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HARMONY OF THE <u>WORLD</u>

A LAW OF INTEGRITY

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HARMONY OF THE WORLD - A LAW OF INTEGRITY

It is hardly possible

for a non – mathematician to assimilate the thought that numerical characters

are of any cultural and aesthetic value

or somehow belong under such notions

as beauty, strength, inspiration.

N. Wiener.

The Harmony: an ancient enigma. I attempted to solve it, at least partially.

When analyzing the process of my own creative activity, I have come to the feeling that the structure of musical compositions is not accidental: it adheres to certain regularities that we apply by intuition. This fact, as well as some others taken from the field of music, has led the author to the problem of harmony long ago…

I. Retrospective Study

Primarily, the problem of harmony emerged in Pythagorean school. In succeeding 2.5 millenniums, a vast literature has dealt with this problem. Such great thinkers as Leonardo da Vinci and Kepler are among those who approached it. Nevertheless, the problem remained unsettled, the law of harmony was not found.

Many investigators of harmony associate it with the golden section[1] and try to derive the sought for law from the known regularities. Some of them are seeking for the physical meaning of harmony, and others - for its biological or psychological aspects, the harmony as such being for them only of minor importance. In reality, the case is somewhat different: the Harmony is a universal notion that cannot be reduced to any one of known regularities. His Majesty the **Number** is ruling here, the number taken in Pythagorean sense, as an expression for the **essence**.

I am a musician. I has come to harmony from music. The process of musical composition is complex and diversiform, but there is (at least, for me) a general rule: one cannot write down the notes arbitrarily, the sense of harmony brings him to such state of mind that the sense of a whole, exact entry of this or that theme and even of each note are as though beforehand predetermined. The precision is here so high that any randomness is excluded.

At best, the written music invokes the sense that you are not its composer, that it is and ever was such by nature. If this occurs, you can be sure that such music will not grow old.

What means “by nature”, from where comes this non-randomness?

It has turned out that this question invokes another one, which has stirred the mankind from time immemorial, namely: how is the world arranged?

Modern, that is classical, paradigm of knowledge (or modern natural sciences) does not discuss the problem of harmony on a broader scale. At the best, it is considered that the existing branches of knowledge (physics, biology, etc.) carry all the conceivable knowledge of harmony. However it is not correct.

The modern paradigm is based on empiric knowledge and represents the multitude of particular (let them be called fundamental) sciences, whereas the harmony is a general law, the law of a single whole. It cannot be based on empiric knowledge, as it should relate to all sciences, and also to art. The knowledge of harmony can be only based on pure intellection. But the experience still remains a criterion of truth, as confirmation of the speculatively formulated laws.

This paradigm actually is not new, but most ancient! It arises now at a new stage enriched with two-millennial development of knowledge.

In this article, I shall briefly outline the fundamentals of the theory of harmony with an emphasis on actual (or experimental) material, which is entirely new and was not known earlier. The theory will be given only inasmuch as it will allow the said actual material to be presented.

So, what is harmony?

I have primarily tried to formulate the logical definition of harmony. It is commonly supposed that harmony is that which integrates the parts into a whole. But what is the nature of this integration, how is it defined? It is the fundamental question! To answer it, I have attempted to understand the history of knowledge and logic of its development. In this endeavor, I was led by my musical intuition and works by Galileo, Newton, Einstein, Planck, Pavlov, Plato, Kant, Hegel, as well as those by the contemporary scientists Urmantsev and Feynman. As a result, the harmony was defined as a paradoxical **equivalence of opposites**, which occurred to be the essence (i.e., interior mechanism) of all laws of natural sciences and arts. The mentioned equivalence of opposites is closely associated with motion, the content of harmony being not the motion itself, but the essence of motion, which is just its opposite: the stability, rest, equilibrium, conservation, constancy... I has named these categories as the terms of harmony. Whereas physics states the laws of motion, my objective was to formulate, broadly speaking, the law of stability. This impelled me to develop new mathematical principles. Three interconnected, following from each other numerical laws have been discovered:

I Qualitativ Symmetry

II Violated Symmetry

III Golden Section

The first two laws have been stated by the author for the first time. The golden section, though known hitherto, has acquired a new and diverse content.

A set of basic numbers have been established and new numerical series derived from the laws thus stated. (Incidentally, a row of basic numbers coincided with enigmatic physical constants, e.g., with number **137**, but this will be discussed later). Further, I have discovered a lot of new experimental facts. For instance: a strict order in the arrangement of planetary orbits; musical tone scale; Mendeleev’s Periodic system of elements; the harmony in genetics, physics, mathematics, in other fields of knowledge and, naturally, in the art, e.g., in the works of classical music (from J.S. Bach to Shostakovich). About 85% of the numbers thus obtained correlate with the numerical series of harmony laws to a high degree of precision. A few examples that follow can illustrate the aforesaid.

1. **The ranked arrangement of planetary orbits** reveals, in particular, an enigmatic relation to the human hearing: there are 7 musical octaves (2^n, n = 0, 1, 2, ... 7) and 7 octaves occurs in the mean solar distances of planets. This can be explained in musical terms: let us imagine the piano keyboard covering 7 octaves (Fig. 1).

If we locate the Sun at the right end of the keyboard, the Pluto will be found at its left extremity. The other planets will occupy the octaves, the Earth and Mars will locate themselves in two adjacent semi-octaves, which are nearly symmetric to each other. This fact was not known in the past. I shall discuss it in detail below.

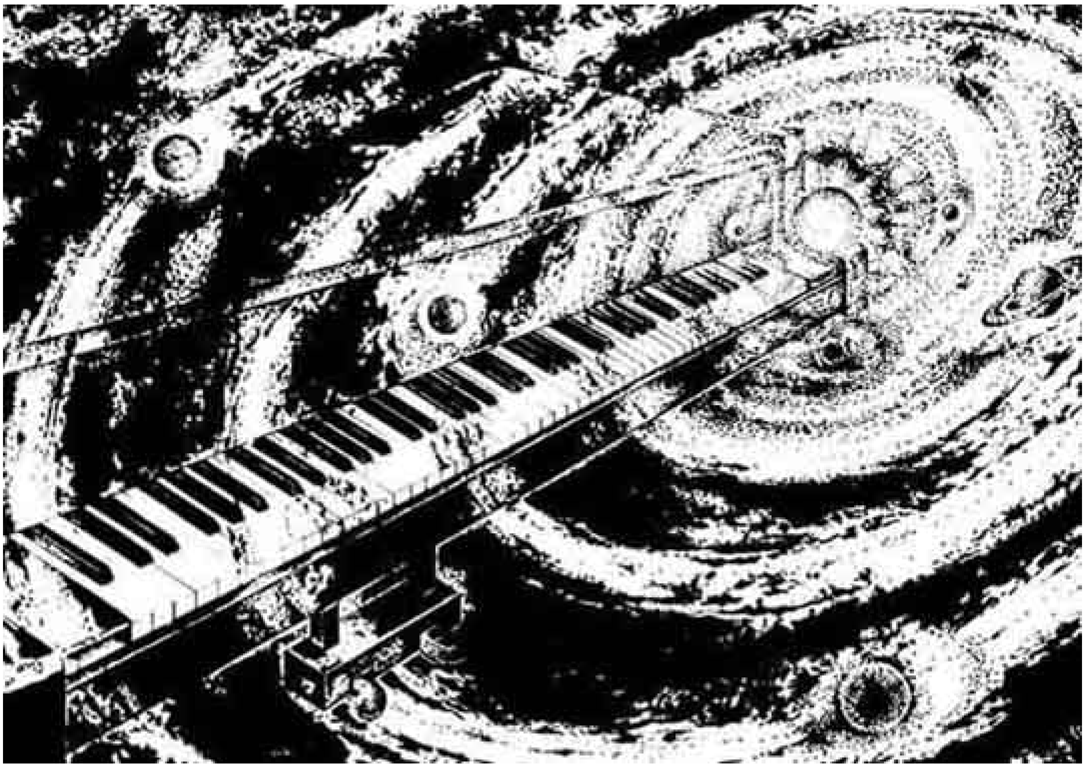

Fig. 1

2. From **Law II**, I have obtained, in particular, **number**

$$q = 0.9428... = 0.485/0.515,$$

whose fundamental meaning is "the violation of halves"[2]. I discovered this number originally in the first movement of Appassionata, which ranks among the most perfect compositions as far as its musical form is concerned. To analyze it, I have used a macroform containing the conventional parameters: the exposition, development, recapitulation (ABA_1). The fundamental nature of recapitulation in music is generally known. Therefore I have posed the question: what is the ratio in which the occurrence of recapitulation divides the form of the whole (the total movement). The counted numbers were distributed as follows: $A + B + A_1 = 3147$, $A + B = 1620$, $A_1 = 1527$ quavers[3]. The ratio $A_1/(A + B) = 0.485/0.515$. I perceived the fact discovered as a "miracle". More recently, I have discovered this number also in many other compositions.

