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UDC 871:875:114:72

THE VITRUVIAN MAN IN THE CIRLE, THE FIVE PLATONIC ELEMENTS, AND THE PREFERRED NUMBERS IN ANCIENT ARCHITECTURE

The virtuvian man in a circle and a square is an architectural scheme used for calculation of preferred numbers. According to Vitruvius, his proportions „were observed (by ancients) in execution of their works ... especially in building temples"[1].

The investigation of the vitruvian man-in-the-circle by Eivind Lorenzen resulted in a number of flexible scales all starting from the cirle's diameter, defined as „the geometrical *orgyia*", equal to 100 „rational fingers" (scale A), or to

$100\ \sqrt{5} : 2 \sim 111{,}805 \sim 112$ „irrational inches" or „single inches" (scale A_1) or to 128 „double inches"[2].

The interpretation of the vitruvian man by Lorenzen, which opened a new insight in the ancient method of designing, was further broadened by Thomas Thieme with the introduction of what he calls „the Δ — Canon", based on $\sqrt{3} : 2$ series and geometrically generated by an inserted equilateral triangle[3].

The listed forms around the vitruvian man, i.e. the square, the circle, and the equilateral triangle, evoke the forms of the platonic elements. According to Plato, the square, circle, and equilateral triangle, are symbols of the earth, water, and fire[4]. The remaining losenge,

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[1] Vitruvius, *De Architectura*, I, I, 3 sq.

[2] E. Lorezen, *Technological Studies in Ancient Metrology*, Nyt Nordysk Forlag, Arnold Busck, Copenhagen 1966;
— E. Lorenzen, „*along the lines where columns are set*", Nyt, Nordisk Forlag Arnold Busck, Copenhagen 1970;
see also the interpretation of Lorenzen's findings in
— Th. Thieme, *Montecassino: An Example of Planning in the Vitruvian Circle*, Opus cula Romana XI: 10, Acta Instituti Romani Regni Sveciae, Stockholm 1976, p 128 sq., and
— Th. Thieme, J. Beck, *La cattedrale normanna di Cefalu*, Analecta Romana Instituti Danici VIII, Odense Un versity Press, 1977, p. 62 sq.

[3] The „Δ — Canon" based on 111 „single inches" orgyia and generating the $\sqrt{3} : 2$ series of sizes was introduced by Th. Thieme in Istanbul, 20. II. 1975 (personal information by Th. Thieme to T. Kurent).

[4] On form of elements: *Timaeus* 55 d sq.

meaning ether, and crescent, symbolizing air, also originate within the same scheme[5].

The addition of another triangle, opposite to the triangle inserted by Thieme, will result in the intersection of triangles in the form of a lozenge. With the addition of an arc with the centre in the middle of square's base-line and with the radius equal to the triangle's height, a crescent can be cut off the cirlce.

The initial sizes of the vitruvian man and his geometrical scheme are

72 (the height of the 6′ man equals 72″);
96 (8′ *orgyia*, equal to 96″);
100 (Lorenzen's 100 fingers long *orgyia*);
112 (Lorenzen's 112 single inches long *orgyia*);
111 (Thieme's 111 single inches long *orgyia*);
128 (Lorenzen's 128 double inches long *orgyia*).

The series, starting from the above numbers with the Lorenzen's coefficient $\sqrt{5} : 2$ and with Thieme's $\sqrt{3} : 2$, result in approximation of numbers, known as symbolic, or mystical, numbers, in historical architectural composition of sizes. In this article, however, I will rather call them preferred numbers.

It is important to understand that numbers in $\sqrt{3} : 2$ and $\sqrt{5} : 2$ series are irrational, but in architectural composition they are to be rounded in the whole numbers. The Lorenzen's 112 and Thieme's 111 „single inches" long *orgyiai*, e.g., are rational approximations of the irrational quantities:

$$100 \times \sqrt{5} : 2 \sim 111{,}805 \sim 112 \text{ and}$$
$$128 \times \sqrt{3} : 3 \sim 110{,}851 \sim 111.$$

The ancient computation with pebbles[6] didn't know irrational numbers. Any number of pebbles is a whole, but one stone is a monade, meaning not only a unit, but also any other whole number[7]. One pebble can signify, e.g., a troop of so many soldiers. Besides, it is important to know that integers in ancient mathematics form families of synonymous numbers. A Pell term[8] in its figured form is equal not only to itself, but also to its related numbers which are 2, 4, 8

[5] On five elements: *Epinomis* 984 b sq.

[6] cf. Lat. *calculus* and Gr. ἡ ψῆφος mean both, the pebble and the calculation.

[7] Archytas and Philolaus call without distinction „the one" also the monad and monad „the one". From:
— H. Diels, *Die Fragmente der Vorsokratiker*, ed. by W. Kranz, 5th edition. DK 44 B 3;

[8] John Pell (1610—1658). More about Pell series in — P. H. Scholfield, *The Theory of Proportion in Architecture*, Cambridge University Press 1958.

. . . and/or 10, 100, 1000 . . . times larger or smaller. This peculiar conception of numbers is due to the figured numbers, where one pebble can mean any number taken as a unit[9].

Having in mind the above precept, we can understand that the arithmetical equivalent of both, of the losenge and of the crescent, is the approximation of numbers 40, 41, and 42. When the intial *orgyia* measures 111, the height of the losenge is about 81:

$81 : 2 = 40{,}5$ which is rounded in 40. The crescent cuts the circle at the distance of nearly 83:

$83 : 2 = 41{,}5$ which is rounded in 41. In an analogous way, in the Lorenzen's 112 $\sqrt{3}$ series, the term 84 is twice 42:

$84 : 2 = 42$.

Number 111 is related to 666, which is equivalent to the number 41:

$666 : 2 = 333$
$333 : 2 = 166{,}5 \rightarrow 166$
$166 : 2 = 83{,}5 \rightarrow 83$
$83 : 2 = 415 \rightarrow 41$.

Besides the number 111, or 666, or 41, the prominent preferred numbers are

108 and its various multiples,
127 and
532[10].

In this article I will not deal with smaller preferred numbers, because their origin in the man-in-the-circle scheme is less convincing than the origin of larger preferred numbers.

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[9] T. Kurent, *Cosmogram of the Romanesque basilica at Stična*, Univerza v Ljubljani, Fakulteta za arhitekturo, Ljubljana 1978, p. 90.

[10] K. J. Conant, Speculum, Cluny Studies 1968—1975, *A Journal of Mediaeval Studies*, vol. L, no. 3, July 1975, The Mediaeval Academy of America, Cambridge, Massachusetts: „In our careful review (of the Cluny churches) we found no dimensions of any significance which were not related to the basic quantities in three systems of symbolic numbers". Under the „three systems of symbolic numbers" are meant:

1. one hundred, some of its multiples and fractions;
2. the year-count of solar-lunar cycle, 532;
3. the number 7.

— K. J. Conant, *Cluny*, Cambridge, Massachusetts, The Mediaeval Academy of America, Mâcon 1968, Chapter Diménsions Systématiques and Symboliques adds the perfect numbers (6, 28, 496) and 153 („Le nombre de poissons de pêche miraculeuse").

— E. Read Sunderland, Symbolic Numbers and Romanesque Church plans, *Journal of the Society of Architectural Historians*, XVIII 1959, pp 94—103, deals with numbers 3, 4, 5, 7, 8, 10, 12, 40, 72, 100 . . .

The above literature is interested primarily in churches and is therefore based mainly on the Bible and Christian sources.

Number 666 is known as the „number of the Beast"[11]. Its symbolic meaning can be deduced from its context in the Bible, from its value in the Pell number-pattern and in the man-in-the-cirle numbers, and from its character in the Russian orthodox belief. It is present in the Pell number-patern as the term 41:

1 1 3 7 17 41 ...

In the man-in-the-circle series, its value is 111 and 41:

In the Bible, the waters of the flood were rising 40 days, which means that the end of rising came the 41 st day[12]. Jonah allowed to Niniveh 40 days; the 41st day will be the end of Niniveh[13]. Jesus was tempted by Satan 40 days; the end of temptation was the 41 st day[14].

In the Russian folklore and literature, numbers 40 and 41 are still alive: there are forty times forty churches in Moskow, meaning there is an infinite number of holy places in the third Rome. A magpie does not approach 40 versts to Moskow, which means that the perimeter around the capital is 41 versts[15]. In the novel *Sorok pervy* („The Forty-first") the heroine and the hero are on opposite sides. She kills 40 enemies; the 41st is her lover[16]. After some eastern beliefs, the soul's fate is decided forty days after death and hence the forty days long mourning. The forty-first day, a commemoration feast takes place.

It is evident from the context in the Revelation that the Beast, though given the power to speak 42 moths, which lasts excessively long, is after all, mortal: for the number of the man equals the number of the beast; and their number is 666. It would not be convincing to limit the beast's 42 month long power with the mere number 41. Therefore the beast's end is promised with the related and equivalent number 666[17].

According to Alberti, number 40 signifies the normal duration[18].

Number 432 appears also in the form of its related numbers, most often as 216, 108, 54, and 27, but also in its larger synonyms.

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[11] „On n'a pas trouvé 666 (signe de la Bête)".
— K. J. Conant, Les diménsions systématiques et symboliques à l'église abbatiale de Cluny, Annales de l'Académie de Mâcon, 3e série, tome XLV, 1960—1961, p 3.

[12] And the flood was forty days upon the earth (Genesis 7, 17).

[13] And Jonah began to enter into the city a day's journey, and he cried, and said, Yet forty days, and Niniveh shall be overthrown (Jonah, 3, 4).

[14] And he was there in the wilderness forty days, tempted of Satan (St. Marc, 1, 13).

[15] Both sayings told by my nonagenarian neighbor Grigorij Harmazanov, born in then rural *Tulska oblast*.

[16] The novel *Sorok pervy* by Boris Lavreniev.

[17] And there was given unto him a mouth speaking great thingh and blasphemies; and power was given unto him to continue forty and two month (Revelation 13, 5).

[18] L. B. Alberti, *De Architectura*, Book IX, V.

According to Berosus[19] the reigning of Mesopotamian kings before the deluge lasted 432.000 years.

