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'' GEOMETRIC CONCEPTS IN PLATO, RELATED TO ART''

NOTE : TRANSLATED FROM THE ORIGINAL GREEK TEXT,
BY P.C. STEFANIDES.

((DOUBLE BRACKETS CONTAIN EXPLANATORY NOTES
TO THE ORIGINAL TEXT))

28 FEBRUARY 1996

Dear Delegates, Hello

I wish, initially, to thank the Presıdent and the Organizing Committee of this Conference, who invited me to speak, today, here, at the DEMOCRITEIO UNIVERSITY OF THRACE.

Also, I wish, to Congratulate the Chamber of Ekastic Arts of Greece, its President and all those who contributed towards realizing this symposium.

I was born in Athens (Aegaleo) in 1945, and I was brought up in Piraeus.
I am a Graduate Electrical Engineer of the UNIVERSITY OF LONDON and Electrical and Mechanical Engineer of the NATIONAL TECHNICAL UNIVERSITY OF ATHENS.

During the last 14 years, I have been working with the Hellenic Aerospace Industry (HAI), while the last two years, I function in this Company, as Superintendent of the Engineering Methods of Aircraft Engines' Manufacturing Co-production programme, between SNECMA and HAI.

My basic high school education in Greece was classical at the LYCEUM PLATO of Piraeus.

My interests have been the foreign languages, painting and choir participation.

My University studies in Engineering, included a lot of Mathematics, which, I never stopped, up to now, to study.

These, together with General Engineering, Electronics and Automatic Control, helped me, during the period of my functioning in the Industry, to implement various applicable automatic systems, innovative in their kind, based on personal and private research, which was granted a National Award.

Periodically, all this work, was presented at, various, National Conferences and National Conferences with International participation (First Conference of Robotics and Automation, of the Technical Chamber of Greece, Conferences of the Institution of Solar Technology etc).

By my continuous contact, with books and knowledge, in subjects concerning motion, forces, energy, power etc., I noticed, that, there exist seven (7) basic forms, which appear to derive one from the other and thus related.

These forms (relationships) necessary for the creation of a ((powerful)) work element, from its conceptual idea to materialization are : Line, surface, volume (mass* of unity density), momentum, force, work (or energy) and power. They are fractions with numerators powers of space (length) and denominators powers of time.

Length ((L^1)) and surface ((L^2)) are timeless ((T^0=1)), Encephalic Concepts.

((L^1/T^0, L^2/T^0, L^3/T^1, L^4/T^1, L^4/T^2, L^5/T^2, L^5/T^3))

By thinking in this way, the above, I was motivated, to get, in touch, with, the *PYTHAGOREAN THEORY* and to be introduced later, to searching *PLATONIC TIMAEUS*, which brought me in resonance with the relationship of *THE GOLDEN SECTION* and its *SQUARE ROOT.*

Before I continue with presenting the last part of my work in this subject (as well as part of the work I presented to the first Conference of *HISTORY AND PHILOSOPHY OF ANCIENT GREEK MATHEMATICS - Research Institute,* Athens 1989), I will refer to the works of various researchers which are related to the Greek Art, its extension to Europe and other places, and, also to Geometry.

In Encyclopaedia Britannica (Vol. 10, 1972, page 829, Greek Architecture) it is stated:

"...*To the Greeks fell the role of inventing the grammar of conventional forms on which all subsequent European Architecture was based...*
Greek was the patient genius, with which perfected every element, rarely deviating from the forward path to invent new forms or new solutions of old problem... This conservative adherence to older types led to such masterpieces as the Parthenon and Erechtheum."

According to *THEOPHANIS MANIAS*, the Greek Beauty and the Greek Spirit found in many works of Antiquity, were not ruined by time, death of people or peoples', fanatism and mania.

* *L^3/T^1, mass rate (for unity density), than mass, seems more natural, in the L/T series above.*

Cities and Sacred Temples, were founded according to plans and scientific computations. Religion of the Ancients was the Absolute Beauty, and the Greeks believed as God this Absolute Beauty.
Aesthetic Beauty, Optical Beauty, in forms and colours, and Acoustic Beauty in music, Ethic Beauty, found in virtue, and Spiritual Beauty in good learning and knowledge.

