Time Travel

To

Ancient Math & Physics

By

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Mindkind Publications

Smashwords Edition

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November 10, 2003
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Universal Principles: The Mysteries of Dolphinboy

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ISBN 978-0-9857850-3-1

Who really knows, and who can swear,

How creation came, when or where!

Even gods came after creation's day.

Rig Veda 10:129 (V.V. Raman Translation)

Table of Contents

Preface

Our Ancient Civilization

Ancient Physics

Ancient Geometry

Ancient Mathematics

Endnotes

About the Author

Contact the Author

Other Books by the Author

Preface

This book is for those who, like myself, are fascinated with our ancient civilizations and who want to know more about their knowledge and the tools they used. We are fortunate to live at a time when sciences, such as archeology, geology, paleontology, biology, and linguistics are providing reliable clues as to the nature and character of our past existence.

Commencing with the Third Millennium B.C., or about the time of the Fourth Dynasty which completed the Giza pyramids, a great deal is known about the more advanced Egyptian and Sumerian civilizations of the time from the records they kept. However, as we travel further back in time, we have to rely on the stones and artifacts left behind in our attempt to understand the nature of these more distant civilizations.

Frequently, however, when we visit the history shelves of our local library or bookstore, we fail to find reliable information about our most ancient civilizations and, all too often, we are confronted with quackery and pseudoscience. Separating the wheat from the chaff was a part of this effort, and the endnotes which follow reflect the best information now available.

From everything we find, it appears the most ancient civilizations worshiped life and motherhood and they flourished in peace and harmony. It also seems their knowledge may have been more profound than the better known civilizations that followed.

It may have been that the ancient manner of thought was entirely different from today. Most likely, the ancients shared in a collective consciousness of their group, which was unified in the worship of Mother Goddess.

We will rely on the device of time travel to study these ancient civilizations, and we will bounce far back into the past to see how our universe was created. We will also rebound into the future to see what it may hold. Once again, science provides valuable clues in making predictions of earthquakes, colliding asteroids and global warming, and it helps us to anticipate and prepare for these dangers.

We can also call upon the wisdom of ancient civilizations to help us prepare for the more immediate threats of disease, poverty, hunger, ignorance and violence. This, perhaps, is what we should be seeking when we study the distant past. How did they learn so much and how were they able to live in peace?

Return to Table of Contents

Our Ancient Civilization

Writing in 1895, H. G. Wells (1866-1946) imagined *The Time Machine* as a sort of open bicycle frame on which the time traveler was able to ride forward thousands of years into the future, which he did for eight days of romance and adventure, to near the end of earth's life, before reversing the levers and returning. In the end, the time traveler left on another journey from which he never returned.

Let us now imagine not a time-travel machine, but rather let us use our mental ability to “virtually” detach ourselves from our gravitational constraints, remaining in the constant electromagnetic flux that surrounds and permeates our universe, and to spin into another stream of time, with its own speed of light, flowing past just beyond the reach of our sensory perception.

First, we must add energy to accelerate our existence in order to skip forward in time about 65 million years to a reference point from which we will rebound, beyond now, back an equal amount of time into the past we want to visit.

We can only guess what the future might be like, but, from the records written in the rocks of the earth, we can reconstruct what it was like in the past. Particularly, let us imagine we have the ability to go precisely to where the earth will be or was at any moment of its life, relative to the electromagnetic moment of now and to “see” what there will be and what there was to be seen.

We must first accept that the earth has been spinning in orbit around the sun for several billions of years as it has slowly cooled, and that its crust is as thin, relatively, as the shell of a bird's egg.

The interior of the earth consists of several layers of molten rock surrounding a yolk of iron and the surface is slightly flat at the poles. If we perceive the earth as rolling on its side or equator, we can see it as a massive flywheel spinning around its heavy spherical core with an incredible amount of potential energy as it rolls around the sun.

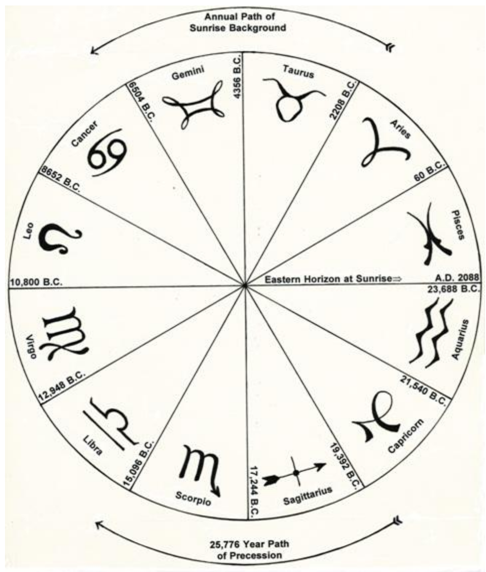
The molten mass of our earth varies little in either its spin or its orbit in relation to the sun; however, the relatively thin crust floats around on the molten magma like ice on water. What we perceive as solid land migrates about, and any particular place may be found at various points upon the surface depending upon the time of our visit.

We can imagine that the axle poles of the planet are the needle of a sewing machine, and the crust is a spherical piece of cloth. As the needle operates up and down, the cloth is drawn across the poles and around the sphere. However, it is the cloth, not the needle that is moving across the sewing surface; relative to the needle, the sewing machine never moves.

As the Earth spins around an axle through its poles, the axle tips wobble about in a circle like a child's toy top or a gyroscope. Relative to the twelve constellations of the zodiac, it takes 25,776 years for the axle to complete one complete gyration, causing the sun to rise each year on the spring equinox at a place slightly behind where it was the year before.

This "precession" of the equinoxes is very slow and it takes 2,148 years for the sun to "back" into each new constellation.

At present, we are just leaving Pisces and preparing to enter the Age of Aquarius. (Figure 1) [1]



Now equipped with the imaginary means to time travel and with a chronometer tied to the movement of the heavens, let us travel back in time to learn about our ancient civilization, before we attempt to look further back and to take a look at our future

A Time of Fire and Death

With our ability to time-trip under control, we can rebound from beyond tomorrow, arcing back across an equal number of years into the past, to the day we have targeted for our first visit to yesteryear, near noon on a warm and clear summer day in the northern hemisphere about 65 million years ago.

The continents are not in the same relationship on the earth's crust as they are today, drifting about as they always have; however, we can still relate North America and Alaska to the two main oceans, and find Siberia on the Asian continent.

Some years earlier, the night skies may have been dominated by the reflected light from a giant comet that had been torn apart during its last visit to the inner solar system, but there was no sentient life on the planet to be amazed or frightened by its appearance. For it was the age of the great dinosaurs, who had ruled the earth for millions of years, patiently eating vegetation and occasionally being eaten by their cousins who had developed a taste for meat.

Here and there could be seen tiny, shrew-like creatures, who had evolved into the first mammals, warm-blooded and just a tad smarter than their reptilian ancestors. Perhaps one of these small mammals looked up at the brightening light in the sky in wonder, just before the first of three or more, and perhaps as many as six, gigantic chunks of rock and ice rained down upon the earth.

Those who watched the televised images of fragments of the Shoemaker-Levy comet colliding one after the other with the surface of Jupiter in 1994, can imagine the effect. Appearing to come out of the sun, the first huge rock slammed down in the Caribbean Sea just off the Mexican Yucatan peninsula, sending shock waves through and around the earth that focused and disrupted the crust on the opposite side of the globe in India. The next may have struck a few minutes later near Avak, Alaska, followed by one near Popigai in Siberia, then two more hit near Kara in western Siberia.

The rocks were pulverized by the impact and their dust, rich in the rare metal iridium, rose into the atmosphere and settled out over time leaving a layer of clay on the surface all over the world. [2]

A ringside seat in the sky might have provided the only safe viewing platform, as all life on earth was immediately put at risk. An intense heat and fire around the globe consumed the vegetation and, as a great cloud of dust and soot blocked the rays of the sun, the earth was plunged into a deep freeze.

Then, as the dust was cleared by a sulfuric acid rain, earth entered a "greenhouse" phase in which temperatures were raised for about 500,000 years. Life was not only hard, it was nigh impossible, and the age of the dinosaur ended, along with much of the life on earth, but, here and there, the tiny mammals were able to survive and to thrive, feasting on the carrion and detritus that remained.

First Ancestors

If we continue our rebound forward in time, bouncing in the direction of now, we can skip about 60 million years and time our next arrival to about five million years ago. The continent of Africa, which had been slowly drifting north, had rammed into Europe at Gibraltar about seven million years earlier shutting the Mediterranean Sea off from the Atlantic Ocean.

The "sea level" of the Mediterranean dropped as it slowly dried up, causing the Nile River to cut a deep channel similar to the Grand Canyon as it flowed north. Then, suddenly, the Atlantic Ocean broke through the Strait of Gibraltar and flooded the Mediterranean basin to the depth of a mile within a single human lifetime. [3]

The mammals had been successful during these 60 million years, and in Africa we can find a concentration of related mammals known as primates. One of these is the mother of all of us, a relative of the ape and chimpanzee, who began to distinguish herself by the ability to walk upright, the use of stone tools and a language she used to communicate her learned knowledge.

Our upright stance allowed for more efficient thermoregulation in that bipeds only expose 7 percent of their body surfaces to the noontime sun whereas quadrupeds expose at least 20 percent at all times. This allows us to lose heat 33 percent faster than quadrupeds. In the same way, our loss of hair allowed for more efficient sweating and evaporation, while retaining hair only on our heads and shoulders to protect from the most direct overhead radiation. [4]

Whether we got used to standing up for long periods of time in an awkward position, or we are descended from aquatic apes who developed supple spines from earning a living in the lakes, we began to evolve into several different related families of humans, all of whom had knowledge of the use of tools, shelter, clothing, fire, and language.

A Time of Ice

Again bobbing forward across the ripples of time, we can select a date about 100,000 years ago and see what was happening. Zeroing in on the North Pole, one of the first things we might notice is that there is more ice in the northern hemisphere than there was during our last visit.

An ice age had commenced about 15,000 years earlier, or 115,000 years ago, when for whatever reason, the snow stopped melting during summers and accumulated in great rivers of ice called glaciers. As the glaciers moved, inexorably, down river valleys toward the seas they compressed and carved the land beneath them. From the remains, we can see where they used to be.

Although we perceive the Ice Age as having been a rather cold and dismal time and we can picture the discomfort of Neanderthals huddled around small fires in drafty northern caves, such a view is parochial in that large areas of the southern hemisphere were quite pleasant for long periods of time. In fact, that might be the normal situation on earth, and we may only be living in a short interlude before the price of real estate begins to drop in the north, and we again migrate home to the south.

Living 100,000 years ago were three species of proto humans, or three divergent types of the same original family. In Africa, black woman and her family had lived for millions of years, and scientists can now tell from DNA testing that we are all related to one woman and her relatives who lived in Africa several hundred thousand years ago. Upon our arrival in time travel, 100,000 years ago, she and her extended family continued to live throughout the African continent.

To the east, along an arc from the Indonesia islands onto the mainland of Asia lived another group of cousins known to us as Java Man (*Denisova hominin*), and his wife and family. And, in Asia Minor and across Europe lived perhaps the most prosperous relative in the family, the Neanderthals (*Homo neanderthalensis*), who had succeeded in staying alive during the harsh cold weather through the use of fire and animal furs for warmth.

Ours was already an ancient civilization making use of science. Our ancestor, *Homo erectus* (or archaic *Homo sapiens*) first began mining ocher (a red oxide of iron) in South Africa at least 350,000 years ago for use as symbolic body paint, or perhaps as protection from insects and the sun.

Evidence of the spread of the ocher mining industry can be found from England, France, Czechoslovakia, and India, to Australia. Heating may have been used to change the color of ocher, which later may have led to the heating of flints, the development of pottery, and the smelting of metals.

Evidence of the early use of symbolic language by archaic Homo sapiens was discovered in 1969 at a Lower Paleolithic site (Bilzingsleben) near Halle in former East Germany. Among a number of artifacts dating from 250,000 to 350,000 years ago was four animal bones bearing unmistakable and deliberate etchings, including an elephant tibia clearly marked with seven and 14 straight lines and another bone with five double lines.

Perhaps even more exciting was the discovery in 1981 of the earliest known carved, human-shaped stone figurine near Berekhat Ram in the Golan Heights. The figurine was found in association with a large number of stone artifacts including scrapers and burins demonstrating a high level of technical competence between two flowing layers of volcanic basalt reliably dated at 800,000 and 233,000 years ago.

Evidence of *Homo erectus* completely disappears from the fossil record around 200,000 years ago being replaced approximately 130,000 to 100,000 years ago by the first remains of our own species, *Homo sapiens* (Latin for "wise man" or "knowing man").

In our appearance, we had grown taller and more slender; our chins jutted forward and our faces were shorter and more tucked under our skulls. We had higher foreheads, without brow ridges, and our brain cavities had expanded to between 1,200 and 1,700 cc. These individuals were anatomically indistinguishable from modern humans. [5]

Though we often credit ourselves with the discoveries of language, art, and science, the most recent evidence demonstrates that our ancestors were also capable of abstract thought and creative endeavors.

A hundred thousand years ago, we had already been engaged in tool making for more than a million years, and the standard hand-axe, our most characteristic product, had become standardized throughout Africa, Europe, and much of Asia. Such conformity could only result from a widespread learned ability to first imagine what the resulting axe should look like before it was knapped from a cobble of stone.

The Birth of Humanity

Bobbing forward another 50,000 years, we can note upon our arrival that the earth's crust has continued to wander about under the North Pole. Commencing around 91,600 B.C., the North Pole migrated from the northwest tip of North America to a location just off the coast of Sweden. It was stable there until about 50,600 B.C., when it again began to migrate, this time in the direction of the Hudson Bay, where it remained until about 9600 B.C., when the crust slipped to its current location. [6]

Relative to the sun, the earth revolves in a stable orbit on the ecliptic plane, and we can reliably pinpoint its axis poles in relation to the sun; however, we cannot be sure of any particular location on its surface in relation to the poles.

In addition to plate tectonics (in which the crustal plates grind against each other in an endless cycle of destruction and creation), it is possible that the entire crust, independent of the equator and poles, may slowly shift up to 40 degrees from time to time. [7]

The movement of the crust, relative to the molten mass, may result in a migration of the poles back and forth and the equator up and down. Such shifts would cause major changes in the climate for the areas of the earth where the movement is most dramatic. Areas can change from arctic, to temperate, to equatorial and back again. [8]

A theory supporting migration of the poles was first advanced more than a hundred years ago by the Swedish paleontologist, Professor A. G. Nathorst. He postulated that the movement could occur over very long periods of time caused by geologic processes such as the raising of mountain ranges causing "one-sided" effects on the earth's axis of rotation. He thought that over millions of years, the poles may have moved as much as 20 degrees of latitude along a line between Japan and Greenland.

The movement would place ancient Bavaria at the same latitude as Algeria is now and would explain the existence of palm trees there in the fossil record. Evidence from multiple observations demonstrated that there is a gradual movement in the same direction that could amount to as much as a degree of movement over a period of 360,000 years. [9]

Albert Einstein believed that, "In a polar region there is continual deposition of ice, which is not symmetrically distributed about the pole. The earth's rotation acts on these unsymmetrically deposited masses, and produces centrifugal momentum that is transmitted to the rigid crust of the earth. The constantly increasing centrifugal momentum produced in this way will, when it has reached a certain point, produce a movement of the earth's crust over the rest of the earth's body..." [10]

On this visit we find that by about 50,000 years ago, our society of Homo sapiens had begun to spin outward in every direction, slightly mingling with and completely replacing all previous related groups, resulting in a single species of humans, with different racial body types.

Evidence of the deliberate burial of the remains of humans identifiable as Homo sapiens has been found in Israel at the Qafzeh and Skhul Caves dating from the period 120,000 to 90,000 years ago.

In Europe, Neanderthal has been replaced by Cro-Magnon; in Asia, Java man has become Asian Women, modern African Woman has emerged in Africa, and Caucasian Woman first appears, just where and how we are not yet sure.

Perhaps we will never be certain of the exact place and time where human civilization began; however, we find that the origin of language and symbolic logic is far more ancient than has been traditionally believed.

Depending upon the school of thought, there are between 5,000 and 10,000 different languages spoken on earth today. These have been organized most generally into 17 major groups of related languages, one of which is Indo-European. Some linguists identify several of these 17 groups as deriving from a remote ancestral language called Nostratic (Latin: *noster*, "our").

Going even further, a minority of linguists seek to reconstruct a single "Proto-Global" or "Proto-World" language as ancestral to all human languages based upon similarities in common words such as man, woman, child, hole, vulva, finger, and water.

From the moment we struck the first flint and created verbal language to teach the making of fire and tools, our species has been defined by our ability to mentally synapse beyond the limitations of instinct, to acquire and expand knowledge, and to teach the tool of learning and the value of exploration and travel to each new generation. *Then is when we truly became human and took our first steps into the family of Mindkind* .

The Dawn of Civilization

If we set our next time bounce to about 25,000 years ago, we finally arrive at a view of earth which bears a similarity to its appearance today. The first thing we would notice is that things are not the same as they were 25,000 years earlier, nor as they are today.