The period of 12.960.000 days, equal to 36.000 years of 360 days each, forms one Babylonian „cosmic year[20]:

$12.960.000 = 60^4 = 30.000 \times 432.$

An analogous period is equal to the platonic nuptial year[21], responsible for the „good or inferior birth". There are 216 days in the seven months birth:

$6^3 = 3^3 + 4^3 + 5^3 = 216.$ But, there are 12.960.000 days in a divine birth:

$(3 \times 4 \times 5)^4 = 12.960.000.$ This number has a square form:

$3600 \times 3600 = 12.960.000.$ Its oblong form is
$4800 \times 2700 = 12.960.000.$

According to Aryabhata[22] the period of 4.320.000 sidereal years, is called in Hindi a *maha-yuga*.

Number 432 has different explanations in the Greek and Jewish gematria. According to the third century A. D. historian Diogenes Laertius[23], Pythagoras had four previous incarnations, spaced 216 years apart, which, combined together, makes the period of 846 years. Besides, the numerical sum of letters forming the Greek version of the name of Pythagoras, equals 864. Another gematric gem: the sum of the letters in the Greek name of Jerusalem is 864.

The numerical value on the pillars called Jachin and Boaz[24] is 2.268, which is composed of numbers 3, 7, and 108:

$2.268 = 3 \times 7 \times 108.$

After Heracleitos[25] a great year consists of 10.800 solar years, which is equal to 360 generations of 30 years each. It is connected with the number 432:

$10.800 = 5^2 \times 432.$

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[19] Berosus was a Babylonian priest (3rd century B. C). Parts of his history of Babylonia are preserved in the writing of Josephus Flavius;
— A. von Gutschmid, *Zu den Fragmenten des Berosos und Kteisias*, Reinisches Museum VIII, 1853;
— Th. Jacobsen, *The Sumerian King Lists*, Chicago University Press 1939.

[20] This Babylonian eon is evidently sexagesimal:
$60^4 = 12.960.000.$

[21] Republic, 546 b sq.

[22] Aryabhata, *Aryabhatiya*, Sanskrit edition, Leiden, Holland 1974.
— See § 1724, Système général du Suryasiddhanta, Chapitre IX. Les sciences, 6. Astromomie in the book:
— L. Renou e J. Filliozat, L' Inde classique, École Française d'extrême-orient; Hanoi, Paris 1953.

[23] R. D. Hichs, *Diogenes Laertius*, The Loeb Classical Library.

[24] I Kings, 7, 15 sq.

[25] DK 22 a 13.

It is interesting, that the number 432 appears also in the Icelandic Edda[26]. The saga offers the number 432.000 as the product of 540 (doors) and 800 (warriors passing through each of the doors):

$$540 \times 800 = 432.000.$$

In the Pell number-pattern, number 432 is recognizable as the term 27:

3 1 5 11 27 ... We know already the synonymous numbers: $432 : 2 = 216$

$$216 : 2 = 54$$

$54 : 2 = 27$. The largest circular canal in Atlantis after Critias has the diameter of 27 stades. Besides, the largest lambda number is 27 and the sum of all lambda numbers is 54:

$$1 + 2 + 3 + 4 + 9 + 8 + 27 = 54 = 2 \times 27.$$

It is probable, that the Babylonian and Indian eons originated in the period required for the complete rotation of zodiac, lasting one great platonic year, or 25.920 years:

$$25.920 : 60 = 432.$$

The hexagesimal system is reflected also in the division of our day in 86.400 seconds, which, again, is connected with the number 432:

$$24 \times 60 \times 60 = 86.500 = 200 \times 432.$$

The number of seconds in a day is numerically comparable with a ,,Brahma day and night" lasting 8.640.000.000 human years, which is the longest unit of Indian time measuring. Since the rhythm of healthy heartbeat corresponds with the rhythm of seconds, it seems that the pulsation of microcosmos and the cycling of macrocosmos are in tune.

The Rig-Veda consists of 432.000 syllables[27].

Number 108 appears in the Chinese composition as the side of the roof of *Ming t'ang*, the base of which measures 72 + 72 and the height 82[28].

Number 432 seems important also to Vitruvius: ,,Pythagoras ... decided to write his precepts after the principle of a cube ... in 216

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[26] The *Poetic Edda*, a compilation of medieval heroic and mythological poems. See the part Grimnismal in
— F. Wagner, *Les poèmes mythologiques de l'Edda*, Faculté de Philosophie et Lettres, Liège, Ligrarie E. Droz, Pariz 1936.

[27] G. di Santillana, *The Origins of Scientific Thought*, The University of Chicago Press, 1961.

[28] See the chapter *Nombres et proportions architecturales* in the book par
— Marcel Granet, *La pensée chinoise*, Éditions Albin Michel, 1968.

lines... A cube retains ist stability ... They seem to have taken their analogy from the cube because this number of verses will be stable like a cube and fixed in memory..."[29]:

$$6 \times 6 \times 6 = 216.$$

Number 432 appears in the man-in-the-circle metrology

as 107,33 in the $96\sqrt{3}:2$ series,
as 216,8 in the $111\sqrt{5}:2$ series,
as 27,4 in the $100\sqrt{3}:2$ series,
as 54 in the $72\sqrt{3}:2$ series and
in the $96\sqrt{3}:2$ series,
as 54,07 in the $111\sqrt{3}:2$ series,
as 53.99 in the $128\sqrt{3}:2$ series, etc.

The outer diameter of Atlantis after Aritias equals 127 stades[30]. In the Pell number pattern, number 127 is the arithmetic mean of the four terms, or better their multiples, which are pointed out by the twenty-seven stones of the last number in the platonic lambda. Multiples of the four terms, implied in 127, are in the ratio of orbital distances of outer planets[31].

In the man-in-the-circle scheme, number 127 appears as $96\sqrt{7}:2 \sim 126{,}99 \sim 127$.

Number 127 is a Mersenne number[32].

In 532 years, the lunar and solar year-count coincide in the same day. Nineteen solar cycles of 28 years are equal to twenty-eight lunar cycles of 19 years:

$$19 \times 28 = 532.$$

This fact seems to be connected with the cosmological theory by Anaximandros[33] that the diameters of the Sun and of the Moon equal 28 and 19 diameters of the Earth, respectively.

To illustrate the preferred numbers built in the architecture of the old world, the dimensional analysis of Emona, an Augustean colony under the present-day Ljubljana, Slovenia, of the Diocletian palace in Split, Dalmatia, of the Romanesque basilica at Stična, Slo-

[29] *De Architectura*, Book V, Preface, 3 sq.
[30] *Critias*, 115 d sq.
[31] T. Kurent, *The Cosmogram of the Romanesque Basilica at Stična*, Fakulteta za arhitekturo Ljubljana 1977/78, p. 52—55.
[32] The prime number, other than 2, which is a divisor of an Euclidean perfect number, is called Mersenne number. Marin Mersenne (1588—1648).
[33] DK 12 A 21,
DK 12 A 22.

venia, of the Byzantine church at Studenica, Serbia, and of the Husrevbey mosque in Sarajevo, Bosnia, will suffice. It would take too much space to present also examples from the old Egyptian, Mesopotamian, Indian, Khmer, Chinese, or Japanese architecture, but the morphological analysis of a Tibetan stupa must be added to the Yugoslav exam ples. A stupa and a mosque belong to the two types of buildings, the form of which is borrowed directly from the platonic or rather from the Chinese elements[34].

The platonic or the Chinese elements are still in use as architectonic forms. A Tibetan stupa is a transformation of a vertical sequence of a cube, sphere, pyramid, crescent, and of a form obviously derived from the losenge of the man-in-the circle scheme. Analogous elements, except the lozenge pinnacle, are forming also typical mosques. The losenge, which is the fifth element, is mathematically superfluous, since it gives no new preferred value. Number 41 is already determined by the crescent. This is probably the reason why Plato usually deals with only four elements[35]. In the catholic iconography the lozenge is transformed in the form called *mandorla* or *vesica piscis*, which is used as a frame around the image of Christ. The quarter of the moon and the shpere are placed under the Vergin's feet. The triangle is the symbol for the Lord[36]. The God is depicted in the triangle as an old bearded man or as an eye, symbolizing, the divine omnisciene.

The square, however, was not adopted by the Christians. It is still one of the masonic symbols[37].

The man-in-the-circle scheme, a simple tool for the calculation of the preferred numbers, defining the order of the cosmic space and the eons of time, was used by the early architects to shape the man-made world. Its forms became symbols described by oriental sages and Plato as elements the world is made of. In this respect, the creation and architecture are close together.

Received Jannuary 10, 1980.

[34] More about the five Chinese elements in:
— M. Granet, *La pensée chinoise*, Éditions Albin Michel, 1968.

[35] With the exception of *Epinomis*, 984 b sq, where all five elements are described.

Only four elements — earth, water, fire, and air — are listed also in the Indian *Charvaka*. See
— V. Ferm, *A History of Philosophical Systems*, Littlefield, Adams and Co, Totowa, New Jersey 1968.

[36] Compare also Exodus 3, 2 sq;
Exodus 23, 17;
Ezekiel 1, 26 sq;
Psalm 29, 7 sq
Psalm 104, 3 sq;
Micah 1, 3 sq.

[37] The day after he had been received into the Lodge, Pierre was sitting at home reading a book and trying to fathom the significance of the Square, one side of which symbolized God, another moral things, a third physical things, and the fourth a combination of these (Leo Tolstoy, *War and Peace*, book V, chapter V).

[38] E. Schilbach, *Byzantinische Metrologie*, C. H. Beck, München 1970, p 24.

Illustration 1

There is a difference between our abstract numbers and the ancient figured numbers, made of pebbles and arranged in different shapes.

Calculi forming triangles, squares, cubes, etc., are easy to visualize and offer a good exercise in the logic of composition. The forms of numbers are stimulating the eidetically gifted. Besides, they have a mnemonic function.

There is no limit of optical analogies for a vivid imagination. Odd numbers of pebbles, e.g., arranged in a triangle similar to the shape of pubic region are said to be male numbers; the split triangle of even numbers is evidently composed of female numbers. Consequently, the first female and the first male mumber, 2 and 3, form the number of love, i.e. 5, which is called γάμος, or the number of Aphrodite.

The figured numbers are a visual form of whole numbers which suits the logic of modular architectural composition. Number of building components in a composition is a whole number. A column, a beam, a building block per se, is a whole; their aliquot parts can not be used in a composition; their modular sizes are equal to whole multiples of a module; there is no such a thing as a half-module; every module, from the smallest to the largest, is a monade, a unit in its own right.

Broken blocks and other amorphous building parts are not modular components, but they can be used as filling material for construction, of a wall, e.g.

