Pythagoras and the story behind the Croton Crown

Archaeological survey indicates the ***Dark Ages of Greece*** extended **from the eleventh to the eighth Century BCE.** Bizarre reasons including an increase in population were attributed to be the cause of most of the changes during this archaic period. It seems most of the palaces of the Mycenaean civilization were destroyed around 1200 BCE. The only palace left un-destroyed was in Athens. But even Athens seems to have had a hard time for the next several hundred years. There were no more kings, but from time to time tyrants (the present equivalent of dictators) ruled. Taxes were not collected. The roads were neglected in an un-repaired state. Trade and commerce suffered badly. The population fell from disease, death. Greeks migrated mainly to the shores of and further inland into Asia Minor (Anatolia) and Egypt. Because Greece was in such bad shape during the Dark Ages, and could not defend herself, it also seems that some of their neighbors to the north invaded Greece and began living in some of the Greek cities. The Greeks called these invaders the ***Dorians***, and called the old Mycenean Bronze Age Greeks, the ***Ionians***. Since a large number had settled along the coast of Turkey people began to call that place ***Ionia (the Yonas of the Iranian Golden Age)***. Here the knowledge of how to make tools and weapons out of iron had spread from the Hittites around the Mediterranean Sea.

It was during such depressing times, about 569 BCE that Pythagoras was born in Samos, an island off the western coast in the Anatolian plateau of Turkey of a Greek Father and an Asiatic mother. An ordinary Ionian of mixed blood he had no opportunity to read or write. There ***has been not a single record of Pythagoras having written anything.*** It was the later, so-called Pythagoreans (his immediate followers and later new conscripts), who did all the documentation and writing and, with it, the claiming and the exaggerating of whatever he is believed to have transmitted in his 'School'. This resulted in all that they claimed to be documented in history as the alleged Pythagoras' original ideas and knowledge. Let us inquire into this rather extraordinary historical anomaly.

Not all that Pythagoras is believed to have transmitted was readily accepted by the Pythagoreans. Indeed, when the Pythagorean Society at Croton was attacked by Cylon, a nobleman from Croton itself, about **480 BCE** Pythagoras escaped to Metapontium. Almost all authors say he died there; some claiming that he committed suicide because of the attack on his Society. After his death in about **480 BCE** the 'Pythagorean Society' expanded rapidly about 500 BCE and later. Knowledge, traditionally being accepted synonymous with power (particularly, at the time) the Society members in their euphoria (rather than in their self-styled wisdom) decided to enter politics. As it often happens the political nature of the, once, amicable members split them into a number of political affiliations and factions. Such were the problems created by these alleged intellectuals that the Society had to be forcefully suppressed. Its meeting houses and halls were everywhere violently sacked and burned. In particular, in the "House of Milo" in Croton 50 to 60 Pythagoreans were trapped and slain. Those who managed to escape or survive the wounds took refuge at Thebes and other places in Egypt. That certainly was the end of their ambitions as they soon went into obscurity.

Pythagoras, while in Samos had somehow managed to remain tolerant of (though disillusioned by) the dictatorial block on the freedom of speech imposed by the, then, tyrant Polycrates, who had seized control of the city of Samos. Around **535 BCE** Pythagoras, who had a natural bent towards intellectual inquiries and learning, which he found gravely lacking in Greece at the time, escaped to Egypt. According to Porphyry he visited many of the temples and witnessed discussions but, as an alien, he was refused admission to priesthood to all the Egyptian temples. It was because there were strong links between Samos and Egypt at this time that Polycrates dispatched a letter of recommendation that he be permitted to enter the 'inner circle' of Egyptian priesthood. This helped him gain admission into the Temple of ***Diospolis***. After completing the rigid temple rites necessary for admission he was ultimately accepted into the priesthood.