Man sensed, and conquered, all kinds of Beauty, through Love, because Love is the synectic substance of the Harmonic Universe.

The Ancients had studied this subject, with religious piety. They had observed the existence, of another Beauty, in Nature.

Beyond this Harmony, which is Visible, and used, today, by architects, decorators, and generally all those occupied with Aesthetics and Arts, there is another Invisible Geometric Harmony.

Circle, Square, Equilateral Triangle, Regular Hexagone, Cube, Pyramids etc., have a Visible Beauty, that man senses by his eyes, and he finds it in these geometric forms.

Symmetries, analogies and other mathematical relationships, were found in the leaves of trees, the petals of flowers, the trunks and branches of plants, the bodies of animals and most important, the human body, which composed an Invisible Harmony, of forms and colours superior than the Visible Harmony.

This Invisible Harmony, we find, in all expressions of the Hellenic Civilization.

According to *EVAGELOS STAMATIS* (Hellenic Mathematics No. 4 Sec. Ed. 1979), *THEOPHANIS MANIAS,* discovered that the Ancient Sacred Temples of the Hellenic Antiquity, were founded according to Geometrical Computations and measurements. In the distances, between these Sacred Locations, *THEOPHANIS MANIAS,* observes, application of, the Golden Section. *EVAGELOS STAMATIS*, also, states that the German Intellectual *MAX STECK*, Professor of the University of Munich, in his article, which he published in the Research and Progress Magazine, he supports that the Western Civilization, Arts, Crafts and Sciences, derive from the influence of the Greek mathematics. The sources that we get knowledge from, about the Greek Mathematics, are the archaeological researches and the literature of the works of the ancient writers.

MATILA GHYKA, in his books, presents widely, the Golden Section and Geometry in relation to painting, sculpture, architecture of human faces and bodies, as well as bodies of animals, plants, and shells, in relation to logarithmic spiral.

Similarly, *ROBERT LAWLOR*, elaborates on these subjects, and additionally, he states, that, the Egyptians, while building the Pyramid, used the ratio 4/SQR (**Φ**) (Four divided by the Square Root of the Golden Number) for the value of Pi (ratio of the circumference of a circle by its diameter - which differs by, approximately, one in a thousand, of the value used today by Science, Technology and Mathematics). *MAX TOTH* (Pyramid Prophesies Edition 1988), correspondingly, refers to this ratio, as a useful, approximate form. He also states that, the Mathematicians, from *HERODOTUS*, have modeled an Orthogonal Triangle, whose small perpendicular, is equal to Unity, the bigger one is equal to SQR (**Φ**) (Square Root of the Golden Number) and its hypotenuse, is equal to **Φ** (Golden Number).

In my Works in 1986, derived one Special Orthogonal Scalene, which has one of its acute angles as Tangent the Square Root of the Golden Number ((the product of the Small side by its Hypotenuse, being equal to the square of the other Bigger side)).

PLATO in his *TIMAEUS*, refers to the *MOST BEAUTIFUL TRIANGLE*.

According to Greek, English, French and possibly other translations, this triangle is being considered as the Orthogonal scalene, having its acute angles 30 and 60 degrees ((however, a ''SQUARE'' has been detected missing, from the Greek text, for compliance with the Pythagorean Theorem)).

The Equilateral Triangle may be formed using six of these scalene triangles and is found on the faces of the Icosahedron, Octahedron and Tetrahedron, solids.

PLATO, indeed, has analysed this Orthogonal Scalene Triangle, in detail, in this manner, but he does not refer only, to this kind, and to the Equilateral Triangle formed by such six triangles.

Analytically, but, somehow, in a hiding way, he speaks about the depth of these solids.

The best method for us, to understand the implication of this meaning, of depth of the solids, is to perform sections and analyze them carefully and patiently.

Apparently, *PLATO*, realizes that he will problematize the investigation for recognition of the *MOST BEAUTIFUL TRIANGLE*, and for this he states: *"...If someone has another one better to state, in their composition, he will not be a foe, but he will be kept a friend…"*

From the sections of the five *PLATONIC* Solids, the most interesting is the Icosahedron (water). In addition to the Golden Number, that we find, there,

we find also a triangle, similar to those of the triangles forming the faces of the Big Pyramid, (four such triangles connected together -in the space- on a square base, form a Big Pyramid).