One pebble is a whole, a unit, which can represent not only what we call number one, but also a legion of the cohorts, a dozen of eggs, a day of twenty-four hours, a decade, or any other composed unit. It is a great simplification in substituting one pebble (meaning 1 legion, e.g.) for so many constituent parts (cohorts or even legionaires, e.g.).

One half of a composed unit is a whole number of constituents; a detachment of an uneven number of soldiers is to be split in two unequal halfs if the poor odd soldier is to be spared.

The multiform meaning of a figured number is probably responsible for the understanding, that a Pell term signifies not only itself but also its synonymous numbers, which are 2, 4, 8, . . . and/or 10, 100, 1000 . . . times larger or smaller.

Illustration 2

Sizes, or better numbers, derived from the man-in-the-circle scheme after E. Lorenzen and Th. Thieme.

The cirlce's diameter and the fathom with their subdivisions, the so-called first and second canon, φ canon, and the Δ canon generate numbers

1 2 3 4 6 19 20 25 28 72 96 100 111 112 128

Note: This illustration is an elaboration of the Tav. 1, *Altezze canoniche del cerchio vitruviano* in the book by
— Th. Thieme, J. Beck, *La Cattedrale Normanna di Cefalu,* Odense University Press, 1977.

Illustration 3

The vitruvian man-in-the-circle-and-the-square is, according to E. Lorenzen, a scheme of preferred sizes; the circle's diameter or the square's side, equals one *orgyia* which can be divided either with 100 fingers, or 128 double inches, or 112 single inches. The listed sizes are interrelated:

$100\ \sqrt{5} : 2 = 111{,}805 \sim 112$ but

$120\ \sqrt{3} : 3 = 110{,}85 \sim 111.$

The 111 single inches *orgyia* was introduced by Th. Thieme with his Δ canon. Geometrically, the same can be achieved with an equilateral triangle inserted in the scheme.

I have expanded the scheme by Lorenzen and Thieme further: Another equilateral triangle, inserted in the opposite side of the square, and the Thieme's triangle intersect in the form of a losenge. An arck with the centre at the middle of the square's base and the radius stretching to the opposite tip of lozenge cuts the circle and forms with it a crescent.

The forms of the man-in-the-circle scheme, i.e. the square, circle, triangle, crescent, and lozenge, are symbols of the platonic elements.

It seems that elements the Cosmos after Plato is made of are an architectural tool forming the man-made world.

Illustration 4

The Chinese and platonic elements are similar. The square, circle, and triangle, symbolize earth, water and fire, in both schools. But the crescent and lozenge, symbolizing the air and ether to Plato, in the Chinese thought mean metal and wood.

Empedocles of Sicily (495—435) held that the world was composed of four elements: earth, air, fire and water.

According to The Indian postvedic *Chārvāka* things have transcendental essence: they are what they appear to be. Only the perceived elements — earth, water, fire, and air — are real.

The numerical value of the Chinese elements forms a scheme similar to magic squares, called *hong fan*.

The connection between Chinese elements and Buddhist architetcture is evident. A stupa, and to a lesser degree, a pagoda, evoke the shapes of the five elements.

Illustration 5

Number 41 is a synonym of the numbers 666 or 111. It appears in the Thieme's $\sqrt{3}$; 2 series.

Starting with the 112 *orgyia* we get the term 84, which is twice 42, and the term 40,92, which is rounded in 41. Starting with the 111 *orgyia* we get the term 83,25, the half of which made whole is 41, and the term 40,70, which is approximated with the integer 41.

The height of the lozenge in the man-in-the-circle scheme is about 81 and its half is close to 40, when the *orgyia* equals 111 units. The crossing of the crescent's arch with the circle marks about 83, the rounded half of which is 41, when the *orghyia* equals 111 unit.

Numbers 40, 42, and 41 in the form of 666, are biblical numbers (Revelation 13).

Illustration 6

The vitruvian man-in-the-circle, popularly known in the drawing by Leonardo, is, according to E. Lorenzen, a scheme of sizes, ranging from the 6 foot fathom of 72 inches to the 128 „double inches" *orgyia*.

The Lorenzen's divisors of the fathom and *orgyia* are 72, 96, 100, 112, and 128. They are starting terms of geometrical series with coefficients from the *helix irrationalium*. The resulting terms are irrational, but should be rounded in integers. Among them, I have found that the most important preferred numbers from the man-in-the-circle scheme in ancient architecture are, besides 3 and 7, *numeri*, or better *numerus*, 111, 108, and 127. It is not easy to grasp that the above numbers are only various manifestations of the same *numerus*, if we do not understand that in figured numbers one pebble can symbolize any other group of pebbles. A Pell term is equal only to related numbers which are 2, 4, 8 ... and/or 10, 100, 1000 ... times langer or smaller, but a figured number equals also numbers multiplied with any coefficient. If we take this, Lorenzen's divisors and preferred numbers are only

manifestations of the same numerus. Subsequent division of 72, 96, 100, 128, 3, 7, 111, 108, and 127, with the coefficient 2, with the rounding of terms in smaller integers, prouves, that the end result of such a procedure is the monad:

72,	36,	18,	9,	4,	2,	1
96,	49,	24,	12.	6,	3,	1
100,	50,	25,	12,	6,	3,	1
128,	64,	32,	16,	8,	4,	1
3,	1					
7,	3,	1				
111,	55,	27,	13,	6,	3,	1
108,	54,	27,	13,	6,	3,	1
127,	63,	31,	15,	7,	3,	1

This baffling mathematical way of thinking leads to mysticism. The Christian monotheism equates the God with the Trinity. In dualism, the two are one. In polytheism, the initial principle dissolves into the whole pantheon. But the strict Moslem monotheism, expressed in the doctrine *Allah wahed ahed* — Allah is one and the only, maybe helped the development of the practical mathematics in Arab world.

Illustration 7

Accroding to Tolstoy's Freemasons, numbers 3 and 7 are most important:

My beneficator then explained to me fully the meaning of the great Square of creation and pointed out to me that the numbers three and seven are the basis of everything (War and Peace, book VI, chapter VIII).

Number three is a triangular number, equal to all $n\,(n+1) : 2$ integers. Its *gnomons* (increments) are n. Number seven is a heptagonal number, equal to $n\,(5n - 3) : 2$ integers. Its gnomons are $(5n - 4)$. Ratios of the above numbers closely approximate irational, values, most common in architectural forms:

$$\sqrt{2}, \quad \sqrt{3}, \quad \sqrt{5}, \quad \sqrt{6} \ \ldots \ \pi, \ \varphi, \ \theta.$$

Illustration 8

The *orgyia* of the man-in-the-circle is subdivided in 72, 96, 100, 111, 112, and 128, parts. Among the terms of series, starting with the above numbers, having the coefficient $\sqrt{3} : 2$ and $\sqrt{5} : 2$, the same numbers reappear. Or, more precisely, some of the irrational terms can be rounded in the preferred integres, 72, 96, 100, 111, 112, 128, and additional terms 40, 41, and 42.

If we remember that synonymous numbers are 2, 4, 8 ... and/or 10, 100, 1000 ... times larger or smaller, it is evident, that the number 666 results in 41:

$$\begin{aligned} 666 : 2 &= 333 \\ 333 : 2 &= 166{,}5 \rightarrow 166 \\ 166 : 2 &= 83 \\ 83 : 2 &= 41{,}5 \rightarrow 41. \end{aligned}$$

The analogous subdivion with the coefficient 3 makes the number 666 equal to 111.

It is interesting that the vibration numbers of the natural harmonical tones are the same numbers: 72, 96, 128, 432, 41 ~ 42.

Besides, the modular multiples of Atlantis rings according to Critias are synonymous to preferred numbers:
100, 40, 112, 532, 729, 72, 96, 42, 432, an 127. Atlantis is a precise model of our heliocentric universe and the preferred numbers in the orbital diameteres are the origin of the pythagorean musical spheres. But, this story is too long to be repeated here. See

T. Kurent, *The Cosmogram of the Romanesque Basilica at Stična*, Fakulteta za arhitekturo, Univerza v Ljubljani 1978.

Illustration 9

Number 666 is the biblical number of the beast. Among the preferred numbers, generated by the man-in-the-circle scheme, we find it in the figures 111 and 41.

Byzantine metrology knew an *orgyia* divided in 111 parts (38). The magic square of the Sun knows number 111 as the sum of numbers forming each of its six columns.

The triangular number 666 after repeated halving results in 41. We know already that figured Pell numbers are equal not only to themselves, but also to related numbers which are 2, 4, 8... and/ or 10, 100, 1000... times larger or smaller. Number 41 is a term in the second Pell series:

1 1 3 7 17 41

Illustration 10

Number 432 is prominent in Indian chronometry. Indian units of time, from the smallest second to the eons the largest of which is the Brahma life-time, appear in the form of numbers related to number 432. This relation of numbers is similar to the families of figured Pell numbers which are synonimous even if they are 2, 4, 8... and/or 10, 100, 1000... times larger or smaller. If this is true, number 432 equals 27, which is the largest number of the platonic lambda:

$$432 : 2 = 216$$
$$216 : 2 = 108$$
$$108 : 2 = 54$$
$$54 : 2 = 27.$$

The sum of lambda numbers is twice larger than 27:

$$1 + 2 + 3 + 4 + 9 + 8 + 27 = 54.$$

Number 432 is built in the Byzantine system of sizes, or more precisely, in the *orgyia* divisible in 108 parts (38).

Illustration 11

Euclid's perfect numbers, 6, 28 and 496, and Mersenne's numbers 3, 7, 31, and 127, are used as modular multiples in ancient architecture.

An Euclidean perfect number equals the sum of its aliquot divisors. From the architectural point of view, in an euclidean perfect number the maximal additive and the maximal multiplicative componibility are combined.

A Mersenne number is a prime number other than 2 among the divisors of Euclidean perfect numbers.

From the point of view that a figured Pell number equals not only itself, but also numbers which are 2, 4, 8... and/or 10, 100, 1000... times larger or smaller, all Euclid and Mersenne numbers are equal. The repeated halving of the perfect number 8128, e.g., results in 127:

$$8128 : 2 = 4064$$
$$4064 : 2 = 2032$$
$$2032 : 2 = 1016$$
$$1016 : 2 = 508$$
$$508 : 2 = 254$$
$$254 : 2 = 127,$$ whcih is a Mersenne number.

