

MATHEMATICS OF HARMONY AND HARMONY OF MATHEMATICS

A. P. Stakhov

Applied Mathematics and Computer Systems Department
Vinnitsa State Technical University
42 Prospekt Cosmonautov 42/130
Vinnitsa 286027, Ukraine

The idea of the Universe's harmony has been got by astronomic observations. At the early stages developing material culture the ideas of *"spherical"* and *"dodecahedron-icosahedron" structure of the Universe* were generated. The first idea resulted in new trigonometry. Its development dates back to Egyptian and Babylonian mathematics. Along with trigonometry π -*number* has come into science as the *first fundamental number constant of mathematics*.

The "dodecahedron-icosahedron" idea is based on comparing cyclical processes in the Solar System, i.e. the 12-years cycle of Jupiter, 30-years cycle of Saturn, 60-years calendar cycle, etc. They have number characteristics of "Platonic solids", viz, the dodecahedron and the icosahedron. The dodecahedron has 12 faces, each of which being a pentagon with 30 edges and 60 flat angles (the number of faces times the number of angles in a pentagon). The icosahedron is a geometric figure dual to the dodecahedron. It has 12 apices, 30 edges and 60 flat angles. The comparison proves that the dodecahedron and icosahedron express the harmony of the Universe. It should be noted, that the golden section is the major ratio of the dodecahedron and icosahedron. That is why the *golden section* was introduced in science as the *second fundamental constant of mathematics*.

Both ideas of the Universe's structure were used by ancient Egyptians and Babylonians for compiling *calendars* as well as developing *time measurement systems and angular values*. The dodecahedron and icosahedron were magic symbols which expressed number harmony of 12 years- and 60 years cycles of Jupiter and Saturn. Due to it the ancient Babylonians chose number 60 as a basis of their notation and the ancient Egyptians decided to divide a year into 12 months, i.e. the number of faces of the dodecahedron. Specifically, each month of the Egyptian calendar comprised exactly 30 days (the number of the edges of the dodecahedron). In accordance with numerical characteristics of the dodecahedron and icosahedron a day was divided into two halves with 12 hours each. Each hour was divided into 60 minutes, each comprising 60 seconds. The whole way of the Sun moving round the orbit was divided into 12 zodiacal parts, each being broken into 30 degrees. Each degree was broken into 60 angular seconds. In accordance with the dodecahedron-icosahedron representation, the celestial orbit of the Earth was divided into 360 degrees. This conformed to the Egyptian calendar year which consisted of 360 days. As a result there appeared a

consistent system of time and angular values measurement. It was in conformity with the *Egyptian theory of harmony based on the golden section*. The theory was confirmed by the analysis of wooden carved panels found in a tomb of *Khaci-Ra*, the ancient Egyptian architect (18 c. B. C.). The discovery is made by the Russian architect I. P. Shmelev [12].

So, since ancient Egypt two concepts have been set in natural science which are based on different ideas of the Universe's harmony. They are the π -number concept which is based on the idea of orbicular nature of planets travelling round their orbits and the golden section concept which is based on the dodecahedron-icosahedron nature of the Universe's structure. In the process of historical development the concepts developed separately. The concept of π -number connected with e -number which appeared after the discovery of logarithms in the 16th century became the basis of simulation processed in inorganic nature. Newton's theory of gravity and mathematical analysis proved to be the best achievements of the concept of the Universe's harmony.

Since ancient times and the epoch of the Renaissance the golden section concept has had more to do with art and biological processes. A substantial contribution to developing ideas of harmony based on the golden section was made by the Italian mathematicians *Leonardo of Pisa (Fibonacci)* [2, 13], and *Luca Pacioli* the author of "Divina proportione". In his book Luca Pacioli made an attempt to state geometric fundamentals of art.

In the 17th century the idea of "dodecahedron-icosahedron" structure of the Universe gains further development in Kepler's works. In his books *Kepler* formulates his geometric and harmonic principles of the Universe's structure. The principles are based on Platonic solids and the so called congruent geometric figures [4].

In the late eighties of the 20th c. the dodecahedron-icosahedron idea of the Universe's harmony based on the golden section comes out ahead in natural sciences. This is confirmed by the discovery of *quasicrystals* [3] with icosahedral symmetry, i.e. 5-fold symmetry which was strictly forbidden by classic crystallography. Owing to the discovery the golden section underlying 5-fold symmetry (a pentagon) has come out ahead in modern physics. Quasicrystals were discovered 100 years after the well-known book "Lectures on the Icosahedron and the Solution of the 5-th Degree Equation" by *F. Klein* [5] had been published. In his book F. Klein brilliantly predicted the role to be played by the icosahedron in mathematics.