One more "miracle". As known from biology, there exists a constant peace-time male/female birth ratio; its mean value is the same for all human races: 106 boys are being born per 100 girls. By the same procedure we obtain 100/106 = 0.485/0.515. (This ratio attains a still more close approximation of *q* at well-to-do parents in England, i.e., in more harmonious conditions of life, where it equals 100/106.1).

The third "miracle". The planet Uranus divides the mean Sun-to-Pluto distance in two halves, which are equal only approximately. Denote by *a* the Sun-to-Uranus distance, by *b* - Uranus-to-Pluto distance; then $a/b = 0.485/0.515$.

The fourth "miracle". When transformed after Law I, the mass ratio of two fundamental particles, proton and K-meson, appears to be 0.485/0.515. (Mass ratios for other fundamental particles are likewise related to harmony).

Thus, one and the same number occurs in phenomena of quite dissimilar kinds (music, genetics, physics).

3. There are two specific problems the physicists strive to solve.

(**1**) **Number 137**: problematic is the nature of empirical dimensionless factor 137 ($\hbar c/e^2 = 1.3703598 \cdot 10^2$, where ħ is Planck's constant *h* divided by 2π ; *c* is velocity of light, *e* is the charge of electron). Dirac considered the problem of number 137 to represent "the first class difficulty".

(**2**) **Violation of symmetry**, "a great problem of dynamics" (R. Feynman). Up to now, these problems have been treated in physical sciences separately.

But from the laws of harmony it is apparent that not two but only one problem does exist here. The second law of harmony is the law of violated symmetry.

Its main numerical value is $\beta=2^{5/11}=1.3703509$. Numbers β and $\hbar c/e^2$ coincide with an astonishing accuracy to the first six digits (it may be shown that factor 10^2 is not essential in comparing these numbers. There is an explanation; in particular,

$$10^{0.137} = 1.37;\ 10^{2.137} = 137).$$

4. **A few examples from music and genetics**. Consider Fugue No.1, op. 87, by Shostakovich. Number 1.37 recurs in the fugue 20 times. By way of illustration, here are the main divisions by parameters ABA_1. The numbers of bars: $A = 39$, $B = 39$, $A_1 = 28.5$. The ratio $A/A_1 = B/A_1 = 1.36842... = 1.37$.

In Mozart's piano sonata in A minor, this number emerges 8 times in its very theme! I have discovered this using the law of qualitative symmetry. The main division of the theme from Mozart's sonata is shown in (Fig. 2.) In this case, there is no need for transformation. The theme comprises 8 bars with 64 quavers. It is subdivided in two contrasting parts, the first containing 37, the second - 27 quavers. Their ratio 37/27 = 1.37037... Compare it with number β = 1.37035... A fantastic precision!

W.A.Mozart. Sonate for Piano a-moll (theme)

$$\frac{37}{27} = 1{,}37037 \qquad \frac{30}{7} = 4{,}286 = a_{+5} \to a_{+15} = 137 \qquad \frac{16}{11} = 1{,}4545 = b_{+2} \to b_{+1} = 1{,}375$$

$$3/5 = 0{,}6 = c_{-2} \to c_{-1} = 0{,}833... \qquad \ln c_{+1} = 0{,}1823 = d_{-5} \to d_{+1} = 1{,}37$$

Fig. 2.

Now let us consult the book “General Genetics” by N.P. Dubinin (Moscow, 1970). In p. 87, we read: “In the case of trihybrid crossing... in the second generation... , the formula of segregation will appear as follows: 27 colored plants and 37 white-corn plants will appear for every 64 plants.” In general, the ratio 37/27 is always present in trihybrid crossing as a consequence of Mendel’s law. The same mathematical relationship, the same fantastic precision!

We can see time and again that different (and fundamental) phenomena appear under the badge of the same number.

I have presented a small fragment of the great problem. We shall try now to think it over logically.

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[1] It is the name given by Leonardo da Vinci to the “Divine Proportion” known since Pythagorean times.

[2] The numerator and denominator of quotient 0.485/0.515 are rounded off to three digits. For any number a =x/y, with x + y = 1 (as with the above cited number q), the magnitudes of x and y are determined from formulae: x = a/(a + 1); y = 1/(a + 1).

[3] In the case of fractional measures, with up– beats, it is more convenient to count the quavers.

III. Qualitative Generalization

Formula **(1)** implies a series of consequences, the most important of which is the **qualitative generalization**. Consider it by the example of interrelation between the rest and motion. On the one hand, the rest is a particular case of the motion; on the other, this case represents a peculiar kind of generalization since all motions (i.e., each particular motion) are indistinguishable from the rest. Thus, the rest is not simply a particular case, but **each** particular case of motion. Clearly, a particular case that is generally contained in all cases of the kind considered may be called a generalization. I have named it the **substantial**, or **qualitative**, **generalization** to underline its dissimilarity to that in common use.

Qualitative generalization has a mathematical meaning. For instance, let us examine the harmonic 1/n series (1) and a more general series $1/n^s$ (2), which contains series (1) as a particular case. Series (2) is a generalization of (1) in the ordinary sense. I denote the latter as **quantitative generalization** because here, the generic is a set [series (2)].

Series (1) represents an important, though particular, case of series (2) inasmuch as it serves as the basis – that general that is contained in each case of series (2). For this reason series (1) is also a generalization of series (2), though not quantitative, but substantial (i.e., qualitative) one.

Another example: Euclidean geometry. All geometries in the extreme particular case become Euclidean, which means that Euclidean geometry is a qualitative generalization (the essence) of geometry as such.

The above considerations give rise to numerical laws because arithmetic is a particular case precisely of the kind described: it is the qualitative generalization of mathematics. Thus, the concrete numbers (figures) are able to express not only the quantity, but also the quality (essence). So the qualitative generalization has led us to numbers as an essence, which proves once again the Pythagorean postulate: the numbers are the essence, the verity.

The notion of Qualitative Generalization was defined by me for the first time. It was used sometimes earlier intuitively and implicitly, as for instance in the expression “an important particular case”, but nobody contributed to it the status of generalization, though precisely this status opens the way to the mathematical principles of harmony. Qualitative generalization is the essence of harmony and the leading concept of this study.

Consider now one more important consequence of formula **(1)**: **the Universe is Harmony**. From **(1)** it follows that the essence of motion is determined by the harmony categories. This means that Harmony is the essence of the Universe. But it was generally accepted heretofore that the essence of the Universe is matter. A dualism emerges, which provokes the question: what is the nature of the matter? This problem became pressing early in the 20th Century when $E = mc^2$ law was discovered. The problem was stated in the following way: what is the nature of the motion carrier (i.e., matter)? The problem is without answer up to now. The development of knowledge in 20th Century proved that there is no permanent material (mechanical) motion carrier. But what then is in motion? That which is in motion cannot be the motion itself! Otherwise it were the pure pointless motion, i.e., pure nonsense. And what is the “non-motion”? Just this implies the categories of harmony: the stability, constancy, equilibrium, etc. Hence, there is no dualism, and no matter as well: there exists harmony! This does not mean that we propose to withdraw the term “matter” from use. It were irrelevant, for instance, to call the concrete things as “harmony”. But harmony is a wider notion than “matter”, it is both inside and outside us. The harmony is primary, it is not determined by any further causes. It is the initial cause of all existent. The harmony makes neither physical nor biological sense. Its meaning is substantial.

Let's try to state it differently.

From identity of opposites it follows: the motion is always unidirectional, always negates itself, that is **always expresses stability**. If this stability is well pronounced, we have that we refer to as a material particle. If such process takes place in a would-be empty space, there will be an impression that the substance emerges from nothing, while actually it is a manifestation (or emanation) of harmony, which follows from the aforesaid.

Thus, **the Universe is Harmony!** The intuition of ancients is astonishing.

From formula **(1)**, we can understand the fundamental nature of the triad, as well as that of numbers 2, 3 and 7 in numerical expressions of harmony, and many other things. For instance, it allows us to draw the conclusion: harmony is a non-space/time category. The proof is based on Planck's constant. It turned out that harmony is the essence of the space-time. There is no point in expressing the essence of space-time continuum in space-time coordinates. It is notable that Einstein had foreseen such a situation. Like Kant, he did not considered space and time as essences that are independent of our senses. He said in this connection: "... to think of these notions of forgotten origin as of necessary and unshakable companions of our thinking, it would be a mistake that could seriously jam the progress of science".

In line with this assumption, I was compelled to change the principles of epistemology by turning them half-round. Specifically, it proved to be essential:

(1) to transfer the point of cognition from motion on its essence, which is stability;

(2) to describe the content of formula ***(1)*** *in other than space-time terms;*

(3) to use the qualitative, not quantitative, generalization as a ***basis*** *for cognition*.

IV. Qualitative Symmetry

The basic mathematical ideas of harmony - the symmetry and mean proportionals (arithmetic, geometrical, harmonic, ...) - were developed by ancients long ago. These ideas together with two fundamental mathematical principles - those of additivity and multiplicativity - formed the basis of cognition and produced, through the qualitative generalization, the mathematical principles of harmony doctrine. Three fundamental laws were discovered.

