

ADDITION TO SRIYANTRA AND ITS MATHEMATICAL PROPERTIES

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Three years after the first publication about Sri Yantra in India, in 1987, as a result of countless persistent attempts, it was possible to publish one small scientific article in the Russian language in the collection “Ancient and Medieval East”. Furthermore, In 1987 the 11th number of “Science and Life” magazine published a popular article about the mysteries of the geometry of Sri Yantra. This article caused a most lively interest from the readers, and received more than a hundred responses, which contained various versions of construction methods of the Sri Yantra. A second, generalized article was written based on this correspondence, which after three year of delays in the editorial staff at the same magazine, did not get printed. Nevertheless, we are deeply grateful to our readers for their time and hard work spent on the study of Sri Yantra, and now, at long last, with a delay of twelve years, we have the possibility to return the favor by publishing some of the most interesting solutions sent to us back then.

Semantic correlate. One of the directions our readers put their efforts into was to find some astronomical and physical *correlate* in Sri Yantra, while considering its cosmological symbolism. Thus Slovakian engineer Vladimir Sagneyster from Bratislava, read those two framing lotuses as the indication of an attempt to increase of the Sri Yantra 8 and 16 times. In this way he revealed a good correspondence between the concentric levels built by him in this relationship of the three Sri Yantra and the orbits of the planets of the solar system (Fig. 10, shows the first two out of three stars examined by him) with a divergence from the real diameters of orbits of about 1.5%. The additional circles in the construction correspond to the boundaries of the asteroid belt and the five trans-Saturnian’s planets.

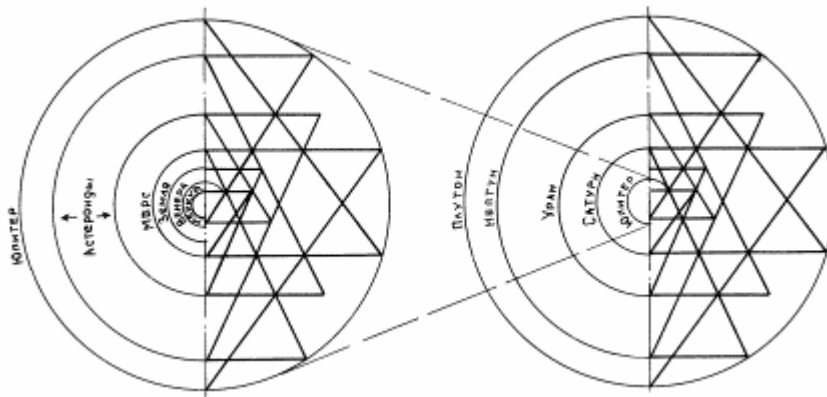


Fig. 10. V.Sagneyster’s astronomical interpretation

Dr. G.P.Ovsyanikov from Saratov conducted a detailed study (for different *soft* versions of *the star*) of the geometric correlate and revealed many impressive relationships close to the number e - the base of the natural logarithms - to the basic parameters of the moon-solar calendar and to astronomical cycles. In particular, he proposed the relationship $yB=yA/e$, which differs from the *precise* value about 1.3%. Based on his results another special, detailed article was prepared for the same magazine, which also wasn't published later on.

Iterative drawing. The application of iterative-drawing techniques for obtaining maximally precise large scale images was another direction of studies.

The absolute record for the scale of the images (with the simplification of ignoring the coaxiality of the external and internal circles) belongs to the worker N.I.Rosohatom from Bataysk city of the Rostov district. Given the 1 meter diameter of the image, he attained *an accuracy of 2.01% in its construction*, with the position of the horizontals at the marks 131, 273, 365, 410, 463, 533, 610, 711, 884 mm, after spending on the iterative reformations twenty-four hours of continuous labor, which can serve as a initial starting point for evaluating the necessary time for iterative drawing.

Note: Here and throughout, the accuracy of the construction was evaluated according to the maximum error (non-coincidence in the intersections of lines) at three critical points (A, A-, B) and was expressed in percentages of the radius R of the external circle. Here we decided not to consider the error at the point E (as a result of the misalignment of the circles' axes), since it usually exceeded greatly the rest of the errors and is about 3-5%. The checking was carried out by a computer program, therefore the given values can differ from those declared by the authors themselves.