The Mersenne number 127 equals all smaller Mersenne numbers:

127 : 2 = 63,5 which is to be rounded in 63
63 : 2 = 31,5 rounded in Mersenne number 31
31 : 2 = 15,5
15 : 2 = 7,5 rounded in Mersenne number 7
7 : 2 + 3,5 rounded in Mersenne number 3
3 : 2 = 1,5 rounded in one. Accoring to this way of thinking, there is only one number, but it obviously has various manifestations.

Illustration 12

Emona, the augustean colony under the present-day Ljubljana, is 360 *passus* long and 300 *passus* wide. Its planning module is 60 *passus* long and its plan is in the ratio 6 : 5, which is a rational approximation of the proportion, called *quadriagon*. Numbers 5 and 6 are consecutive terms in the first Pell series:

1 2 5 12 ...
6

The preferred numbers in the dimensional composition of Emona are following:

300 *passus* width equals 2 modules of 150 passus
3 „ „ 100 „
5 „ „ 60 „
6 „ „ 50 „
10 „ „ 30 „
12 „ „ 25 „
100 „ „ 3 „
532 „ „ 45 *digiti*, if the tollerance of + 0,25 % is permitted;
360 *passus* length equals 6 modules of 60 *passus* or
432 „ „ 50 *uniciae*;

the diagonal of the 360 × 300 *passus* plan equals
127 modules of 666 : 3 *unciae* or
666 „ „ 127 : 3 „ if the approximation with the difference of 0,27 % is permitted.

More about Emona in the book
— M. Detoni and T. Kurent, *Modularna rekonstrukcija Emone — The Modular Reconstruction of Emona*, Narodni muzej, Ljubljana 1963.

Illustration 13

The Diocletian palace in Split, Dalmatia, is theoretically 24 modules wide and 29 modules of 5 *passus* long. Numbers 24 and 29 are terms of the first Pell series:

1 2 5 12 29
24

The ratio 29 : 24 is close to the proportion of *Quadriagon*. But the theoretical sizes are adjusted either because of the proportional, or because of numerological, or perhaps, because of both, reasons: The northern elevation is 24 M (5 *passus*), or 120 *passus*, long, but the southern elevation is one module longer. It is 125 *passus* long. The theoretical length of the western elevation is 29 modules, but because of the correction, its actual length is 5 *gradus* longer. Its length is 147,5 passus.

The eastern elevation is sligtly longer because of the larger southern width and larger than 147,5 *passus*.

> 147,5 *passus* length results in 532 M (66,6 *sicilici*).
120 *passus* length equals 432 modules of 66,6 *sicilici*,
125 *passus* lenth equals 2 M (15.000 *sicilici*)
3 M (10.000 *sicilici*)
5 M (6.000 *sicilici*)
6 M (5.000 *sicilici*)
10 M (3.000 *sicilici*)

Illustration 14

The Romanesque basilica at Stična, Jugoslavia, is a modular composition based on *l'aune de Bordeaux*, equal to 1,191 m, and on numbers, used as modular multiples.

Besides numbers 1, 2, 3, 4, 5, 6, 7, etc., the prominent preferred numbers in Stična are 127, 432, and 666.

127 modules of two *pieds* is the width of the area „under the church roof", determined by the intersections of the terrain with the lines pojected by the saddle roof of the central aisle.

432 modules of two inches is the width of the church at the entrance side. Unfortunately, the original western elevation was destroyed and the still standing church is for one *intercolumnium* shorter. Therefore, I have no proof that the entrance walls were thicker than the remaining walls along the side aisles. But the still standing church of St. Aurelius in Hirsau, Bavaria, said to be the model for Stična, has the entrance-side-walls reinforced, making the western elevation wider and consequently equal to 432 modules.

666 modules of one *triens* is the overall length of basilica.

For further rading:

— T. Kurent, *The Cosmogram of the Romanesque basilica at Stična*, Fakulteta za arhitekturo, Ljubljana 1978.

Illustration 15

The dimensional composition of the Byzantine Church at Studenica, Serbia, is regulated with the Byzantine system of sizes. The interplay of two planning modules, M 11′ and M 3′, determines all dimensions of the composition. Among the modular multiples, the following preferred numbers can be found:

2 3 4 6 12 127 432 666

Illustration 16

The forms of the platonic elements — earth, water, fire, and air — schape typical mosques here represented by the Gazi Husrevbey mosque in Sarajevo, Jugoslavia.

The forms of the five Chinese elements — earth, water, fire, metal, and wood shape a typical Buddhist stupa.

Illustration 17

The forms of the platonic elements were adopted by the Christian iconography. In the Catholic world, the triangle is associated with the Lord, the crescent and the sphere are the pedestal of the Virgin, and the form called *mandorla* or *vesica piscis* is used as a frame for the figure of Christ.

— This *mandorla* around the Christ enhroned is a copy of a miniature from the manuscript *des Trois Colombes* (*Bibliotheqne municipal*, Troyes, XII siècle).

— The image of the Lord with the triangular aura hovering over the globe is a part of a steel-engraving from the book by F. Lampe, *Zgodbe Svetega pisma*, Družba sv. Mohorja, Celovec 1894.

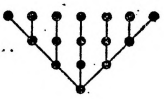
— The leaflet with a prayer to the Virgin, standing on the new moon and the earth, circulated in Slovenia around the turn of the century.

INTEGERS

n 1, 2, 3, 4, 5, ...

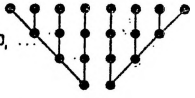
ODD NUMBERS

$n+1+n$ 1, 3, 5, 7, 9, ...



EVEN NUMBERS

$n+n$ 2, 4, 6, 8, 10, ...



PERFECT NUMBERS 28, 496, 8128, ...

AFTER EUCLID $6=1+2+3$

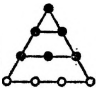
PYTHAGOREAN TETRAKTYS $10=1+2+3+4$

AFTER VITRUVIUS $16=6+10$

AFTER ALBERTI $100=10^2=1^3+2^3+3^3+4^3$

TRIANGULAR NUMBERS

$\frac{n(n+1)}{2}$ 1, 3, 6, 10, 15, ...



GNOMON

n 1, 2, 3, 4, 5, ...

RECTANGULAR NUMBERS

$n(n+1)$ 1, 2, 6, 12, 20, ...

GNOMON

$2n$ 1, 4, 6, 8, 10, ...

SQUARE NUMBERS

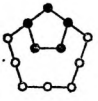
n^2 1, 2^2, 3^2, 4^2, 5^2, ...

GNOMON

$(2n-1)$ 1, 3, 5, 7, 9, ...

PENTAGONAL NUMBERS

$\frac{n(3n-1)}{2}$ 1, 5, 12, 22, 35, ...

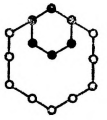


GNOMON

$(3n-2)$ 1, 4, 7, 10, 13, ...

HEXAGONAL NUMBERS

$\frac{n(4n-2)}{2}$ 1, 6, 15, 28, 45, ...

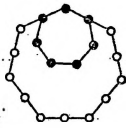


GNOMON

$(4n-3)$ 1, 5, 9, 13, 17, ...

HEPTAGONAL NUMBERS

$\frac{n(5n-3)}{2}$ 1, 7, 18, 34, 55, ...



GNOMON

$(5n-4)$ 1, 6, 11, 16, 21, ...

POLIGONAL NUMBERS

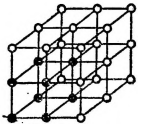
$\frac{n(X(n-1)-2(n+2)}{2}$

GNOMON

$X(n-1)-(2n-3)$

CUBIC NUMBERS

n^3 1, 8, 27, 64, ...



GNOMON

$3n^2-3n+1$ 1, 7, 19, 37, ...

TETRAHEDRAL NUMBERS

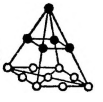
$\frac{n(n+1)(n+2)}{1\cdot2\cdot3}$ 1, 4, 10, 20, 35, ...

GNOMON

$\frac{n(n+1)}{2}$ 1, 3, 6, 10, 15, ...

PYRAMIDAL NUMBERS

$\frac{n(n+1)(2n+1)}{3\cdot2\cdot1}$ 1, 5, 14, 30, 55, ...