In **525 BCE** ***Cambyses***, son of Cyrus the Great, invaded Egypt, won the Battle of Pelusium and captured Heliopolis and Memphis. Pythagoras was taken as a prisoner of war, and, therefore as a slave to Babylon. In Babylonia in the Zarathushti **Maghavan Brotherhood Guild**, which was originally founded by ***Dai-aauku*** (Gk: Diocese) was Gaomata, a rather ambitious Maghavan as the Principal. It was under the tutelage, authority and guidance of the, then, Zarathsuhti Pontiff ***Zarades (also called Zaradus*** in history). He was the supreme Mobedan Mobed, equivalent to the present Roman Pope, both under Cambyses and later, ***Daraius I***) that Pythagoras attained deep knowledge and understanding of the Gathic and Avestan Philosophy. It is worthy of note that it was the name of this Royal Papacy, which prompted some historians to incorrectly place the birth of Zarathushtra in Babylonia and the incorrect date to 550 BCE. Pythagoras was instructed in the sacred rites and learnt about mathematics, geometry, philosophy of ideas, intellectual ideals and spiritual knowledge. He also reached the acme of perfection in ***Arithmetic, Geometry and Music*** and the other mathematical sciences taught by the Babylonians. It was here that Pythagoras's young mind was firmly impressed. Here he first learnt the importance of numbers and the dependence on the ***interaction of contraries or pairs of opposites -*** good and evil; positive/negative; light/darkness; right/wrong; rationality/irrationality; outwardness/inwardness…etc.

Pythagoras had also borrowed from the teachings of the Buddha and the Egyptian priests

The concepts of the transmigration of the soul (repeated cycles of rebirth in another earthly form- ***Reincarnation***) and **Vegetarianism** (eating of flesh being abominable) were clearly learnt by Pythagoras in Egypt and certainly borrowed from news emerging from India. The concept of eating vegetable food only was prevalent, at the time, both in the teachings of the Buddha and the priests of Egyptian Temples. The concept of Reincarnation was clearly 'borrowed' from the contemporary teachings of ***Gautama Siddhartha, the Buddha*** (the Wise One) born around **565 BCE** in the city of Kapilavastu, India. The extraordinary Greek claim that because of the vast distance there could not possibly have been any contact whatsoever between India and Egypt, is incorrect. Egypt (the modern version for the Roman Aegyptus) was called Mizr, at the time. That there were trade contacts and regular exchange of information with ***Mizr*** **is indicated in Vedic Texts** (also termed Missr, Missra and Mishra). The Indo-Iranian Sumerian rulers, Sharrukin (Sargon I circa 2334-2279 BCE) and son, Manish-tishu are mentioned in Clay Tablets found in the Mohenjodaro diggings (The Indus Valley Civlisation; now called the **Saraswati-Sindhu Civilisation**).

The reason why Pythagoras could not possibly have picked up the ***concept of Reincarnation*** (repeated cycles of rebirths in another earthly form) from the Zoroastrian Pontiff, Zarades in Babylonia is because of our unique belief in the presence of our individual Fravashis. **One's Fravashi is, indeed, one's own individualised 'Guardian Spirit', which (like Ahura Mazda) is perfectly good and totally incorruptible.** It was present before the individual's birth and will continue to exist forever – in a state of perfect timelessness. It follows that when one's Soul (Urvan) is being judged at Chinvato Peretu (the Bridge of the Separator of the good from the evil during the 'first Judgment') one's Fravashi, obviously, cannot be judged. Since each person's Fravashi was already present from the beginning of the Creation before the person was born. At the birth of each person the individual Fravashi forms part of the physical body and it will continue to exist even after the person's death, when the Fravashi of the dead moves back into the Spiritual state and continues to exist eternally in the spiritual world in the eternal glow of Garo-dēmāna (Gathic word). The equivalent Avestan word is Garo-nmāna, Pahlavi word, Garosmān and Gujarati word Garothmān.

Indeed, our Fravardigan Days (Gujarati: Muktad) are actually reserved for the very invocation of the Fravashis of our departed beloved for obtaining their blessings of good health and beneficent yearnings. Zarathushtra's extraordinary vision of 'the end of Time' as ***Frasha (kar) / Fərashəm*** [Avestan / Frashokereti; Pahlavi: Frashekart] – **'making afresh / anew'** (Yasna 30.9 - Gathic Fəra is Avestan Fra) fully explains the reunification of each individual Fravashi with the resurrected body at 'the end of Earthly Time/the Solar System'. The Fravashi is then fully reunited with the resurrected physical individual body. This extraordinarily amazing vision, in fact, not only explains fully, in the Religion of Zarathushtra the total absence of the belief in Reincarnation (repeated cycles of material rebirth in different forms, even other than human in real life on Earth) but also induces the full impact of the Fravashi being reunited with the resurrected body. Zarathushtra's visionary concept of 'the end of Time' has been improperly expurgated in Christianity as the Apocalypse or the Doom's Day, without really explaining why a second judgment is at all necessary. The Christian Apocalypse fails to explain the Zoroastrian concept of the total annihilation of evil at that time, since in Christianity 'God' made everything - the good as well as the evil.