The Wisconsin Glaciation, which started about 115,000 years ago, had reached its maximum accumulation about 60,000 years ago, and the North Pole had stabilized in the area of the Hudson Bay about 48,000 years ago.

In Europe, the Wurm Glaciation started about 70,000 years ago in Scandinavia and Scotland and ultimately covered most of Denmark and England and much of Germany. It extended to the east over Poland and Russia and south over all of Switzerland and included much of France, Italy and Austria.

The Ice Age caused the level of the oceans to drop substantially, up to 90 meters, and much of the shallow coastal areas that are submerged today were once dry land. Around a smaller Mediterranean Sea separating Europe and Africa, we find the first evidence of the arrival of individuals known as Cro-Magnon around 40,000 to 30,000 years ago.

It is not yet clear whether Cro-Magnons assimilated with or replaced Neanderthals, a species which was rapidly disappearing. The latest DNA testing indicates Neanderthals were of a separate linage than Cro-Magnons, although it appears the two species may have intermingled.

Subsequent civilizations, variously known as Old European, Reindeer or Magdalenian, flourished for thousands of years and spread across Europe into Asia. Art from these civilizations can still be seen as wall paintings in caves, some of the entrances to which are now underwater, and as carved images of Mother Goddess.

The earliest art may have been performed by Neanderthals, but recent uranium-thorium dating identifies red-pigment stencils almost 41,000 years old. The most common stencils are of the human hand, but others depict dots, disks and line drawings.

We find evidence of sophisticated flint mining in the Nile Valley as early as 40,000 years ago. It is at about this same time (35,000 years ago) that we find early evidence of counting in 29 notches carved on a baboon's thigh bone which was recovered in the Lebembo Mountains in Africa. Slightly younger is a wolf bone found in Czechoslovakia, which has 55 notches and is 30,000 years old.

A cave near Ulm, Germany sheltered human culture for thousands of years and has provided archeologists with evidence of its longevity. A 40,000-year-old layer reveals an ancient appreciation of art in the forms of a Venus figurine, a flying water bird and a half-human, half-lion figure. A 35,000-year-old layer provided evidence of music in a bird bone flute with five precisely drilled holes, and another ivory flute has been dated to 30,000 years ago. [11]

The Ancient Mariners

Increasingly, there is compelling evidence of the existence of a lost maritime civilization prior to historic times. Evidence of this civilization can be found by studying the most ancient maps in existence, maps that were created at a time when Antarctica was still *Terra Australis Incognita*, but which clearly demonstrate that the map makers were aware that Antarctica was a continent and which demonstrate its shape.

The oldest of these maps is one compiled by the Turkish admiral Piri Reis (ca. 1465 - ca. 1555) from earlier maps which shows the northern coast of Antarctica, the western coast of Africa and the eastern coast of South America. The Piri Reis map shows details of Queen Maud Land although modern geological evidence demonstrates that the area was last free of ice more than 6,000 years ago. [12]

Other old maps compiled from even more ancient sources also showed Antarctica in an ice-free condition. Included is the Oronteus Finaeus (1494-1555) map drawn in 1531, several maps prepared by Gerard Kremer, also known as Mercator, (1512-1594) in 1569, and Philippe Buache (1700-1773) in 1737.

In particular, Buache's map shows Antarctica as divided into several islands, which was not known until a comprehensive seismic survey was carried out in 1958.

These ancient maps suggest that we may have once inhabited the world as an intelligent race of mariners and that we mapped the earth's surface with a high degree of accuracy. Such maps were not compiled by landlubbers; they were made for sailors to find their way home across the waterways of the earth using familiar guideposts in the sky for directions. [13]

What remains to tell us of the civilization we once enjoyed? From the map projections, we must have understood spherical trigonometry, and certainly we could not only tell time but could tell time very accurately. The ancient observatories located around the rims of the seas, such as Stonehenge, Silbury Hill, and Newgrange (established as early as 3000 B.C.), may have served to facilitate navigation.

Most likely, our ancient civilization understood the concept of science, although our technology may have been rudimentary. For example, simple batteries have been found in archeological digs in Iraq, along with ancient manuscripts from India telling how to wire them in sequence.

We understood chemistry and the various minerals and ores found in and near Egypt. [14] We knew much about metals, their differences and alloys, and we created an extensive language of words, first identified in ancient Sumerian cuneiform tablets, to describe the smelting processes.

When Did Time Begin?

In the Third Century B.C., an Egyptian priest by the name of Manetho compiled a list of kings that still forms the basis upon which modern scholars calculate the various dynasties of Egypt. Commencing more than 36,525 years ago, the "gods," such as Ra, Osiris, Isis and Horus, ruled for the first 13,900 years, followed by the Demigods, Spirits of the Dead, and finally by human pharaohs.

The Egyptian calendar carries a starting date of 49,214 B.C.; however the First Dynasty for which there is a historical basis dates from 3100 B.C.

When the Greek historian, Herodotus of Halicarnassus (ca. 484 - ca. 425 B.C.), visited Egypt, he reportedly was informed that there had been "four occasions when the sun rose out of his wonted place – twice rising where he now sets, and twice setting where he now rises." This may refer to one-and-one-half cycles of precession totaling 39,000 years. [15] (*See above* Figure 1)

At the time of the Spanish conquest, the Aztecs believed they lived in the fifth of five "suns" stretching back in time more than 17,141 years. Although the exact period of the Fifth Sun was unknown, it was already thought to be old and that it would end with a great movement of the earth.

According to the Mayas, who dated their civilization or "long count" from 3113 B.C., the Fifth Sun is to end on December 23, 2012. [16] As this date follows closely upon the publication of this book, we will have a front row seat to judge the prediction for ourselves.

Whether we ourselves are the children of God, created by God, or the result of experimentation by aliens from outer space, whether we are the progeny of time trippers from the future who were able to travel to the past with only their scientific knowledge, naked and without tools, or whether we just simply evolved here as a result of our own effort and initiative, it appears that we lived in great peace and harmony with nature and each other for thousands of years.

Migration of The Ancient Mariners

Starting about 17,000 years ago, the Wurm Glaciation began to retreat in earnest; by 13,000 years ago the maximum extent of the Wisconsin Glaciation began to melt and the sea level was raised by 50 meters.

A recent comparison between ice cores from Antarctica and Greenland shows that both areas experienced a rapid warming, as great as 59 degrees within a 50-year period, at about the same time around 12,500 years ago. [17]

The Ice Age in the northern hemisphere had completely withdrawn by 8000 B.C., and by 5000 B.C. the sea level was raised by another 40 meters.

Commencing in about 14,500 B.C. and lasting for about 2,000 years, there was a great extinction of species on earth. It has recently been postulated that the extinction may have been caused by the explosion of a massive comet over the North American continent approximately 12,900 years ago. Immense wildfires may have killed large populations of mammals. [18]

Humanity survived these disasters by migrating.

Although the accepted conservative view is that the Americas were populated by Asians who moved across the Bering Strait during the Ice Age when it was solid land, there is also strong evidence that migration may have occurred because our ancient civilization was seafaring.

Since the rising ocean levels following the Ice Age have covered areas of habitation along the coast, excavations on the Channel Islands off the coast of California have allowed archeologists to postulate that maritime sailors from Asia explored the west coast of America 13,000 years ago.

In addition to the Asians who may have crossed at Beringia, there is evidence that proto-Japanese may have hunted birds and fish along the coast. Delicate barbed arrowheads and broad crescent arrowheads found on the islands are similar to points dating from 16,000 years ago found in Japan. [19]

The most recent DNA evidence establishes a relationship between the settlers of coastal regions from Alaska to Tierra del Fuego more than 10,000 years ago. [20]

Seven thousand years ago, the coast of Southern California was occupied by a technologically sophisticated civilization. Evidence of this culture, consisting of mortars, grinders, weights, and projectile points, has been located offshore and underwater near San Diego. [21]

Testing of the skeleton of a female recently found on Santa Rosa Island off the coast of Santa Barbara resulted in a radiocarbon date of 13,000 years making it the oldest human remains in North America. [22]

It has been determined that a settlement at Monte Verde in Chile containing stone tools, fire pits, and hide-covered huts can be reliably dated to about 12,500 years ago. More recent carbon dating of seaweed has moved inhabitation back to 14,100 years ago. [23]

South American peanuts have been found on the coast of China at an archeological site dated 3000 B.C., and there are a number of similarities between Central American and Chinese cultures. Jade beads are found in the mouths of corpses of both cultures, and both the Shang Dynasty (1525-1027 B.C.) and the Olmecs (1300-900 B.C.) worshiped big cats without lower jaws.

Wheeled toys, knotted strings, ax-shaped coins, and conical-lidded cylinder pots are found in both cultures, and the Chinese legend of Fu-sang refers to a paradise located beyond the Eastern Sea. Interestingly, there was no millet or rice located in the Americas, indicating that some of the movement of cultures may have been from the Americas toward Asia. [24]

Within the period approximately 12,000 years ago accepted by most archaeologists for the occupation of America, are the distinctive fluted spear points, or Clovis flints, dated to 10,900 to 11,200 years ago, which were first found in New Mexico. [25] These points are different from and less delicate than those found on the Channel Islands and in Japan.

The earliest of these "Clovis" points are also found in the southeast part of North America and they are most similar to artifacts found, not in Asia, but from the Solutrean culture which lived in France and Spain. Both cultures made beveled, crosshatched bone rods, idiosyncratic spear points of mammoth ivory, and triangular stone scrapers.

Support for direct cross-ocean migration to the eastern shores of America has been discovered in an archeological dig near Carson, Virginia. A prehistoric campsite at the "Cactus Hill" site has been firmly dated to be as early as 15,000 B.C. and includes primitive stone points. More modern "Clovis" spear points were located in a hearth found to be about 10,900 years old. One theory is that the earlier settlers were proto-Spaniards who may have sailed across the Atlantic as early as 18,000 years ago. [26]

Abandonment of the Clovis-first model of settlement received support with the discovery of a massive cache of artifacts buried under Clovis remains near Austin, Texas. The 16,000 artifacts are at least 15,500 years old and raise new questions about how and when America was settled. [27]

Additional support of an earlier Atlantic crossing was provided by the discovery of a tapered stone blade with a 22,000-year-old mastodon tusk near the mouth of the Chesapeake Bay in 1970. The discovery lends credence to the "Solutrean hypothesis" which holds that Stone Age Europeans paddled along the edge of an ice cap to North America during the last ice age. [28]

The additional discovery of stone tools from other mid-Atlantic sites are correlated with similar tools found at Solutrean sites in Spain and France. These tools are also believed to be at least 21,000 years old.

The range of the ancient mariners extended into the north Atlantic where evidence of the Maritime Archaic Red-Paint Cultures of western Scandinavia and northwest Europe can be found and carbon-dated in Norway as early as 5500 B.C. Operating oceangoing ships and hunting swordfish and marine mammals, they colonized Labrador and New England by 5000 B.C., a land which became known as Iarghal (Beyond-the-Sunset). [29]

We don't know how much warning the ancients had, but with our shorelines and settlements awash in the rising oceans, it appears we began to migrate to the Andes in South America, the Nile Valley in Egypt, and elsewhere, where we set about relocating our navigation points in the sky and reorienting our maps.

Trusting in the familiar constellations, we said goodbye to Virgo one morning on the spring equinox around 10,800 B.C. as we watched the sun rise for the first time in the House of Leo.

We settled in for a 2,148-year visit and began to carve the lion-shaped Sphinx facing due east and erected a high obelisk between her paws to measure time and location. We laid out the Giza precincts and may have built the bases of the pyramids as observatories to relocate the geodetic navel of the earth and to recalculate our charts of the stars.

With our compasses reoriented, our ancient ancestors found a new pole star to navigate by and steered more often toward the more pleasant northern hemisphere.

Archaeologists have identified the emergence of a farming culture known as the Natufian in a broad area between Jericho, Asia Minor, and the Euphrates around 13,000 years ago. For 1,500 years during a reversal of Ice Age warming, the Natufians used sickles of carved deer antlers embedded with flakes of flint to harvest the natural stands of native wheat and rye. They also gathered wild barley, lentil, and vetch, and the fruit of the hackberry, plum, pear, and fig tree, as well as the caper bush. However, when the Ice Age again ended and warming resumed, the Natufian culture collapsed. [30]

Obsidian found at archeological sites in southern Greece and identified as having come from the island of Melos provides evidence of travel by boat in the Aegean Sea at the dawn of history around 6500 B.C. Here too is evidence that we were engaged in the cultivation of emmer and einkhorn wheat, peas and vetch, as well as the domestication of sheep and goats. [31]

Soon thereafter, the island of Crete was settled by seagoing immigrants from Anatolia, and the Minoan civilization was founded by 6000 B.C. For more than four thousand years, a peaceful society based upon the worship of the Mother Goddess flourished on Crete and the surrounding islands.

Influence of the Mother Goddess civilization extended throughout Europe and as far east as Mesopotamia, and its knowledge was transmitted in the first written language. The language is not known to contain words relating to war and slavery, and its art did not depict violence as a way of life. Its culture not only recognized and emphasized the rights of women, but it involved a high degree of equality in the sharing of wealth. [32]

Emerging evidence from behind the former "Iron Curtain" powerfully demonstrates that the Black Sea was shut off from the Mediterranean at the Bosporus Strait during the Ice Age when the sea level dropped worldwide.

Becoming a large fresh water lake, the Black Sea was the center of a fruitful culture that was destroyed when the rising water of the Mediterranean Sea broke through the Strait approximately 7,500 years ago. The forced migration of the survivors of this culture into China, India, Iraq, Syria, Israel, Egypt, Greece, and Europe gave rise to the spread of the Indo-European language and culture into these areas. It is likely that this event is the historical basis of the Great Flood recorded in the Old Testament. [33]

By 4000 B.C., advanced civilizations arose in the Andes, Sumer, the Indus Valley, and in Egypt. From then until now, human society has oriented itself to the land rather than the seas, and has redirected its spiritual worship from life and the Mother Goddess toward violence, death and the standards of war.

Return to Table of Contents

Ancient Physics

We may never know or discover the full extent of the knowledge of physical sciences possessed by the ancients, or recover from its loss, but we can imagine its logical extent from the available archeological record.

From all evidence, it is increasing clear that a learned society existed, which was primarily focused upon a full world view of all the seas and their successful navigation over thousands of years. Evidenced is a sophisticated comprehension of the physical movement of the earth in relation to the heavenly bodies based upon a high order of scientific observation and systematic recording.

We can also see that the ancients were not only mariners but that one of the reasons they sailed was to seek out metals to mine, smelt and forge into the tools they used to cut stones and timbers used in building homes and ships.

We are also learning that their understanding of physics involved a high level of chemistry, not only exhibited in metallurgy, but in the mixing of chemical electrolytes to power electric batteries perhaps used in electroplating metals.

It may have been that the ancients' mode or manner of thought was entirely different from that of today. A comparison has been made between the "solar knowledge" of today based upon words and concepts and the "lunar knowledge" of the ancients based upon intuition and the ability to grasp things as a whole.

Differing from the fragmented knowledge of today when no one individual can possibly know everything, the ancients may have shared a "state of heightened consciousness in which they understood some secret of cosmic harmony and its precise vibrations, which enabled them to feel an integral part of the world and nature." [34]

Under this view, ancient individuals were never rugged individualists; he and she were always members of a group and shared in the collective consciousness of the group much like a fish in a school or a bird in a flock. The collective civilization may have been totally unified in the worship of Mother Goddess, a religion in its entirety.

The Loss of Inertia

The core of our ancient civilization survived the last slippage of the earth's crust and comet bombardment, and its cultural knowledge was still intact when the foundations of the pyramids and the Sphinx were reoriented more than 11,000 years ago, and the Nile Valley was colonized.

By the time the pyramids were completed in about 2500 B.C. much of the ancient knowledge of physics appears to have still been in practical use as evidenced by the quality of materials and construction used in completing the pyramids and the restoration of other megalithic buildings at that time.

Neither the Egyptian civilization which followed, nor the Sumerian civilization which began at about this time, was ever again so talented. Both civilizations continued to flourish; however, their level of knowledge of the physical processes never returned to where it was in the beginning, although some of the tools of geometry and mathematics survived as useful in a society now oriented to the land, rather than the sea.

Lost was the science of mentally imaging related actions and reactions within the physical world, which was replaced by attribution of all observable natural phenomena to the "gods" who resided in the realms of heaven.

Bouncing forward in time several thousand years to a little more than two thousand years ago, we can pick up recorded history in the Fourth Century B.C., when Aristotle (384-322 B.C.) and other classical Greek scholars used the last remaining tools of mathematics and geometry and the ancient measures they had learned from the Egyptians to simplify, excessively, their understanding of physics.

With their world view limited to the small Mediterranean Sea, and with what little they learned from Alexander's conquest of the East, the Greeks tried to explain what they observed, but they had little understanding of the underlying physical foundations.

Aristotle and the others lost sight of the fact that mass inherently has inertia and naturally moves, unless a force is used to slow it down, and erroneously concluded that mass does not move unless forced to. He and the other Greeks could never understand why mass kept moving, because they had such difficulty getting it going. Along with the later Egyptians, they extended the idea that mass had to be powered by imagining that the "gods" moved the sun, moon, planets and stars around the earth.