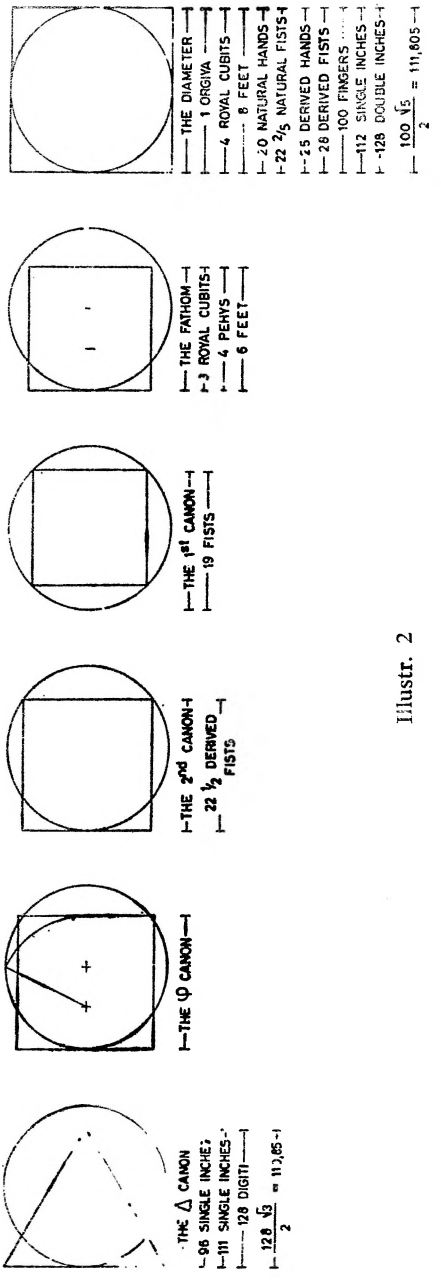


GNOMON

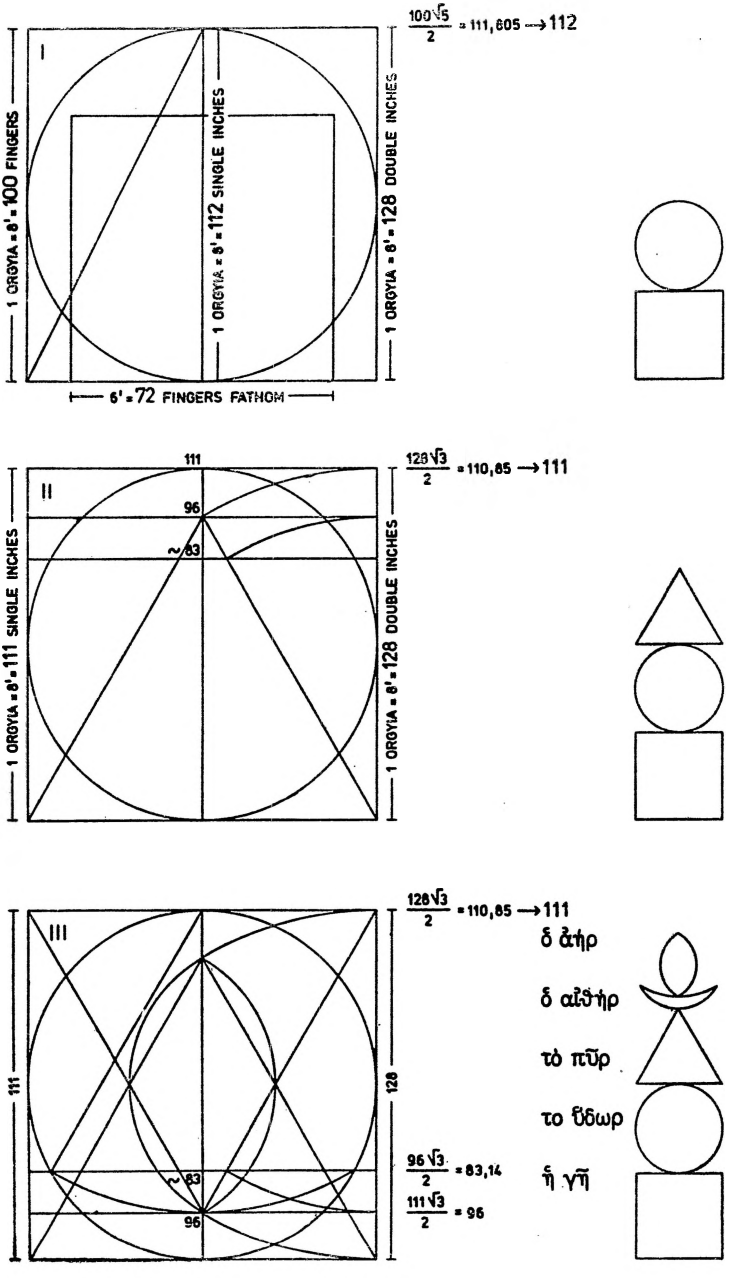
n^2 1, 4, 9, 16, 25, ...

gr. ἡ ψῆφος ~ lat. calculus

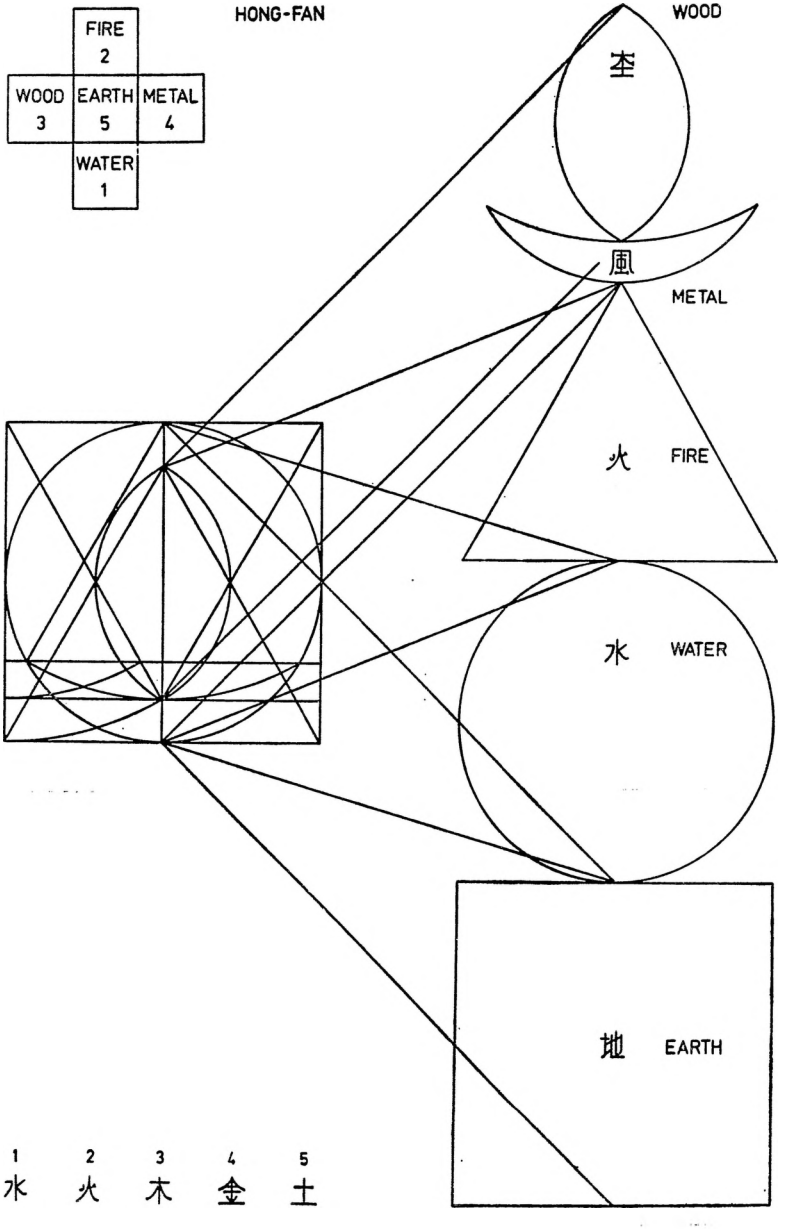
Illustr. 1


THE Δ CANON
96 SINGLE INCHES
111 SINGLE INCHES
120 DIGITI
$\frac{120\sqrt{3}}{2}$ = 113,85
THE φ CANON
THE 2nd CANON
22 ½ DERIVED FISTS
THE 1st CANON
19 FISTS
THE FATHOM
3 ROYAL CUBITS
4 PEHYS
6 FEET
THE DIAMETER
1 ORGIYA
4 ROYAL CUBITS
8 FEET
20 NATURAL HANDS
22 2/5 NATURAL FISTS
25 DERIVED HANDS
28 DERIVED FISTS
100 FINGERS
112 SINGLE INCHES
128 DOUBLE INCHES
$\frac{100\sqrt{5}}{2}$ = 111,805

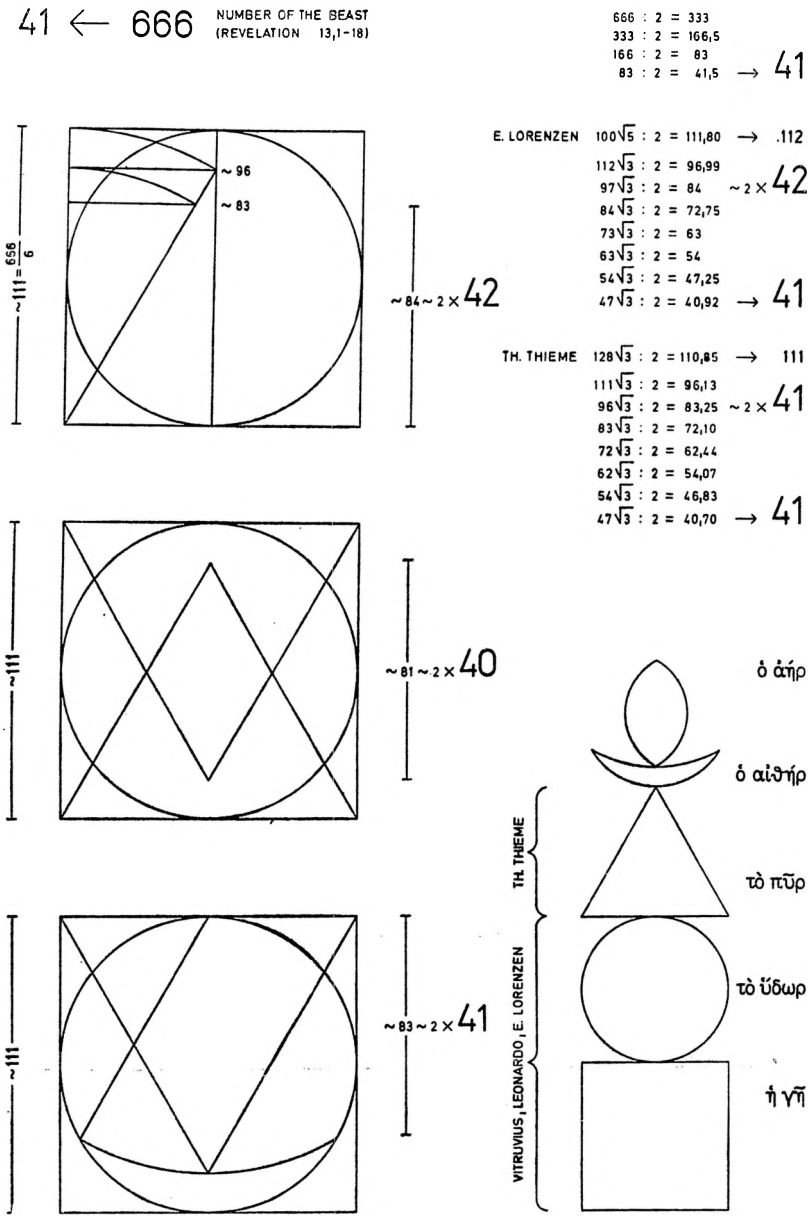
Ilustr. 2


I
1 ORGYIA = 8' = 100 FINGERS
1 ORGYIA = 8' = 112 SINGLE INCHES
1 ORGYIA = 8' = 128 DOUBLE INCHES
6' = 72 FINGERS FATHOM
100√5/2 = 111,805 → 112
II
111
96
~83
1 ORGYIA = 8' = 111 SINGLE INCHES
1 ORGYIA = 8' = 128 DOUBLE INCHES
128√3/2 = 110,85 → 111
III
111
128
~83
96
96√3/2 = 83,14
111√3/2 = 96
128√3/2 = 110,85 → 111
ὁ ἀήρ
ὁ αἰθήρ
τὸ πῦρ
το ὕδωρ
ἡ γῆ