It is also rather strange that after the death of Pythagoras his original teaching about the ***concept of Vegetarianism*** was distorted by many of his followers to suit their own life style. They claimed they practiced Vegetarianism only because the souls of all living creatures pass after death into other living creatures. Others occasionally ate flesh regularly and some refrained from eating meat only because of their bizarre claim of a 'taboo' rather than Pythagoras' philosophical teachings. They also altered the concept of reincarnation claiming 'it was not the same in all species' of the animal kingdom, claiming that in some it occurs until its 'eventual purification' is established.

In those days many a slave earned his freedom from some thoughtful and humanistic master, often because of a long faithful and industrial service to the master and sometimes because of appreciable intellect. After earning his **freedom offered by the Pontiff Zarades in 520 BCE** Pythagoras left Babylon and returned to Samos. Polycrates, the tyrant had been assassinated in early 522 BCE and Cambyses had died in the summer of 522 BCE. Pythagoras had a short stay in Crete shortly after his return to Samos to study the system of laws there. Back in Samos he founded a 'school' which was called the ***Semicircle.*** He tried to use his symbolic method of

teaching, which was similar in all respects to the lessons he had learnt in Egypt and Babylonia. The Samians however were not very keen on this method and treated him with utter ridicule.
Visiting Croton (present name Crotone), a sea port on the east coast of southern Italy (called Magna Graecia, because it was part of Greater Greece) in about **518 BCE,** he managed to attract many followers to form a **'Society'.** As the head of the 'Society' he formed an inner circle of followers known as ***Mathematikoi***, who lived permanently with the 'Society'. They had no personal possessions and were strict vegetarians (as in the Temples of Egypt and Babylonia - specifically they ate no beans). They were taught by Pythagoras himself and obeyed strict rules. The beliefs that Pythagoras held were (a) *that at its deepest level,* ***reality is mathematical in nature,*** (b) *that* ***philosophy can be used for spiritual purification,*** (c) *that one's* ***soul can rise to the ultimate union with the divine,*** (d) *that certain* ***symbols have a mystical significance*** *and* (e) *that* ***all brothers of the order should observe strict loyalty and secrecy***.

Pythagorean teachings

Rite and rules: They performed purification rites and followed moral, ascetic, and dietary rules to enable their souls to achieve a higher level in their subsequent lives and thus eventually be liberated from the reincarnation 'cycle of rebirth.' This also led them to regard the sexes as equal, to treat slaves humanely, and to respect animals. The highest purification was, of course, ***'philosophy'***
Numbers Theory and Mathematics: They believed that umbers constitute the true nature of all things – the very essence of things was number. Even abstract ethical concepts like justice–could be expressed numerically. That relationship between musical notes could be expressed in numerical ratio. The later Pythagoreans, after his death even elaborated a bizarre theory of numbers. Pythagoras made remarkable contributions to the mathematical theory of music. He was a fine musician, playing the lyre. He even used music as a means to help those who were ill. He found that vibrating strings produce harmonious tones when the ratios of the lengths of the strings are whole numbers; these ratios could be extended to other aspects of life.
Geometry: The basics were: -
(i) The **sum of the angles of a triangle is equal to two right angles**. Also the Pythagoreans knew the generalization which states that a polygon with n sides has the sum of interior angles $2n - 4$ right angles and sum of exterior angles equal to four right angles.
(ii) The Babylonian theorem - **in a right angled triangle the square on the hypotenuse is equal to the sum of the squares on the other two sides.**
Astronomy:
The **Earth was a sphere at the centre of the Universe**. He also recognized that the **orbit of the Moon was inclined to the equator of the Earth** and he was one of the first to realize that Venus as an evening star was the same planet as Venus as a morning star
Philosophy: Primarily, however, Pythagoras was a philosopher: His views: -
a) The dynamics of world structure has dependence on the ***interaction of contraries or pairs of opposites***
b) The viewing of ***the soul as a self-moving number*** experiencing a form of rebirth and understanding.
c) ***All existing objects*** were fundamentally ***composed of form and not of material substance***.
d) Further, Pythagorean doctrine (probably conjured up by the Pythagoreans after his death) identified the ***brain as the primary locus of the soul***.
Ethics: the Pythagorean were famous for their mutual friendship, unselfishness, and honesty but when the urge to enter Politics occurred (as noted above) there was utter ruin