Law I: Qualitative Symmetry. In this section, we briefly review three basic ideas (or steps) that led us to this law.

Step one. Qualitative generalization of symmetry as such. I have called it the proportion of symmetry. It denotes bisection of the whole. This proportion (which is in effect an equality) is the essence of any symmetry. Take, for instance, the mirror symmetry. The basic case contained in all cases of this form of symmetry can be defined as follows: a point and its reflection cut out in a straight line a segment that is halved at the center of symmetry: the case of symmetric division of a length, which represents the proportion of symmetry. The latter is a more wide (or general) notion than the mirror symmetry because it can be applied not only to geometrical and spatial conceptions but also to those of biological, acoustic, musical, architectural, or any other nature.

Step two. Write the qualitative equality

$$\boldsymbol{a} \eqsim 2^n \boldsymbol{a} \qquad \textbf{(2),}$$

where symbol $\eqsim$ denotes “qualitative equals” and n is an integer. Qualitative equality is the basic idea of mathematical principles of harmony. Formula **(2)** generalizes the principle of dichotomy and also contains the qualitative generalization of symmetry insofar as it duplicates the proportion of symmetry in each half, fourth, eighth, etc. of the whole. To put it differently, numbers 1/2, 1/4, 1/8, ... or 2, 4, 8, ... , i.e., the integral powers of 2, express the qualitative significance (essence) of symmetry.

Formula **(2)** can be interpreted through two fundamental phenomena: (i) cytokinesis (cell fission in two) in biology; (ii) octave similarity in music. Octave similarity is actually so fundamental that removal of an octave from music would mean the abolition of music itself. We shall consider now at greater detail what is the octave similarity.

Let us play some melody, then play it one octave, two octaves higher (or lower). Such transpositions do not change the essence of the melody that remains the same. These transpositions are nothing but a symmetrical transformation. The octave sounds are qualitatively equal to each other. They are in the ratio of integer-valued powers of 2 (by this are meant the quotients of frequencies). In common symmetry, a figure remains unchanged after transformations. In the case considered, just the quality, essence will last. I have offered here a musical example because I think music to be a bright light illuminating the concealed essence of the Universe.

Step Three. Formula **(1) A is non-A** has been interpreted as a link between straight line and curve (or, more accurately, between straightness and curvature) and represented as relationship of additive and multiplicative principles. In line with this assumption, the arithmetical and geometrical means were understood as two symmetries and then, through a number of qualitative generalizations, converted into the form of qualitative symmetry (S_q), which is the law of numerical transformations.

Derivation of S_q and other laws is presented more elaborately in [1] and [2]. I shall summarize here the transformations of S_q that help to solve this almost three millennium old problem.

Denote the qualitative symmetry by S_q. This symmetry divides the number axis into ranges confined by the integer powers of $\sqrt{2}$. They will be called S_q– factors. The principal factor is $\sqrt{2}$. The S_q– ranges are numbered. Let there be:

$$\overset{-3}{\div}(\sqrt{2})^{-2}\overset{-2}{\div}(\sqrt{2})^{-1}\overset{-1}{\div}(\sqrt{2})^{-0}\overset{+1}{\div}\sqrt{2}\overset{+2}{\div}(\sqrt{2})^{2} \ldots;$$

where the upper indices -3, -2, -1, +1, +2 ... are the numbers of ranges. In music, these ranges may be interpreted as half-octaves. Denote the i-th range by $\overset{i}{R}$, where i is the number of corresponding range. The ordinals of ranges associated with numbers will be denoted by lower indices: a_i. Thus, notation a_{+1} means the number a in the range $\overset{+1}{R}$. By this is meant that $\sqrt{2} > a > (\sqrt{2})^0$. Let it be the number 1.236. Brief notation: $a_{+1} = 1.236$, or $1.236 = a_{+1}$. A transformation is transfer of a number from one range into another. An example of the transformation of a from +1 range into another ranges is given in Table 1.

Table 1

Qualitative Symmetry Transformations

$$\perp \overset{+1}{a \cdot 2^0} \perp \overset{+2}{a^{-1} \cdot 2} \perp \overset{+3}{a \cdot 2} \perp \overset{+4}{a^{-1} \cdot 2^2} \perp \overset{+5}{a \cdot 2^2} \perp \overset{+6}{a^{-1} \cdot 2^3} \perp \overset{+7}{a \cdot 2^3} \perp \ldots$$

$$\perp \overset{-1}{a^{-1} \cdot 2^0} \perp \overset{-2}{a \cdot 2^{-1}} \perp \overset{-3}{a^{-1} \cdot 2^{-1}} \perp \overset{-4}{a \cdot 2^{-2}} \perp \overset{-5}{a^{-1} \cdot 2^{-2}} \perp \overset{-6}{a \cdot 2^{-3}} \perp \overset{-7}{a^{-1} \cdot 2^{-3}} \perp \ldots$$

Each range limit is denoted by transformation symbol $\perp$; the upper indices (+1, +2, +3 ...; -1, -2, -3 ...) are the range order numbers.

With reference to this table, it can be seen that transformations of S_q take the form: $a \perp a^k \cdot 2^n$, where symbol $\perp$ denotes the transformation; k = +1, -1 (the sign alternates in each consequent range); n is an integer changing by 1 in each second range. The general formula of transformations, or **Law I**, has the form:

$$\boldsymbol{a_i = a_j^{\,b} \cdot 2^c}, \qquad \textbf{(3)}$$

where i, j are the numbers of ranges; a_j is a given number; $b = k_i \cdot k_j$ and can take only two values: $b_1 = +1$, $b_2 = -1$; depending on b, number c can also take on only two values: $c_1 = n_i - n_j$; $c_2 = n_i + n_j$. If $b = b_1$, then $c = c_1$; if $b = b_2$, then $c = c_2$. It is convenient to take the values of k and n from Table I. Transformation with b = +1 denotes $a_i = 2^c a_j$, whence $a_i \eqsim a_j$, i.e., we have a qualitative equality in terms of formula (**2**). Transformations of S_q form a group satisfying all the requirements of four axioms of the group theory. Thus, according to formula (**3**), number a taken in any given range j , i.e., number a_j , may be transferred into any desired range i, i.e., into number a_i . Transformations of S_q can be expressed with the use of symbol $\perp$ with indication of the relevant range numbers, for instance:

$$\overset{-1}{0.729} \perp \overset{+1}{1.37} \perp \overset{+2}{1.46} \perp \overset{+6}{5.84},$$

or using the arrow and varying the subscript (i.e., the range number) of the same number:

$$a_{-1} = 0.729 \rightarrow a_{+1} = 1.37 \rightarrow a_{+2} = 1.46 \rightarrow a_{+6} = 5.84 .$$

Let us take now numbers 1.46 and 1.37; to illustrate the transformation by formula **(3)**, we shall show how 1.46 transforms into 1.37. Number 1.46 belongs to $\overset{+2}{R}$, i.e., the given number $a_j = a_{+2} = 1.46$. Transform it into $\overset{+1}{R}$.

So, $i = +1, j = +2$. From formula (3), $a_{+1} = 1.46^{b} \cdot 2^{c}$. Determine b and c:

$$b = k_i \cdot k_j;$$

k is a power of a in Table I: $k_{+1} = 1$, $k_{+2} = -1$. Whence $b = k_{+1} \cdot k_{+2} = (1) \cdot (-1) = -1$, i.e., $b = b_2$ and therefore $c = c_2 = n_i + n_j$ where n is a power of 2 from Table 1: $n_{+1} = 0$; $n_{+2} = 1$. We also find

$$c = n_{+1} + n_{+2} = 0 + 1 = 1.$$

Thus, $b = -1$, $c = +1$. The final result is:

$$a_{+1} = 1.46^{-1} \cdot 2^{+1} = 1.37.$$

The essence of Law I proved to be **Law II**: the **Violated Symmetry** (Fig. 3). Law I is based, in particular, on the interrelation between geometrical (x_g) and arithmetical (x_a) means; according to Law II, this relation appears as x^2_g/x_a, which is the harmonic mean (x_{harm}). Law II using S_q generates numerical series that express essentially the derivations from S_q-factors. The main numbers are

$$\beta = (\sqrt{2})^{10/11} = 1.3703509\ldots$$

as deviation from $\sqrt{2}$, which is the principal factor of S_q (compare $\sqrt{2} = 1.414$ and 1.370), and $\alpha = (\sqrt{2})^{-1/11} = 0.969$ as deviation from 1; furthermore, 0.833, 0.800, 0.943, 0.750, 0.714, 0.792, 0.865, 0.852, etc.