By using the sections of the four solids, we find the relationships, between them i.e. the Icosahedron with the Octahedron, the Tetrahedron and the cube. In addition, if we add the sections (one next to the other), of the three solids, Icosahedron, Octahedron and Tetrahedron, there remains an empty space which is triangular.

Finally, in the section of the Dodecahedron we find a triangle, fitting this empty triangular space.

So, in this manner we obtain an additional relationship, of the Dodecahedron with the other four Platonic solids.

Dodecahedron was considered as the fifth solid, mentioned by PLATO in his Timaeus and was given the name of AETHER, by the philosophers.

Relating *PLATOS, ''TIMAEUS* (section 54) statement .....''*ΤΡΙΠΛΗΝ ΚΑΤΑ ΔΥΝΑΜΙΝ ΕΧΟΝ ΤΗΣ ΕΛΑΤΤΟΝΟΣ ΤΗΝ ΜΕΙΖΩ ΠΛΕΥΡΑΝ ΑΕΙ''*...(where Plato refers to the *''MOST BEAUTIFUL TRIANGLE''*) and that of STEREOID (section 31 and 32) where the 4 elements are bound to become unity by the *MOST BEAUTIFUL BOND* ((....which most perfectly unites into one both itself and the things which it binds together; and to effect this in the most *BEAUTIFUL* manner is the natural property of *PROPORTIONS.-*

-.....*ΔΕΣΜΩΝ ΔΕ ΚΑΛΛΙΣΤΟΣ ΟΣ ΑΝ ΑΥΤΟΝ ΚΑΙ ΤΑ ΞΥΝΔΟΥΜΕΝΑ ΟΤΙ ΜΑΛΙΣΤΑ ΕΝ ΠΟΙΗ. ΤΟΥΤΟ ΔΕ ΠΕΦΥΚΕ ΑΝΑΛΟΓΙΑ ΚΑΛΛΙΣΤΑ ΑΠΟΤΕΛΕΙΝ*-)), also analysing this ratio ((FIRE : AIR = AIR : WATER and AIR : WATER = WATER : EARTH and thus
FIRE : AIR = AIR : WATER = WATER : EARTH)),

by interpreting it as ((two pairs of orthogonal scalene triangular surfaces, all similar in their kind)) four triangular surfaces bound together ((their sides' lengths having these ratios)) on a system of three (3) Orthogonal Cartesian axes of reference ((x,y,z)), we derive a scalene Orthogonal triangle ((from the surface of this STEROID - with coordinates : (O,O,O), (O,O,T^2), (T,O,O) AND (0,1/T, 1/T^2)-)) whose HYPOTENUSE IS THE CUBE POWER OF THE SMALL PERPENDICULAR SIDE, THE BIG PERPENDICULAR SIDE IS THE SQUARE OF THE SMALL, AND ((ONE OF THE ACUTE ANGLES)) HAS AS TANGENT THE SQUARE ROOT OF THE GOLDEN NUMBER ((also the product of the small perpendicular by the hypotenuse is the square of the big perpendicular)).

By applying *THE PYTHAGOREAN THEOREM*, on this triangle we obtain a biquadratic ((fourth order)) equation.

((T^4-T^2-1=0, from, T^6 = T^4+T^2, via Φ^2-Φ-1=0))

from which we obtain the size of the small perpendicular ((T)) as the Square root of the Golden Number ((T=SQR(Φ).))

Finally, by placing this triangle in a circle, so that the hypotenuse of this triangle is chord to the circle((whereas the small perpendicular is touching the diameter, or the hypotenuse being the diameter of the circle)), we get mathematical relationships and symmetries, which relate Art to PLATONIC Geometric Concepts.

I Thank you.

((The Speech ended, by the verse ''ΥΜΝΟΣ ΣΤΟ ΠΑΝ'' from the Greek Anthology of CHRISTOS SYMSARIS ''SACRED MANIA'' followed by slides' projection, for explanations and demonstration of the PLATONIC SOLIDS' configuration, structural forms, specially built for such an occasion)).

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