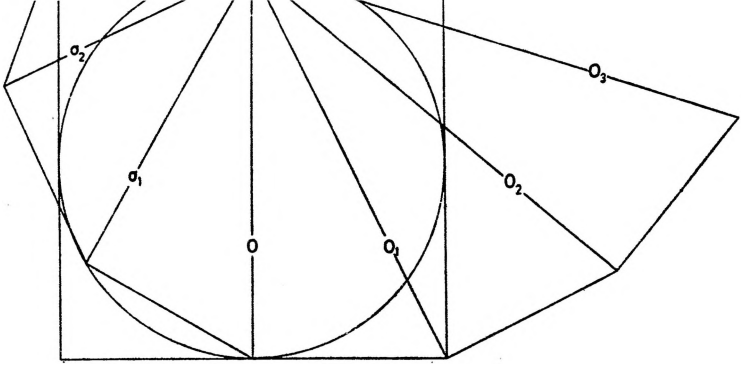
Illustr. 3


HONG-FAN
FIRE
2
WOOD
3
EARTH
5
METAL
4
WATER
1
WOOD
李
風
METAL
火
FIRE
水
WATER
地
EARTH
1 2 3 4 5
水 火 木 金 土

Illustr. 4

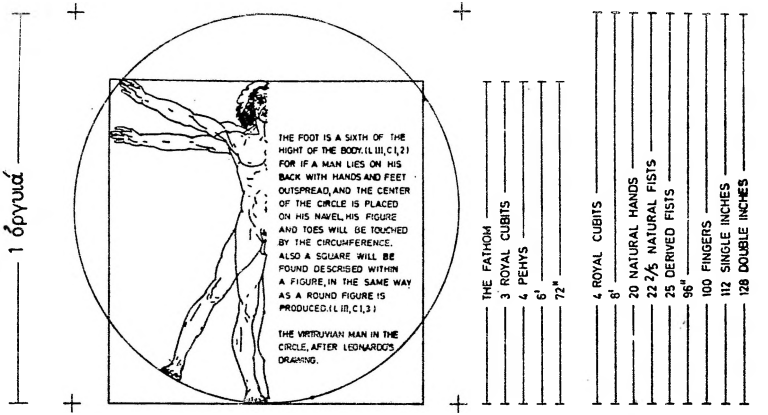

41 ← 666 NUMBER OF THE BEAST (REVELATION 13,1-18)
666 : 2 = 333
333 : 2 = 166,5
166 : 2 = 83
83 : 2 = 41,5 → 41
E. LORENZEN 100√5 : 2 = 111,80 → .112
112√3 : 2 = 96,99
97√3 : 2 = 84 ~2×42
84√3 : 2 = 72,75
73√3 : 2 = 63
63√3 : 2 = 54
54√3 : 2 = 47,25
47√3 : 2 = 40,92 → 41
TH. THIEME 128√3 : 2 = 110,85 → 111
111√3 : 2 = 96,13
96√3 : 2 = 83,25 ~2×41
83√3 : 2 = 72,10
72√3 : 2 = 62,44
62√3 : 2 = 54,07
54√3 : 2 = 46,83
47√3 : 2 = 40,70 → 41
~111 = 666/6
~96
~83
~84~2×42
~111
~81~2×40
~111
~83~2×41
ὁ ἀήρ
ὁ αἰθήρ
τὸ πῦρ
τὸ ὕδωρ
ἡ γῆ
TH. THIEME
VITRUVIUS, LEONARDO, E. LORENZEN

Illustr. 5

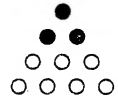


ὁ ὄργυιά	σ_1	O_1	O_3
128 DOUBLE INCHES	$\frac{128\sqrt{3}}{2}$ = 110,85125...→ (111)		
100 FINGERS		$\frac{100\sqrt{5}}{2}$ = 111,86339...→ 112	
96 DAKTYLOI		$\frac{96\sqrt{5}}{2}$ = 107,33126...→ (108)	$\frac{96\sqrt{7}}{2}$ = 126,99606...→ (127)

Illustr. 6


1 ὄργυιά
THE FOOT IS A SIXTH OF THE HIGHT OF THE BODY.(L III, C I, 2)
FOR IF A MAN LIES ON HIS BACK WITH HANDS AND FEET OUTSPREAD, AND THE CENTER OF THE CIRCLE IS PLACED ON HIS NAVEL, HIS FIGURE AND TOES WILL BE TOUCHED BY THE CIRCUMFERENCE.
ALSO A SQUARE WILL BE FOUND DESCRISED WITHIN A FIGURE, IN THE SAME WAY AS A ROUND FIGURE IS PRODUCED.(L III, C I, 3)
THE VIRTRUVIAN MAN IN THE CIRCLE, AFTER LEONARDO'S DRAWING.
THE FATHOM
3 ROYAL CUBITS
4 PEHYS
6'
72"
4 ROYAL CUBITS
6'
20 NATURAL HANDS
22 2/5 NATURAL FISTS
25 DERIVED FISTS
96"
100 FINGERS
112 SINGLE INCHES
128 DOUBLE INCHES

σ3



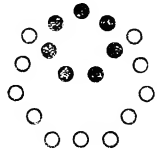
TETRAKTYS
1+2+3+4 = 10

(NUMERUS)

$$\frac{n(n+1)}{2} = 1, 3, 6, 10, 15, \ldots$$

(GNOMON)

$$n = 1, 2, 3, 4, 5, \ldots$$

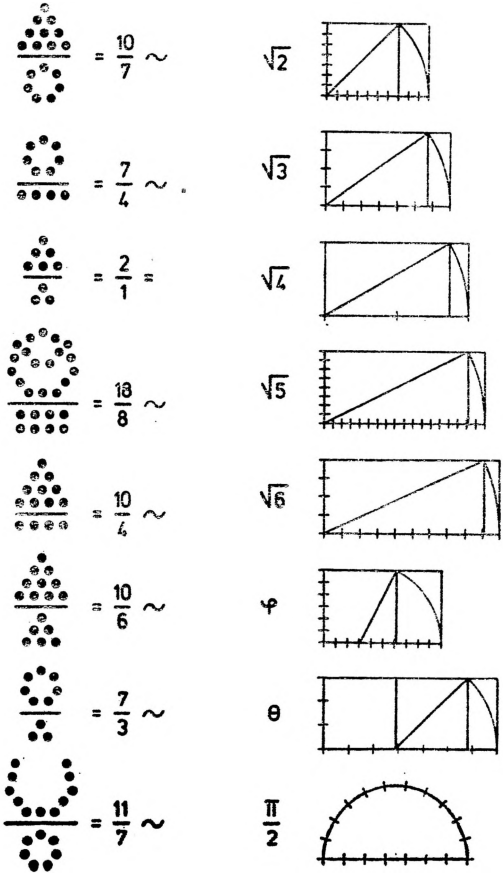


(NUMERUS)

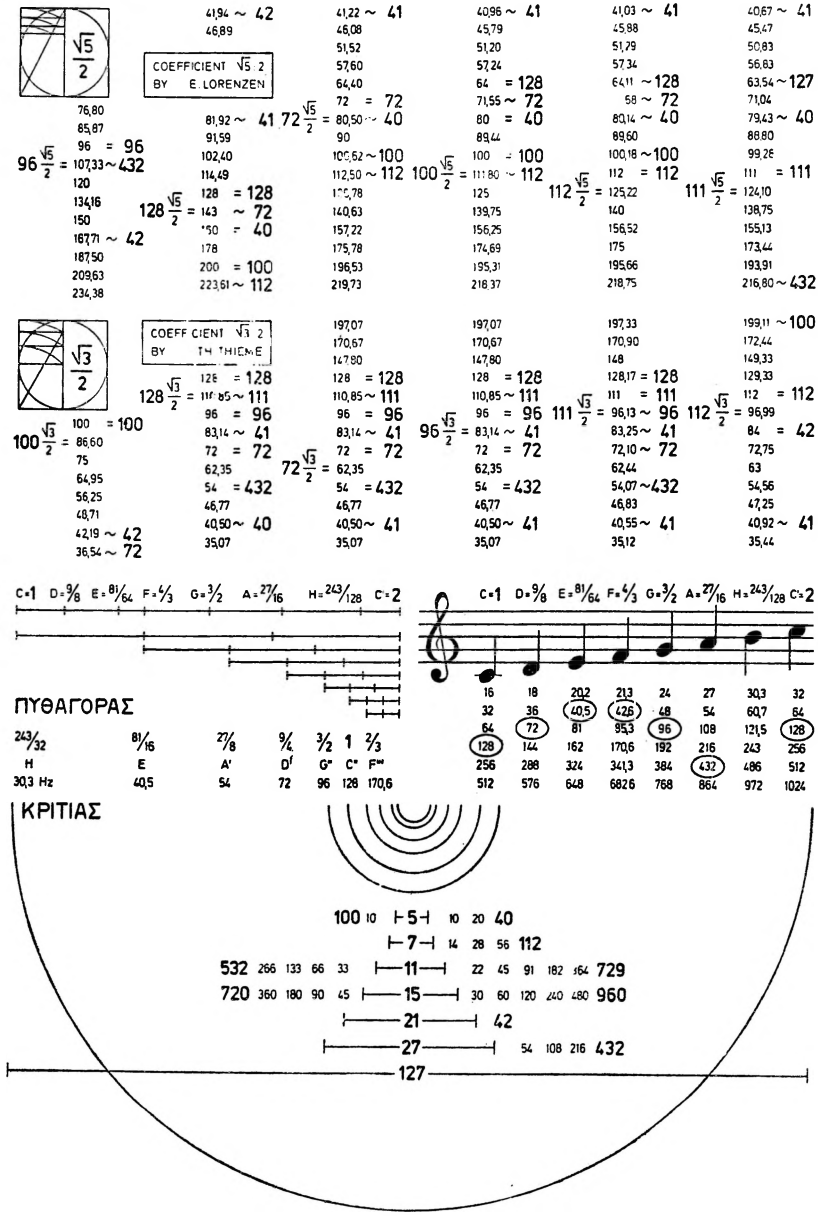
$$\frac{n(5n-3)}{2} = 1, 7, 18, 34, 55, \ldots$$