Archaeological findings:
Clay Tablets reveal this knowledge had been recorded 2 millennia before the birth of Pythagoras. To show that Pythagoras obtained the above knowledge in Babylonia here are some archaeological findings – Courtesy – article by J J O'Connor and E F Robertson: - Pythagoras's so-called 'original' work found in ancient Clay Tablets of Susa and the origins of 'the Theorem' in Babylonian and also in Indian Mathematics.

Plimpton 322 is the tablet numbered 322 in the collection of G A Plimpton housed in Columbia University.

Pythagorean Theorem in Mathematics of India
A brief outline of a study of the Theorem.

In all early civilizations, the first expression of mathematical understanding appears in the form of counting systems. Numbers in very early societies were typically represented by groups of lines, though later different numbers came to be assigned specific numeral names and symbols (as in India) or were designated by alphabetic letters (such as in Rome). Although today, we take our decimal system for granted, not all ancient civilizations based their numbers on a ten-base system. In ancient Babylon a sexagesimal (base 60) system was in use.

The decimal system in Harrappa [Saraswati-Sindhu Civilisation, previously known as the Indus Valley Civilization circa 2,500 BCE. It extended over a large land mass from Saraswati (Avestan Haraqvaiti - present southern Afghanistan) eastwards through to the delta of the Indus River. Recent diggings have shown even the North of Gujarat was involved].

In India a decimal system was already in place during the Harappan period, as indicated by an analysis of Harappan weights and measures. Weights corresponding to ratios of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, and 500 have been identified, as have scales with decimal divisions. A particularly notable characteristic of Harappan weights and measures is their remarkable accuracy. A bronze rod marked in units of 0.367 inches points to the degree of precision demanded in those times. Such scales were particularly important in ensuring proper implementation of town planning rules that required roads of fixed widths to run at right angles to each other, for drains to be constructed of precise measurements, and for homes to be constructed according to specified guidelines. The existence of a gradated system of accurately marked weights points to the development of trade and commerce in Harrappan society.

Mathematical knowledge and its application during the Vēdic period

In the Vēdic period, records of mathematical activity are mostly to be found in Vēdic texts associated with ritual activities. However, as in many other early agricultural civilizations, the study of arithmetic and geometry was also impelled by secular considerations. Thus, to some extent early mathematical developments in India mirrored the developments in Egypt, Babylon and China. The system of land grants and agricultural tax assessments required accurate measurement of cultivated areas. As land was redistributed or consolidated, problems of measurement came up that required solutions. In order to ensure that all cultivators had equivalent amounts of irrigated and non-irrigated lands and tracts of equivalent fertility - individual farmers in a village often had their holdings broken up in several parcels to ensure fairness. Since plots could not all be of the same shape - local administrators were required to convert rectangular plots or triangular plots to squares of equivalent sizes and so on. Tax assessments were based on fixed proportions of annual or seasonal crop incomes, but could be adjusted upwards or downwards based on a variety of factors. This meant that an understanding of geometry and arithmetic was virtually essential for revenue administrators. Mathematics was thus brought into the service of both the secular and the ritual domains.

