## Series on Knots and Everything — Vol. 65

In 1971, Alexey Stakhov was elected to the post of the Head of the Department of Information and Measurement Technology of the Taganrog Radio Engineering Institute, where he worked for 7 years (1971–1977). During "Taganrog period", Stakhov defended his **Doctoral Dissertation** (1972), received the academic title of the Professor (1974) and wrote his first book *Introduction to the Algorithmic Theory of Measurement* (1977) ("Soviet Radio", Moscow).

In January 1976, according to decision of the Soviet Ministry of Higher Education, Prof. Stakhov was directed on a 2-month scientific trip to Austria for scientific work at leading Austrian Universities (in particular, at Vienna and Graz Technical Universities). On the concluding stage of his stay in Austria, Stakhov made the speeches about his scientific direction on the Graz Technical University and then on the joint Session of the Austrian Cybernetics and Computer Societies (Vienna). His speeches aroused great interest of the famous Austrian scientists. 4 leading Austrian scientists in his supporting letters highly evaluated deep scientific ideas of Prof. Stakhov.

The present 3-volume book is intended for a wide audience, including teachers of high schools, students of colleges and universities and scientists in mathematics, theoretical physics and computer science.

The excerpt of the academician Yuri Mitropolsky, the head of the Ukrainian mathematical school, from the letter to Prof. Stakhov:

"Stakhov's publications are closing a cycle of his long-term research on the creation of a new direction in mathematics, the 'Mathematics of Harmony'.

One may wonder what place in the general theory of mathematics Stakhov's work may have. It seems to me that it is in the last few centuries as Nikolay Lobachevsky said, 'Mathematicians have turned all their attention to the advanced parts of analytics and neglected the origins of Mathematics, and not willing to dig the field that has already been harvested by them and left behind.' As a result, it has created a gap between 'Elementary Mathematics' — the bases of modern mathematical education — and 'Advanced Mathematics'.

In my opinion, the Mathematics of Harmony, created by Professor Stakhov, fills that gap. Mathematics of Harmony is a huge theoretical contribution to the development of 'Elementary Mathematics', and as such it should be considered as having great importance for mathematical education."

## Yuri Mitropolsky

Doctor of Sciences in Theoretical Mechanics, Professor
Academician of the National Academy of Sciences of Ukraine
Academician of the Russian Academy of Sciences
Honorable Professor: The Mathematics Institute of the National Academy of Sciences of Ukraine
Editor-in Chief of the Ukrainian Mathematical Journal

**World Scientific** 

www.worldscientific.com 11445 hc ISSN 0219-9769



Preface	to the Three-Volume Book	xi
Introduc	ction	xxv
About ti	he Author	xxix
Acknow	ledgments	xxxi
Chapte		01.251
1.1	Applications	1
1.1	The Idea of the Universeal Harmony in Ancient	
1.0	Greek Science	1
1.2	The Golden Section in Euclid's <i>Elements</i>	7
1.3	Proclus Hypothesis and New View on Classic	
	Mathematics and Mathematics of Harmony	14
1.4	Some Simplest Mathematical Properties of the	
	Golden Ratio	21
1.5	The Golden Ratio and Chain Fractions	24
1.6	Equations of the Golden Proportion of the	
	Nth Degree	26
1.7	Geometric Figures Associated with the	20
		00
1 0	Golden Section	30
1.8	The Golden Section in Nature	40

viii	i Ma	thematics of Harmony as New Interdisciplinary Direction $-$ Vo	ol. I
	1.9	The Golden Section in Cheops Pyramid	43
	1.10		48
	1.11	Golden Section in the Art of the Renaissance	52
O1			
Ci	apte	r 2. Fibonacci and Lucas Numbers	59
	2.1	A History of the Fibonacci Numbers	59
	2.2	The Sums of the Consecutive Fibonacci	
	0.0	Numbers	66
	2.3	Cassini's Formula	69
	2.4	Lucas Numbers	71
	2.5	Binet's Formulas	76
	2.6	Steinhaus's "Iron Table"	80
	2.7	Pythagorean Triangles and Their Presentation	
	2.8	Through Fibonacci and Lucas Numbers	82
	2.9	Fibonacci Numbers in Nature	87
	2.0	Fibonacci Numbers and Solution of Hilbert 10th Problem	000
	2.10	Turing and Fibonacci Numbers	92
	2.11	Role of the Fibonacci Numbers Theory in	95
		Modern Mathematics	00
		i The Idea of the Universeal Marmony in Ancient	98
Ch	apter	3. Pascal Triangle, Fibonacci p-Numbers	
		and Golden p-Proportions	103
	3.1	Binomial Theorem	103
	3.2	Pascal Triangle	103
	3.3	Diagonal Sums of Pascal's Triangle and Fibonacci	104
		p-Numbers	107
	3.4	The Extended Fibonacci p-Numbers	116
	3.5	Generalization of the Golden Section Problem	118
	3.6	Algebraic Equations for the Golden p-Proportion	
		and Vieta's Formulas	121
	3.7	Binet's Formulas for the Fibonacci $p$ -Numbers	126
	3.8	Binet's Formulas for the Lucas $p$ -Numbers	127

Chapte	r 4. Platonic Solids: From Plato's Cosmology to Fullerenes and Quasicrystals	133
4.1	The Golden Section in Platonic Solids	
4.2	Archimedean Truncated Icosahedron and	133
	Stellate Polyhedra	138
4.3	The Mystery of the Egyptian Calendar	142
4.4	Dodecahedral-Icosahedral Doctrine	150
4.5	Johannes Kepler: From "Mystery" to	
	"Harmony"	151
4.6	Icosahedron as the Main Geometric Object	
	of Mathematics	155
4.7	Usage of the Regular Polyhedra in the	
4.0	Fine Art	160
4.8	Dan Shechtman's Quasicrystals	176
4.9	Fullerenes	184
4.10	Platonic Solids and New Ideas in the Theory	
	of Elementary Particles	187
Conclus		191
Bibliography		197