(GNOMON)

$$(5n-4) = 1, 6, 11, 16, 21, \ldots$$



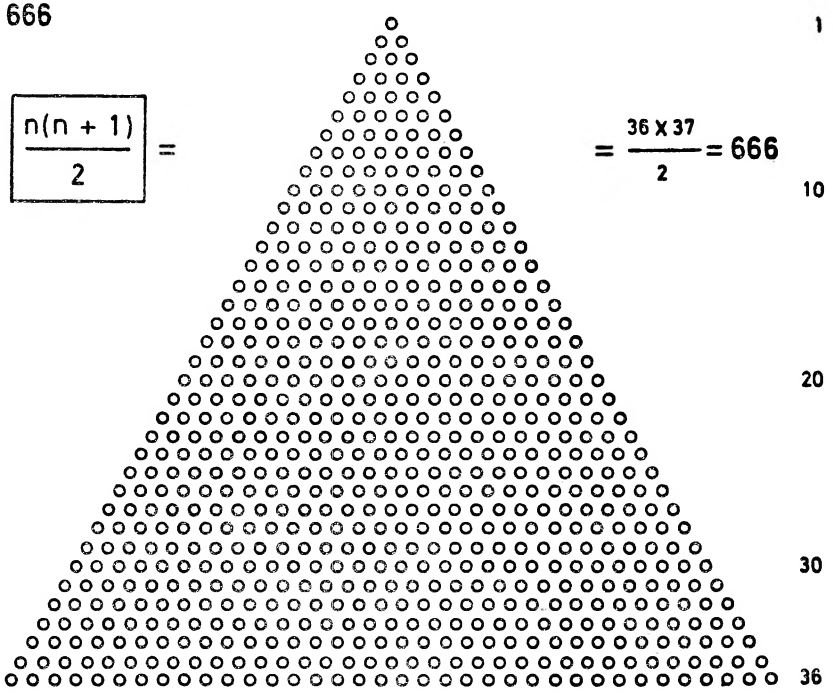
Illustr. 7


√5/2
COEFFICIENT √5/2
BY E. LORENZEN
√3/2
COEFFICIENT √3/2
BY TH. THIEME
ΠΥΘΑΓΟΡΑΣ
ΚΡΙΤΙΑΣ

Illustr. 8

666

$$\frac{n(n+1)}{2} = \frac{36 \times 37}{2} = 666$$



6	32	3	34	35	1
7	11	27	28	8	30
19	14	16	15	23	24
18	20	22	21	17	13
25	29	10	9	26	12
36	5	33	4	2	31

111 + 111 + 111 + 111 + 111 + 111 = 666

THE MAGIC SQUARE OF THE SUN
AFTER CORNELIUS AGRIPPA(1486-1535)

666 : 2 = 333
333 : 2 = 166,5 ⟶ 166
166 : 2 = 83
83 : 2 = 41,5 ⟶ 41

0 - 1 - 2 - 5 - 12 - 29 - ...
1 - 1 - 3 - 7 - 17 - 41 - ...

Illustr. 9

DIVINE YEAR	1					
HUMAN YEAR	360	1				
DAY	129 600	360	1			
HOUR	3 110 400	8 640	24	1		
MINUTE	186 624 000	518 400	1 440	60	1	
SECOND	11 197 440 000	31 104 000	86 400	3 600	60	1

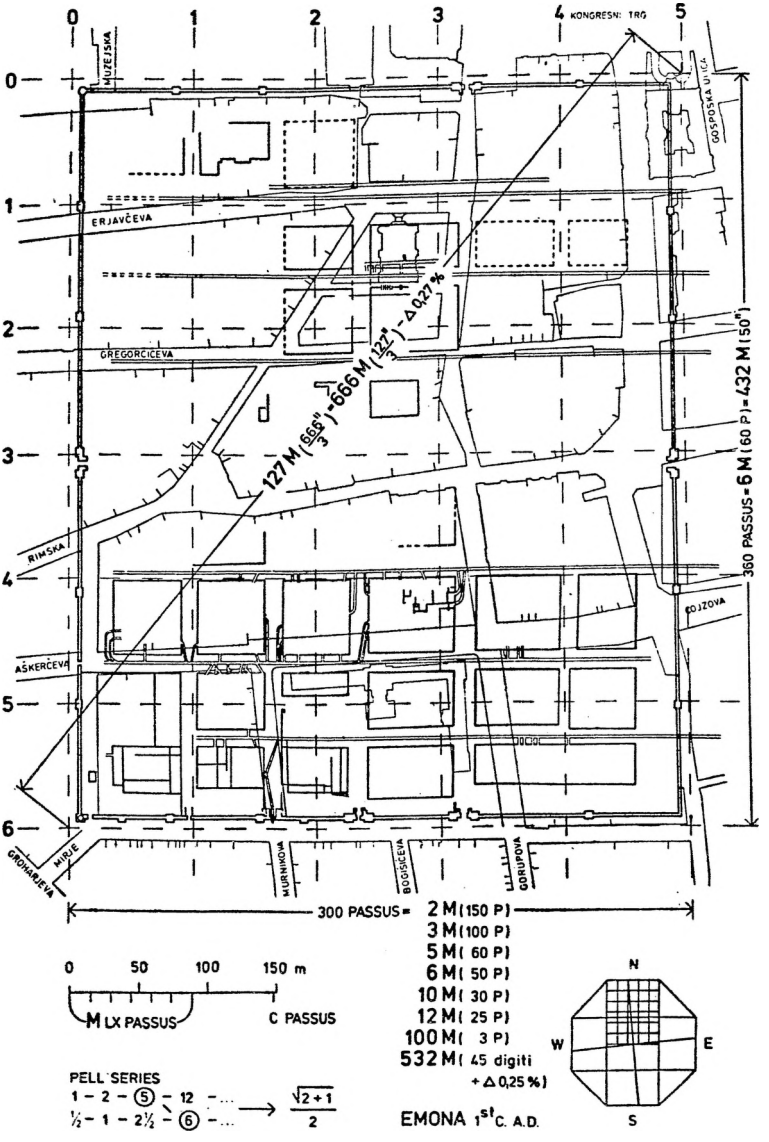
BRAHMA LIFE-TIME	1					
BRAHMA YEAR	100	1				
KALPA (BRAHMA DAY OR NIGHT)	72 000	720	1			
MAHA YUGA: KRITA YUGA	720 000 000	720 000	1 000		1	
MAHA YUGA: TRETA YUGA						
MAHA YUGA: DVAPARA YUGA						
MAHA YUGA: KALI YUGA						
DIVINE YEAR	864 000 000 000	8 640 000 000	12 000 000	4 800 3 600 2 400 1 200	12 000	1
HUMAN YEAR	311 040 000 000 000	3 110 400 000 000	4 320 000 000	1 728 000 1 296 000 864 000 432 000	4 320 000	360

Illustr. 10

n	EUCLID'S PERFECT NUMBERS $N = (2^{n-1}) \times M_n$		MERSENNE'S NUMBERS $M_n = 2^n - 1$
2	$6 = 1 + 2 + 3 =$	2×3	3
3	$28 = 1 + 2 + 4 + 7 =$	$2^2 \times 7$	7
5	$496 = 1 + 2 + 4 + 16 + 31 + 62 + 124 + 248 =$	$2^4 \times 31$	31
7	$8128 = 1 + 2 + 4 + 8 + 16 + 32 + 64 + 127 + 254 + 508 + 1016 + 2032 + 4064 =$		127
	$= (2^{7-1}) \times (2^7 - 1) = 2^6 \times (128 - 1) = 2^6 \times 127$		
13	33550336		8191
17	8589869056		131071
19	137438691328		524287
31	2305843008139952128		2147483647

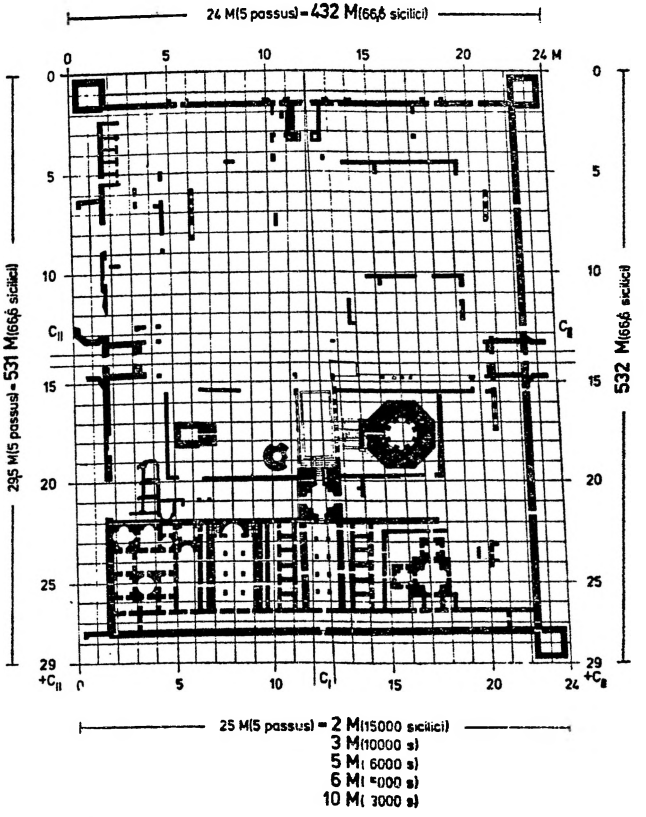
$127 : 2 = 63{,}5$
$63 : 2 = 31{,}5$
$31 : 2 = 15{,}5$
$15 : 2 = 7{,}5$
$7 : 2 = 3{,}5$
$3 : 2 = 1{,}5$
1

Illustr. 11



TURRIUM MURORUMQUE FUNDAMENTA SIC SUNT FACIENDA, UTI FODIANTUR, SI QUEAT INVENIRI, AD SOLIDUM ET IN SOLIDO, QUANTUM EX AMPLITUDINE OPERIS PRO RATIONE VIDEATUR, CRASSITUDINE AMPLIORE QUAM PARIETUM, QUI SUPRA TERRAM SUNT FUTURI, ET EA IMPLEANTUR QUAM SOLIDISSIMA STRUCTURA. VITRUVII DE ARCHITECTURA LIB. I./5

Illustr. 12



PELLI SERIES

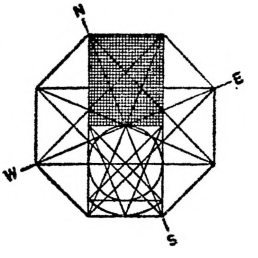
$1 - \theta - \theta^2 - \theta^3 - \theta^4 - \theta^5 - \ldots$