Arithmetic operations ***(Ganit)*** such as addition, subtraction, multiplication, fractions, squares, cubes and roots are enumerated in the ***Nārad Vishnu Purānā*** attributed to ***Vēda Vyās (pre-1000 BCE)***. Examples of the knowledge of 'calculation in lines' ***(Rēkhā-ganit)*** are to be found in the ***Sulva-Sutras* of *Baudhayana (800 BCE)*** and ***Apasthamba (600 BCE),*** which describe techniques for the construction of ritual altars in use during the Vedic era. . Mathematics was classified either as ***Garna*** (Simple Mathematics) or ***Sankhyān*** (Higher Mathematics). Numbers were deemed to be of three types: ***Sankhēya*** (countable), ***A-sankhēya*** (uncountable) and ***A-nant*** (infinite). The Sanskrit word for Geometry was ***'Gēōmit'.*** Although the Chinese were also using a decimal based counting system, the Chinese lacked a formal notational system that had the abstraction and elegance of the Indian notational system, and **it was the Indian notational system that reached the Western world through the Arabs (who emerged after 641 CE with the defeat of the Sassanians coinciding with the ousting from most of Europe of her Roman masters).** Digits 1 to 9 are still called ***'hindsa'* in Arabic**. Their alleged 'first' introduction of **'zero'** was also 'borrowed' from the **Hindu 'decimal system'**. The true significance is perhaps best stated by the French mathematician, Laplace: ***"The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions."***
Mathematics played a vital role in **Āryābhatta*'s*** revolutionary understanding of the solar system. His calculations on **'pi'**, the circumference of the earth (62,832 miles) and the length of the solar year (within 13 minutes of modern calculation) were remarkably close approximations. In making such calculations, Āryābhatta had to solve several mathematical problems that had not been addressed before, including those in algebra ***(beej-***

ganit) and trigonometry ***(trigonmiti*** - used in India for deciding the position, motion et-cetera of the spatial planets). It was the Arab mathematician, al-Khwārizmi (780-850 CE) who expurgated the Hindu text of Beej Ganit in his book, which he titled **'al-Gebr'**, which soon became Algebra in Europe. It was even attributed to him as the inventor.

Pythagorean Theorem in Mathematics of India - A brief outline of a study of the Theorem.

It is likely that these texts tapped geometric knowledge that may have been acquired much earlier, possibly in the Harappan period. *Baudhayana's Sutra* displays an understanding of basic geometric shapes and techniques of converting one geometric shape (such as a rectangle) to another of equivalent (or multiple, or fractional) area (such as a square). While some of the formulations are approximations, others are accurate and reveal a certain degree of practical ingenuity as well as some theoretical understanding of basic geometric principles. Modern methods of multiplication and addition have clearly emerged from the techniques described in the Sulva-sutras. The ***Sulva-sutra*** of ***Baudhayana*** **is considered to be the oldest as well as the most systematic and detailed version of the text.** Scholars are not agreed on the precise date of the sutra, but the text clearly pre-dates Panini (c. 520-460 BCE) and is generally thought to have been written in the **5th - 6th century BCE.** His statement "in a ***Deergh-chatursh*** (Rectangle) the ***Chētra*** (Square) of ***Rajju*** (hypotenuse) is equal to sum of squares of ***Parshvāmani*** (base) and ***Triyangamani*** (perpendicular)' indeed sums up the so-called Pythagorus' theorem.

The ***Taittiriya Samhita*** quotes, "He who desires heaven may construct the falcon-shaped altar; for the falcon is the best flyer among the birds; thus he [the sacrificer] having become a falcon himself flies up to the heavenly world." It is described in Chapter 11 of Baudhayana's text. The **construction of the Fire altar** needs a total of 200 bricks of five different shapes in the first layer. The second layer is similar in shape and also needs 200 bricks, but five additional brick types are required. In constructing the altar, the bricks were laid in such a way that no brick rested on another of the same size and shape. Generally, there were five layers, the odd ones being replicas of the first layer and the even ones of the second layer. Using the dimensions of the bricks given in ***angulas*** in the text, and taking 1 ft = 16 ***angulas*** the span of the altar-falcon comes to 40.5 ft or 12.3 metres. The altar about knee-high would have an area 7 1/2 square ***purushas*** (one ***purusha*** being the height of a man with uplifted arms (120 angulas - 71/2 feet or 2.3 metres), which comes to 56.25 sq. ft or 5.29 sq. metres. This knowledge would have helped the Vedic people in the planning of the construction of their intricate temple complexes.

The Pythagoreans (in the same manner as they followed Gautama Buddha's teachings) were obviously familiar too with the Upanishads and applied their basic geometry from the Sulva Sutras. An early statement of what is commonly known as the Pythagoras theorem is to be found in *Baudhayana's Sutra: The chord which is stretched across the diagonal of a square produces an area of double the size.* A similar observation pertaining to oblongs is also noted. His Sutra also contains geometric solutions of a linear equation in a single unknown. Examples of quadratic equations also appear.