While Aristotle could imagine that heavier weights might fall at the same speed as lighter ones in a perfect vacuum, he could not admit the possibility of such a vacuum, and since for him, it did indeed appear that heavier things seemed to fall faster than lighter ones, at least in water, no further explanation was necessary.

Writing a generation earlier than Aristotle, Democritus (460-370 B.C.) and others were able to imagine that all mass was ultimately composed of what they called atoms, but the Greeks were unable to differentiate any further than the simple categories of earth, water, fire and air, and assumed that each had different kinds of atoms.

With their narrow world view, the Greeks were able to explain simply their everyday observations of wood burning and smoke rising, rocks sinking in water, and the heat of the sun, at least for their practical needs and to their satisfaction.

Plato (427-347 B.C.) told a story about the difficulty of understanding and explaining the physical processes. In his Allegory of the Cave, humans are depicted as slaves chained in the dark recesses of a cave in which the only thing they see are the shadows cast by unseen fires behind them, made by people holding various objects over their heads.

One slave is released into the real world and observes both its beauty and the nature of the objects, which the slaves have seen only as shadows. Responding to a duty, the slave, now a philosopher, returns to the cave and attempts to explain to the others what the real world outside is like. The others reject what he says and threaten him with death if he continues to disturb their orderly, yet benighted, existence.

Plato concluded that, irrespective of the risk, philosophers have the duty to explore and to offer alternative explanations for observable phenomena.

Aristotle and the other Greeks either forgot or never learned the science of creative thinking. Because they remembered and used only the tools of critical thinking, most of the ancient secrets of physics were lost to human society for more than 2,000 years, along with all that might have been.

Only in the last century have we regained the knowledge to scientifically conceptualize the physical creation of our universe.

In the Beginning

It is not that mass is stupid, it is just mindless, and from the time it is created from pure energy it has but one goal: to move, endlessly, in a "straight line" around a great curve back to where it started, seeking attractive companionship along the way. [35]

The Birth of Matter. In the beginning of our universe, about 12 to 13 ½ billion years ago, according to current theory, [36] there existed only an unlimited dark void into which was born a single spark of light, smaller than a grain of sand. We still hear the echoes of the moment as static on our radios and can see it as "snow" on our television sets.

We visually imagine the birth as a "big bang," or fireball of pure energy, which almost instantly and incomprehensibly inflated to the size of a basketball, before slowing at several plateaus into a continuous expansion that continues to this day. Thus, our universal Gaia was born; she cried out, and with each respiration, she grew stronger and survived.

The inflation was not quite uniform, and in the chaos, tiny, "quarky" bits of pure energy flashed about, without rest or mass, and began to coalesce in groups of threes into measurable entities, without electric charge, which we know as neutrons. In a quick series of short steps, since a neutron cannot stand to be alone for more than about a minute, the first stable electrical particles came into being.

The neutron, which is without charge, spits out a particle similar to a photon of light, which immediately splits into a neutrino, without mass or electrical charge, and a tiny, negatively charged electron, leaving behind a slightly-reduced, positively-charged proton, about which a captive electron nervously vibrates.

Although the electron (also known as a beta particle) is more than 1,800 times smaller in mass than the proton, its negative charge exactly balances the positive charge of the proton. This family group, consisting of a single neutron that has divided into a proton and electron, makes up an atom of hydrogen, the basic chemical element of the universe.

If we imagine the nucleus of an atom to be the size of a dust particle, the orbiting standing wave of the much smaller electron would represent the outside walls of a huge surrounding building. Thus, what we perceive as mass is mostly nothing at all, surrounded by a perception of solid matter created by clouds of electrons, which are at once both everywhere and nowhere at all.

Neutrons and protons, which join together in increasingly larger nuclei, are bound together by the super glue of the strong nuclear force, the most powerful force in nature. With the slightly weaker force related to the decay of a neutron and the electron's escape, or "beta decay," the combined great power of the nuclear forces reaches out only a tiny, million-billionth of a meter.

Thus, any two hydrogen atoms, separated or passing by at any greater distance, will not "electromagnetically" notice each other, unless they accidentally bump into one another, "gravitationally," which they often tend to do, bouncing back and forth about a hundred-billion times a second, at room temperature.

After about 300,000 years of existence, as the universe cooled, the hydrogen atoms began to organize themselves into massive gaseous clouds.

Within these clouds, the lone protons of hydrogen atoms began to marry an eligible neutron to become deuterium, or heavy hydrogen. Then, in a joint wedding, two atoms of deuterium came together in a nucleus of two protons and two neutrons, surrounded by their two electrons, to become a very stable atom of helium.

Soon, these gigantic churning clouds of hydrogen and helium stretched across the expanding "universe," some extending more than 500,000 light years in diameter, and began to exhibit their collective "gravitational," as distinct from their nuclear or electromagnetic, attractiveness for each other.

With just a few seeds of lithium and other rare elements, these clouds organized into the first rotating galaxies and began the job of making stars and planets.

While the invisible gravitational "force" exhibited by the combinations of mass into clouds of gas, galaxies and stars is the weakest of nature, it seems to have the greatest range, with our earth's "gravity" easily "attracting and attracted" by every member of our local solar system, and perhaps well beyond.

One way of estimating just how far the influence of earth may reach is to imagine a "mini" or little bang or "mini nova," consisting of the instantaneous release of all the nuclear forces binding all the atoms of the earth, including ourselves, and to see just how far news of the explosion would carry. It is likely that evidence of our former existence would be observable far beyond the Milky Way.

As we imagine the extent of this invisible influence, we can begin to see that all condensations of mass swirl around in their unique places within and as a part of the original, primordial amniotic energy.

All mass, irrespective of size, distorts the area around itself, yet remains attached to and a part of all other mass. This invisible field, which we define as space-time, negatively compresses around organized mass, resisted by the full extent of its positive latent energy, which is substantial, and whose reach carries the message of its power.

However, our blue water earth is far too forgiving and kind to blow apart, and there's no need to have it explode for us to imagine a different place from which to start. So, let us bounce forward in time to about four and a half to five billion years ago to experience the birth of our sun.

The Mass Generator

In our earlier time travel, we left off at about 300,000 years after the creation of our universe, when the temperature cooled down to about that of the surface of the sun, expansion slowed down to the speed of light, and matter became "positively" uncoupled from the "negative" energy which produced it.

At this time there existed gigantic clouds of hydrogen and helium gases, in a ratio of about three to one, that began to form into the first galaxies of stars. The first generation of stars was far more massive than today and we can see the results in the form of quasars, the most distant and energetic sources of radiation in the universe. These quasars are the remaining cores of gigantic stars which blew apart in events we call supernovas.

Star Birth. Assuming that the universe began about 12 to 13 ½ billion years ago, we can bounce forward in time to about four-and-a-half to five billion years ago when our sun was born.

It now appears that star formation may occur as the result of the shock waves caused by a supernova moving through a cloud of dust, hydrogen, helium, and other elements, causing a localized concentration of gases to begin swirling around a common center of gravity.

When the sun first formed from a cloud of these molecular gases, it contracted under the force of its own gravity and began to get hotter in the center from the compression in the same way the temperature within a bicycle tire is elevated as the volume of air is increased. Or, conversely, as an automobile tire becomes heated from being driven over the road, the pressure within the tire increases.

As the temperature approached 15 million degrees centigrade in the core of the sun, it became so hot that a nuclear reaction began to occur in which the electrons were stripped from the hydrogen nuclei to form a plasma of free electrons. Within this plasma, which acts as a gas, two hydrogen nuclei can join together with two neutrons to form a helium nucleus (also known as an alpha particle) releasing a small amount of excess energy (about 0.7 percent), that we perceive as the sun's radiation.

The total mass of the sun is about 330,000 times that of the earth, creating a pressure 300 billion times the pressure of the earth's atmosphere at the surface and compressing a density at the core approximately twelve times that of lead.

Although the sun converts five million metric tons of mass into energy every second, after four-and-a-half billion years of effort, our sun has only consumed about 4 percent of its original stock of hydrogen. However, only 0.7 percent of that 4 percent has actually been lost in the form of radiation, with the balance converted into helium nuclei and retained within the plasma core.

In another five billion years, the sun will have converted enough hydrogen into helium in its core to begin to run short of hydrogen, although there will still be plenty of hydrogen left in its outer layers. When this shortage occurs, the core will begin to shrink and the helium will get hotter. When the compression becomes great enough, the helium itself will begin to "burn," and the sun will begin to swell up into a "red giant," whose circumference will balloon out to near the earth’s orbit.

During this expansion phase, three helium nuclei (each with two protons and two neutrons for a total of four) will combine together into atoms of carbon, each with six protons and six neutrons (12).

Because our sun is not large enough, its generation of elements will end here, as it will not have enough mass or internal pressure to move up the scale to produce atoms of greater complexity. When the sun exhausts the helium fuel in its core, it will shrink down to a carbon cinder about as large as the earth. Here it will stabilize as a small white dwarf star, and it will shyly shine for a very long time.

Star Dust. If the sun was twenty-five times larger, its main phase would be much shorter than our sun's projected ten-billion-year lifetime, but the times would be far more interesting.

In these larger stars, hydrogen burning only lasts about seven million years, the helium about 500 thousand years, and the carbon would be burned up in 600 years. In doing so, two carbon (12) nuclei stick together to form magnesium (24), which releases an alpha particle to become neon (20), or ejects two alpha particles to become oxygen (16).

Once a massive star has consumed its carbon, it begins to fuse its neon and oxygen core into atoms of magnesium, phosphorus, sulphur, and silicon. Ultimately two silicone (28) atoms fuse together to form a nuclei of iron (56), the most chemically stable of all energy states.

In these giant stars, following carbon burning, the neon will only last one year, the oxygen six months, and the silicon will fuse into iron in a single day. Any star which is larger than eight times that of the sun will follow the same process; however, the smaller they are, the longer it takes.

Star Death. When the day finally comes when there is but iron in the core of these giant stars, and the iron is so stable that no further nuclear reactions can take place to exert outward pressure against the full weight of the surrounding star, the iron nuclei will merge with the electron plasma into a solid core of neutrons. Within just a second, a ball of iron about the size of the earth collapses into a ball of neutrons about the size of a mountain, consisting of about one part to 24 parts of the total solar mass.

As the outer layers fall inward at about 15 percent of the speed of light and strike the core from every direction, its enormous energy is bounced back producing an enormous shock wave sufficient to blow the star apart.

During the instant of explosion, sufficient energy is produced to fuse elements far heavier than iron, all the way up the ladder of element formation to that of uranium. All of these heavier elements are swept away, along with a massive release of neutrinos, leaving only the core, which becomes a neutron star. In rare cases, where the star is extremely large, its core becomes a black hole from which no light can escape.

As the shock wave of a supernova extends through the star's home galaxy it sets up the conditions for further star formation and seeds it with the elements necessary for life. All the identifiable matter in the universe is composed of 99 percent hydrogen and helium; the remaining one percent, true star dust, make up planets, like the earth, and its inhabitants, such as ourselves.

The Metes and Bounds of the Universe

About four-and-a-half to five billion years ago, the shock wave of a supernova moving through one of the spiral arms of the Milky Way provided just enough push or compression for a cloud of hydrogen and helium gas, seeded with the dust of previous novas, to collapse into a unique gravitational entity.

As it swirled around its center, the entity formed a saucer shape with a bulge in the middle, which with time and compression began to radiate its excess energy. The bulge became our sun, and across its equatorial plane, the leftover matter began to organize itself into bands of mass separated by clearings, or gaps of space. With the bump and grind of the gravitational dance, these bands of star dust slowly organized themselves into the planets and asteroid belt as we know them.

The Veil of Comets. Out beyond the outermost planet, which was probably Neptune in the beginning, the sun's "gravity" was insufficient to organize planets. The excess mass coalesced into frozen comets, composed of rock and ice, extending the edge of the saucer plate by about 100 AU (one AU equals the distance from the earth to the sun).

This extension is known as the Kuiper Belt and contains at least a billion comets. On a smaller scale, if we imagine that the earth was the size of a button and was one inch from the sun, the Kuiper Belt would be 100 inches, or slightly less than three yards away. [37]

In addition to comets, large icy planetoids range through the Kuiper Belt and likely account for the late planet Pluto, its largest moon, Charon, and some of the moons of the regular planets. Approximately 40 such objects beyond Pluto have been discovered since 1992.

In 2003, astronomers discovered a planetoid approximately the same size as Pluto (which was named Sedna, or 2003 VB12), and they first photographed a new “planet” (identified as 2003 UB313 and tentatively named Xena), with a diameter 435 miles larger than Pluto. Xena is almost 10 billion miles from the sun and takes twice as long as Pluto to complete its orbit.

Although larger than Pluto, there was a controversy as to whether Xena should be promoted as the 10th planet or if Pluto should be demoted from being a planet. The issue was resolved on August 24, 2006 when the International Astronomical Union decided that to be a planet, an object must orbit a star, be large enough for its own gravity to pull it into a spherical shape and it must have cleared out the neighborhood around their orbits. Pluto failed to remain a planet since it orbits in the midst of icy debris. It, along with Xena and Sedna, will be known henceforth as a “dwarf planet.”

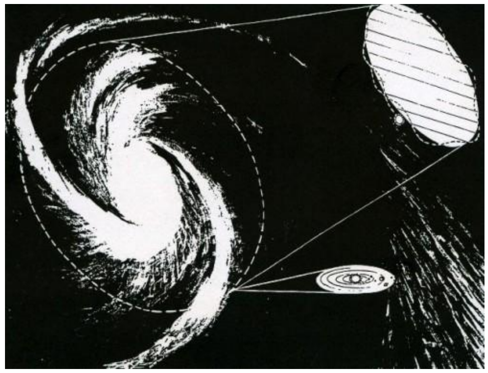
Related to the Kuiper Belt, but organized differently, is the outer Öpik-Oort Cloud, a spherical shell of about a trillion comets, which extends out as far as 100,000 AU. Using the same analogy as above, if the earth was a button one inch from the sun, the Öpik-Oort Cloud would be located a little more than one-and-one-half miles away.

At this distance from the sun, the comets in the cloud are beyond the influence of the planets; however, they can be affected by the gravity of passing stars. Within the outer shell is a more dense inner cloud, flattened in toward the solar plane, extending out a few thousand AU from the sun and which may contain as many as six trillion comets.

In total, there are at least ten trillion and perhaps as many as a hundred trillion comets in a spherical shell surrounding the plane of our "traditional" solar system.

Galactic Years. Although we have become accustomed to viewing our solar system as the sun surrounded by the flat plane of its planets, we can perhaps better see it as a spherical egg, within which the yolk spins, swirling the white substance in two layers, the flat solar plane and the inner shell of comets. The entire egg itself orbits around the center of the Milky Way galaxy, about two-thirds of the way to the visible edge, at a speed of approximately 220 kilometers per second, taking about 225 million years for each orbit, or galactic year. Thus, in galactic years, our solar system is only an adolescent, about 15 years old.

Within each of these orbital years, the sun slowly moves up and down through the galactic plane like a carousel horse, with each up-and-down cycle taking approximately 62 million years, causing it to move through the galactic plane every 31 million years. (Figure 2)



Another way of looking at the sun's orbit is to see it as a standing wave similar to that exhibited by the path of an electron around a nucleus, albeit far slower and with less frequency between successive crests.

Earth's Siblings. This then is the immediate world we live within, and, even into the lives of some who read this, this was the only "universe" known, until our powers of observation improved sufficiently to locate other galaxies beyond the Milky Way. But, before moving on to describe our galaxy and the balance of the universe more fully, let us pause for a moment to reflect upon the siblings of earth and the uniqueness of this small planet we live on.

The first four planets of the solar system, Mercury, Venus, Earth and Mars are spherical rocks, with iron cores. On Mercury and Mars, most atmospheric gas has been evaporated and blown away by the solar wind, and earth is the only one with an atmosphere which permits the accumulation of liquid water.

The asteroid belt follows Mars, and it may have been prevented from forming into a planet by the gravitational tidal forces of the next planet. Jupiter is the largest planet in the system and is primarily composed of gases, as are the next three planets, Saturn, Uranus, and Neptune.

Pluto, the former planet, is mainly a rock, whose frozen gases may have been blasted away by a collision with its icy moon, Claron, another refugee from the Kuiper Belt.

Mother Earth and Her Dancing Partner. The earth has yet to cool enough to solidify the molten rock that circulates around her inner core of iron. The crust upon which we live floats on this molten mass, and is very thin in comparison to the entire planet, proportionately as thin as the shell of a bird's egg.

The earth's radius is approximately 3,964 miles, or 6,378 kilometers. The solid crust ranges from only 25-60 kilometers under the continents and just four to eight kilometers under the oceans. Although we perceive our landscape as greatly varied between tall mountains and oceanic depths, if the earth was reduced to the size of a billiard ball, its surface would appear just as smooth.

The molten core not only acts to provide warmth against the bitter cold of the vacuum, but, the movement of electrons between its various layers also sets up electric currents which swirl outward and manifest themselves in a magnetic field that encloses earth in its embrace. This magnetic field helps protect us from solar radiation by reflecting and channeling the radiation into the magnetic poles of the planet, which we see as the auroras.

During the period of planetary formation, extending from about four-and-a-half billion years ago to about four billion years ago, all the planets were built up by the impact and adhesion of innumerable objects.