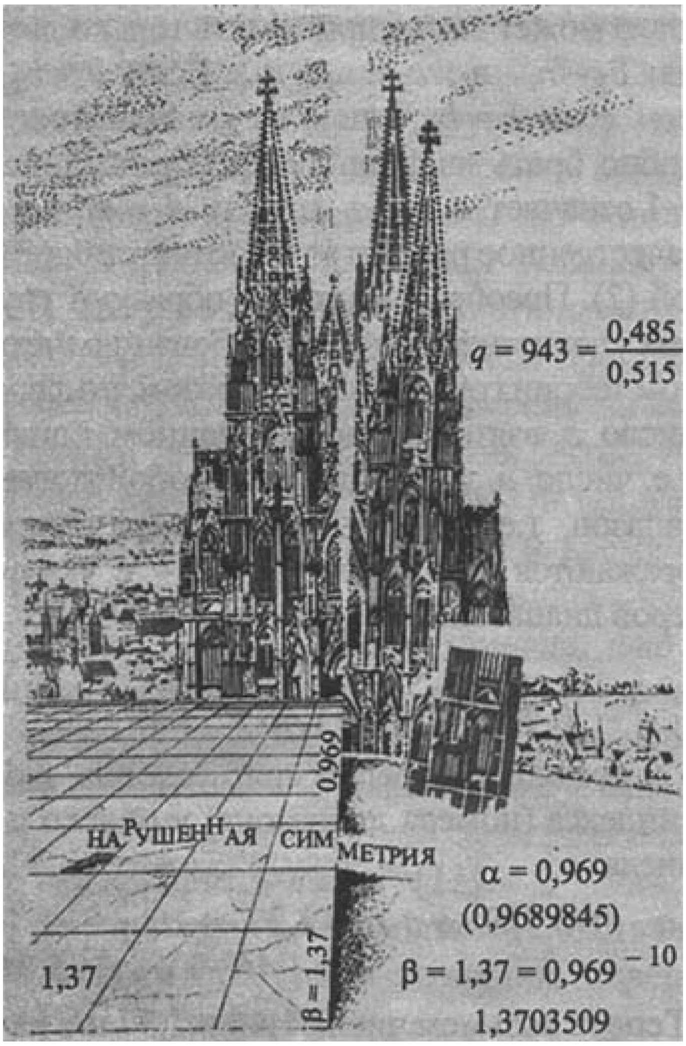

Fig. 3

Law III — the **Golden Section** (Fig.4) — was deduced from Laws I and II. This law generates numerical series as well. Its main numbers are

$$\mathbf{\Phi} = (\sqrt{5} + 1)/2 = 1.618;$$

$$\mathbf{\Phi}^{-1} = 0.618;$$

$$\mathbf{\Phi}^{-2} = 0.382;$$

and also 0.944, 0.972, 0.874, 0.894, 0.786, and others.

Fig.4

The numbers derived from **Laws II and III**

are invariant under transformations S_q. For all invariants, except for three principal ones: 1.37, 1.618, and 0.417,

I use $\overset{-1}{R}$ as the effective range.

Hereafter, I shall exemplify the facts related mainly to these principal numbers.

V. Problem- Related Experimental Evidences[5]

1. Correlation between the Golden Section and number 137. Using S_q, I was first to discover the linkage between Φ and 1.37. This linkage is multiform. Consider one example.Assume a_{-2}= 0.618, b_{-3} = 0.382. These numbers divide the unit length in terms of the golden section (0.618 + 0.382 = 1). The symmetry point (geometric mean) $x_g = \sqrt{a_{-2}.b_{-3}}$ = 0.486 is located between these numbers, i.e., it deviates from 0.5 = $(\sqrt{2})^{-2}$. Transform a_{-2} = 0.618 into $\overset{+1}{R}$ and b_{-3} = 0.382 into $\overset{+2}{R}$, i.e., into the region of $\sqrt{2}$ as the principal S_q-factor ($\sqrt{2}$ is the bound between the ranges +1 and +2). From formula (3), a_{+1} = 1.236, b_{+2} = 1.528. The center of symmetry $x_g = \sqrt{a_{+1}b_{+2}}$ = 1.374 (see Table 2).

Table 2

Interrelation between the Golden Section and number 137

		$a_i = a^b_j \cdot 2^c$
$a_{-2} = 0.618$ $b_{-3} = 0.382$	$x_r = \sqrt{a_{-2} \cdot b_{-3}} = 0.486$ ↓	(0.486/0.500 = 0.972)
$a_{+1} = 1.236$ $b_{+2} = 1.528$	$x_r = \sqrt{a_{+1} b_{+2}} = 1.374$	($1.374/\sqrt{2} = 0.972$)

This impels us to look at the golden section from another point of view. It turns out that, after having found number 137 in the nature, the physicists were the first to discover the golden section! But number 137 is many-sided, which can be seen from Table 3, so that the problem of number 137 is much more complicated than in physics. It should be mentioned in passing that it is impossible to explain the violated symmetry in the framework of physics, which is based on the uncertainty (i.e., inaccuracy) principle. The violation of symmetry is also inaccuracy. There is no sense in explaining the inaccuracy by inaccuracy. *The removal of space-time takes away the uncertainty*. For that reason *high precision is a fundamental feature of harmony*.

In other words, *there is no linkage to experiment in the mathematical form of a law*, be it the law of physics, chemistry, etc. The laws of harmony are *numerical laws that can be applied to numbers*. To reveal harmony, experimental numbers shall consist of no less than three significant digits.

Table 3

Number 137

1. $\beta = 2^{5/11} = 1.3703509...$	= 1.37
2. $l = 1.37128857...$	= 1.37
3. $\eta = (\sqrt{3} + 1)/2 = 1.3660254...$	= 1.37

4. K = 1.370388...	= 1.37
5. K_1 = 1.37038508...	= 1.37
6. 1.374243...	= 1.37
7. 1.3739536...	= 1.37
8. 1.369306...	= 1.37
9. 1963 г: $\hbar c/e^2 = 1.370388 \,.\, 10^2$	
10. 1969 г.: $\hbar c/e^2 = 1.3703602 \,.\, 10^2$	
11. 1975 г.: $\hbar c/e^2 = 1.3703598 \,.\, 10^2$	

Numbers (1), (2), (3) are derived from **Law II**, numbers (4), (5), (6) are derived from the Golden Section, numbers (7), (8) have been found from musical series, numbers (9), (10), (11) are the values of the physical dimensionless constant $\hbar c/e^2$ experimentally found in different years.

2. Qualitative Symmetry as Applied to the Interplanetary Distances. In Table 4, the relation r/R (where r is the average distance of a planet from the Sun, R - from the Sun to Pluto) covers 14 ranges of S_q, or 7 octaves. For the sake of uniformity, all the numbers from the indicated ranges are transformed by formula **(3)** into $\overset{-1}{R}$. Following such transformation, number *c* in formula (3) assumes the absolute values 0, 1, 2, 3, … , 7, as shown in the table. These values, i.e., the powers of 2, increase without gaps, which denotes the ORDER in interplanetary distances[6].

This order, which was discovered by application of S_q , is consistent with the **Law I**. Moreover, all the numbers in Table 4 coincide with the principal numbers of the **Laws II and III**. We call attention to this striking coincidence.

Here is one example. Let us consider Mars. Number 0.809 is the golden section taken in the range $\overset{-1}{R}$. The main number of the golden section lies in $\overset{+2}{R}$*, i.e., a_{+2}* = Φ = 1.618034. Transform it into the Mars number range $\overset{-10}{R}$. From **(3)**, a_{-10} = 0.03863, which agrees with the Mars number to the last digit. The coincidence is striking. It were impossible to disclose the “golden” nature of the Mars number without resort to S_q.

A more sophisticated treatment of the Table 4 data and other facts associated with interplanetary distances show that the Earth has the most harmonious S_q-factors.

Table 4

Harmony in arrangement of planetary orbits

Planet	*r/R*	2^c	$\overset{-1}{R}$
Pluto	1		
Neptune	0.76570 ($\overset{-1}{R}$)	2^0	0.766

Uranus	0.48534 (R^{-3})	2^1	0.971
Saturn	0.24292 (R^{-5})	2^2	0.972
Jupiter	0.13194 (R^{-6})	2^3	0.947
Asteroids	0.0714 (R^{-8})	2^4	0.875
Mars	0.03863 (R^{-10})	2^5	0.809
Earth	0.02536 (R^{-11})	2^5	0.811
Venus	0.01834 (R^{-12})	2^6	0.852
Mercury	0.00982 (R^{-14})	2^7	0.796

Source of the data: Lang K. Astrophysical Formulas. Moscow, 1978.

3. *Pure and Tempered Musical Series*. In full series (complete with the octave) shown as (A) and (B) in Fig. 5, the center of symmetry in both sequences $x_g = \sqrt{ab} = \sqrt{2}$, where a and b are two arbitrary members of the (A) or (B) series spaced symmetrically about its mid-point. If we eliminate the octave (as a recurrence)[7], the similar center of symmetry in both series will shift by 1.37. This means that both musical series are governed by the **Laws I and II**.