Further, an engineer from Leningrad, S.V.Morozov, came to the conclusion that the usual drawing tools are not allowing (making it possible) to obtain the necessary precision in the constructions with a diameter bigger that 490 mm. As a result, for an image of 490mm in diameter, he obtained the horizontals at the marks of 57, 131, 178, 202, 229, 266, 307, 360, 443 mm with an accuracy of the construction of 0.667%. He also noticed the following empirical rule: $57+443=500$, $131+360=491$, $178+307=485$, $229+266=495$, i.e. the sum of the ordinates of the opposite horizontals is close to the size of the radius of the outer circumference with an accuracy of 2%.

Continuing this direction, V.A.Smirnov from Ufa also assumed the presence of some simple "magical numbers" or relationships in the structure of Sri Yantra, which made it possible to reproduce it in the antiquity, relatively simply. As a possible approximation he proposed the following: $R:yC:yA:yB = 146:116:41:15$, which results in the best accuracy in the construction (approximately 0.41%), for this direction.

Analytic-calculus direction. The third direction was represented by the analytical calculations of the geometry of *the star*. Here V.A.Smirnov from Ufa using a self-written FORTRAN program and his two geometric findings (see below) attained the accuracy of construction of 0.046% with the following position of the four horizontals: $yA=0.281$, $yD=0.8427023$, $yC=0.7966(6)$, $yB=-0.1024091$.

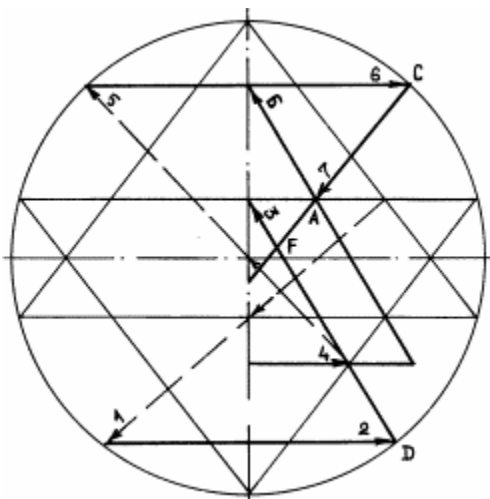


Fig. 11. V.A.Shchekotkov's and S.L.Dydkin's method

Furthermore, V.A.Smirnov, by means of calculations on the calculator and by graphing the change of the coordinates depending on the value of y_A , showed the impossibility of fulfilling the conditions of the coaxiality of the outer and inner circumferences and the coincidence of the point of inflection of central triangle with the point of intersection of the near straight lines, although the difference between *the roots* happened to be very small $\Delta y_A = 0.001$.

In this direction, special credit for the academically precisely executed work, goes to 2nd World War's veteran, "st.n.s." of Sukhumi's Institute of Physics and Technology, Dr. E.S.Yampol'ski, who analytically derived the formulas for all of the Sri Yantra's horizontals and in results of calculations on a manual calculator by using a method of linear interpolation obtained values that were different from the values calculated on a super computer on the sixth digit.

Heuristic algorithms. The direction in which most of our readers went into with their search, was towards the finding of heuristic methods of construction with the use of compasses and the rule.

One of the elegant methods for determining the positions of points C and D (for which *the accuracy of the construction* is 0.73%) was proposed independently by V.A.Shchekotkov - a wired communications regulator from the Elektroizolator village, Moscow district and by a student of the Kharkov Institute of Radio-Electronics S.L.Didyk, based on the use of two auxiliary secants, passing through the point of intersection of the large triangles (Fig. 11)

The secant for the D point also was revealed by the earlier mentioned V.A.Smirnov from Ufa. In this case he proved from the similarity of the triangles 1-3-A- and 2-D-A-, that the position of the D point is obtained in this case with an absolute accuracy (Fig. 12). In this case the iterative loop for reforming *component 1* becomes unnecessary, thus the proposed formula 1 which calculates the labor expense of the construction of *the star* simplifies insignificantly: $N = bcd + cd + d$. While at it, V.A.Smirnov revealed an elegant accelerated method for iterative construction of *component 2* (see also fig. 12).