It was during the Late Heavy Bombardment, which lasted 20 million years, that meteorites likely carried in the water, oxygen, carbon dioxide and organic compounds which allowed earth to become a greenhouse for life. [38]

During that same period, the earth probably collided with a planetary object the size of Mars, and their combined momentum produced so much heat that it melted whatever crust earth may have built up, leaving only a molten ocean on its surface. The object itself was destroyed in the collision, and whatever metallic core it originally contained merged with that of the earth's.

The object's outer layers then joined with the earth's crust in being splashed out into space, forming a ring around the earth on a slight tilt from the equatorial plane. With time, the ring coalesced into the moon. Finally, any residual rotational energy the moon possessed was surrendered to the stronger gravitational pull of earth, locking the moon into a stable orbit in which she always presents the same face to earth.

Earth is different from the other planets in having an orbiting moon which is far larger in proportion to the size of the earth (1:4) than the moons of any other planet. With its tilted orbit and massive presence, our moon tugs the tides, which tune the oceans to the harmonies of life.

The force of the impact may have dramatically increased the spin of the earth, giving us our brief 24-hour day, rather than the retrograde, slightly less than one-year day of our sister planet Venus. The collision may have also caused the slight tilt in the earth's axis, which provides us with the seasons and, consequently, the nursery within which life could begin.

Today, the earth and the moon embrace each other in a gravitational dance as they waltz together around the sun, first one, then the other closest to the sun. The odds are that, without the moon and the manner in which it formed, life would never have arisen on earth. Calculating all of our chances, it may be that only one such opportunity can arise in an entire galaxy, such as our Milky Way, during its lifetime.

The Milky Way. During the first part of our universe's formation, until about seven or eight billion years ago, the universe may have been composed of innumerable clouds of gas, each surrounding a tiny irregularity in the original expansion.

The movement and gravitational attraction of these clouds of dust and hydrogen and helium gases caused them to regularly collide and merge together and to form ever-larger galaxies of stars. Since then, it is estimated that at least half of the galaxies have merged with other galaxies of a similar size.

It is believed our Milky Way galaxy slowly formed from perhaps a million smaller gas clouds. Each new collision with a gas cloud would set off a burst of star formation resulting in the globular clusters which spherically surround the Milky Way in much the same way that the Öpik-Oort Cloud surrounds the solar system.

These globular clusters are as old as the universe and as young as seven billion years. The gas left over from these cluster formations joined with the Milky Way, enlarging its size and increasing its gravitational attraction for other clouds.

With time, the Milky Way formed its spiral arms, which can be seen as density waves, behind which stars, such as the sun, back up until they are able to pass through the traffic jam, as the stars move more rapidly around their orbits, than the Milky Way revolves around its own center.

The Milky Way contains approximately a hundred billion stars, of which the sun is only a mediocre representative, but, for whom our God of Wisdom may have a particular concern for the gift of its third child and the progeny of her womb.

The life span of the Milky Way itself is limited, as it inexorably attracts and is attracted by other galaxies. In time it will merge with the spiral galaxy known as M31, which we can see as the nebula of the Andromeda constellation and which is the only galaxy which appears to be approaching us. However, since M31 is still two million light years away, we have little to worry about at the moment.

Although the stars within merging galaxies are sufficiently spread out so that they do not actually collide when two galaxies meet, the clouds of dust and gas within the galaxies and its surrounding "dark matter" do come together. The resulting shock waves and gravitational chaos set off a spectacular display of brilliant blue-white stars.

It seems to be the fate of all spiral galaxies ultimately to collide with others in the formation of giant elliptical galaxies. Perhaps, just as the rarity of circumstances limits the number of life-sustaining water planets, with large moons, orbiting in just the right place around warm yellow singular stars without a binary twin, even this chance of life may only occur in virginal spiral galaxies. [39]

The Balance. If we imagine the sun to be the size of a shirt button, we would not find the next star, or button, until we traveled 90 miles down the shirt front. However, if we imagine the entire Milky

Way as a shirt button, the next one down, the M31 galaxy, would be located only five inches down the shirt.

Then, since both the Milky Way and M31 are part of the same "Local Group" of galaxies, the same analogy of using a button for the Local Group would place the next button, the "Sculptor Group," 24 inches down the shirt front. Thereafter, we could find hundreds of similar buttons concentrated in the space of a basketball about 10 feet away, and the next cluster of buttons would be about 65 feet away.

Using the same scale of distance, our entire universe, including the most distant clusters of galaxies, could be hung out to dry within a spherical clothesline with a one-kilometer diameter. Relatively, we can see that galaxies are much closer together than are the stars to each other within the galaxies.

Life in the Future

The conditions that allow life to exist on earth are fragile and subject to a wide variety of catastrophes which occur in a chaotic and unpredictable manner. Someday, the pleasant conditions we enjoy will end and human life will no longer be tenable on earth. That day may be tomorrow, or it may be five billion years from now, but the only thing for certain is that the end will come. What is uncertain are the manner and the means; however, there are a number of alternative scenarios.

It will be billions of years before the death of our sun or the universe, but for earth and for those of us who inhabit its surface, an earlier end is virtually certain. Of all the physical threats to the existence of human life on earth, the greatest danger is that of a collision with a comet or asteroid, given the fact that earth moves about its orbit at a speed of 67,000 miles per hour and collides with a killer rock about 10 km across about once every hundred million years.

Since the deepest spot in the oceans is only about 11 km deep, with the average about 3.7 km, it really doesn't matter where the comet or asteroid strikes, it's going to destroy most life on earth. [40]

On a smaller scale, an object bigger than one km in diameter strikes earth about 60 times every 10 million years, or about once every couple of thousand years. Such a collision results in a crater about 13 km in diameter and releases an explosive force of about 20,000 megatons of TNT.

During the formation of the solar system about 3.8 to four billion years ago, earth and the other planets were impacted by numerous comets and asteroids in what is called the Late Heavy Bombardment.

Subsequent impacts have remained relatively constant since about 3.5 billion years ago, primarily resulting from the sun's 62-million-year cycle of bobbing up and down in its path around the Milky Way galaxy. (*See above* Figure 2) As a result, the solar system passes through the galactic plane every 31 million years, which disrupts comets from the Öpik-Oort Cloud causing a swarm of comets to move through the inner solar system.

The earth and the rest of the solar system are just above the plane, and consequently have experienced increased comet activity during the last 1-5 million years.

The crossing of the galactic plane 65 million years ago probably caused a large asteroid or comet to strike the Yucatan Peninsula in Mexico near where the village of Puerto Chicxulub (Mayan: tail of the devil) is now located. The impact dug out a crater 180 km in diameter and caused the extinction of the dinosaurs.

During the crossing about 35 million years ago, the earth was struck by a comet or asteroid that created a crater 85 km across, which we now see as Chesapeake Bay.

Even if a comet does not strike the earth, it can still threaten our lives, particularly if it crosses earth's orbit. As it sweeps through the inner solar system, a comet slowly disintegrates leaving behind an ever-expanding tube of dust and debris through which the earth must pass each year as it orbits the sun.

The most spectacular examples are the Taurid meteor showers resulting from the breakup of Encke's Comet, originally a giant about 100 km across that split up tens of thousands of years ago. The earth spends almost half of the year flying through its debris, entering in April and emerging in late June during the Beta Taurids. The earth then reenters on the other side of the sun in October, resulting in the Alpha Taurids between November 3 and 15, before coming out in December.

Encke's Comet also accounts for seven of the 80 known “Apollo” asteroids (those that cross earth's orbit). The largest is Hephaistos, which is about 10 km in diameter.

One likely result of the breakup of Encke's Comet is known as the Tunguska event. It occurred on June 30, 1908 during the Beta Taurids at a location north of Lake Baikal in Russia. An asteroid or a meteor entered over western China, moving from southeast to northwest, and exploded 15,000 feet above the ground. The blast wave devastated approximately 2,000 square km of forest with a force equivalent to 20 to 100 megatons of TNT.

In comparison, the Hiroshima atomic bomb possessed a force of only 100,000 kilotons of TNT, while the largest nuclear warhead ever tested reached 57 megatons and the largest operational warheads only possess a destructive force of 25 megatons. A one-kilometer asteroid explodes with the energy of about a million megatons of TNT, and a fireball with the energy equivalent of the Hiroshima bomb is produced high in the atmosphere about once a year by minor cosmic impacts.

The Perseids meteor shower arrives on or around August 11-12th each year as a result of Comet Swift-Tuttle, a 10-kilometer giant, whose orbit continues to intersect that of earth's. It was first recorded in 68 B.C., later reported in Chinese journals dated in 1737, and subsequently found to have a period of 130 years. It last appeared on September 26, 1992, when its predicted date of arrival was off by 17 days.

New calculations predict the next appearance of Swift-Tuttle on August 14, 2126, when it is expected to miss earth by 24 million kilometers; however since it is locked in a gravitational embrace with Jupiter, with 11 orbits of Jupiter for each orbit of the comet, it will closely approach earth for at least the next 10,000 years, and the exact dates of its arrivals cannot be known.

Swift-Tuttle poses one of the greatest dangers known to earth and will continue to be a threat for a very long time in the future.

We are presently aware of approximately 300 objects greater than 1,000 meters in diameter known to have orbits that intersect earth's, and we find about 30 new objects each year; however, it is estimated that we are only aware of about 8 percent of those which threaten earth.

Following are the most significant recorded sightings and events that have endangered our present generation:

On February 12, 1947, forty years after the Tunguska event and about 5,000 km east, or about 375 km from Vladivostok, Russia, a meteorite with a mass estimated at 100 tons disintegrated in the air with an explosive power equal to several megatons of TNT. It rained down debris causing 120 craters.

In April 1972, a fireball was observed traveling south to north over the Rocky Mountains in the western United States. It rained down a glowing trail of tiny meteors as it skimmed through the earth's atmosphere about 55 km above Montana before heading back out into space above Canada. Its size was as much as 1,000 tons, far larger than the comet or asteroid which caused the Tunguska event.

On April 15, 1978, a United States military satellite recorded a meteor with a five-kiloton yield bursting into a fireball in the daytime over Indonesia. For one second the fireball would have been as bright as the sun to someone looking up from below.

On the night of April 9, 1984, the pilot of a Japanese cargo plane traveling 644 kilometers east of Tokyo, Japan, observed the explosion resulting from the splashdown of an asteroid in the nearby ocean. The resulting giant mushroom cloud rose from about 4,000 to 18,000 meters in two minutes.

On March 23, 1989, an asteroid with a diameter of 200-500 meters came within 691,870 km of earth's orbit. Had the earth arrived in its orbit only six hours earlier, the asteroid would have struck earth with an explosive force equivalent to more than a million tons of TNT. It would have created a crater about 7 kilometers in diameter and ejected enough debris into the atmosphere to cause a global disaster.

On February 1, 1994, a meteor entering the earth's atmosphere was recorded by six United States spy satellites. Traveling on a northwest to southeast path, it entered the atmosphere far north of New Guinea. Crossing the equator, it exploded 20 km above the sea northwest of Fiji. The meteor was moving at about 20 kilometers per second, or 72,000 km per hour, had a mass of more than a thousand tons, and exploded with a force of about 100 kilotons of TNT.

On March 15, 1994, a 10-meter asteroid passed by at less than half the distance between the earth and the moon. The asteroid was first observed just the day before as it narrowly missed the earth.

One such close encounter has been observed each year during the last decade; however it is estimated that unnoticed near misses (or hits) probably occur about once or twice a week.

In May of 1996, a 1,000-meter asteroid was discovered only four days before it crossed earth's orbit, missing us by only four hours.

On January 7, 2001, a massive, 500-meters-wide asteroid passed within 600,000 kilometers of earth. Had it struck earth, nothing within 150 kilometers of the impact would have survived.

On June 17, 2002, researchers discovered that an asteroid 150-300 meters in diameter moving at approximately 23,000 miles per hour had just passed within 75,000 miles of earth three days before. Reporting scientists stated that asteroids of about 100 meters in diameter pass within 250,000 miles of earth about 50 times a year.

Declassified United States military data indicate that satellites detected 136 atmospheric explosions with yields of one kiloton or more between 1975 and 1992. Since these events occur in the infrared spectrum, they are not usually visible from the earth's surface and, since the satellites are programmed to watch for unnatural events such as nuclear detonations, it is likely that there may have been at least 10 times more events than were reported.

In 1998, astronomers announced that a mile-wide asteroid known as 1997 XF11 may be on a near-miss or collision with earth on October 26, 2028. Although they calculate that it should miss earth by 30,000 miles, the estimate has a margin of error of 180,000 miles!

If 1997 XF11 were to collide with earth at its speed of more than 17,000 miles per hour, it would explode with an energy of approximately two million Hiroshima-sized atomic bombs. On land, it would leave a crater 20 miles across and its dust cloud would darken the sun for weeks, if not months.

Even without striking the earth, passing comets create a "zodiacal" dust cloud which covers most of the inner solar system. As the earth moves in its orbit, it sweeps up several thousand tons of dust every day, most of which is too fine to burn as meteorites and which slowly rains to the surface.

Depending upon its concentration, which varies, the zodiacal dust may contribute to a major cooling of the earth about once every hundred thousand years resulting in periodic ice ages separated by warmer periods lasting about 15,000 years. Since it has been about 10,000 years since the last ice age ended, another ice age is probably waiting down the road, just around the corner.

Earth’s Fiery End. Over the eons, the sun will continue to become warmer and, in about another billion years or so, the earth’s oceans will boil away and she will no longer be able to sustain life. About 7.59 billion years from now, the sun will finally exhaust its store of hydrogen, first in its core and then in the outer layers, and it will balloon out into a giant red star, 256 times larger than it is now and 2,730 times as bright.

The earth will skim along the flame tops and will slowly surrender to the gravitational tug of the sun, until the day she spirals down and rejoins the mass from which she was born.

Together, they will ultimately become a tiny dwarf star and will slowly fade away. [41]

Return to Table of Contents

Ancient Geometry

Although the Greeks provided the word *geometry* (to measure the earth) and raised its study to become a virtual religion, they themselves recognized that their original knowledge came from the Egyptians.

It is not known to what extent the Egyptians themselves inherited their science from more ancient civilizations, but they demonstrated their knowledge of advanced geometric principles in their megalithic building projects, most accurately in the construction of three pyramids traditionally associated with the pharaohs of the Fourth Dynasty (2575-2467 B.C.), Khufu, his son Khafre, and grandson Menkure.

This traditional dating is now being questioned by persuasive evidence that the foundations of these three pyramids, associated temples and the Sphinx may have been laid out and constructed as early as the Eleventh Millennium B.C., and the pyramids and megalithic temples were only later completed and restored by the Fourth Dynasty almost nine thousand years later.

No matter how the Ice Age ended, the melting of its massive glaciers caused the raising of sea levels worldwide and released gigantic amounts of moisture into the atmosphere, which fell as heavy rains.

During this recovery period, Egypt was blessed with an abundance of rainfall and a moderate climate. The Sahara was dotted with lakes and blossomed with vegetation, and the area around the Nile River may have been one of the most pleasant places on earth to live.

A three-thousand-year golden age of agriculture began in Egypt around 13,000 B.C. with the use of sickles to harvest grains and grinding stones to process flour.

The archeological record shows a decline in farming after 10,500 B.C. with a return to fishing, and the geological record provides evidence of great flooding at about the same time.

A dry spell then lasted for thousands of years until about 7000 B.C. when increased rains introduced the "Neolithic Subpluvial" epoch which lasted for about 4,000 years, during which the weather was again quite pleasant.

By 3000 B.C., the weather patterns changed to the hot and dry climate that continues to exist in Egypt. [42]

From erosion patterns caused by running water on the flanks of the Sphinx and the walls of the Valley Temple (traditionally associated with the second, or Khafre Pyramid), geologists have determined that these structures were carved and constructed as early as 10,500 B.C., and no later than 5000-7000 B.C. [43]

The stones used in the construction of the Valley Temple, some weighing more than 200 tons, were carved from the bedrock around the Sphinx, and the first 30 feet of Khafre's Pyramid were also built of megalithic stones.

Both the Khafre and Khufu pyramids may have been earlier laid out and constructed as flat-topped elevated platforms with slanted interior passageways and shafts aligned for the observation of various stars. In the same way that precession causes the shifting of the constellation background at the spring equinox, the same phenomenon provides an up-and-down motion of all visible stars over the same 26,000 year cycle. (*See above* Figure 1)

In 10,450 B.C., the constellation of Orion would appear above the southern horizon at its lowest point in the cycle. At the same time, the arrangement of the three belt stars in relationship to the Milky Way were exactly duplicated on the ground by the placement of the three pyramids in relationship to the Nile River. [44]

Today, Orion rises almost due east and is close to attaining its highest point in the sky above the southern horizon.

When the Great Pyramid was completed by Khufu, it included several diagonal shafts that originated in the King's and Queen's Chambers. The southern shaft (4.8 x 8.4 inches) from the King's Chamber is sighted upon where the belt of Orion would have been between 2600-2400 B.C. The southern shaft (8 x 9 inches) from the Queen's Chamber was aimed at the meridian transit of Sirius around 2400 B.C.