The author was first to discover that qualitative symmetry S_q relates the tempered sequence to the golden section. This relation can be derived also from Table 3. Number 1.37424 (Table 3, No. 6) is obtained from the golden section, number 1.37395... (Table 3, No. 7) - from the tempered section. Both numbers ere equal with a precision of four significant digits: 1.374 (the inaccuracy is not accidental). This implies that the tempered sequence expresses all three laws of harmony, i.e., the canon (scale) itself is harmonious. This fact is worthy of notice. It is generally agreed that tempered sequence has been devised to eliminate the disharmony arising within the pure natural sequence, that sequence (B) is in rough agreement with sequence (A) (Fig. 5), and that the existing discrepancy is not essential for our ear. Contrary to this belief, the fundamental nature of sequence (B) is established here. It is shown that the human-crated sequence is akin to harmony to a greater extent than the natural sequence. **There is nothing strange in the fact that the tempered sequence forms the basis of the European musical culture**. What it means is that European music is based on irrational numbers. The numbers derived from the laws of harmony are also irrational. Hence, irrational numbers are in the heart of Nature. Whereas the natural sequence of numbers is readily obtained as something secondary from the same laws of harmony.

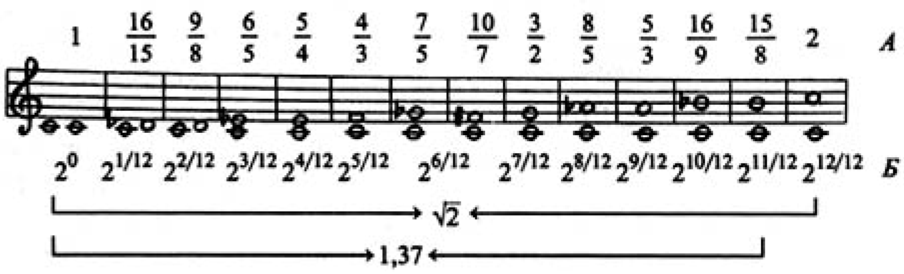

Fig. 5

4. Newton's Solar Spectrum. Newton argued that the chromatic spectrum correlates with a musical scale. If MX = CM = 1/2 (Fig. 6), the distances of color boundaries to point X constitute the mentioned numerical series corresponding to frequency ratios of the 7-step scale.

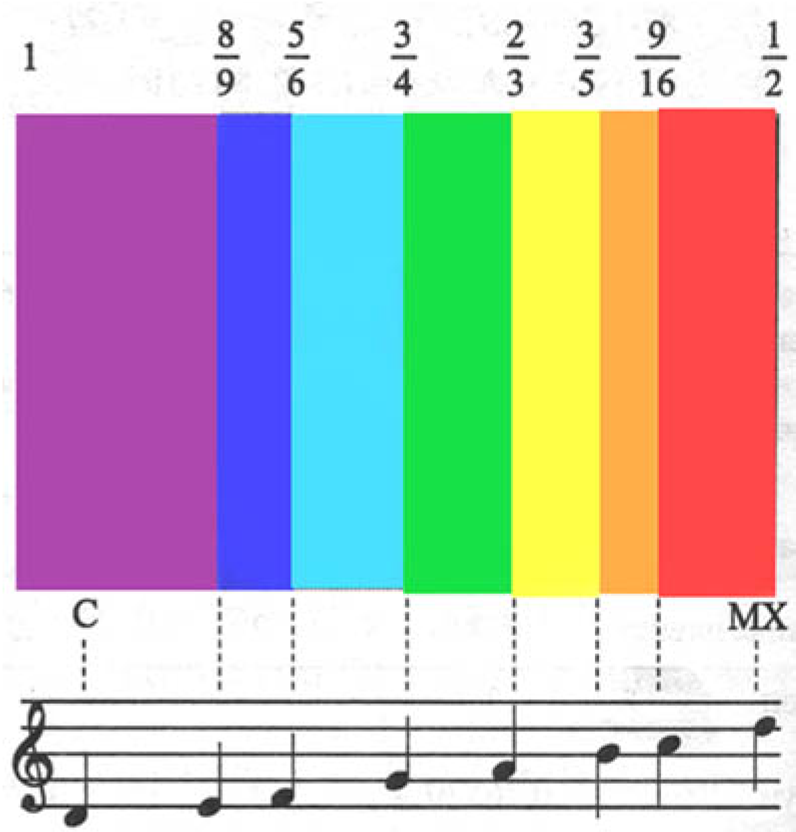

Fig. 6

5. Musical Series and Mendeleev's Periodic Table. The Periodical Law is essentially the subgroup analogy that divides the chemical elements into three groups: nontransitional (8), transitional (10), and lanthanides (14). The arrangement of these groups in the Periodic Table forms the multiplanar rhythmic structure, a composition. To examine this composition, we unfold the Table into a line and designate the elements of the same subgroup by the same letters. This procedure reveals the rhythms running through the entire Table; I have called them the rhythms of the whole. Their ratios transformed by formula **(3)** into $\overset{+1}{R}$ and $\overset{+2}{R}$ form a series that coincides precisely with musical series (A). This fact leads us to suppose that the arrangement of elements in the Table is determined not only by physical laws but also by the law of harmony. Besides, the disclosed fact suggests that the Table may have element No. 118 as its final constituent..

6. ***Number 0.417***. For the time being, it is an enigmatic but, possibly, the most fundamental number of harmony derived from **Law II**. In Fig. 7, the universal constant (the ratio of the gravitational attraction to the electric repulsion of two electrons) is shown. R. Feynman in his Lectures on Physics have called attention to an enormous value in the denominator: $4.17 \,.10^{42} = 0.417 \cdot 10^{43}$.

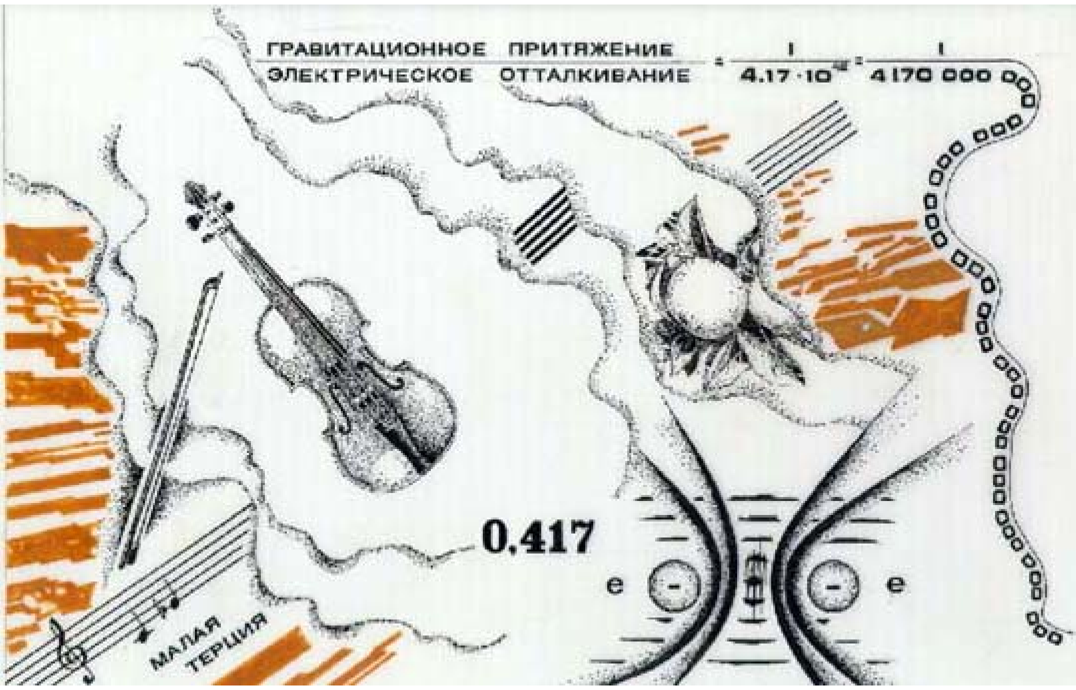

Fig. 7

Leaving aside the zeros (as it was in the case of number 137), we shall consider number 0.417 itself. Through S_q this number correlates with the golden section and number 137 and also with many fundamental problems. An example will be given below. In music, number 0.41666(6) represents the minor third

$$0.41\overset{-3}{666}\ldots\perp 0.8\overset{-1}{333}\ldots\perp\overset{+1}{1.2}.$$

These numbers can be expressed as the ratios of integers:

$$\overset{-3}{5/12}\perp\overset{-2}{3/5}\perp\overset{-1}{5/6}\perp\overset{+1}{6/5}\perp\overset{+2}{5/3}\perp\overset{+3}{12/5}.$$

It is precisely these numbers that are responsible for the structure of musical form in the overwhelming majority of eminent compositions by Bach, Mozart, Beethoven, Tchaikovsky, Prokovyev, Shostakovich. Consider, for instance, the First Book of "The Well Tempered Clavichord" by J.S. Bach. The structure of themes in 12 out of 24 fugues is expressed by number 0.8333... A similar situation holds when we observe the fugues by D. Shostakovich, op. 87: number 0.833 dominates in 12 out of 24 fugues. In other fugues, as in the case of Bach, we arrive at 1.37, 0.8, 0.714, and other principal numbers.