Apasthamba's sutra (an expansion of Baudhayana's with several original contributions) provides a value for the square root of 2 that is accurate to the fifth decimal place.
Apasthamba also looked at the problems of squaring a circle, dividing a segment into seven equal parts, and a solution to the general linear equation. Jain texts from the 6th Century BCE such as the ***Surya Pragyapti*** describe ellipses. Modern-day commentators are divided on how some of the results were generated. Some believe that these results came about through hit and trial - as rules of thumb, or as generalizations of observed examples. Others believe that once the scientific method came to be formalized in the ***Nyāya-Sutras*** - proofs for such results must have been provided, but these have either been lost or destroyed, or else were transmitted orally through the *Gurukul* system, and only the final results were tabulated in the texts. Such study of Ganit i.e. mathematics was given considerable importance in the Vēdic period. The dissection, however, is a Hindu achievement; the original so-called Pythagoras drawing (of the right-angle triangle with the three squares) bears the inscription 'Look' (behold), which must convince the reader better than any verbal argument.

The ***Vēdang Jyotish (1000 BCE)*** includes an extra-ordinary statement pointing to the Hindu origin of Mathematics: ***"Just as the feathers of a peacock and the jewel-stone of a snake are placed at the highest point of the body (at the forehead), similarly, the position of Ganit is the highest amongst all branches of the Vēdas and the Shāstras."***

The (so-called) Theorem of Pythagoras. Its actual origin in much earlier times and its latter day proofs

The Theorem of Pythagoras which most of us remember in the form in which it was taught to us at school, states that the sum of the squares on the two shorter sides of a right-angled triangle is equal to the square on the hypotenuse.

Although algebraically expressed in the familiar form $a^2 + b^2 = c^2$, this equation really applies in a geometrical sense to areas of all other well-defined shapes besides squares. We could have, for instance, replaced the words *'squares'* by '*semi-circles*, or *parabolas*, or *similar triangles*, and still have been correct.

Take a square shaped piece of paper, and after folding it along the lines shown dotted, as in Diagram 'A', reopen and examine the shapes and sizes of the subdivisions you have created. You will find that there are eight equal right-angled triangles.

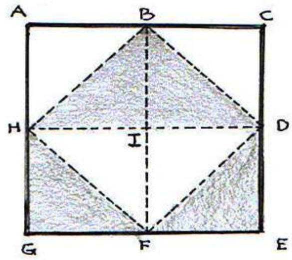

Diagram A

Now, if you name the junctions where the lines intersect by calling them A, B, C, D, E, F, G, H and I, you will readily see that HDF is a right angled triangle with the right angle situated at F, and that the sum of the triangles HGF and DEF mounted on the shorter sides HF and DF are equal in area to the similar larger triangle HBD mounted on the hypotenuse HD.

You have just discovered the theorem of Pythagoras in one of its simplest 'avatars'. You should therefore not be surprised if anyone were to tell you that the ancient civilizations also knew about such relationships.

There is ample evidence to show that the Babylonians, the Indians, and the Egyptians all knew about such relationships long before the theorem relating to it was included by Euclid in his book called 'ELEMENTS'. This came to be better known after some clay tablets from the time of Hammurabi were unearthed in Mesopotamia during archaeological excavations in the last century, and the writings on them were deciphered and interpreted.

There is one called the Tel Dhibayi Tablet, inscribed on which in cuneiform writing there is the algebraic solution given to the problem of finding out the lengths of the sides of a rectangle when its area and the length of its diagonal are known. This indicates that the Babylonians of the time were also well versed in algebra, and of course that they knew about the relationships between the lengths of the sides of right-angled triangles.

One of the other such tablets is the Plimpton Tablet (see clay tablet above), which actually lists 15 right-angled triangles in which the slopes of the diagonal to the base range from about 45° to about 60°. This tablet was difficult to decipher, because it was damaged and had certain parts missing. But most of its contents are now fairly well determined and several triangles which are definitely right angled from the dimensions mentioned in the tablet can be easily recognized.