All this, indirectly confirms the correct direction of our reasoning, at least, relative to the priority (or larger proximity to the prototype) of *stars of type II* in comparison with *stars of type I*.

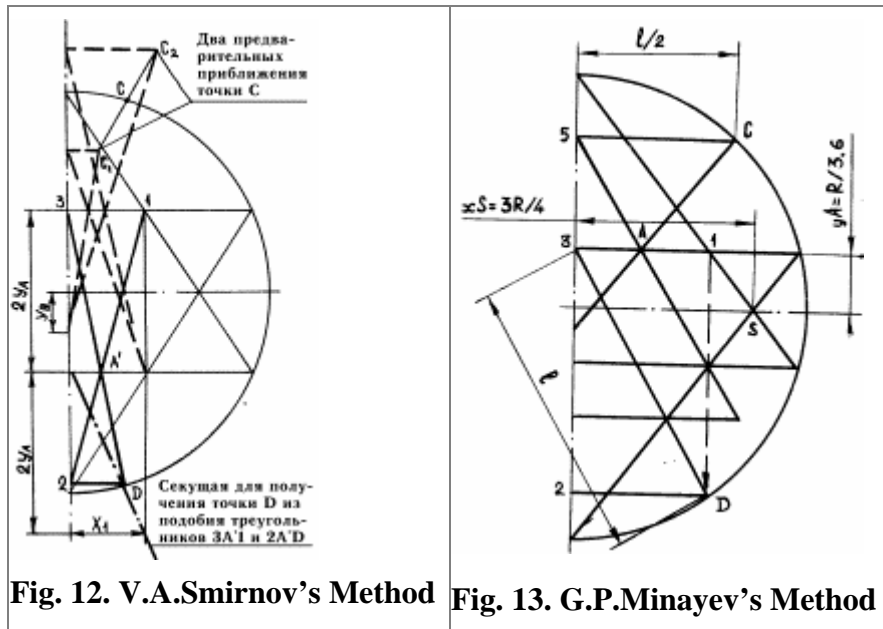


Fig. 12. V.A.Smirnov's Method **Fig. 13. G.P.Minayev's Method**

Another successful method was proposed by G.P.Minayev from Suma (precision=1.6%), which uses the following relationships between the lengths L of the sections: $L(2,3)=L(3,1)$, $L(5,C)=L(3,D)/2$. He also proposed two of the most successful methods for determining the parameter yA : $yA=R/3.6$ and $xS=R*0.75$ (S – point of intersection of the large triangles) that deviates from the exact values only with 0.6% and 0.2% (Fig.13)

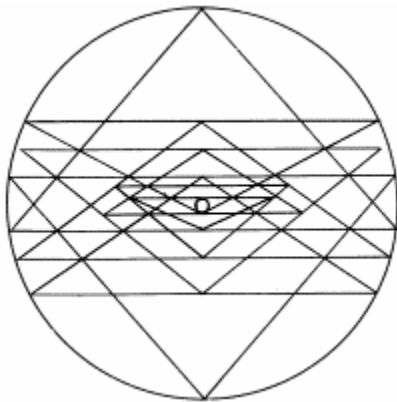


Fig. 14. The maximum form of the star (in Indira Gandhi's memory)

The majority of the readers choose to simplify their task, by ignoring the rather difficult to achieve conditions of the *coaxiality* of outer and inner circumference, thus reducing the complexity of the task to the quite acceptable value of $N=bc+c$ (taking into account V.A.Smirnov's proof), and gained by doing this the freedom of choosing the value of yA .

This allowed the above mentioned G.P.Ovsyanikov and V.A.Shchekotkov to trace the geometrical change of the Sri Yantra with the change of yA and find out the minimal

form of star Sri Yantra at $y_A=0.1355$, touching outer circle by their 12 angular points (fig. 14, further reduction of y_A makes triangles of a star to cross the boundaries of outer circle). G.P.Ovsyanikov and V.A.Shchekotkov were first to bring this variant in light, They devoted this variant of a star in the memory of Indra Gandhi . In relation to this, it is remarkable, that the very first article on initial mathematical research results on Sri Yantra appeared in September 1984 in the 21st no of " Soviet Land".