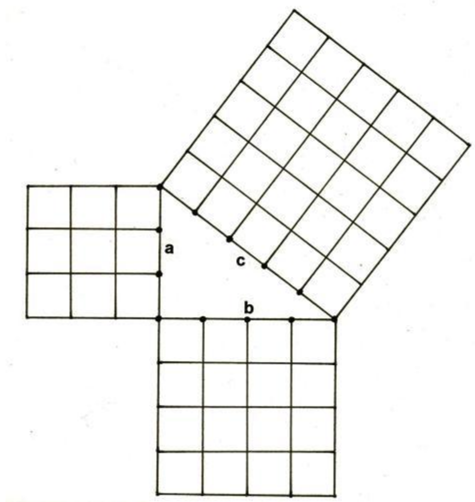
By the orientation of these magnificent structures, the ancients were able to preserve a record in stone establishing when the constructions were built. By the architecture they used, they were able to demonstrate the sophistication of their knowledge, their understanding of the world they lived upon, and its geometry.

A measure of Egyptian science was taken when the country was visited by the Greek historian, Herodotus, who recorded his observations in *A History* in about 440 B.C. Through these friendly visits, the Greeks acquired the practical knowledge of the Egyptians, based upon thousands of years of observation and experience, reduced these secrets to pen and paper illustrations, and used their alphabetical written language to more accurately describe their methods.

The Right-Angle Theorem

It appears that Mother Nature provided the impetus for the Egyptians to put their science to practical use. Each year the Nile would overflow its banks, depositing a thick layer of rich silt, and would wash away many property markers. To determine land ownership and to facilitate the collection of taxes, the priests had to annually oversee the surveying of vast fields in the Nile Valley.

Egyptian surveyors probably used a tool known as the "twelve-knot rope," which may have been used in other ancient locations as well. A long rope was divided into 12 equal lengths by knots with the ends tied together, and was then stretched in a triangle around three posts, so that one side equaled three lengths, one four lengths, and the other five. The 90° right angle produced by the rope could have been used to lay out vast plots of land, requiring accurate corners and very long straight lines. The surveyors came to be called "rope stretchers," from the teams of slaves used to carry and position the long ropes and large stakes. (Figure 3)

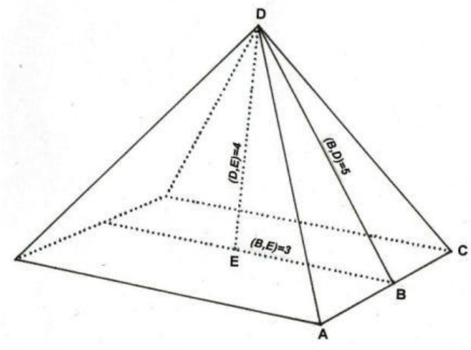


At some point, it was learned that the square on the hypotenuse (side opposite the right angle) of the triangle always equaled the sum of the squares on the other two sides or legs. Thus, 3x3=9, 4x4=16, 9+16=25 and 5x5=25. Algebraically, the theorem or equation is stated as: $a^2 + b^2 = c^2$.

Among the Classical Greeks who studied the ancient knowledge was Pythagoras of Samos (ca. 569 - ca. 475 B.C.), who lived for a number of years in Egypt. He provided a proof for the right-angle theorem and established a society for its study. Thus, this method of calculating right angle proportions became known as the Pythagorean Theorem, although it was already ancient when Pythagoras learned it.

The proportions 3:4:5 were used to construct the Khafre Pyramid, which may have been the first constructed on the Giza plateau. It is set on the highest point, and the first 30 feet were built with megalithic stones, indicating that it may have been originally used as a flat-topped geodetic observatory before being later completed as a pyramid.

Each side of the base of Khafre's Pyramid (AC) is equal to 246 cubits, its perimeter measures 984 cubits, its height (DE) equals 164 cubits, and its apothem, which connects the center of each side to the top (BD), can be measured by 205 cubits. (Figure 4)



Each of these measurements can be divided by 41, resulting in proportions of 24 for the perimeter, three for half of a side (AB or BE), four for the height (DE), and five for the apothem (BD).

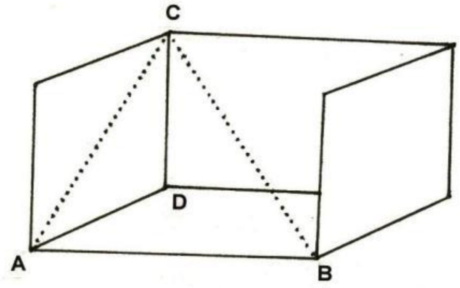
The cubit used in the construction of Khafre's Pyramid may have been approximately equal to 7/8ths of a modern meter. [45] It is equally probable that other lengths of measurement were used, such as the royal cubit of 525 millimeters; however, in every case, the proportions of the internal right-angle triangle formed by half of the base, height, and apothem are 3:4:5.

If we stand at the center of one side of the pyramid and look up at the top along the apothem (BD), we can use the visible outside measurements to determine the invisible internal height (DE). Referring again to Figure 4, we can subtract nine (the square of the half-base (BE)–three) from 25 (the square of the apothem–five), to arrive at 16 as the square on the height.

Then we can determine the square root (√) of 16 to be four which gives us the height of the pyramid.

Thus, as long as we know any two of the sides of a right angle triangle, we can calculate the length of the other side by use of this theorem.

The proportion was also built into the "King's Chamber" of the Khufu, or Great Pyramid. The floor measures 10 (AD) by 20 (AB) cubits and the height of the ceiling measures 11.18 cubits (CD). First, we must divide each of these by five to reduce the proportions, finding them to be 2:4:√5(2.236). (Figure 5)



If we use the right-angle theorem, we can deduce that the diagonal on the side wall (AC) is equal to three (since 2x2=4 plus √5x√5=5 for a total of nine, whose square root is three). Next, we can deduce the long diagonal from one corner of the ceiling to the opposing diagonal corner on the floor (BC) as equal to five (since 3x3=9 plus 4x4=16 for a total of 25, whose square root is five).

Thus, the internal right-angle triangle consists of the length of one side of the floor (AB=four), the diagonal on the side wall (AC=three), and the long diagonal from the ceiling to the opposite corner on the floor (BC=five).

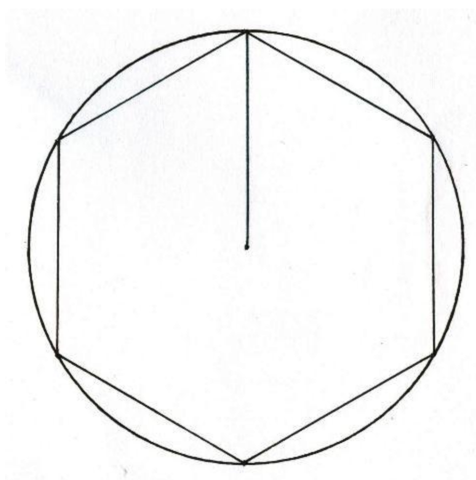
The 3:4:5 right-angle triangle became known as "the supreme principle of the production of the world" according to the Jewish writer Philo (20 B.C. - 50 A.D.), and the total of its squares, 9, 16, and 25, or 50 became a sacred number represented by the Hebrew letter N.

One of the Dead Sea Scrolls, the *Manual of Discipline* (or Community Rule) may be making such a reference when the writer spoke of the "holy of holies and the letter N" meaning, "the supreme sacredness of the number 50."

Pieces of *Pi*

The Egyptians also made use of another basic geometric formula in calculating the length of a circle constructed from a given radius. It is not difficult to imagine the Egyptian priests placing a stake in the sand and using different lengths of rope to trace out large circles.

When they laid the rope into the circular groove, they found that three lengths of the radius were almost long enough to measure a half circle, but it was always a little bit short. The shortage can be illustrated by constructing a hexagon with sides equal to the radius within the circle it produces. (Figure 6)



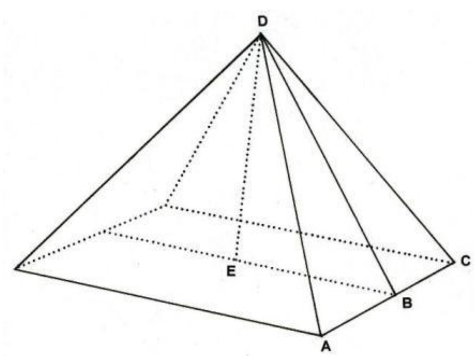
The measure of the outside curved line traveled by the tip of the radius and the space it contains results in the essential mathematical proportion known as *Pi*. The value of *Pi* has been calculated by modern computers to trillions of decimal places, but the first ten places are usually sufficient for most calculations, 3.14159 26535. [46]

In 1858, one of our most ancient mathematical documents was discovered wrapped in a mummy by the Scottish Egyptologist Alexander Henry Rhind (1833-1864). Known as the Rhind Papyrus (or the Ahmes Papyrus after its scribe, the priest Ahmes) and copied around 1650 B.C. from an earlier document, the papyrus contains 84 problems and their solutions.

Problem 50 states that a circle has the same area as a square whose side is 8/9 the diameter of the circle. Algebraically, and with the diameter designated as d, the problem can be restated as *Pi*(d/2)2 = [(8/9)d]2. After cancelling d^2 from both sides of the equation, the result is *Pi*/4=64/81, or *Pi*=256/81, for a decimal value of 3.16049, which is slightly too large.

Measurements of the Khufu Pyramid indicate that the knowledge of geometry in more ancient times may have been much more accurate than that later recorded by Ahmes.

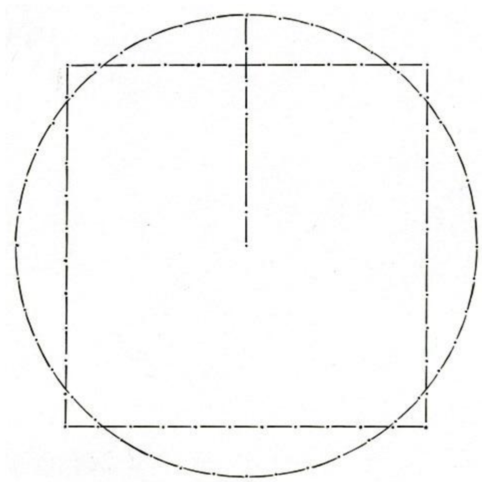
The Great Pyramid appears to have been constructed according to a royal cubit equal to approximately 0.524148 meters. Irrespective of the measuring standard and the fact that the top of the pyramid is missing, it is generally conceded that the original height (Figure 7 DE) was probably intended to be equal to 280 cubits, that each side of the base (AC) was measured by 440 cubits, and the perimeter by 2x880=1,760.



Irrespective of the measure, the ratio of the perimeter is always approximately equal to the height multiplied by *Pi* times two, an unlikely accident. Thus, using the modern value of *Pi*, (3.14159 26535) and a height of 280, one half of the perimeter is equal to 879.645942980, slightly less than 880. [47]

Most likely, the ancients used a value for *Pi* based on the continuing fraction 22/7, which results in 3.142857 142857.... When this value is substituted and multiplied times the height (280), the result is exactly 880. Moreover, when the height (280) and half perimeter (440) are each divided by 40, the results are seven and 22, the very numbers of the magic fraction.

Using these numbers we can construct a drawing of the square base and a circle of the same length, and a radius or height, all constructed with the same units of measure. (Figure 8)



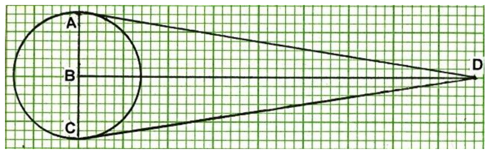
The proportion produced by 22/7 must have appeared magical, as it almost perfectly measured both the square and the circle. Indeed, if 0.142857 is multiplied times seven, the result is 0.999999, or essentially one. Thus, in a further refinement, the radius of seven can be seen as an approximation of one composed of seven pieces of 0.142857 and that the circumference, 2*Pi*, is accordingly composed of exactly 44 pieces.

Or, we can imagine that the height (7x7) can be equal to 49 of these pieces of *Pi*, and the circumference is equal to 308 pieces of *Pi* (7x22x2). Moreover, when it comes to accurately knotting a long rope into equal lengths of cubits, each divided into seven parts, the height can be measured by 1,960 pieces, each side by 3,080 pieces, and the circumference by 12,320 pieces.

In the Third Century B.C., a Classical Greek scholar, Archimedes of Syracuse (ca. 287-212 B.C., used rudimentary algebra to construct an imaginary polygon of 96 sides inside and a slightly larger one outside a circle to determine that the value of *Pi* stood between the product of 3 10/71 and 3 1/7 (which results in 22/7).

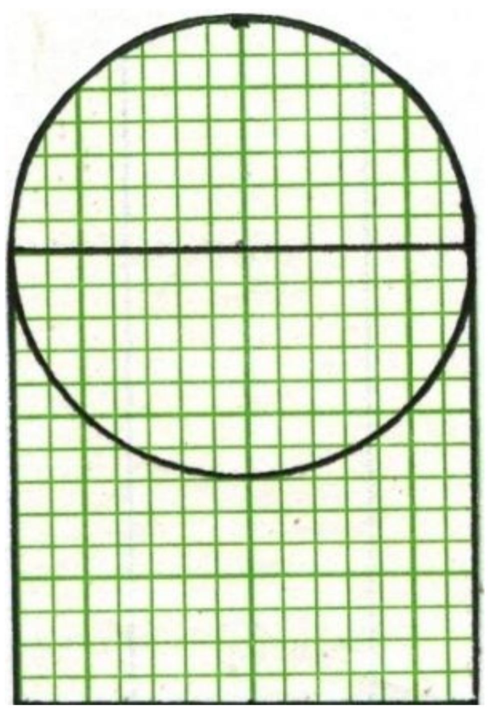
The accuracy of this approximation can be gauged if we use the most modern measurements of the Great Pyramid base in inches, for a total perimeter of 36,277, and divide by 2*Pi* to calculate the height in inches. The result with modern *Pi* is 5773.760079870 inches, and with ancient *Pi*, it is 5771.437079545. Thus, at a height of 160 yards, or longer than 1 1/2American football fields, the error is only 2.323000325 inches, reflecting the 0.012644890 difference in the two derivations of *Pi*.

Archimedes established the area of a circle by proving that the area of a right triangle having a side equal to the radius of a circle (Figure 9 AB) and the other equal to its circumference (BD) would have the same area.



If we use the modern formula which provides that the area of a circle equals *Pi* times the radius (r) squared (A=*Pi*r^2), and use a radius of seven, we can first determine the circumference of the circle to be 43.982297149 (*2Pi*r) and its area to be 153.93804021 (*Pi*x49). Then, if we double the long isosceles triangle along the "circumference" line and use the formula (A=1/2bxh), which says that the area of a triangle is equal to one half the base (7) times the height (43.982297149), we can easily calculate an area for the double triangle of 307.876080043. Dividing that number by two produces 153.93804021 for the area of the original triangle, which is exactly the same as the area of the circle.

Archimedes also theorized that the area of a circle is to a square on its diameter as 11 is to 14. If we again use a radius of seven and again find the area of the circle to be 153.938040021, we can divide by the proportion 11 to give us 13.994367274. (Figure 10)



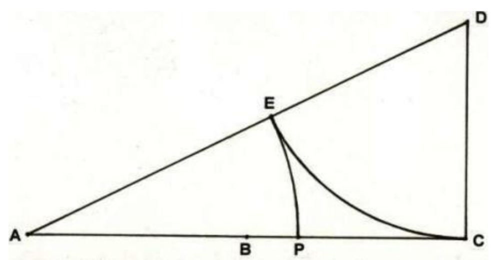
To compare the two, we can square the circle's diameter of 14 to produce 196 which, divided by the proportion 14, again gives us 14, which is close to 13.994367274. However, if we substitute ancient *Pi* at 3.142857, we find the circle's area to be 153.9999999, which divided by the proportion 11 gives us exactly 14.

If we divide the original proportions, 14 by 11, the answer is 1.27272727, another magical number we will next encounter as the approximate square root of the Golden Proportion.

The Golden Proportions of *Phi*

It appears the ancients also used another geometric marvel called the Golden Proportion, or Ratio, by the Classical Greeks. It is usually defined as that point where any line or measure can be divided into two parts in which the smaller is proportional to the larger in the same manner that the larger is to the total. The Golden Proportion, also known as *Phi*, is 1.61803389.

To demonstrate how the Golden Proportion is derived, one needs to draw a line (Figure 11 AC) divided in half (B), and construct a right angle with the side line (CD) equal to half the base line length (AB).



If the two lengths are connected by a hypotenuse (AD) and the length of the side line is subtracted from the hypotenuse, the remainder (AE) is equal to the Golden Proportion of the base line (AP).

The Golden Proportion is also calculated as one plus the square root of five divided by two, $(1+\sqrt{5})/2=1.61803389$. To demonstrate how this formula is derived, we can again rely upon Figure 11 using a base length of two (2x2=4) and a side of one (1x1=1). We can use the right-angle theorem (4+1=5) to determine the hypotenuse must be equal to the $\sqrt{5}$ (2.236067977).

Using the Golden Proportion formula, we add one to 2.236067977 ($\sqrt{5}$) and divide 3.236067977 by two, to arrive at the Golden Proportion, 1.61803389.