7. *Two unique examples related to music*. Let us come back to the Fugue by Shostakovich and Sonata by Mozart.

Shostakovich, Fugue No. 1, Op. 87, in C major. Recall the conventional parameters of the macroplan: exposition A = 39, development B = 39, recapitulation A_1 = 28.5 bars. The Fugue as a whole: A + B + A_1 = 106.5 bars.

The values of ratios shown below, each of them being transformed with formula **(3)** into $\overset{+1}{R}$, show an astonishing picture of interrelation between the whole and its parts in the fugue:

$$A/A_1 = B/A_1 = (A + B)/A_1 = (A + B + A_1)/A = (A + B + A_1)/B = (A + B + A_1)/(A + B) = 1.37.$$

Furthermore, a theme in A minor emerges in the development in bar 57 from the onset of the fugue. This is perceived as an important milestone that creates one more macroplan in the fugue. Consider the following milestones from the beginning of this fugue: 39 bars up to the starting point of development; 57 bars to the rise of the theme in A minor; 78 bars to recapitulation; 106.5 bars - the fugue from beginning to end. Calculate the ratios:

$$39/57 = 0.6842 = a_{-2} \rightarrow a_{+1} = 1.37;$$

$$57/78 = 0.7308 = b_{-1} \rightarrow b_{+1} = 1.37;$$

$$78/106.5 = 0.732 = c_{-1} \rightarrow c_{+1} = 1.37.$$

Two addenda:

(i). Number 1.37 lies in the range of $\overset{+1}{R}$; number 137 falls within $\overset{+15}{R}$; 57 bars mentioned above are equal to doubled recapitulation (28.5 . 2 = 57). Relate these numbers to the whole:

$$57/106.5 = 0.535 = a_{-2} \rightarrow a_{+15} = 137;$$

$$28{,}5/106.5 = 0.2676 = b_{-4} \rightarrow b_{+15} = 137.$$

(ii). Take number $\beta = 1.37$ that can be presented as $\beta/1$. Its relation to the whole

$$\beta/(\beta + 1) = 0.578 = a_{-2}$$

and the ratio

$$1/(\beta + 1) = 0.422 = b_{-3}$$

may be thought of as derived from β. Transform these numbers into $\overset{-1}{R}$. From formula **(3)**, we obtain: $a_{-1} = 0.865$; $b_{-1} = 0.844$. We shall take now several other ratios combining parameters ABA_1 from the fugue. Having transformed each ratio with formula **(3)** into $\overset{-1}{R}$, we arrive at:

$$A/(A + A_1) = A/(B + A_1) = B/(A + A_1) = B/(B + A_1) = 0.865;$$

$$A_1/(A + A_1) = A_1/(B + A_1) = 0.844$$

Number 1.37 recurred in microplan 4 times more. The principle numbers that determine the structure of the theme are here 0.417 and 0.750; there are present also characteristic numbers 0.800; 0.714; 0.944, and others.

Hence all ratios of the fugue main parameters are expressed through a single number, namely 1.37, which is the principal number of **Law II**. We emphasize that, apart from bar counts, there are in music a lot of other most important parameters; this is an extensive special problem.

None the less this example, as well as some others presented here, indicates that the art expresses harmony of the Universe. This provides the answer to an eternal enigma of the mankind: what is the reason for which the art does not get old with the time? Since **the mission of an artist is to express the heart of the world, i.e., an time-independent universal law**.

Let us consider now the theme from Sonata in A minor by Mozart (Fig. 2). All the numbers in this figure denote the count of quavers. In the foregoing, we have examined the main division 37/27 =

.37037. Now we shall take care of smaller subdivisions inside 37 and 27. The first phrase (14) is repeated, but not precisely (16). Further an allusion to the repetition follows, then immediately - an interrupt (7). This interrupt is significant for it is followed by a contrast inside the theme (27). It is therefore reasonable to relate 30 and 7, whence we find

$$30/7 = 4.285... = a_{+5} \rightarrow a_{+15} = 137.14...$$

Consider next the contrast itself (27). It incorporates two similar discontinuous phrases (with stops), two bars each (16), and one continuous phrase (11):

$$16/11 = 1.4545... = b_{+2} \rightarrow b_{+1} = 1.375.$$

We have now a microstructure:

$$3\overset{-2}{/}5 \perp 5\overset{+2}{/}3 \perp 5\overset{-1}{/}6.$$

Thus, we obtained 1.37037; 1.375; 137.1, and 5 times 0.8333 ($\overset{-1}{R}$) or 0.417 ($\overset{-3}{R}$). All this is found just in the Sonata theme. It is an unique case! The structure of the whole first part is built on the same two numbers 0.417 and 1.37.

Notably, these principal numbers of harmony are fundamental in music as well as in physics: two universal constants proved to be interconnected by S_q and by their logarithms.

8. ***Interrelation between numbers 1.37 and 0.417.*** This relation is manifold as the numbers themselves. We shall consider here only one case. Take number

$$\tau = 1.199986464\ (1.199\overset{+1}{9}86464 \perp 0.833\overset{-1}{3}42732 \perp 0.416\overset{-3}{6}71366)$$

and number

$$l = 1.371288574.$$

Number l is fundamental since

$$\lg l = l/10, \text{ i.e., } 10^{0.1371288574} = 1.371288574.$$

We can demonstrate a correlation between τ and l ; $\ln \tau = 0.182310277$. I draw your attention:

$$0.182\overset{-5}{3}10277 \perp 1.371\overset{+1}{2}88574,$$

i.e., $\ln \tau$ transforms into number l . Furthermore,

$$\ln l = 0.315750862;\ \lg \tau = 0.79176347 \cdot 10^{-1}.$$

It is pertinent to note that

$$0.3157\overset{-4}{5}0862 \perp 0.791\overset{-1}{7}6347,$$

i.e., $\ln l$ transforms into $10 \lg \tau$. It follows that the bases of natural and denary logarithms are harmonically conjugated. Consider numbers $\lg e = 0.4342...$ and $\ln 10 = 2.3025…$ Recall that the laws of harmony are based on the mean proportional values: geometric mean $x_g = \sqrt{ab}$, arithmetic mean $x_a = (a + b)/2$, harmonic mean $x_{harm} = 2ab/(a + b)$. Let us take the mean proportionals of lg e and ln 10. Since these two numbers are reciprocals, we have $x_g = 1$; and as far as x_a and x_{harm} are also reciprocals, $x_a = (\lg e + \ln 10)/2 = 1.37$ and $x_{harm} = 2\lg e \cdot \ln 10/(\lg e + \ln 10) = 1.37^{-1}$. It is surprising! But no less surprising is the interrelation of e and π .

9. *Interrelation of e and π*. Let us take the mean proportionals $\pi = 3.1415...$ and $e = 2.7182...$; $x_a = (\pi + e)/2 = 2.9299... = a_{+4}$; $x_g = (\pi .e)^{1/2} = 2.9222...... = b_{+4}$; $x_{harm} = 2\pi .e/(\pi + e) = 2.9146... = c_{+4}$. Transform these numbers into range +1. From Formula **(3)**,

$$a_{+1} = 1.3652.. = 1.37;$$

$$b_{+1} = 1{,}3687... = 1{,}37;$$

$$c_{+1} = 1{,}3723... = 1{,}37.$$

Consider now the ratio e/π = 0.865. Number 0.865 (as shown above) is a derivative of 1.37. There is no need in comments.

10. *Queen of Spades* (Fig. 8). An example of A.S. Pushkin’s intuition. The Three, Seven, Ace - there we have 137! (Notation in Fig. 8: the first bars of Fugue No. 1 by Shostakovich).

Fig. 8

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[5] The term “experimental” is used here in a broad sense: I do mean, firstly, the numbers obtained with the use of S_q in analyzing different events; further it denotes establishing new facts and interrelations through S_q, and also many other things of the kind. Some relations found experimentally are hardly discernible from theoretical ones.

[6] Empirical Titus-Bode formula $R = 8 + 3.\ 2^n$ ($n = 1, 2, 3, \ldots$) gives only rough approximation of interplanetary distances up to Uranus and is quite inconsistent with the orbits of Neptune and Pluto.

