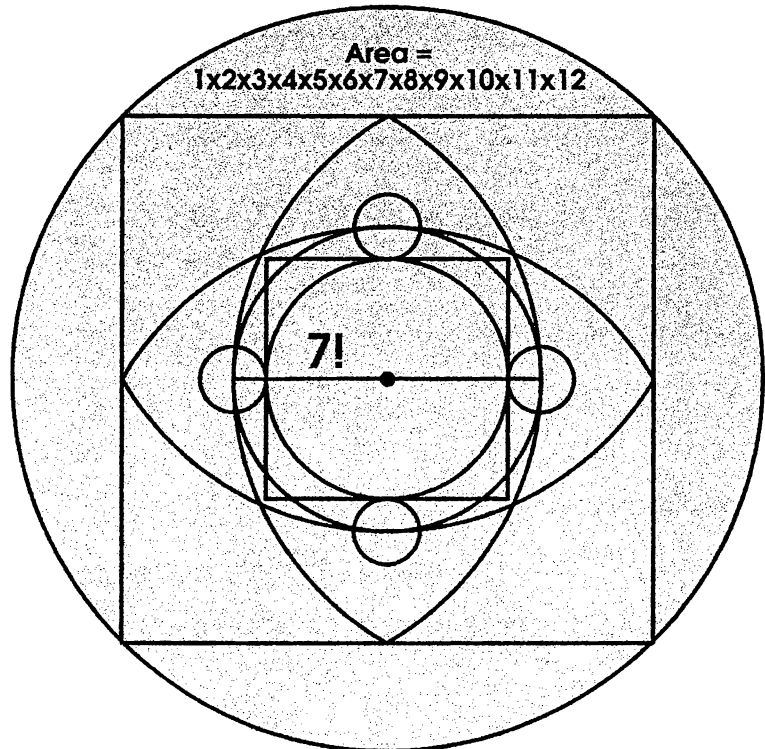
$$\text{Area} = (22/7) \times 6 \times (1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7) \times (1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7)$$

These elements can be factored, combined and rearranged to reveal that the area of circle which the Divine Architect constructed to symbolically encompass the universe, this orderly cosmos, is

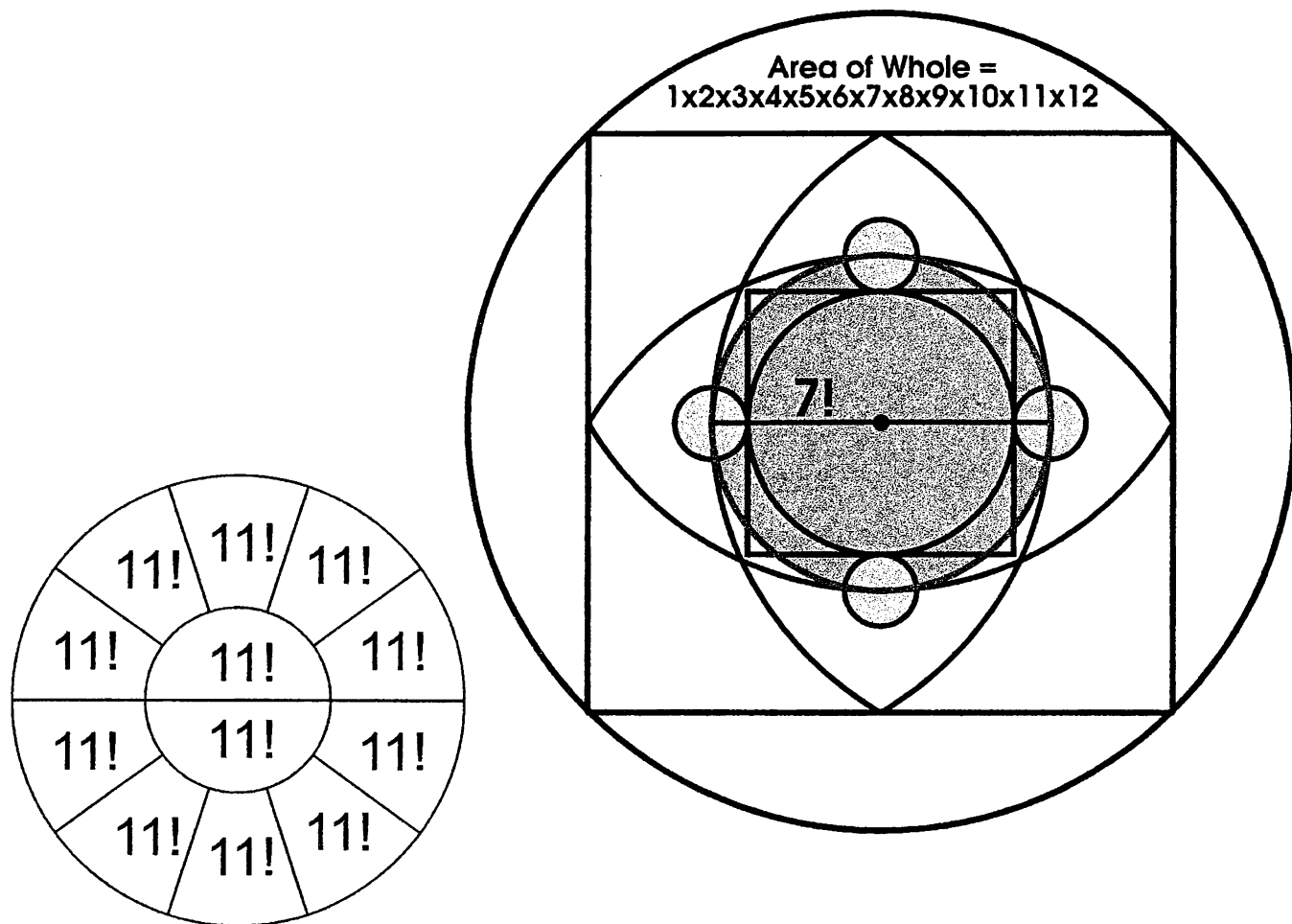
$$\text{Area of the Cosmological Circle} = 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 12!$$