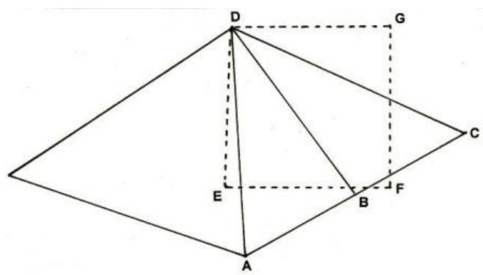
If we substitute a length of one and a height of 0.5, the hypotenuse must equal the $\sqrt{1.25}$ (since 1x1=1 plus 0.5 x 0.5=0.25 equals 1.25), or 1.118033989. Then, when 0.5 is subtracted from 1.118033989, the result is 0.61803389, the Golden Proportion of one, which is known as the Golden Mean.

Just as the ancients relied upon the magic fraction 22/7 for a working value of *Pi*, it also appears that they may have known that the related fraction 196/121 produces a near value of 1.619834711 for the Golden Proportion.

They also knew that the square root of the Golden Proportion could be determined by four divided by 3.1428574 (or 14/11) which equals 1.272727. Thus, the ancient value for the square root of the Golden Proportion is only slightly lower than the modern value of 1.273239.

Using 1.272727 as the square root of the Golden Proportion, the ratio between the height of the Great Pyramid (280 cubits) and its half base (220) is exactly equal to the square root of *Phi*, (220 x 1.272727 = 280).

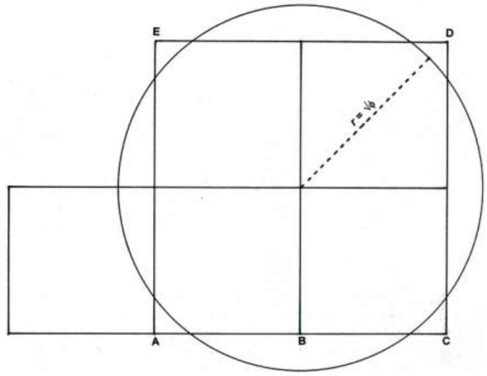
If we again use the right-angle theorem, we can first calculate an apothem equal to 356.089 in order to discover that each face (Figure 12 ABCD) has almost exactly the same area [1/2base (220) times the apothem (356.089)], 78,339.58, as a square on the height (DEFG) [2802=78,400].



This ancient proportion can also provide a correct solution of the secret formula defining the Round Table of the Grail, which was probably based upon ancient Hebrew and Egyptian documents recovered in Jerusalem by the Knights Templar during the Crusades and which formed a part of their esoteric knowledge. [48]

This formula [*Phi*^{2}(12/10)=*Pi*] attempts to reconcile the areas of a circle, square and rectangle, each having a perimeter of eight. This results in the radius of a circle, with a circumference of eight, being approximately equal to the square root of the Golden Proportion in the same manner that 4/*Pi*=√*Phi*.

If we insert modern values into the formula, we find that *Phi*^{2} (2.618033989) times 12/10 (1.2) equals 3.141640786, which accurately produces the first three places of *Pi*. Then, using a value of two for each side of the square (Figure 13 ACDE) and a perimeter of eight, we can find that half of one side (AB=1) times the square root of the Golden Proportion equals the radius r), or 1.273239, which times *Pi* equals 3.999998289, or approximately one half the square's perimeter. Thus the formula does provide an approximate basis for comparing the circle, rectangle and square, all having a perimeter of eight.



For a better solution of the mystery, we must first substitute the ancient fractional value of 1.619834 for the Golden Proportion, and use its square root, 1.272727, for the radius, then multiply by ancient *Pi* (3.1428574), to get exactly four for half the perimeter of the circle.

Next, we substitute a perimeter of 44 (ACDE) and 11 for each side of the square, finding one half of a side (AB) to be 5.5, which, when multiplied by 1.272727, results in a radius r) of exactly seven. Then, when seven is multiplied by ancient *Pi* (3.1428574), the result is 22 for one half of the circle and exactly 44 for the perimeter of all three shapes for King Arthur's table.

However, if we multiply the ancient value of the Golden Proportion squared (Phi^2) times 1.2, the result is 3.148634625, which is slightly less accurate than both the modern and the ancient value of 3.142857 for *Pi*, but still better than Ahmes'.

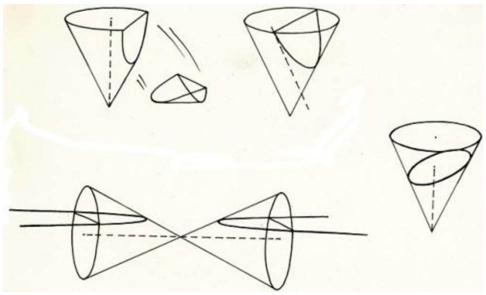
The reason is that four divided by *Pi*, or 14/11, provides only a close approximation of the square root of the Golden Proportion, as is the fraction 196/121 only an approximation of the Golden Proportion. Although the difference is only 0.000512 in decimal calculations, the ancient value for the Golden Proportion cannot compare with the perfect value of *Phi* derived from the √5, as seen above.

The modern value for the Golden Proportion, 1.61803389, when squared, results in the identical decimal proportion, or 2.61803389. All of this only begins to define the essence of its value as a golden internal ratio of all lengths of measurement, however numbered, rationally or irrationally, or exhibited in an eye-pleasing manner, such as the radiating seeds of a sunflower or the spiral of our Milky Way galaxy.

Parabolic Curves

The primary advancement by the Greeks over the ancient geometry they inherited from the Egyptians was in achieving a partial understanding of parabolic and elliptical curves, which are forms of conic sections. They were interested in these peculiar curves produced when cutting across cones (such as those we use to hold ice cream) of different lengths and circles. These curves came to be known as *parabolas* from the Greek word for comparison.

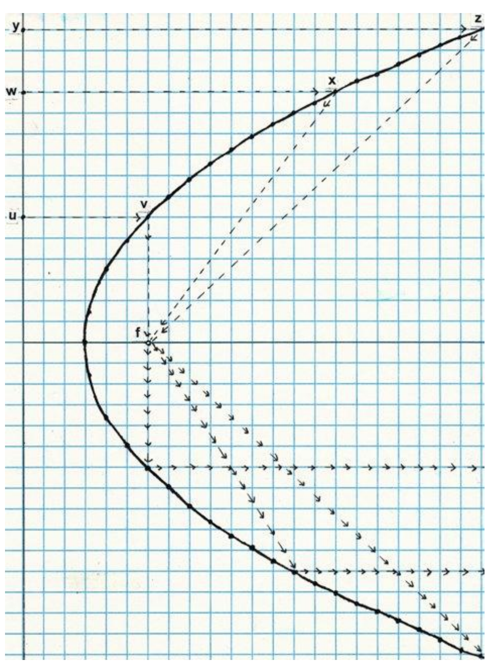
Conic sections can be observed whenever a circular cone is sliced by a plane parallel to an element of the cone, such as its center line or side. But principally, the Greeks were concerned with the parabola (Figure 14 top) and the ellipse (Figure 14 right), which is the path taken by planets around the sun. The hyperbola (Figure 14 bottom) is produced by slicing two nose-to-nose cones.



Knowledge of parabolic curves resulted in formulas to not only to calculate the volume of conical wine jars in use at that time, but later to determine the best shapes for the hulls of ships, the wings of airplanes, automobile headlights and satellite receivers.

The parabolic curve also traces the path of a stone tossed into the air in relation to the spinning surface of the earth, the trajectory of an artillery shell, or the path of an intercontinental ballistic missile.

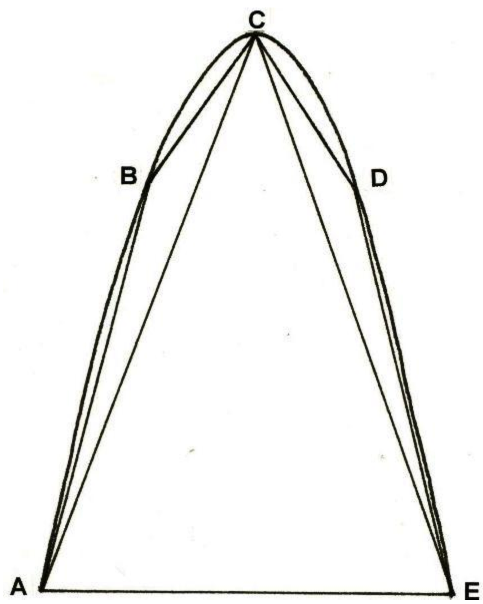
We can map a simple parabola as a plane curve (v,x,z) generated by a point moving so that its distance from a fixed point, or focus, (f) on a line is equal to its right angle distance from a perpendicular line (u,w,y). (Figure 15)



Thus a light bulb placed at the focus (Latin: *hearth*) will result in its rays of light being reflected out in parallel lines into infinity, of in the reflection of incoming electromagnetic waves back to the focus.

Once Archimedes divided a circle into 96 pieces to find its approximate value, he turned to the more difficult problem of measuring parabolic curves. He constructed a curve and began to divide its interior by triangles in proportionally reducing its area in a geometric progression.

Assigning one as the area of the Figure 16 ACE triangle, he found that the fraction 4/3 (1.33333333) defined the practical limits of progression (and the approximate ratio) as the narrowing triangles approached the infinite, a conceptual tool he was missing.



Archimedes may have experimentally engineered his calculations in constructing parabolic mirrors to reflect the sun's rays in an unsuccessful attempt to blind the invading Romans or to burn their ships.

Although he made good use of elementary algebra and guessed correctly that the ellipse was defined by its major and minor axes, Archimedes failed to determine the area under the hyperbolic curve. In addition to the concept of infinity, he also lacked the decimal notation system and the calculus required to provide a rigorous mathematical proof, for which civilization had to wait for almost 2,000 years. Nor did he apparently notice that the fraction 4/3, which he used to measure the interior of the parabolic curve, could also have provided a solution to the volume of a sphere ($V=4/3Pi r^3$).

Euclidean Geometry

Following the founding of Alexandria by Alexander the Great in 331 B.C. and the fragmentation of his empire upon his early death, one of his Greek generals, Ptolemy I Soter, took control of Egypt. With the conquests of Alexander, the age of the Greeks passed from the Classical to the Hellenistic and its center moved to Alexandria.

Ptolemy's son, Ptolemy II Philadelphus established the Museum and Library of Alexandria and began collecting originals of most of the known books in the world, ultimately totaling more than 700,000 scrolls.

Archimedes' books were surely found on the library shelves, along with other classics, such as the writings of Zeno of Elea (ca. 490-430 B.C.), who proposed the problem known as Zeno's paradox. That is, if a runner moves from the start to the finish line in decreasing half-steps (1/2+1/4+1/8+1/16+1/32+1/64...), he will never finish the race, for there will always be another length left to be divided in half, however small and practically invisible.

While the Greeks recognized that certain geometric progressions approached finite limits, such as 22/7 and 4/3, they could not conceive of an infinity, which can only be imagined and could not be proved, therefore, by the mysteries of geometry they inherited from the Egyptians and the ancients.

Among the Hellenistic scholars attracted to Alexandria were Erastosthenes (276-194 B.C.), Ptolemy's librarian, who calculated the radius and circumference of the earth to within 5 percent of their true values (thanks mainly to mutually canceling errors), and Euclid of Alexander (ca. 325 - ca. 265 B.C.), who compiled all proven geometric theorems into a 13-volume work known as the Elements.

The methods Euclid developed and his articulation of axioms remain a foundation for the study of geometry, generally, although its rigid limitations and consequential utility have been largely replaced by non-Euclidean geometry in the calculation of the modern laws of physics and cosmology, such as those relied upon and articulated by Einstein.

Before Julius Caesar's Roman soldiers murdered Archimedes in Syracuse as he sketched geometric diagrams in the sand, before they accidentally burned the Alexandria library, before the library was again sacked by an orthodox Christian mob and later by Islamic warriors, before the very foundations of the library sank under the harbor waters during an earthquake, and before the Dark Ages descended, great was the ancient knowledge then extant. So much was to be shamelessly destroyed and needlessly forgotten.

Emerging From the Dark Ages

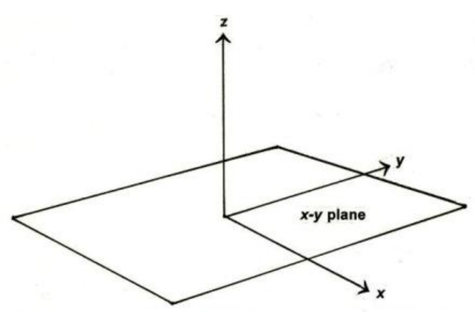
It would not be until the Seventeenth Century that Galileo's telescope would allow everyone with a lens to see clearly for themselves that the earth was round and that it moves around the sun. To reconcile the new evidence, Western scholars resurrected the ancient tools of geometry and mathematics to describe the telescope's revelations, and fueled the race for knowledge that continues to cycle the course at increasingly dizzy speeds.

Among the early contributors to the new sciences was René Descartes (1596-1650), a French intellectual, who is generally credited with the development of analytical geometry. That is, he combined the languages of algebra and Euclid's geometry into a powerful tool to calculate and plot the celestial objects which were first being seen through telescopes to move through space.

Descartes was a soldier who dreamed that God had entrusted him with the key to unlocking the secrets of the universe. He became a philosopher whose motto was, "I think, therefore I am," and who believed in a rational world governed by reason and mathematical design.

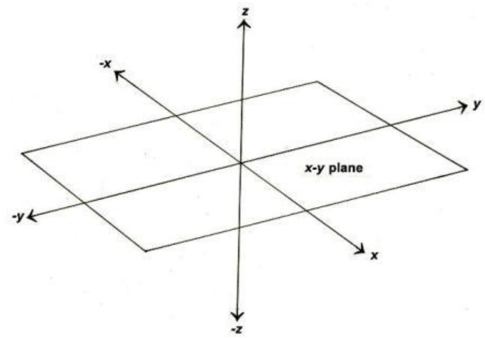
It is said that Descartes conceived his method of coordinates one day while lying in bed watching a fly crawl across the ceiling. He was able to imagine the ceiling converted into a graph consisting of parallel and perpendicular lines, bounded on the left side and the bottom by two right-angled legs, or axes, which he designated as x and y. With this tool, he could plot, numerically, every point along the insect's wandering track across the ceiling by reference to its right-angle measurements from these two lines.

Building upon his original concept, "Cartesian Coordinates" came to be constructed with three perpendicular straight lines or axes, in which the lines x and y are on a horizontal plane, z is vertical, and all three are perpendicular to each other. Thus, any spatial point in the space defined by these lines can be pinpointed by right-angle measurements from points of positive numbers along each of the lines, the accuracy depending upon the precision of measurement. (Figure 17)



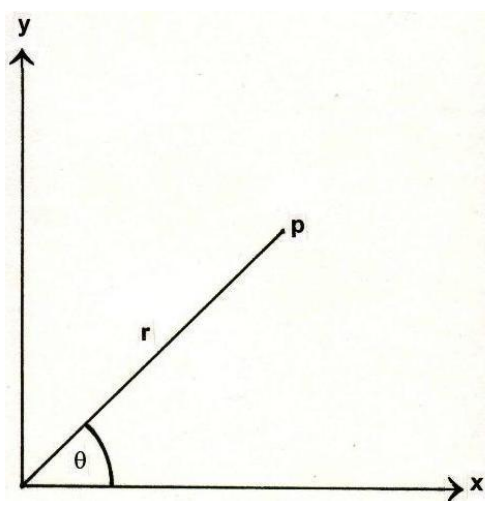
However, since this illustration defines only one quadrant, it becomes necessary to resort to negative numbers if points are to be defined in the other seven quadrants of a Cartesian cube. This is done by extending each axis through the center and by labeling points on its inverse axis with negative numbers.

In Figure 18, the addition of -x, -y, and -z produces a three-dimensional geometric model that can be used to measure and plot any object of study, including Descartes' fly, should it take wing and fly into the next room, out the window, or to the moon.



However, its usefulness is plagued by the practical difficulty of contending with the negative or inverse numbers that necessarily enter the equation when one strays from the positive x,y,z quadrant. Moreover, there were the mysterious rules required to mathematically manipulate negative numbers generally, and imaginary concepts, such as the square root of negative one, specifically, for them to fathom.

Cartesian Coordinates also provide the ability to use "polar coordinates" to locate any point P on a plane by reference to its distance from three axes by a numerically rigorous process. We can simplify the effort in plotting points by reference to the length of a line (r) connecting the point (p) and 0 and by the angle (θ) between the line and any one Cartesian axis, such as x or y. (Figure 19)



Isaac Newton was later to mention polar coordinates as one of eight different coordination systems which could be used to define spiral curves, and Jakob Bernoulli (1654-1705) relied upon them extensively in determining the nature of many different curves.

Today, many applications, such as air traffic control radar, make use of polar coordinates; however, they must always be anchored to a numerically rational system of Cartesian coordinates.

Return to Table of Contents

Ancient Mathematics

It is quite possible that genetically, within all living creatures, is an inherent or instinctive sense of numbers or counting. Experiments done with animals show that a female mammal appears to be constantly aware of the exact number of her children and will quickly begin to search for one that is missing. On a more primitive level, some birds will voluntarily abandon their nest if the number of eggs is reduced below a certain minimum number required for survival.