[7] The comments to the experiment involving elimination of the octave: 1) In series A, number 10/7 shall also be removed.. 2) A musical series (or scale) divides the octave into 12 parts (into 12 equal parts in tempered tuning) or sounds. 3) In compliance with formula (2), the tonic and second intervals are qualitatively equal, i.e., $1 \approx 2$. 4) The octave, while repeating the tonic, is the 13[th] sound in the row. 5) Eliminating the octave violates the symmetry of the scale and shifts it by a small second, which is the structural unit of musical scale. 6) This shift is of fundamental importance for it retains 12 original qualities or sounds so that music remains intact. Because of this, the violates symmetry needs to be expressed here by a fundamental number, which is what we actually observe. Number 1.37 is constant in B-series, whereas it oscillates about 1.37 and equates this value as the average in A-series due to the non-uniform subdivision of the octave. By this means $\sqrt{2}$ ties together the complete scale, i.e., its symmetrical members, or the related qualities: the octave and tonic, quart and quint, mediant and sixth, etc. (this particular case of S_q is known in music as interval inversion). At the same time, number 1.37 ties together the incomplete, violated scale, i.e., its asymmetric members, or unequal qualities, all 12 of them, so that it represents a more profound expression of integrity. The latter remark is essential: it immediately follows that the significance of numbers can be revealed from music and then found in the nature. Specifically, number 137 has the same meaning in physics: it relates to each other the universal constants that just embody the integrity of the creation.

VI. The Integral Numerical Spectrum of Harmony

Qualitative symmetry can multiply the numbers distributed over the ranges just as well as collect them. For instance, all numbers from any remote ranges can be transformed by S_q into $\overset{-1}{R}$. Rounding the numbers to the third decimal place would transfer all the infinitude of numbefinite set of 294 numbers [in $\overset{-1}{R}$, there is a total of 294 numbers from 0.707 = $(\sqrt{2})^{-1}$ to 1.000 = $(\sqrt{2})^{0}$].

The principal numbers inherent to the laws of harmony are gathered in Table 5. They bear dissimilar conceptual loads, but we disregard this fact for the present. Nonetheless some links are shown in the table: for instance, the numbers related to β , Φ , τ are marked respectively by numbers *b, f, t*. There are also given in the table the integer powers of α and numbers β , *l*, Φ , τ , *q*. This spectrum is not ultimate, it will be adjusted as our knowledge progresses.

Besides, the said spectrum creates a rather dense numeric lattice. For that reason, when comparing the experimental numbers with spectral ones, the conceivable extreme deviation for $\overset{-1}{R}$ is $\pm 5 \cdot 10^{-4}$. In Table 5, there are, all in all, 96 numbers, i.e., 32.6 % from 294 numbers representing the total numerical continuum as shown above. The main principal numbers are marked out with bold characters. There are 48 of them, i.e., 16 % of the total. These numbers, and especially the main principal ones (16 %), account for 60 - 80, sometimes up to 90 % of numbers derived from experimental data in different fields of knowledge and arts. The areas of study covered, in particular, musical compositions, musical scales, Mendeleev's Periodic Table, interplanetary distances, mass spectrum of elementary particles, mathematics, genetics, etc. I was first to discover by application of S_q all the phenomena outlined here, including those of musical nature. Some examples were given above.

Table 5

The Integral Numerical Spectrum of Harmony

t	**0.714**		0.810		0.899
	0.715	**b**	**0.811**		0.900
	0.716	**Φ^{-1}**	**0.809**		0.898
	0.72(72)		0.8125	**f**	**0.9045**
f	**0.728**		0.815		0.908
l^{-1}	**0.729**		0.8234	**t**	**0.909**
$\alpha^{10}=\beta^{-1}$	**0.730**		0.826	α^{3}	0.910
	0.731	α^{6}	0.828	**t**	**0.917**
	0.732		0.829		0.926
f	**0.735**		0.832	**b**	**0.933(3)**
	0.741	τ^{-1}	**0.833**	**b**	**0.934**
	0.742	**t**	**0.834**	**b**	**0.937**
	0.749		0.837	**b**	**0.938**
b	**0.750**		0.839	α^{2}	**0.939**
α^{9}	0.753	**b**	**0.842**	**b**	**0.941**
	0.759	**b**	**0.844**		0.942
f	**0.764**		0.8485	**q**	**0.943**
	0.7655	**b**	**0.852**	**f**	**0.944**
	0.774	α^{5}	0.854	**f**	**0.947**

α^8	**0.777(7)**	**t**	**0.857**	**b**	**0.954**
	0.785		0.863		0.959
f	**0.786**		0.864		0.967
	0.789	**b**	**0.865**	**b**	**0.968**
	0.791		0.868	α	**0.969**
t	**0.792**	**f**	**0.874**	**b**	**0.970**
	0.793	**b**	**0.875**	**b**	**0.971**
t	**0.794**	α^4	0.882	**f**	**0.972**
b	**0.795**		0.884	**b**	**0.984**
f	**0.800**	**b**	**0.888(8)**	**b**	**0.985**
α^7	0.802	**t**	**0.891**		0.986
	0.805		0.893	**b**	**0.992**
	0.808	**f**	**0.894**		1.000

Table 6

Harmony in mass spectrum of elementary particles

m/m_e	$\overset{-1}{R}$		m/m_e	$\overset{-1}{R}$	
μ	0.808	+	$D\pm$	0.893	+
τ	**0.852**	+	D^0	**0.891**	+
$\pi\pm$	**0.937**	+	n	0.898	+
π^c	**0.969**	+	Δ	**0.938**	+
η	**0.9535**	+	Σ^+	0.880	
$k\pm$	**0.943**	+	Σ^0	0.878	
k^0	0.951		$\Sigma -$	**0.874**	+
$F\pm$	0.942	+	Ξ^0	**0.7959***	+
$B\pm$	**0.794**	+	$\Xi -$	**0.792**	+
B^0	**0.794**	+	$\Omega -$	0.799	
p	0.897		Δ_c^+	**0.917**	+

Source of the data: Handbook of Physical Values, Moscow, 1991.

* This number corresponds to namber 0,795 in Table 5 (more precisely, it is equal to 0,795495).

Consider still another example. Using formula **(3)**, transform into $\overset{-1}{R}$ the particle-to-electron mass ratios for elementary particles stable to the strong-interacion decay. The result: 77 % of the numbers thus obtained coincide with the numbers from Table 5 with 76 % of them falling on the crucial (i.e., 16 %) numbers. This example is illustrated with Table 6 (where "+" denotes coincidence of numbers). Note that particles W± and Z are absent in Table 6 because experimental values of their masses have been determined with a rather great inaccuracy. But this is of no basic importance, for our construction displays here a considerable strength margin: the cases of coincidence with Table 5 numbers constitute 77 % ! Even with 50-% coincidence, this fact would serve as a reliable verification for the laws of harmony (for numerical spectrum of Table 5 represents not 50, but only 32 % of real continuum, to say nothing of 16 %). By the way, meson resonances (namely, their masses related to the electron mass and transformed by **(3)** to $\overset{-1}{R}$) disclose about 50-% agreement with the Table 5 numbers.

Let us come back to Table 4. All its 9 numbers (100 %) agree with the numbers of Table 5. As this takes place, 8 of them (88 %) coincide with the crucial 16-% numbers. An apparently sole exception to this rule is represented by Mercury number 0.796. This number is lacking in Table 5 where we find 0.795 instead. We shall attempt to be more precise. Table 5 gives us 0.795495. The calculations for Mercury yields 0.79557. The agreement is excellent: the variance amounts to no more than $7.5.10^{-5}$. It follows that only approximate picture can be reconstructed using three-valued numbers. We gain the impression that the stated laws and obtained results only half-open the curtain concealing the whole ocean of unknown events.

VII. Qualitative Symmetry and Laws II and III

Disharmony.

We shall examine now, what is the meaning of **Laws II and III. Law II** was derived from S_q and unexpectedly revealed an identity with the harmonic proportion. The ancients have named it precisely so not by accident. Consider separately two proportions: the harmonic and golden ones. The harmonic proportion:

$$(a - x)/(x - b) = a/b \, .$$

Its sense: the part of the minor value by which the mean exceeds this minor value is the same as that part of the major value by which the latter exceeds the mean. The golden proportion:

$$a/b = (a + b)/a \, .$$

Its sense: the minor part stands in the same relation to the major one as the latter to the whole. In both cases, the mean proportional is a link that controls the integration of parts into the whole. Both proportions have been known heretofore. The harmonic proportion by itself (i.e., without S_q) does not produce numbers. It dropped out of investigators' field of vision. The golden section was sought for in different phenomena, often by forcing the data to fit the model and by manipulating with number 2. These proportions lacked a connecting link. Qualitative symmetry turned out to be this link. It vivified the proportions and converted them into laws generating numerical diversity. Owing to S_q , all the above discoveries were made, new facts and correlations have been found. This also points to the heuristic nature of S_q

We shall take now a quick look at the notion of disharmony. Like the motion, it is relative but nevertheless substantial in the expression of harmony. The disharmony is varied. Its main attributes are the contrast and symmetry. But the same notions are the attributes of development. Indeed, imagine the ideal symmetry. Let it be some particular figures: the circle, sphere, square, cube. We shall carry out an imaginary experiment. Take, for instance, the square and extend it over the whole - over all the nature. All the inanimate and animate objects - windows, apartments, buildings, people, animals, plants - would be quadratic. It were not our world! Here is an evident disharmony. We obtain the same result with spheres, or cubes, or spheres and cubes together, etc. The same is true for qualitative symmetry. If we separate it from **laws II and III**, e.g., when any random numbers are being transformed with respect to S_q, then S_q invariants lose their meaning, and the precise meaning of symmetry will come to light: it is the form (regularity) of transformation (the motion), i.e. disharmony. Thus, symmetry as such is commensurate with disharmony. Following are several examples.