For instance, Serial No. 1 corresponds to the triangle (119,120, 169) in which the slope is very close to 45°. Serial No. 5 corresponds to (65, 72, 97), whereas Serial No.6 relates to (319, 360, 481). No. 11 is the triangle (3, 4, 5) with which every one has a nodding acquaintance, and No. 15 corresponds to (28, 45, 53).

The Egyptians were building pyramids using triangles of similar shapes. The Khafre Pyramid at Giza has an angle of elevation of 53° 7.8' compared to triangle (3 ,4, 5), which has an elevation of 53° 5'. That is not the only pyramid in which such matching angles can be traced. The Draco (Red) pyramid at Dahshur and the upper portion of the Bent Pyramid, also at the same place, both have angles of elevation corresponding to (20, 21, 29) that is close to 45°.

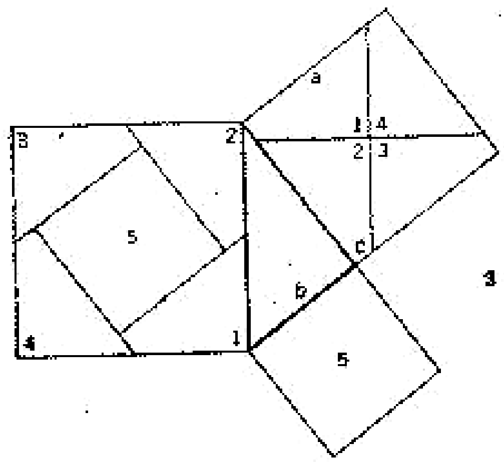

Diagram B

To ancient India we owe the diagram 'B' shown above. It is one of the dissection proofs of the theorem we have been talking about. The original drawing bears the inscription: "Behold" which carries greater conviction than any verbal argument.

There are many other such dissection proofs not requiring verbal arguments to support them. Making a note of this we may now consider the **proof** of the theorem attributed by Euclid (c. 300 BCE) to Pythagoras, which appears in the book called Elements. In a sense it is also Euclid's proof, because it appears twice in his book in two different forms, which have many common features.

This proof is definitely **not of the dissection type**, and involves the comparison of congruent (and in the second version, of similar) triangles. The first version bears the label Proposition 47, Book I. while its converse is labelled Proposition 48. The entire Book I consists of propositions included to pave the way for these last two theorems.

What is also important to note is that the Pythagoreans had at one stage come upon an impasse in their thinking when they discovered, as they did themselves, that in an isosceles right-angled triangle, where both legs were of the same length, no integer could be found for the length of the side facing the right angle within the triangle. This went totally against their philosophy that all such relations, **and everything in nature could be expressed in whole numbers.**

This hurdle was crossed using the theory of proportionality, which Eudoxes (408-355 BCE) had developed, and which is described by Euclid in Book V. This theory did not depend on measurements. It is only thereafter in Book VI that we find the second proof of the same theorem. My purpose in mentioning all these details is to remove the confusion, which often arises when the theorem of Pythagoras is discussed.

It could be said in conclusion that Euclid confirmed, by a different line of thinking, what others had also discovered earlier.

The Silver Croton Crown

These unique coins were Pythagoras's physical symbolisms of the ideas of the inter dependence on the interaction of contraries or pairs of opposites – good/evil, right/wrong, inward/outward…etc he had been taught in Babylonia. Born in the island of Samos, Greece, during her Dark Ages he had not learnt to write. There are no documents known directly attributed to his writing. It was the Pythagoreans after his death who wrote whatever he would have taught and even elaborated on it.

The Croton Crown from my collection

Obverse

Reverse

The symbolism of opposites is in the **incuse/excuse** molding of the coin metal. Note that the front (**Obverse side)** of my coin shows the raised portions (**'excuse'- outward molding** of the coin metal, akin to a rock bas relief) of a tripod holding a Fire container at its top. Note that the feet of the three legs of the tripod bear the' lion's paw' character found in the bas relief of the Achaemenian thrones at Persipolis. Similar 'lion's paw' bases are seen on the reverse side of some Sassanian Coins depicting the heavy Achaemenian type Fire altars. The back (**Reverse side)** of the coin shows **the opposite 'incuse' or 'cut in' depressed portions** in the metal of the coin, exactly opposite to and copying the raised portions on the Obverse side of the coin. The Obverse and Reverse of the coins, thus, form a perfect match (as one would notice on an embossing of paper or tin, in modern times). Modern numismatists call the coin a 'Croton Crown', since it was minted in ancient Croton (now the port town of Crotone in Southern Italy), where he had established a school. In those days the territory of Croton extended across the narrow peninsula from sea to sea, and we note that some of its early incuse coins are struck in the joint names of Croton and some neighboring town, e. g. (Sybaris), (Temesa) and Pandosia.