More basically, we find within all elementary mass, however identified, recurring numerical sequences, whether it is the atomic numbers of the chemical elements, the seeds of a sunflower, the spirals of a pine cone, or the radii of a snowflake.

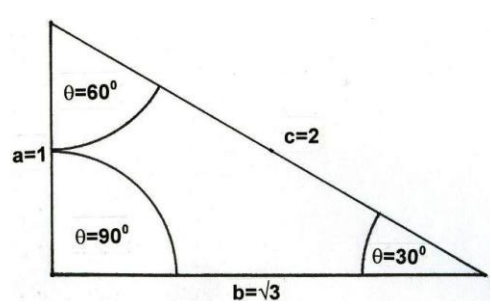
A Last Voyage With the Ancient Mariners

Before navigating the shoals of mathematics, it seems essential to rest at anchor for a moment and to reflect upon several additional geometric mysteries, the better to chart the shoreline which joins the sea of geometry with the land of mathematics.

The great value of the right-angle theorem and the reason for using it to construct the Khafre pyramid can be traced to the need of the ancients to chart the heavens accurately for purposes of navigation and to survey the land of their new colonies for settlement and cultivation. To accomplish this task, the ancients used elementary trigonometry, which is a computing tool that advances beyond the right-angle theorem.

Trigonometry uses the internal angles of a right-angle triangle to determine the ratios of the lengths of its sides, and is founded upon the fact that the internal angles of all flat triangles always equal a total of 180^o.

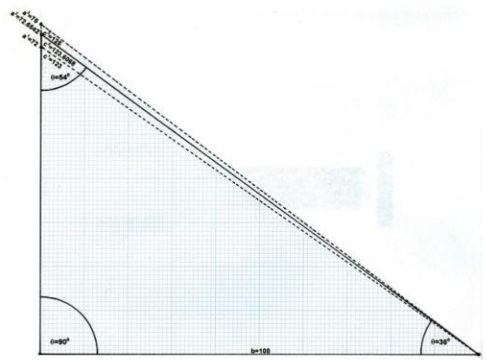
For example, in the simple $1:\sqrt{3}:2$, or $90^o:60^o:30^o$, right-angle triangle shown in Figure 20, the length of the leg (a) opposite the 30^o angle is half the length of the hypotenuse (c), and the length of the leg (b) opposite the 60^o angle is $\sqrt{3}$ times the length of the other leg (a).



These fixed proportions of length to degree of angle are the basis of the trigonometric functions and allowed the ancient mariners to calculate their position relative to the equator by the angle of the horizon to the sun, moon, and certain known stars.

The ancients used a special right-angle triangle, based upon the Golden Proportion and known to them as *mr*, to calculate the value of angles used in basic trigonometry. The exact *mr* was constructed with a side of 72.6542, a base of 100, and a hypotenuse of 123.6068 (2/*Phi* x 100), producing a 36^{o} angle between the hypotenuse and the base leg and a 54^{o} angle between the hypotenuse and the side.

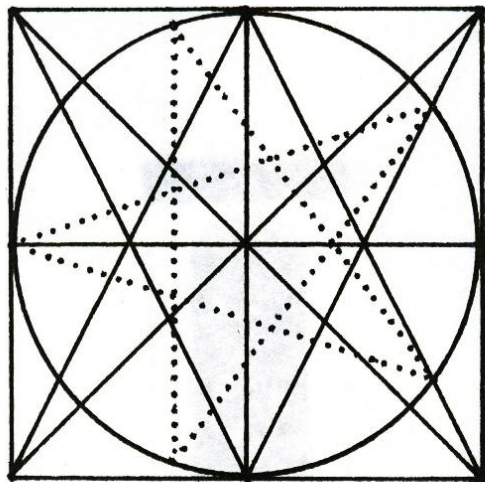
The *mr* was approximated with a triangle of 72:100:123, and, in a further simplification, the same approximate angles are produced by the basic 3:4:5 right-angle triangle, that can be enlarged 25 times to 75:100:125. (Figure 21) [49]



In the first approximate *mr*, the side opposite the 36^{o} was found to be 72, that allowed the calculation of the trigonometric functions of all half-degree angles between 0^{o} and 36^{o}. Then, since 36^{o} is 2/5 of a right angle of 90^{o}, and is 1/10 of a full circle of 360^{o}, *mr* allowed the calculation of the trigonometric functions for all angles.

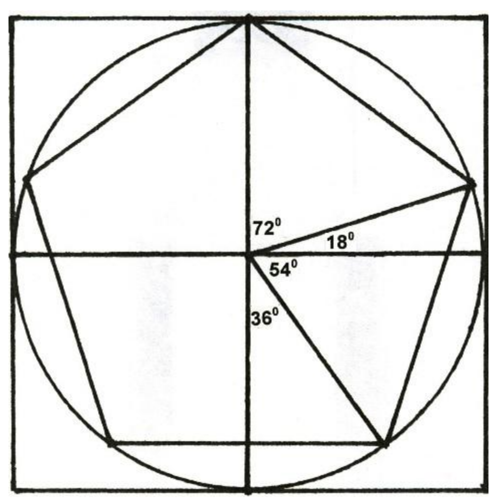
It was for this reason that the ancients considered the *mr* triangle to be the basic element of the cosmos, and perhaps why one of the ancient names of Egypt was *To-Mera*, or the land of the *mr*.

Another geometric calculating tool used by the ancients was a drawing of a circle within a square, which was divided into four parts by a cross, or "+." Next, by constructing diagonals, they were able to inscribe within the circle the figures of a pentagon, hexagon, octagon and decagon. (Figure 22)



The most useful of these inscribed polygons as a calculator was the pentagon, which defined a five-pointed star. The importance of this polygon, which represented the ancient number 23 and which was adopted by the Pythagoreans as the symbol of the initiated, was based upon the fact that it automatically divides the lines it crosses into their golden proportions.

Finally, by using the pentagon inscribed inside a circle, the ancients may have been able to observe and measure the irrational sums of √2, √3, and √5, as well as their multiples and fractions without arithmetical computations. (Figure 23)



The pentagon also allowed the calculation of the basic trigonometric functions in the same manner as the *mr* triangle to demonstrate Sin 18^o = 1/2*Phi*, Sec 36^o = 2/*Phi*, Sin 54^o = *Phi*/2, and Sec 72^o = 2*Phi*. [50]

Evidence that the ancients were familiar with trigonometric functions can be found in problem 56 of the Rhind Papyrus that asks, "If a pyramid is 250 cubits high and the side of its base 360 cubits long, what is its *seked*?"

From an analysis of the problem we learn that the seked is the cotangent of the angle between the base of the pyramid and its face. In other words, it is the ratio of half the side of the base of the pyramid to its height, or the run-to-rise ratio of its face.

This problem demonstrates that it was no accident that the ancient Egyptians were able to maintain a constant slope of each pyramid face relative to the horizon. This knowledge allowed the builders to constantly check their progress to ensure that the required slope was maintained and that the seked was the same for each of the faces. [51]

The First Calculators

During the last century, as archeology has advanced to a science and the centers of ancient civilizations have been subjected to systematic excavations, we have found many references to incredibly large numbers among the ruins. Mostly, these numbers have been associated with calendar functions as they seem to record the dates and frequencies of various phenomena, such as the period of revolution and conjunctions of the planets, and to reconcile these observations with the periodicity of the earth's movement.

Found carved in stone among the Mayan ruins are huge numbers going back more than 403 million years, and found stamped in clay on cuneiform tablets found in Iraq are tables of numbers representing a span of 6,200,000 years, expressed in seconds. Most interestingly, the most ancient data are also the most accurate.

We do not know for sure how the ancients calculated these numbers, for we have only the results, but we do know they must have employed a fairly sophisticated system of mathematical calculation.

A cuneiform tablet recovered in 1854 at Senkereh, Iraq (near ancient Babylon), and dated between 2300 and 1600 B.C. records a list of numbers and their squares in an adjacent column. To derive these accurate results, it is likely the ancients used a form of counting that relies upon an abacus, which is a flat board, table, or any surface on which is drawn horizontal lines representing ascending fractions, one, and multiples of one, and which can be divided down the middle by a vertical line.

The word *abacus* is Latin and may have been derived from the Greek word *abax*, that means a "flat surface" or from the Hebrew word *avak*, meaning dust. "Counters," such as small pebbles, were used on the abacus to represent numbers. The Latin word later used to designate these counters was *calculus*, meaning a small *calx*, the word for limestone, from which they were often manufactured. [52]

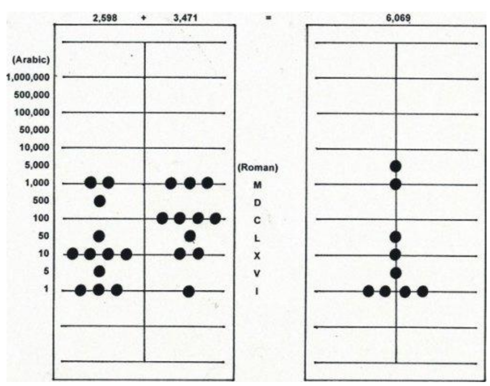
Counters have been found in excavations at Jericho and Gezer in Israel, and at ancient Kish in Iraq. Additional evidence for the early use of the abacus can also be found in the Americas, where native

Indians were found to use pebbles for counting, and in Mayan ruins where kernels of corn were found strung in groups of ten on parallel strings.

The earliest evidence of the use of calculators by the ancient Egyptians is recorded on several papyruses, one of which has been dated to about 1500 B.C. It shows a grid of 100 dots arranged in ten rows, divided by a horizontal line halfway down. The grid may have served a calculating function, for we know the later Egyptians used the abacus, since it was commented upon by the Greek historian Herodotus, who noted that the Egyptians counted by pebbles in a manner opposite to the Greeks.

Numbers were designated by placing counters on the various horizontal lines to represent their subdivisions and fractional parts. To solve problems in addition, the second number was represented on the other side of the vertical line in the same manner as the first, and the counters of differing values were then moved together to the center on their respective horizontal lines.

Once the number of counters on any horizontal line totaled five, they were removed from the board, and one counter was placed above the line. When there were ten (one above the line and five on it), the counters were removed, and one was placed on the line above. Figure 24 represents the addition of 2,598 and 3,471 for a total of 6,069.



Subtraction was performed in the reverse manner as addition, division involved repeated subtraction, and multiplication was performed by repeated addition.

The modern abacus, known in Chinese as a *suanpan* and in Japanese as a *soroban*, was derived from Western civilization and did not come into popular use in the Orient until the Seventeenth Century. Its function is similar to the ancient abacus; however, sliding beads are used instead of counters.

The classical Greeks considered mathematics to be secondary in importance to geometry, largely because the geometric proofs derived were self-evident and did not always require mathematical notations. For these reasons, and because the abacus and counters were in common use, Greek scholars found it relatively easy to perform most necessary calculations.

For all their brilliance in geometry, the Greeks did not advance mathematics much beyond the fractions and abacus acquired from the Egyptians. As did the Hebrews and others, the Greeks interchanged letters of their written alphabet for the expression of common whole numbers. These symbols were used, over and over, in increasingly complex fractions to prove their observations.

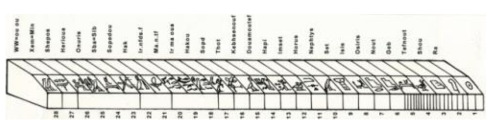
It appears, however, that the ancients may have earlier solved many of the mysteries of mathematics, as well as those of geometry, which knowledge was either lost before the arrival of the Greeks, or that the Greeks failed to comprehend fully.

The Ruler of the Earth. A numbering system can be established with any base, with the number ten being the common or decimal base we use today in ordinary transactions, and two, or plus and minus, as the binary base for computer or electronic calculations.

Irrespective of base, there are various progressions of numbers that have a logical internal relationship. One such series is known as perfect numbers, in which the sum of their proper divisors is equal to the number itself. The first of these (excluding one itself) is six, in which 1+2+3=6, and the second is 28, in which 1+2+4+7+14=28.

Using the perfect numbers of six and 28, the ancients were able to derive a set of numbers they used to construct their standards of linear measurement, or rulers. They started with one hand (75 mm) divided into four fingers (18.75 mm each) and joined four hands of 16 fingers into a "foot" (300 mm). One-and-one-half "feet" were then joined to construct a "yard," or cubit consisting of six hands of 24 fingers (450 mm), that was the common cubit of the ancient world.

Finally, the ancients added another hand of four fingers to the common cubit to complete the sacred cubit consisting of seven hands and 28 fingers (525 mm). Five of the 28 fingers could be further subdivided into fractional parts from ½ to 1/6. These graduations allowed for the accurate measurement of any line segment encountered in practical applications. (Figure 25)



The value of this numbering system was that it allowed for the practical computation of most problems that confronted the ancient surveyors, such as the need to double or divide various plots of land in half. Thus, for them, the area of a square with a side of 70 was half of a square with a side of 100, that was half of a square with a side of 140. Under this system, the diagonal of a square was both 10/7 and 14/10 of the side.

This produced an approximate value for the square root of two (√2) as between 1.42857 and 1.4; however, when greater accuracy was required, they simply averaged the two results, (1.42857+1.4)/2, to arrive at the fairly accurate figure of 1.41428.

Moreover, as we earlier found, the fraction 22/7 provides a workable value of 3.142857 for *Pi*, the fraction 14/11 provides an approximate value of the square root of the Golden Proportion (√*Phi*), 1.272727, and 196 (142) divided by 121 (112) results in a close approximation of the Golden Proportion.

Each of the first 28 numbers was associated with a particular god, demigod, or ancient leader. Thus, one was Ra, designated by a circle with a dot; four was *Geb*, represented by a duck; six was *Osiris*, represented by half of a three-step ziggurat with a dotted eye under it; seven was *Isis*, represented the same as six except that the eye does not have a dot; 10 was *Horus*, represented by a falcon; 12 was *Hapi*, represented by two ducks; 23 was *Sba-Sib*, represented by a five pointed star; and 28 was *ou-ou*, or WW, represented by two falcons.

This system of calculating provided the ancients with the mathematical ability to measure the earth, which they did to a degree of accuracy not achieved again until the time of Newton.

The Girdling of the Globe. Beginning with the perfect number six, the ancients divided the period of a single rotation of the earth into two halves (night and day) of 12 (two times six) hours, for a total of 24 hours. Each hour was then divided into sixty (ten times six) minutes, which were each divided into sixty seconds, for a total of 86,400 seconds per day.

The circumference of the earth was then divided into 360 (62x10) degrees, each of which could be further subdivided by 60's into minutes (') and seconds ('') of arc for a total of 1,296,000 linear elements of curved geographical measure.

These two sets of measurement allow for the calculation of the amount of time it takes for a single degree along the equator to move past or under the sun. Thus, a geographical degree (1^0) is equal to four minutes of time, and a minute (1') of geographical degree is equal to four seconds of time. Conversely, a minute or second of time is equal to 15 minutes (15') or 15 seconds (15'') of one geographical degree.

This use of 60 and its multiples by the ancients is known as the sexagesimal (base-60) system.

With these tools, the ancients were able to girdle the globe by a series of lines, or chords, that divided its surface into 360 longitudes running north and south and 180 latitudes running east and west. This method provides a grid of 64,800 polygons, which are nearly square at the equator, but which become triangles where they come together at the poles.

When the modern system was adopted using the ancient coordinates in the time of Newton, England ruled the seas and possessed the only accurate chronometers; therefore, the prime meridian of 0^o

longitude was made to run through the observatory at Greenwich, from which we get Greenwich Mean Time.

The set of modern longitudes extends both east and west from Greenwich, usually in 15^o increments, to the opposite side of the earth where the international date line is located at 180^o between east 165^o and west 165^o longitude.

Latitudes were defined as perpendicular to the longitudes, extending up and down from the equator to north and south 90^o latitudes, which are the north and south poles.

In addition, the latitude of 23^o27' north is known as the Tropic of Cancer, and 23^o27' south is the Tropic of Capricorn. At the tropics, the sun shines perpendicularly on the longest days of the year, or summer solstices, in each hemisphere.

At the equator, the sun's rays are perpendicular on the spring and fall equinoxes, at which time the night and day are equal.

The ancients constructed the Great Pyramid at the intersection of the longitude and latitude that crosses the greatest amount of land mass on earth. They established their prime meridian through the center of Egypt and the pyramids, perpendicular to the equator, and deduced the lengths of the latitudes and longitudes.

To do so they may have established an observatory slightly north of the Tropic of Cancer on the island of Elephantine at the southern border of Egypt. The island may have contained a deep well, from the bottom of which the edge of the sun could be seen at midday on the summer solstice to fully illuminate the well without shadow.

In addition, by the construction of sight lines within the pyramids, they may have been able to accurately measure the transit of significant stars. By their use of the Great Pyramid and obelisks as sun clocks, they could calculate precisely the exact length of the day and year. From all this, they were able to calculate a precise geographical cubit of 0.4618 meter, slightly longer than the sacred cubit of 0.450 meter.