1. Optical illusions (e.g.: parallel lines shaded in a certain way show up as curves; dark spots appear between black squares, at the points where angles (vertices) converge to a point, etc.) are based on contrasts and symmetry (Fig. 9). There are symmetric figures (squares) and double contrast (that of color and lines). Let us eliminate a single contrast, e.g. change the squares for circles (Fig. 10 a) or change the angle (Fig. 10 b), and the illusion will disappear either totally or in part. Sometimes the optical illusions are ascribed to the imperfection of the eyesight. But the eye ascertains an objective disharmony, therefore the phenomenon is perceived as distorted, which it is in effect. This means that our eyes are far from being imperfect; quite on the contrary, they are perfect to the highest extent, for they perceive not the outside but the essence of phenomena.

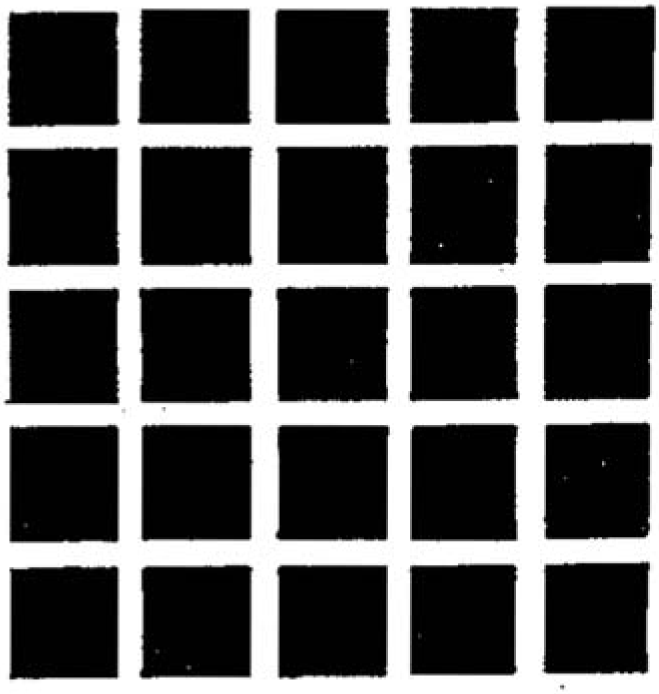

Fig. 9

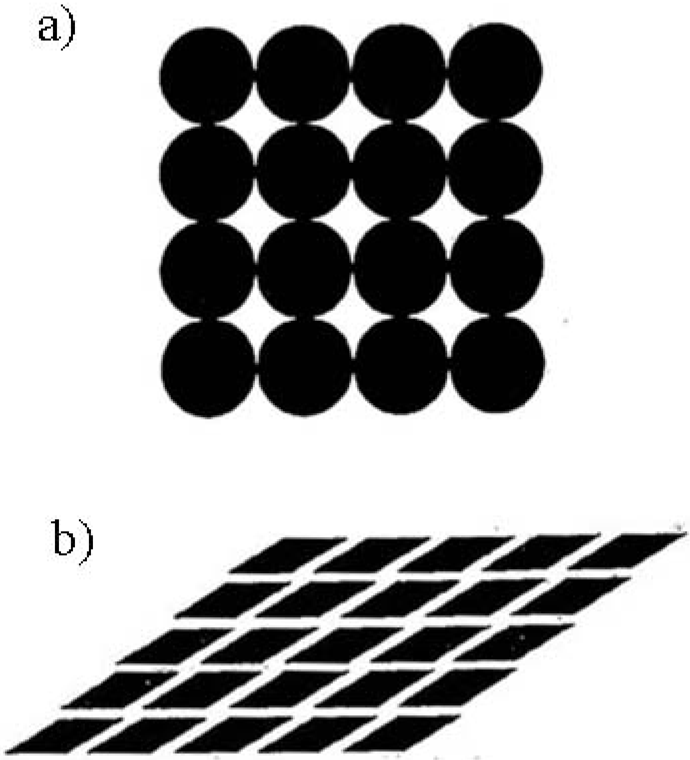

Fig. 10

2. **The development** in musical compositions. Let us take the parameters ABA_1 . Whereas the exposition and recapitulation express first and foremost the stability, on account of which the violated symmetry dominates there, the main function of the development (or mid-part) is to express instability (disharmony), and I have discovered that here is the domain of symmetry. This pertains to all the musical styles and ages. The most striking examples: Mozart, Symphony in G minor; Beethoven, the Ninth Symphony, Appassionata; diverse compositions by Prokofyev and Shostakovich.

Let us consider now the development in a broad sense. Examples: (i) In music, the development as a section of the sonata form is in full agreement with the general notion of development. (ii) In music, there exists a symmetrical network comprised of 2, 4, 8, 16, etc. bars. It is found in such sections of the form as sentences and periods. The said dichotomy is violated in the minor as well as in the major sections. Recall that dichotomy is an important particular case of S_q which corresponds to formula **(2)**, i.e., to the qualitative equality. Just this case constitutes the basis for development: without symmetry, there is no violation of symmetry. (iii) The same regularity is observed in biology: division of a cell in two - dichotomy - is the heart of development. (iv) Consider formula **(1), A is non-A.** It contains two negations ("A" is negated by the set "non-A", whereas each "non-A" negates itself because each "non-A" is "A"). In the time-base sweep, we obtain the well-known Hegelian triad ABA_1, or negation of negation. We see at once that this triad is in complete agreement with the musical form. Moreover, it underlies each integral development, may it be the historical change of scientific paradigms, artistic styles, etc. Its meaning is as follows: A is thesis, B is antithesis, A_1 is synthesis. A statement that is valid at stage A is invalid at stage B and valid again (as synthesis) at stage A_1.

Let us take one example.

(A) Ptolemy: the Earth rests, the Sun is moving; (B) Copernicus: the Earth is moving, the Sun rests; (A_1) Einstein: the Earth rests and the Sun is moving in the "Earth" coordinate system, but the Earth is moving and the Sun rests in the "Sun" system.

One more example: (A) a particle; (B) not a particle but a wave; (A_1) a particle-wave. Two sentences of the first example ("the Earth rests, the Sun is moving" and "the Earth is moving, the Sun rests") are mirror images of each other. Here, the symmetry and contracts (antisymmetry) are exposed explicitly, they constitute the basis of development.

Thus, the essence of harmony of the whole, the violated symmetry, is being expressed as disharmony of parts, as symmetry. Therefore the main point of the outlined problem, and that is essential for understanding of the latter, is **qualitative symmetry**.

The foregoing leads us to certain assumptions. If the changes in a living organism point to the growth of symmetry, this is fraught with sicknesses and, possibly, death. And further: because the essence of harmony is the violated symmetry, it follows that the laws of conservation recognized by the modern natural sciences have to be violated in their depth. But this falls outside the scope of this article.

Concluson

I have exposed a new standpoint for the Universe as harmony. It does not disprove - just the reverse, it rests on the existing knowledge and penetrates into its depth. At the same time, the cognition of the world harmony brought into existence a new paradigm of knowledge, for it is neither physics, nor biology, nor chemistry… The mankind have always sought for a system of knowledge whose logical principles should produce the basis for mathematics and, further, experimental sciences. Such is indeed the theory considered. This theory aroused from a turn in understanding the rest-to-motion relation. From that turning-point, a virgin land of truth has come to light. It was difficult even to imagine the existence of such a field.[8]

Really, in this brief article I have presented many NEW experimental facts (or discoveries) expressing harmony and belonging to the most fundamental phenomena of science, mathematics, music.

This discovery will serve to unravel the deepest secrets of the Universe and to conquer the present disharmony (incurable diseases, disturbed ecology, etc.). In this connection, a significant progress can be expected in working on the problem of artificial intelligence and, specifically, in harmonizing the work of the computer.

One more conjecture. Since numerical harmony ties together all the nature, we are observing the universal numerical resonance. This can lead us to energetics of a totally new kind with a possible gain in harmony as compared with atomic energetics (I keep in mind the law $E = mc^2$). It is not inconceivable that in future, when harmony will be more thoroughly understood, the mankind will succeed in extracting the energy from any mass with the use of said resonance. But it will be another civilization!

In closing I cannot but bring forward a striking statement by R. Feynman about Pythagoras that elucidates, in my opinion, the problem of harmony. In the Pythagoras discovery (...two strings sound more harmonically if their lengths correlate as 2:1, 3:2, etc.), R. Feynman discerned three aspects: experiment, mathematics, and aesthetics, and argued that “so far, the physicists succeeded only in the first two of them”. “It seems that general theory of aesthetics has hardly advanced since Pythagorean times”. Thus, the third aspect is aesthetics. The ideas set forth in this article are just the ones that develop this third aspect.

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[8] Only a minor portion of the author’s material is offered in this article.

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