In the late eighties owing to activities of American mathematicians, members of the *Fibonacci Association* and Slavonic scientists grouped within the International workshop "The golden section and problems of systems harmony" (Kiev - 1992, 1993; Stavropol - 1994) the fundamentals of new mathematical theory were stated. It is *mathematics of harmony* which relates to art, biology and computer engineering.

Mathematics of harmony has structure of classic mathematical analysis. It is based on *algorithmic measurement theory* [7, 8, 9] using the Fibonacci numbers and the golden ratio. Algorithmic measurement theory generates an infinite set of new number series, in particular, the Fibonacci p -numbers,

power number sequences, binomial coefficients, and binary and numbers sequences. The number sequences have to become a matter of further study for a *new number theory*. The approach to results in limitless expention of its subject as well as in natural combination of *classical theory of numbers and theory of Fibonacci numbers*.

Algorithmic measurement theory generates an infinite number of new methods of positional number representation. They are *number systems with irrational bases (the Fibonacci and golden ratio codes)* [10] which entail *new information fundamentals of computer engineering (Fibonacci-Computers)* [6].

A Binet formula gives a new fundamental system of functions. They are the *Fibonacci and Lucas hyperbolic functions* [11] which from the basis for biological processes simulation. *New geometric theory of phyllotaxis* discovered by O. Bodnar [1] confirms effectiveness of the new system of fuctions used for processed simulation in living nature. As for its value, the discovery can be compared with that of Kepler and Newton. It is essential to emphasize that harmonic blending of two ideas as for the Universe harmony ("*spherical*" and "*dodecahedron-icosahedron*" ones) played an important part in developing material culture of mankind. Owing to this blending ancient calendars, systems of time and geometryc angles measuring were developed. New mathematical theory created within modern natural sciences is called mathematics of harmony, it is based on the golden section and intended for process simulation in organic nature. It should be noted that its combination with classical mathematical analysis based on π - and e -numbers and intended for process of simulation in inorganic nature will result in *superior harmony in mathematics*. It will further demonstrate its effectiveness both in physical and biological sciens.

The view history of mathematics based on the idea of the Universe's harmony is the basis of reorganizing secondary and higher education. The idea of the Unoverse's harmony based on the golden section should be a fundamental one for a new system of education. The idea will result in raising the "harmonic" component in education as well as favor humanities coming together with exact and natural science.

REFERENCES

1. Bodnar O. Y. Goemetriya phyllataxisa (Geometry of phyllotaxis), Doklady AN Ukrainy, 1992, №9, p. 9-14.
2. Vorobev N. N. Chisla Fibonachchi (Fibonacci Numbers), Moskva, Nauka, 1978, p. 1-144.
3. Gratias D. Kvazikristally (Quasicrystals), Uspekhi Fizicheskikh Nauk, 1988, t. 156, №2, p. 347-363.
4. Danilov Y. A., Smorodinsky Y. A. Johannes Kepler: ot "Mistry" do "Harmony" (Johannes Kepler: from "Mystery" to "Harmony"), Uspekhi Fizicheskikh Nauk, 1973, t. 109, №1, p. 175-209.

5. Klein V. F. Lektsii ob ikosaedre i reshenii uravneniy pyatoy stepeni (Lectures on the Icosahedron and the Solution of the 5-th Degree Equation), Moskva, Nauka, 1989, p. 336.
6. Luzhetsky V. A., Stakhov A. P., Vakhovsky V. G. Logikodostovernye kompyutery Fibonachchi (Logic-Valid Fibonacci Computers) / Pomekhoustoichivye kody. Kompyuter Fibonachchi (Fault-Tolerant codes. The Fibonacci Computer), Moskva, Znanie, 1989, p. 64.
7. Stakhov A. P. Vvedenie v algoritmicheskuyu teoriyu izmereniya (Introduction in the Algorithmic Measurement Theory), Moskva, Sovetskoe radio, 1977, p. 288.
8. Stakhov A. P. Algoritmicheskaya teoriya izmereniya (The Algorithmic Measurement Theory), Moskva, Nauka, 1979, p. 64.
9. Stakhov A. P. The golden section in the measurement theory / Computers & Mathematics with application, 1989, v. 17, №4-6, p. 613-638.
10. Stakhov A. P. Kody zolotoy propotsii (The Golden Ratio Codes), Moskva, Radio i svyaz, 1984, p. 140.
11. Stakhov A. P., Tkachenko I. S. Giperbolicheskaya trigonometriya Fibonachchi (Fibonacci Hyperbolic Trigonometry), Doklady AN Ukrainy, 1993, t. 208, №7, p. 9-14.
12. Shmelev I. P. Fenomen Drevnego Yegipta (Fenomen of Ancient Egypt), Minsk, Universitetsky RIT "Lotats", 1993, p. 64.
13. Vajda S. Fibonacci & Lucas numbers, and the Golden Section. Theory and Application, Ellis Horwood limited, 1989, p. 190.