$1 - 2 - 5 - 12 - (29) - 70 - \ldots \longrightarrow \lim \frac{\theta}{2}$

$2 - 4 - 10 - (24) - 58 - 140 - \ldots$

$\frac{29}{24} \sim \bigcirc$ (QUADRIAGON) $\sim \frac{\theta}{2}$

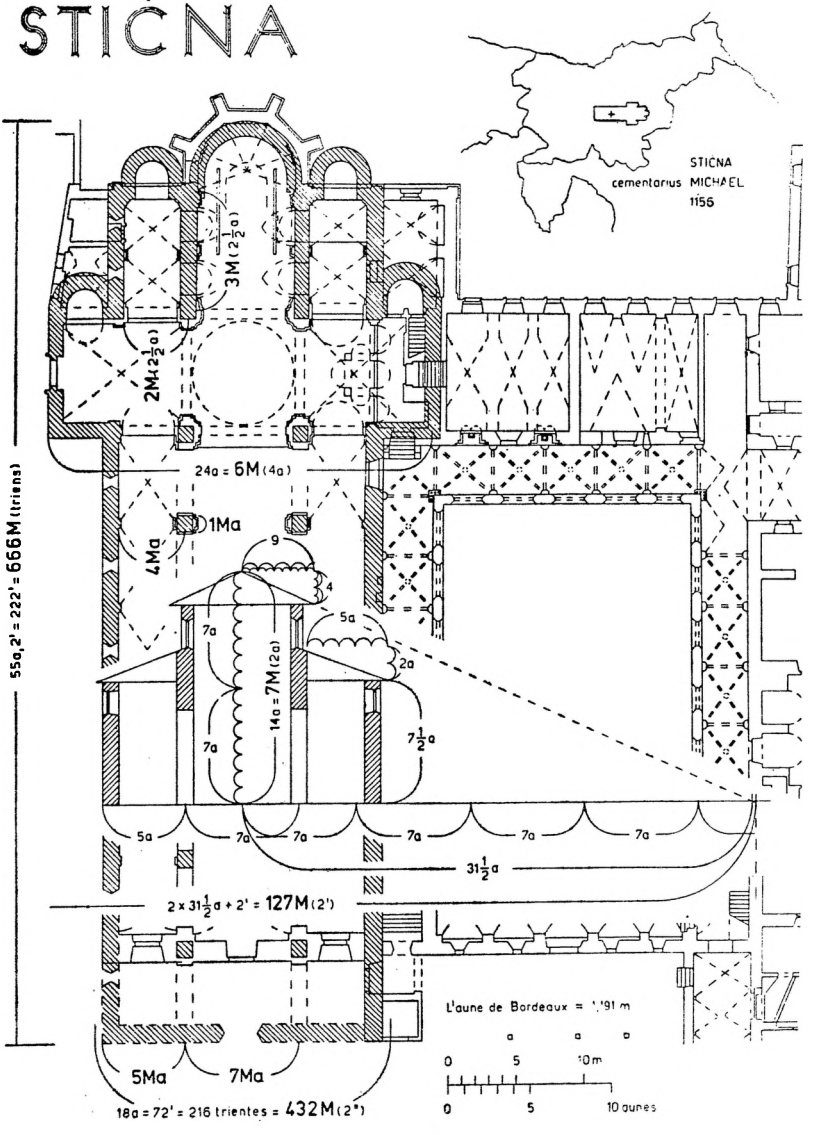
$\frac{\theta}{2} = \frac{\sqrt{2}+1}{2} \sim 1{,}207\ldots$



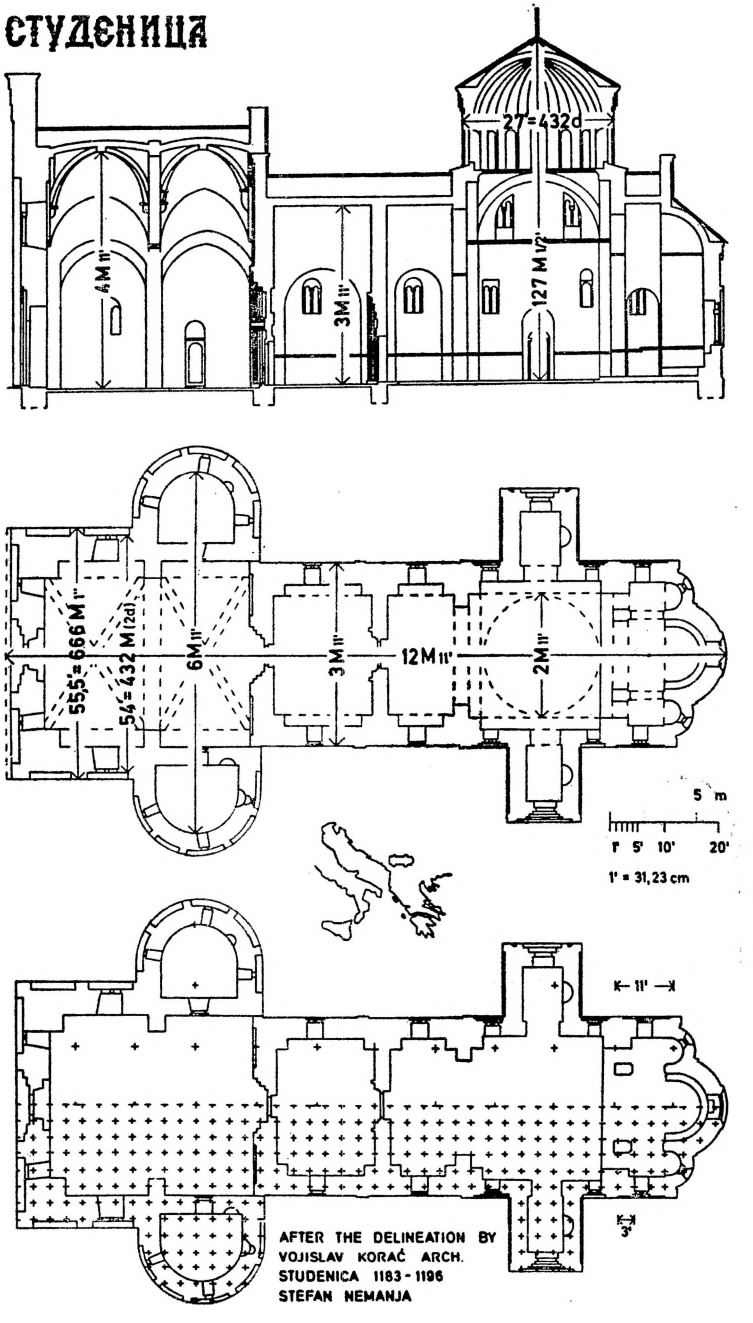
1 MODULUS = V PASSUS
C_I = CORRECTIO PROPORTIONALIS
= 1 MODULUS = V PASSUS
C_{II} = CORRECTIO PROPORTIONALIS
= ½ MODULI = V GRADUS

TURRIUM MURORUMQUE FUNDAMENTA SIC SUNT FACIENDA, UTI FODIANTUR, SI QUEAT INVENIRI, AD SOLIDUM ET IN SOLIDO, QUANTUM EX AMPLITUDINE OPERIS PRO RATIONE VIDEATUR, CRASSITUDINE AMPLIORE QUAM PARIETUM; QUI SUPRA TERRAM SUNT FUTURI, ET EA IMPLEANTUR QUAM SOLIDISSIMA STRUCTURA. VITRUVII DE ARCHITECTURA LIB. I C V

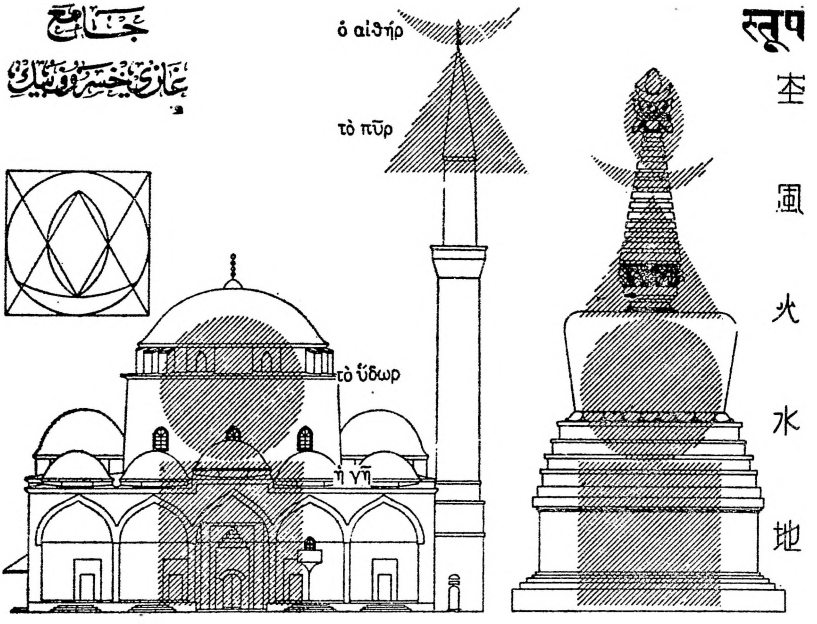
Illustr. 13


STIČNA
STIČNA
cementarius MICHAEL
1156
3M(2½a)
2M(2½a)
24a = 6M(4a)
1Ma
4Ma
9
4
5a
7a
2a
14a = 7M(2a)
7½a
5a
7a
7a
7a
7a
7a
31½a
2 × 31½a + 2' = 127M(2')
55a,2' = 222' = 666M (trians)
L'aune de Bordeaux = 1,191 m
0 5 10m
0 5 10 aunes
5Ma
7Ma
18a = 72' = 216 trientes = 432M(2')

Illustr. 14


СТУДЕНИЦА
27=432d
4M 11'
3M 11'
127 M 1/2'
55,5'=666'M 1'
54'=432 M (12d)
6M 11'
3M 11'
12M 11'
2M 11'
5 m
1' 5' 10' 20'
1' = 31,23 cm
11'
3'
AFTER THE DELINEATION BY
VOJISLAV KORAĆ ARCH.
STUDENICA 1183 - 1196
STEFAN NEMANJA

Illustr. 15



Illustr. 16

O Marija brez madeža spočeta,
prosi za nas,
ki se k tebi zatekamo.

Illustr. 17