An Astronomical Calculator. The ground plan of the three pyramids maps the relationship of the three main belt stars of the constellation Orion and the "Milky Way" to the pyramids and the Nile river. The word Orion is derived from Sah for Osiris, "The Lord of the South."

Because of its own unique proper motion, Sirius (the "Dog Star" following at the heels of the great hunter, Orion) appears in the east at dawn each year, almost exactly 365.25 days after the previous rising.

Sirius is not only the brightest star in the heavens, but it is the only star possessing the requisite proper motion to coincide with the solar year (measured between equinoxes) of 365.2242 days. However, because of the precession of the equinoxes, Sirius, along with all other heavenly objects, also rises 20 minutes later than the year before, in what is known as the sidereal year of 365.5636 days.

The ancients may have built the Great Pyramid to represent a scale model of the northern hemisphere of the earth and to record permanently both their methods and measurements. At midday on the spring equinox the sun can still be observed to "swallow" its shadow on the north face of the Great Pyramid at the moment the angle of the sun becomes parallel to the angle of the face along its apothem.

Extending to the north was a smooth pavement constructed with a pattern of stones that allowed for the precise measurement of the sun's shadow, and extending to the south was a similar pavement allowing for the measurement of the sun's reflection from the pyramid's original highly polished surface.

The Hellenistic Greek, Agatharchides of Cnidus (? - ca. 150 B.C.), served as a guardian of the king of Egypt in the Second Century B.C. He recorded that the length of one side of the Great Pyramid base was intended to represent 1/8 minute of degree, and the apothem was equal to 1/10 of a minute of degree.

When measured by the geographical cubit, one side of the pyramid base is equal to 500 geographical cubits, and the apothem is equal to 400 geographical cubits. Thus, 500 times eight equals a minute of arc, 500 times 60 equals a degree, and 500 times 360 equals 86,400,000.

Since there are 86,400 seconds in a day, the distance traveled by the spinning earth at the equator each second is exactly 1,000 geographical cubits, or slightly more than 1,000 miles per hour.

The importance and validity of the ancient legends conforming the proportions of the Great Pyramid to the earth was later recognized in the Seventeenth Century by Isaac Newton, who had to delay the publication of his general theory of gravity until he could obtain accurate measurements of the earth.

John Greaves (1602-1652) measured the Great Pyramid's dimensions in 1638, and using Greaves' data, Newton deduced that the pyramid had been built on the basis of two different cubits. The "profane" cubit of 20.63 inches (450 mm) resulted in the 10x20 cubit King's chamber, and the "sacred" cubit (between 24.80 and 25.02 inches, or 525 mm) which had been reported by Flavius Josephus (37- ca. 101 A.D.) in describing the circumference of the pillars of the Israelite Temple in Jerusalem.

Although Newton's conclusions regarding the lengths of the cubits were fairly accurate, his calculations of the size and volume of the earth were inaccurate, because Greaves was unable to get down to the base of the pyramid due to accumulated debris.

Newton had to wait until 1671 when the French astronomer Jean-Felix Picard (1620-1682) was finally able to measure a degree of latitude as approximately 69.1 English statute miles. From this, Newton was able to calculate the dimensions of the earth more accurately in arriving at his conclusions regarding its gravitational mass.

We can only imagine the effect on history if Greaves had been successful in obtaining the true measure of the Great Pyramid, and Newton had been able to more quickly publish his theory of gravitation and method of calculus. Human society could have gained an exponential thirty-year advantage, and we might have traveled to the moon by the beginning of this century, instead of fighting two destructive world wars and unnecessarily inventing nuclear weapons.

The circumference of the earth has been measured by modern satellites to be 24,902.45 miles; its polar radius is 3,949.921 miles. Multiplied by 5,280 (feet per mile), the circumference is 131,484,936 feet and the polar radius is 20,855,582.88 feet.

For convenience, using feet rather than meters, the circumference of the Great Pyramid is 3,023.16 feet and its height is 481.3949 feet. To determine the scale used by the ancients, we can divide the pyramid dimensions into the earth's measurements to arrive at a close approximation of 1:43,200.

The use of this scale could have hardly been accidental since 43,200 is not only one half of the number of seconds in a day, it is also directly related to the precession of the equinoxes.

Precession is based upon the fact that the polar axis of the earth slightly wobbles, which results in the sun rising on the spring, or vernal, equinox at a point in its house, or constellation, slightly behind where it was the year before. The movement is so slight as to be almost unnoticeable, amounting to about 1^{o} every 72 years. Thus, it takes almost 2,160 years to move through the 30 degrees accorded to each of the 12 constellations of the zodiac, and 4,320 years to move through two. (*See above* Figure 1)

While this in itself might be coincidental, the number 4,320, and its variations such as 432, 4320, 432,000 and 4,320,000, are found in the numbering systems and legends of all ancient civilizations, from the Mayans to the Hindus. It is the basic meter of time. According to the Mayan long count that began on August 13, 3114 B.C., the age in which we live is to end on December 23, 2012. [53]

The Golden Numbers

A group of internally related numbers is known as the Fibonacci series and is attributed to Leonardo Bigollo Fibonacci (1170-1250), who is considered to be the greatest mathematician of the Middle Ages. He traveled with his father to Algiers, where he learned the Hindu system of numbers from the Muslims.

Later, in Egypt, Fibonacci learned the mysteries of the ancient numerical series in which each new number is the sum of the previous two. The series, 1+2+3+5+8+13+21+34+55+89+144... results in the ratio between each successive number fairly quickly becoming equal to the Golden Proportion.

In addition, as we noted earlier, the ancients were aware of the secret "Templar" formula, *Phi*2 x 6/5 = *Pi*, that is a function of the Fibonacci series. First, each number in the series can be divided by the previous number to provide an approximation of the Golden Proportion, that becomes accurate to nine places at the 24th number of the series. Second, each number can be multiplied by 1.2 (6/5) and then divided by the second previous number to provide an approximation for *Pi*, that also achieves a limit of 3.141640787 at the 24th number of the series.

Fibonacci may not have been aware of the *Pi* function of the series, for in his *Practica Geometriae* published in 1220 A.D., he relied upon the fraction 864/275 as an approximate value of 3.141818 for *Pi*, even though it was slightly less accurate than that provided by his series.

A Fibonacci series can be commenced by any number. Thus, *Phi*+2*Phi*+3*Phi*+5*Phi*, or *Pi*+2*Pi*+3*Pi*+5*Pi*, or any other number can begin the series, that will arrive at the same limits as above at approximately the 24th operation.

Fibonacci is credited with introducing the modern decimal system to Europe, which was still struggling with Roman numerals and Greek letters. Although there is evidence the Hindus employed the first nine numbers as early as the Third Century B.C., the use of zero doesn't appear in the archeological record until the Ninth Century A.D.

The Hindus called the zero a *sunya*, meaning "empty," and when the Arabs adopted the system, they called it a *sifr*, that became a *zefirum*, or "cipher." It took hundreds of years before the Europeans fully accepted "Arabic" numbers, including the concept of zero.

The regular use of the abacus and counters continued into the Seventeenth and Eighteenth Centuries, and the British Exchequer didn't abandon the use of counters until 1826.

Although the Golden Proportion is an irrational number, it is not transcendental like *Pi* and *e*, and, therefore, can be represented algebraically. Symbolically, although it is numerically irrational, we can determine its supreme orderliness by noting that *Phi* (1.61803389) and its square (2.61803389) are both represented by the identical decimal expression. Not only is this true, but amazingly enough $Phi^2+Phi = Phi^3$, $Phi^3+Phi^2 = Phi^4$, and $Phi^4+Phi^3 = Phi^5$.

Numbers are magical. They have always been magical, and they will remain magical, everywhere and whenever there is something to be measured and counted, and there is someone to wonder what and why.

Return to Table of Contents

Epilogue

At least, let us learn this from this little book: In the earliest time of human civilization – we lived in peace and our wisdom was profound. With the discovery of war and the resulting self destruction -- we abused our knowledge and lost our way.

Just imagine where we would be today had our energy and resources been directed to peace and exploration, rather than war and conquest. We would be there looking back at here, rather than here looking out at there.

It is not too late to recover what has been lost, but time is short. As we rapidly exhaust the resources of the garden wherein we live, we must adapt or die. The choice is ours.

If we fail to act wisely and our light goes out, Mother Earth will spin on and, in just a thousand years or so, the rivers will once again run clean to the oceans.

After a galactic moment, another child will look up and will begin to count the cycles of the moon, note the solstices, chart the movement of the planets, and will dream of flying to the stars.

They will find the artifacts of our existence and will wonder what and why.

Return to Table of Contents

Endnotes

[1] Since the twelve constellations are not distributed uniformly around the zodiacal circle, and it is difficult to determine the moment when the spring equinox on March 20th moves from one to the next, there are differences of opinion regarding the advent of the Age of Aquarius. Figure 1 is based upon Sitchin, Zecharia, *When Time Began* (New York: Avon Books, 1993), p. 26.

[2] Gribbin, John and Mary, Fire on Earth: *How Asteroid and Comet Collisions Have Shaped Human History – And What Dangers Lie Ahead* (New York: St. Martin's Griffin, 1996).

[3] Ryan, William B. F. and Pitman, Walter C., III. Noah's Flood: *The New Scientific Discoveries About The Event That Changed History* (New York: Simon & Schuster, 1998), p.88.

[4] Reader, John. *Africa: A Biography Of The Continent* (New York: Alfred A. Knopf), p. 87.

[5] Reader, John, op. cit.

[6] Hapgood, Charles H., *Path of the Pole* (New York: Chilton Books, 1970) and (Kempton, Illinois: Adventures Unlimited Press, 1999); Flem-Ath, Rand and Rose, *When The Sky Fell: In Search of Atlantis* (New York: St Martin's Press, 1995).

[7] The crustal movement is different that the shifting of the magnetic poles, which are also in constant movement due to a normal oscillation of the earth's magnetic field. According to Joe Stoner, a paleomagnetist at Oregon State University, the north magnetic pole has moved 685 miles from Arctic Canada toward Siberia in just the past century, and the movement appears to be accelerating.

[8] Hapgood, Charles H., *Earth's Shifting Crust: A Key to Some Basic Problems of Earth Science* (New York: Pantheon Books, 1958).

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[16] Sitchin, Zecharia, *The Lost Realms* (New York: Avon Books, 1990), p. 33; Hancock, Graham, op. cit., pp. 98-101.

[17] “Ice Age Ended Abruptly, New Study Shows.” *Los Angeles Times*, October 2, 1998, p. A29.

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[24] *Quest For The Past: Amazing Answers To The Riddles of History*, (Reader’s Digest, 1984).

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[32] Riane Eisler, *The Chalice & The Blade: Our History, Our Future* (New York: HarperCollins Publishers, Inc., 1987); Gimbutas, Marija, *The Civilisation of the Goddess: The World of Old Europe* (London: Thames and Hudson, edited by J. Marler, 1991).

[33] Ryan, William B.F. and Pitman, Walter C., III, op. cit., p. 149.

[34] Wilson, Colin, *From Atlantis To The Sphinx: Recovering The Lost Wisdom Of The Ancient World* (New York: Fromm International Publishing Corporation, 1997), pp. 6-13, 329, 335.

[35] Gribbin, John and Mary, *In the Beginning: After COBE and Before the Big Bang* (Boston, New York, Toronto, London: Little Brown and Company, 1993); Spielberg, Nathan and Anderson, Bryon D., *Seven Ideas That Shook the Universe* (New York: John Wiley & Son, Inc., 1987); and Speyer, Edward, *Six Roads From Newton: Great Discoveries in Physics* (New York: John Wiley & Son, Inc., 1994); and Asimov, Isaac, *Asimov on Physics* (New York: Avon Books, 1976) were all relied upon in the following essays.

[36] Using data obtained from the Hubble space telescope, scientists have lowered the estimated age of the universe from the earlier believed 15 billion years.

[37] These relative distances are drawn from John and Mary Gribbin's *In the Beginning*, (op.cit.) except they use candies instead of buttons; they attribute the analogy to Marcus Chown.

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[39] The concept that the earth is a living being was proposed by James Lovelock in *The Ages of Gaia: A Biography of Our Living Earth* (W. W. Norton and Company, Inc., 1988). If this is true, then Mother Earth herself is a favored daughter of a living universe.

[40] The background for this section was primarily drawn from Gribbin, John and Mary, *Fire On Earth: How Asteroid and Comet Collisions Have Shaped Human History--And What Dangers Lie Ahead* (New York: St. Martin's Griffin, 1996); Barnes-Svarney, Patricia, Asteroid: *Earth Destroyer or New Frontier?* (New York and London: Plenum Press, 1996); and Zebrowski, Ernest, Jr., *Perils Of A Restless Planet: Scientific Perspectives On Natural Disasters* (Cambridge: Cambridge University Press, 1997).

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[46] Beckman, Petr, *A History of π (Pi)* (New York: St. Martin's Press, 1971).

[47] Tompkins, Peter, op. cit.

[48] The formula for the Round Table of the Grail, and the drawing upon which Figure 13 was based, is set forth in Appendix I of *Bloodline of the Holy Grail* by Laurence Gardner (Shaftesbury, Dorset; Rockport, Mass.; Brisbane, Queensland: Element Books, Ltd., 1996). The formula was also found by Schwaller de Lubicz in the tomb of Rameses IX, except that the fraction 6/5 is relied upon rather than 12/10 for producing the decimal number 1.2.

[49] In addition to the data and drawings depicted in Figures 20 through 23, one of the great services provided by Peter Tompkins in his *Secrets of the Great Pyramid* is a book-length appendix, *Notes on the Relation of Ancient Measures to the Great Pyramid* by Livio Catullo Stecchini, from which information on the *mr* and other measurements was derived.

[50] In trigonometry, "Sec" designates secant, which is the function that, for an acute angle, is the ratio of the hypotenuse of a right triangle of which the angle is considered part and the side adjacent to the angle. "Sin" designates sine, which is the function that, for an acute angle, is the ratio between the side opposite the angle when it is considered part of a right triangle and the hypotenuse. (Webster's New Collegiate Dictionary).

[51] Maor, Eli. *Trigonometric Delights*. Princeton: Princeton University Press, 1998, p. 6. (Another delightful book by Professor Maor.)

[52] Pullan, J. M., *The History of the Abacus* (New York: Frederick A. Praeger, Inc., Publishers, 1969).

[53] Hancock, Graham, op. cit.

Return to Table of Contents

About The Author

For more than 40 years, William John Cox vigorously pursued a career in law enforcement, public policy and the law. As a police officer, he was an early leader in the "New Breed" movement to professionalize law enforcement.

Cox wrote the *Policy Manual* of the Los Angeles Police Department and the introductory chapters of the *Police Task Force Report* of the National Advisory Commission on Criminal Justice Standards and Goals, which continues to define the role of the police in America.

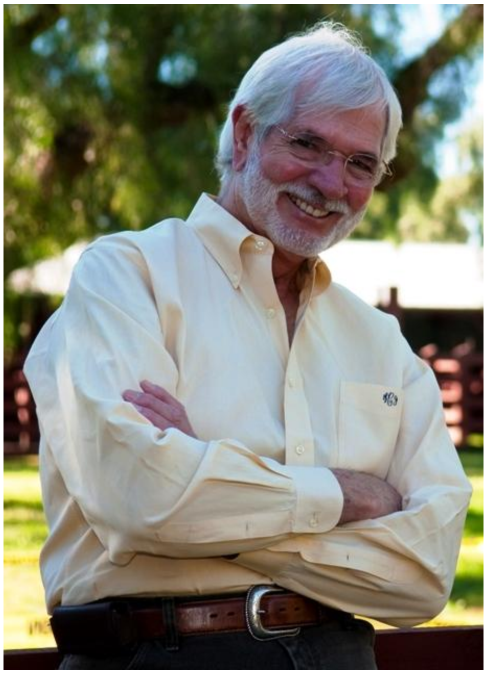
As an attorney, Cox worked for the U.S. Department of Justice to implement national standards and goals, prosecuted cases for the Los Angeles County District Attorney's Office, and operated a public interest law practice primarily dedicated to the defense of young people.

Professionally, Cox volunteered *pro bono* services in two landmark legal cases. In 1981, representing a Jewish survivor of Auschwitz, he investigated and successfully sued a group of radical right-wing organizations which denied the Holocaust. The case was later the subject of the Turner Network Television motion picture, *Never Forget*.

Cox later represented a "secret" client and arranged the publication of almost 1,800 photographs of ancient manuscripts that had been kept from the public for more than 40 years. *A Facsimile Edition of the Dead Sea Scrolls* was published in November 1991. His role in that effort is described by historian Neil Asher Silberman in *The Hidden Scrolls: Christianity, Judaism, and the War for the Dead Sea Scrolls*.

Cox retired as a Supervising Trial Counsel for the State Bar of California, where he led a team of attorneys and investigators who targeted the prosecution of attorneys accused of serious misconduct and criminal gangs engaged in the illegal practice of law.

Over the years, Cox has written extensively on public policy, politics, philosophy and the human condition.



Return to Table of Contents

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Return to Table of Contents

Other Titles by the Author

You're Not Stupid! Get the Truth:

A Brief on the Bush Presidency

(2004) Progressive Press

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(1978) CLS Publishing - Print

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(2012) Mindkind Publications - Electronic

Return to Table of Contents