Seven and twelve, spirit and structure, poles of the Cosmological Circle, yearn for each other.

When the "squared" circle has a radius equal to the product of the numbers one through seven (7!), the area of the total Cosmological Circle is equal to the product of the numbers one through twelve (12!).



This is the numerical culmination of our particular Cosmological Circle journey, although there remain relevant numbers not explored here but can be found in some books of the Bibliography. It's possible to go deeper into numerical details at each stage of its construction. The numbers one through twelve, eternally set principles of the creating process, are now all accounted for, each proportionally represented as wholes within One Whole. Their interwoven combinations of the numbers one through twelve take shape as a geometric construction, the ultimate round table, our universal amphictyony. It's the ideal circle originally constructed by the Divine Architect to bound and limit undifferentiated chaos, instilling order and transforming it to Cosmos. Its simple numbers allow our rational mind to appreciate its elevated wisdom. Their relationships present to us an image of harmony, full diversity in one symphony. There's a place for every number in its proper place and proportion. This harmony reveals itself to minds prepared to receive it. Perhaps by pondering and exploring the Cosmological Circle we can become, as Plato suggests, citizens of this ideal "city", and perhaps resonate with its harmonious relations and invite its lessons to transform this 'chaotic' world.



The Cosmological Circle's area (12!) can also be seen as a dozen sections whose same area is the numbers one through eleven multiplied together (since $11! \times 12 = 12!$).

Can you find other ways to divide the Cosmological Circle's area into equal sections?

“Do not seek to follow the footsteps of the men of old; seek what they sought.”

-- Matsuo Basho (1644-1694, Japanese poet)

Bibliography

The View Over Atlantis by John Michell, Ballantine Books, 1972

The New View Over Atlantis by John Michell, Harper & Row, 1983

City Of Revelation by John Michell, Ballantine Books, 1972

The Earth Spirit by John Michell, Thames & Hudson, 1975

Twelve-Tribe Nations and the Science of Enchanting The Landscape by John Michell and Christine Rhone, Phanes Press 1991

Sacred Geography of the Ancient Greeks by Jean Richer, translated by Christine Rhone, State University of New York Press, 1994.

The Temple At Jerusalem: A Revelation by John Michell, Samuel Weiser Publications, 2000

The Dimensions Of Paradise by John Michell, Adventures Unlimited Press, 2001

How The World Is Made: The Geometer's Story Of Creation by John Michell (Forthcoming 2007)

Watercolor paintings by John Michell on the web at:

http://www.thehope.org/jm_art.htm and <http://www.thehope.org/njframe.htm>

All Done With Mirrors by John Neal, Secret Academy Press, 2000

The Journey To the West by Wu Ch'eng-en, four volumes translated and edited by Anthony C. Yu, University of Chicago Press, 1977

Architecture, Time and Eternity (Volumes 1 and 2) by Adrian Snodgrass, Aditya Prakashan, 1990

History of Federal Government in Greece and Rome by Edward A. Freeman, Macmillan & Co., 1893

The Canon by William Stirling, Kessinger Press, 1897

A Little Book Of Coincidence by John Martineau, Walker & Company, 2002

A Beginner's Guide To Constructing The Universe by Michael S. Schneider, HarperPerennial, 1995

Constructing The Universe Activity Books (Volumes 1, 2, 3, 4) by Michael S. Schneider, 2003-2006

Watercolor paintings by Michael S. Schneider (see pages 74-80) on the web at:

<http://www.constructingtheuniverse.com/paintings.html>

www.constructingtheuniverse.com