The equivalent Roman replica coins (see below) called 'Staters' were struck during the reign of four Roman Emperors, who were vigorously antagonistic to Sassanian power. This same theme appeared on coins struck for **Septimus Severus** (193-211 CE), **Julia Mamaea** (231-235 CE), **Trajan Decius** and his wife, **Herennia Etruscilla** (249-251 CE). The Severans (nine Roman Emperors ruling from 193 to 235 CE - from Septimius Severus 193-211 CE to Severus Alexander 222-235 CE) relied even more heavily on astrologers than the average person. On Trajan's Stater the Reverse side has Pythagoras touching a globe with a wand. He had been unable to win any battle against the Persians and the assumption is that this caused him to honor Pythagoras as no one had done before. Since the globe appears without a Roman deity such as Sol or Jupiter or the ruling emperor, one can assume that the globe Pythagoras is shown as divining represents our planet.

<u>A brief historical overview of the time gives a fair idea</u>

It is important to note that the Romans won battles during their conquest of most of Europe but failed to win any battle against the Persians. They were ousted twice from Asia by the conquest of their Eastern Capital of Antioch by Khusru I, the Great (Anoush e Ravan e Adil), who then forced them into costly treaties with a heavy tribute payable annually in gold. In shear frustration, they had to move their Capital further north to Constantinople. It is no wonder they struck coins to commemorate the Pythagorean claims of the assumed originality of the ideas.

Severus Allexander had occupied the Parthian territory of Mesopotamia from the warring Parthian brothers, Vologases VI (Valkash), who ruled from the Capital, Ekbatana and his younger brother, Artabanus IV (Ardavan), who made his Capital in exile in Ctesiphon. Ardeshir I (Parthian Governor in Pars) took advantage of this split between the brothers. In 224 CE he advanced towards Ctesiphon, killed **Artabanus IV** in the Battle of Ctesiphon and occupied Ctesiphon. During the same year 224 CE, he defeated and captured **Vologases VI** in the Battle of Hormus, thus becoming the Overlord, the King of Kings of all Parthia. Vologases died in prison in 226 CE, a date incorrectly attributed by some historians to the beginning of the Sassanian dynasty.

Ardeshir I then turned his attention to the Roman occupation. He sent envoys to the Roman Emperor, **Severus Alexander** (222-235 CE) with a message to tell Severus to "vacate the lands of my Hakhamani ancestors", which he regarded as rightly his own, "by right of inheritance." Severus replied by treating the envoys as captives. Ardeshir, at once crossed the Euphrates River with heavily reinforced divisions. Severus totally misjudged Ardeshir's determination. He deployed his army into three detached divisions. First, Ardeshir annihilated the south division aimed at Susa, Capital of Elam. He, then, routed the middle division commanded by Severus himself. Severus's third division tried to enter via Armenia but Ardeshir crushed their advances. Alarmed by these defeats and by further advance of Ardeshir Severus he pleaded for truce in CE 232 at a costly price – the annexation of entire Mesopotamia to the Sassanian Empire and an additional heavy annual payment of a tribute from the Roman Capital, Antioch**. Julia Mamaea** was Severus's mother and co-ruler (231-235 CE) in Rome. She was a very dominant mother to the point of choosing a wife of her fancy for her son. She interfered constantly with the administration and the Senate during her 4 years as co-ruler. Both mother and son were assassinated in 235 CE. When **Trajan Decius** (249-251 CE) tried to instigate a revolt in Armenia, a Sassanian Province to secede from Sassanian Airan the revolt was put down with a heavy hand by Shahpur I (240-271 CE). He quelled the revolt, defeated the Roman army, drove them out of Armenia and appointed his Army Commander as Ruler with reinforcements to quell any further unrest.

Roman Silver Staters

Obverse Reverse

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